Jacob Bjorheim *Editor*

Asset Management at Central Banks and Monetary Authorities

New Practices in Managing International Foreign Exchange Reserves

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"Practical and powerful insights from a hall of fame of investors, central bankers and scholars, are packed into this one volume. If you could have only one book on central bank asset management, this would be it."

—Peter R. Fisher, Clinical Professor, Tuck School of Business at Dartmouth

"Jacob Bjorheim draws on his long experience in sovereign asset management to pull together a rich collection of insights from a broad range of expertise. Asset management at central banks has evolved and expanded considerably over the past decade. This book is a timely source of information and guidance."

—Guy Debelle, Deputy Governor, Reserve Bank of Australia

"Central bank balance sheets have grown at a tremendous pace over the last decade and a half. Drawing on contributions from scholars and experienced central bankers from around the world, this timely and insightful book sheds light on how central banks are, and should be, managing their growing balance sheets."

—Kjell G. Nyborg, Chaired Professor of Finance, University of Zurich. Author of Collateral Frameworks: The Open Secret of Central Banks

"Central banks and monetary authorities are charged with, and being held accountable for, managing portfolios of foreign currency assets of unprecedented size. The essays in this admirable book, written by some of the world's most highly experienced officials, cover the full range of why and how this is currently being done and how new developments are affecting old practices. Interesting conceptually and immensely useful practically."

—William White, Senior Fellow at the C.D. Howe Institute. Former Head of the Monetary and Economic Department with the Bank for International Settlements (BIS) and chairman of the Economic and Development Review Committee at the OECD

"An excellent and timely review of modern international reserve management, which ought to be read by everyone working with, or simply interested in, international asset management and finance as well as monetary and economic policy. The spectrum of authors is broad and their combined insight is very valuable."

—Tom A. Fearnley, Investment Director, Norwegian Ministry of Finance

"With "Asset Management at Central Banks and Monetary Authorities", Jacob Bjorheim has achieved an editorial tour de force. The book assembles the insightful views of the leading experts in the field, both from an academic and practitioners' perspective. It bridges the gap between the macroeconomics of central banks and the financial management of their reserves. A must read to understand how central banks are special in the group of institutional investors."

—Eric Bouyé, Head of Asset Allocation and Quantitative Strategies, Treasury Department, The World Bank

"The balance sheet is a large and important toolbox for any central bank and specifically the foreign exchange reserves constitute one of the more powerful of these tools. This book provides excellent insight about the various perspectives of managing reserves at a central bank."

—Heidi Elmér, Director of Markets Department, Severiges Riksbank

"The world of international reserves has changed since the global financial crisis. In this volume, Jacob Bjorheim has assembled a stellar cast of experts to explain how and what that means for reserves management. With chapter authors like Andrew Ang, Jennifer Johnson-Calari, Robert McCauley, Ravi Menon, Simon Potter and Philip Turner, it is a book that every reserve manager must read."

—Eli Remolona, Professor of Finance and Director of Central Banking, Asia School of Business in collaboration with MIT Sloan

"Jacob Bjorheim has succeeded in bringing together a first-class team of experts, and organising their contributions in an articulated journey from the central banks' policy mandate to their asset management practices. An indispensable post-crisis update of the subject and a required reading for anyone professionally involved with central bank's asset management, or simply curious about a topic benefitting otherwise from limited research."

—Louis de Montpellier, Former Global Head, Official Institutions Group, SSGA, and former Deputy Head, Banking Department, Bank for International Settlements (BIS), Basel

"At last a book that shares with a wider audience, deep insight in a unique, challenging and ethical approach of asset management developed and implemented in the secretive world of central banks. If you wonder how to manage funds that stand ready for use at short notice in times of stress, then this book is for you. Two features make it such a valuable read and a must-have reference: First, the very comprehensive list of themes covered from a rich diversity of angles. Second, the very impressive list of prominent institutions and authors that have contributed and shared their analysis and practical approaches of the issues presented. What is better than to get the information directly from first-hand practitioners, experts and managers themselves in their own words?"

—Jean-Pierre Matt, Former Head of Financial Analysis at the Bank for International Settlements (BIS) and founder of Quanteis—a quantitative capital management company

"This book holds the promise to become the go-to guide for anyone wishing to learn more about the management of official foreign exchange reserves. Central bankers in particular, but also those providing services to central banks, will find benefit from the broad scope in subject matter and varied perspectives being presented. I am yet to see a compendium on official reserve management with similar reach in subject matter."

—Leon Myburgh, Former Head Financial Markets Department, South African Reserve Bank (SARB), Pretoria

"This is an immensely timely book at a time when central bank operations, and their balance sheets, remain "larger for longer". Following the Financial Crisis 10 years ago, and with the Covid-19 Recession about to break, central bank balance sheets are at the forefront of the authorities' response to economic issues as never before. Yet the management of their now large-scale assets remains a little known and little studied area. The authors of this book combine extensive technical and practical experience, and their observations will fill an important gap in the literature at a critical time."

—Freyr Hermannsson, Former Head of Treasury, Central Bank of Iceland, Reykjavík

Preface

During the last two decades, central bank balance sheets, with minor interruptions, have experienced dramatic changes in their size and composition. There are two main reasons for this: First, following the Asian economic and financial market crisis years of 1997 and 1998, regional central banks and monetary authorities actively accumulated massive *foreign currency reserves* to stem potential future crises of confidence and "sudden stop" scenarios. Second, since the onset of the Global Financial Crisis (GFC), that erupted in the US housing market in 2007/2008, systemically important global central banks, such as the US Federal Reserve, the Bank of Japan, and the European Central Bank, engaged in nontraditional monetary policy activities that dramatically increased their balance sheets' holding of *domestic assets*. But this past developments have been overshadowed in volume by the recent monetary policy responses to the outbreak of the global COVID-19 pandemic.

While the balance sheet expansion and its changing asset mix of private and public sector debt have been noticed, most of the public and private sector attention has been directed towards the central banks' monetary policy mandate. Discussions, therefore, have primarily been focused on the effectiveness of applying nontraditional monetary policies to reach the goals of economic growth, full employment, and price stability. Topics such as "credit- and quantitative easing," "forward-guidance," "zero-lower" bound, and negative interest rates have as a consequence dominated the recent debate. During the GFC, it also became clear that a monetary policy that targets low and stable inflation cannot guarantee financial and macroeconomic stability. Central banks and monetary authorities, therefore, have moved on from the hitherto narrow and limited micro-prudential regulatory and supervisory perspective towards a macro-prudential orientation in which the stability of the financial system as a whole takes center stage. Finally, public and private sector concerns have most recently turned towards the new kids around the central bank block, i.e. digital currencies, blockchains, distributed ledgers, and large technology firms turning financial institutions. As the Bank for International Settlements (BIS) points out in its 2019 annual economic report, such innovations present new and complex trade-offs between financial stability, competition, and data regulators.

Under circumstances in which monetary and macro-prudential policies are experiencing a historical repositioning with diffuse limits and uncertain outcomes, it is understandable that the operational, day-to-day management of the central bank's balance sheet has taken a back-seat role in the ranking of priorities. The investments of their reserves, i.e. their domestic and international assets situated on the "left-side" of the balance sheet have received even less interest. The neglect offers a timely and important opportunity for this new book to review how central banks and monetary authorities themselves operate to fulfil their reserve management mandate.

This edited volume is aimed directly at the balance sheets of central banks and monetary authorities and the way their international, foreign exchange reserves are managed. Each chapter is written by carefully selected institutions and their representatives with the aim to highlight specific aspects of their asset management activities in a balance sheet context. In particular, the chapters review the sources and uses of domestic and international assets, how they complement—or possibly conflict with—the implementation of monetary and financial stability goals, the asset management mandate, as well as the investment decision-making process from strategic and tactical asset allocation considerations to investment strategies, risk management, governance, reporting, and control. The book also looks ahead. It points towards new developments in the practices of reserves management. How, for example, could equities be incorporated in a portfolio of traditional fixed income reserve assets? Which stance could a central bank take with respect to considering environmental, social, and governance (ESG) criteria when implementing a strategic asset allocation? Or, should "factors," i.e. historically broad and persistent sources of return, replace the traditional country/industry/asset portfolio construction process?

These deep insights on asset management practices at public sector institutions are complemented with individual contributions from leading academics and representatives from International Financial Institutions. Their focus is directed towards the central banks' reserve management mandates, their large balance sheets as well as topics related to reserves accumulation, reserves adequacy, implied costs and risks, and the consequences for the commercial banking system.

With this, the book primarily aims at increasing transparency and attention towards the investment management of international assets in a balance sheet context. The book underscores the fundamentals of central bank asset management practices in a novel and up-to-date way, offering a timely advancement of the pre-GFC "received view" and providing an intellectual contribution to an under-researched field of central bank activities that will, we believe, attract an increasing level of scrutiny going forward. The book's secondary goal is knowledge sharing. In a clear succinct structure, the book offers its readers a comprehensive reference to current and new developments within the area of asset management at central banks. Finally, the book also closes a gap in the existing literature and brings an up-to-date

overview of best practices from central bank professionals and academic representatives.

The targeted audiences are public sector asset owners and investors, regulatory and supervisory authorities, private sector financial market participants and asset managers, academic bodies and research institutions, as well as external service providers and consultants.

Zurich, Switzerland Jacob Bjorheim

Acknowledgements

When I left the Bank for International Settlements (BIS) in 2017, I could look back on ten years of public service as its Head of Asset Management. Not only was I privileged to have been selected to such a senior role, but I also, unknowingly, arrived at a most interesting time. In 2007, just a few months after I had taken office, an unspecified rumble started in an opaque corner of the US financial market. Although some public and private sector observers, notably my BIS colleagues in the Monetary and Economics Department, had pointed towards emerging local and global imbalances, no one at that time foresaw the unprecedented economic and financial market disruptions that were to be followed by equally unprecedented public sector policy reactions.

During the years of the global financial crisis (GFC), having a mandate to "act as a bank for central banks," BIS Asset Management intensified its efforts to support its public sector counterparts in their reserves management activities. We restructured our week-long knowledge-sharing events that were organized in Switzerland, four times a year for central bank and monetary authority staff, and added asset management to its curriculum. We established the Asset Management Associates Program that invited senior official sector representatives to spend four weeks with us for a deep-dive into the topics of asset allocation and risk management. On demand from our customers, we created innovative collective investment funds that central banks used to quickly and efficiently gain access to new market and asset classes. And we deepened our collaboration with other public sector organizations involved in the management of official reserves such as the World Bank's Reserves Advisory and Management Program (RAMP), the Fondo Latinoamericano de Reservas (FLAR), and the Executives' Meeting of East Asia-Pacific Central Banks (EMEAP).

All these important developments would not have been possible without the support and guidance extended to us by numerous public sector institutions and their knowledgeable, experienced, and dedicated staff. Now, having contributed to this new book on Asset Management at Central Banks and Monetary Authorities, the various authors have again demonstrated their commitment towards their professional environment. I am deeply thankful for their continued support. I also extend

my gratitude to Gunter Pleines and Louis de Montpellier, who led the BIS Banking Department through the challenging GFC years, to staff at BIS Asset Management, notably Alex Joia, Pierre Cardon, Joachim Coche, and Vahe Sahakyan, and to our dedicated Financial Analysis team headed by Jean-Pierre Matt. Finally, I am indebted to the skillful Springer editorial team with Lorraine Klimowich at its helm, whose invaluable support was essential to the publication of this book.

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Chapter 1
Introduction

Jacob Bjorheim

Central banks and monetary authorities are public sector institutions, established by law, and given specific mandates to fulfill.[1] Of these mandates, monetary policy is the primitive. It is conducted to keep the real economy growing, level of employment high, long-term interest rates moderate, inflation low, and the financial system stable. Everything else the central bank does is subsumed under this monetary policy mandate. As a consequence, also the management of foreign and international reserves is subsumed under the primacy of monetary policy.

In order to implement its monetary policy mandate and reach the goals as defined, the central bank has a toolbox of instruments at its disposal. This toolbox has three compartments. They can be labeled "traditional," "non-traditional," and "very non-traditional." The traditional compartment contains instruments such as the "minimum reserves" that commercial banks are required to hold at the central bank's balance sheet or "standing facilities" that they can draw from to increase their own level of operating liquidity. The non-traditional instruments came into existence as a policy response to the Global Financial Crisis (GFC) that erupted in 2007–2008. "Forward guidance," for example, was used by central banks to influence market participant's behavior by telling them what it intended to do next. Another non-tradtional instrument is "credit- and quantitative easing". It was initiated as a multi-facetted instrument used to purchase assets from the private sector in exchange for central bank money. Finally, in the compartment of very non-traditional instruments we find, for example, "negative interest rates" that charges a fee on commercial banks reserves that are held in excess of the minimum regulatory reserves at the

[1] Throughout this book, central banks and monetary authorities are used interchangeably.

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central bank balance sheet. "Helicopter money" also fits well into this compartment. It suggests that a central bank could fulfill its mandate by a permanent expansion in the stock of central bank money to finance, for example, an expansionary, pro-growth, fiscal policy.

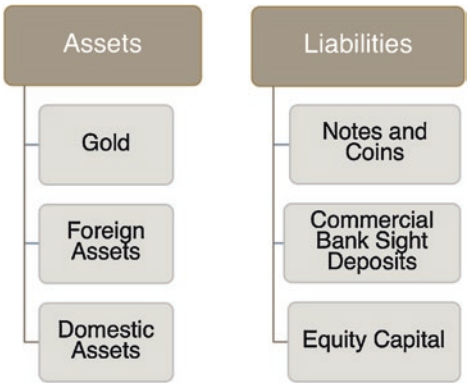

Fig. 1.1 A stylized central bank balance sheet

All policy toolbox instruments, traditional or innovative, are intended to reach specific goals as pointed out above. The central bank's balance sheet plays a crucial role in this respect. In fact, it is the main monetary communication channel between the public and the private sector. Figure 1.1 shows a stylized version thereof and establishes that central banks and monetary authorities indeed maintain balance sheets, and that they are not dissimilar to those we can observe in other public and private sector institutions.

The size and composition of the balance sheet mostly reflect the central bank's monetary policy decisions: "…whenever a central bank transacts with the rest of the world—that is when it issues currency, conducts foreign exchange operations, invests its own funds, engages in emergency liquidity assistance, and, last but not least conducts monetary policy operations—all of these operations affect its balance sheet." (Bindseil 2004). Other factors such as the size of the economy, the use of electronic means of payment, the importance and structure of the financial system, and its regulatory regime, also influence the central bank's balance sheet.

For the purpose of this book, the balance sheet of the central bank and in particular its asset side is of utmost interest. As shown in Fig. 1.1, it is primarily composed of gold, as well as foreign and domestic assets. It is common that a central bank refers to these assets as "reserves".[2]

Gold has long been a traditional item on the central bank's balance sheet. The World Gold Council claims that gold is "…a source of long-term return, a diversifier that can mitigate losses in times of market stress, a liquid asset with no credit risk that has outperformed fiat currencies, (and) a means to enhance overall portfolio performance" (World Gold Council 2019). Many central banks would agree.

[2] We will use the terms "international assets," "international reserves," "foreign exchange reserves" interchangeably.

However, most central banks hold this precious metal passively in their vaults as the scope for its active management is limited.

More important than gold are the two other elements shown in the stylized balance sheet, i.e. the foreign and the domestic assets. Foreign assets or foreign reserves are by definition assets denominated in a non-domestic currency. International reserves have various origins. Some countries intentionally increase their reserves by, for example, borrowing non-domestic currencies from international capital mar`late reserves unintentionally through current account surpluses. In fact, exporting natural resources such as oil, gas, cacao, and copper have been a traditional source of foreign exchange income for many countries. Reserves are also held for different reasons. Some countries see them as a precautionary stock that can be used as a "war-chest" in a so-called sudden-stop scenario in which foreign capital inflows abruptly come to a halt—or even go into reverse. Other countries look upon their reserves as a means to signal confidence and reliability or even to improve their international credit-rating in order to lower international borrowing costs. Ultimately, however, the international, foreign exchange reserves are accumulated, held, and managed by the central bank to increase the room to maneuver in the implementation of monetary policy decisions. Hence, it is often argued that international reserves must be managed according to a hierarchical order of guiding principles, i.e. "safety first," then "liquidity" and, finally, "return." This engrained paradigm has been challenged—notably by Fisher and Keely (2013), Castelli and Gerlach (2019). In their recent study, Castelli and Gerlach ask whether central banks are too risk averse as investors and conclude that they indeed are.

Another frequently encountered point about foreign exchange reserves is whether the amount held is "adequate" or not. The International Monetary Fund has developed a system of indicators to help developing countries answer this question. In most cases, it shows that reserves are held in excess of what is considered adequate (IMF 2019). A further issue often reflected upon is related to the risks and costs of accumulating and holding large, or even excessive foreign exchange reserves. The risks can be analyzed at different levels. A narrow perspective would focus on the central bank's balance sheet and in particular its equity capital. If the central bank follows a "mark to market" accounting standard for its invested assets, any valuation loss in its profit and loss statement would be taken against its equity capital. A broader view focuses on the, possibly negative, implications with respect to the implementation of monetary policy measures. Reserves are also costly to hold. In this regard either the "negative-carry" in which the return on invested international reserves are lower than the costs of their domestic "sterilization," i.e. a balance sheet view, or the wider social and economic opportunity costs come into focus (Rodrik 2006).

In order to illustrate some of the points just made and expand the discussion to also encompass the role of the domestic assets, let us now take a closer look at two very different central bank balance sheets—that of the Swiss National Bank (SNB) and that of the US Federal Reserve System (US FED). As a result of executing its mandate to ensure price stability while taking due account of domestic economic developments, the SNB balance sheet has grown from CHF 126.9 bn at the end of

2007 to CHF 860.9 bn at the end of 2019 (SNB 2019). The driver behind this "lengthening" of the balance sheet is the item "foreign currency investments," i.e. foreign assets. This balance sheet entry has increased from CHF 50.5 bn to CHF 794.0 bn during the same period. At the end of 2019, the SNB held approximately 40% of its foreign currency investment in USD and 35% in EUR. The 25% balance was allocated towards more than a dozen other currencies. These investments are neither held as "cash" in the SNB's vaults nor as deposits with other public and private institutions. A closer look at the SNB's international assets reveals that 81% of the reserves were held in public and private sector debt obligations and 19% in international, non-Swiss, shares. The bond allocation was invested in highly creditrate issuers. In fact, 80% of the debt obligations are rated "AA" and better. While the international bond portfolio is managed actively against specific benchmarks, the equity portion is not. In this, riskier, asset class, the SNB takes a neutral or passive stance by replicating global equity indices. Nonetheless, since 2015, the SNB has exercised its shareholder voting right at the annual general meetings of companies in which they are invested (ibid).

This historically unprecedented bond-purchasing program is a consequence of the SNB's monetary policy decisions. But how has the SNB financed this extraordinary growth in its foreign assets? This question can be answered by studying the liability side of its balance sheet. There we find the positions "Sight deposit of domestic banks" as well as "Sight deposits of foreign banks and institutions".[3] Such deposits are held in commercial bank's accounts that the SNB has opened for them on its own balance sheet. The accounts hold commercial bank's regulatory minimum reserves, facilitate payments between themselves and the central bank, and, hoard liquidity reserves for their own operational purposes. The growth in the stock of foreign currency assets has, in other words, a counterpart on the liability side of the balance sheet: Whenever the SNB buys a foreign currency bond or a share, it credits, in CHF, the sight deposit accounts of its transactional counterpart, i.e. a commercial bank. The SNB's bond-purchasing program has therefore also massively increased the supply of central bank money, i.e. CHF.

Let us compare and contrast the SNB balance sheet growth and composition with that of the Federal Reserve System in the USA. At the end of 2007, total assets of all Federal Reserve Banks came to a consolidated USD 893.8 bn (US FED 2019). Thereof, "securities held outright," i.e. domestic U.S. Treasury securities totaled USD 754.6 bn. At the end of 2019, the balance sheet had swelled to USD 4′173.6 bn of which USD 2′328.8 bn was invested in U.S. Treasury securities and USD 1′419.9 bn in domestic mortgage backed securities (MBS). The financing mechanism is similar to the one applied by the Swiss National Bank, i.e. in exchange of the purchased assets, the US FED credits the accounts of its depositary institutions on its balance sheet. Again, the consequence is a massive increase in the supply of central bank money, i.e. USD. We have continued to see further growth in central bank's balance sheets as they respond to the COVID-19 pandemic during the first

[3] In Fig. 1.1, the two SNB positions are summarized as "Commercial Bank Sight Deposits."

half of 2020. The US FED alone has increased its assets to USD 6′721 bn (4 May 2020).

The main difference between the balance sheets of Swiss National Bank and the US Federal Reserve System can be seen in the composition of its assets. In the Swiss case, at the end of 2019, close to 95% of its reserves was denominated in foreign currencies. In the US FED case, 95% is held in domestic currency assets. The reason for this spectacular disparity can be traced back to the differences in their respective monetary policies. While the SNB has followed a monetary policy that implies intervening in the international foreign exchange markets to prevent an excessive appreciation of the CHF, the US FED has intervened in its domestic financial market through various non-traditional monetary policy instruments, i.e. credit- and quantitative easing to keep employment high, inflation low, and long-term interest rates moderate.

Since the outbreak of the GFC, the SNB and the US FED are just two examples of central banks that have sported a remarkable increase in their balance sheets (Fig. 1.2). As demonstrated, some central banks have increased their international, foreign currency reserves while others have let their domestic asset base balloon.

The recent phenomenon of expanding central bank's balance sheets has several implications. Some claim that central banks and monetary authorities have gone beyond their given mandates and need to be reigned-in (Tucker 2018). In particular, monetary policy should return to its pre-Global Financial Crisis operations which in essence means deciding on the level of the official short-term interest rate and steering the supply of central bank money. This, it is argued, does not require a balance sheet size of the current magnitude. Others, i.e. mainly central banks, see themselves as implementors of their given public policy mandates. It was never their goal

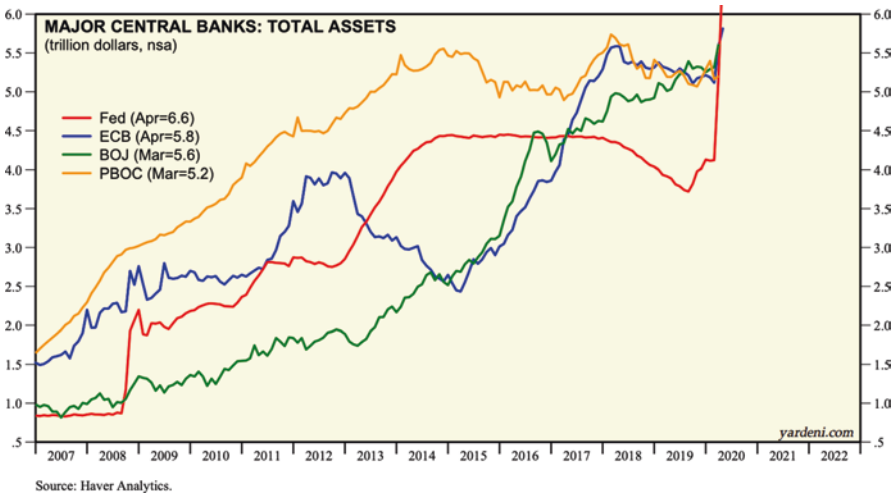

Fig. 1.2 Total balance sheet assets of major central banks (in USD tr) (Yardeni 2019)

to lengthen the balance sheet and alter its composition. These unintended consequences were caused by monetary policy decisions driven by endogenous circumstances - they would argue. Today, therefore, they vigorously defend their continued goal and instrument independence from, in their view, damaging short-term political influences.

This book does not take a stance in this debate. Its views are refreshingly non-normative as it focuses on the practices related to the management of the international reserves. For the purpose of this volume, the emphasis on international reserves is obvious. In contrast to the domestic assets, which are administered in a mechanistic, pre-announced way, international reserves are mostly actively managed. It implies that central banks have explicitly formulated investment decision-making structures and processes. Such structures and processes govern the way their foreign exchange reserves are allocated between various asset classes and currencies, and why they are bought, sold, or kept. The investment decision-making frameworks, policies, and procedures in addition, define and document internal organizational set-ups, reporting lines, risk controls, governance structures, escalation procedures, etc. Combined, these issues make the risk aversion of an institution visible.

One of the main purposes of this book is therefore to highlight the investment decision-making processes as a practice that is followed in the active management of international reserves. Not only is the pool of foreign assets large and growing. In fact, it is up more than 70% from USD 6.7 tr at the end of 2007 to USD 11.8 tr at the end of 2019 (Fig. 1.3). Reserves are also concentrated in terms of currency composition and ownership. From the International Monetary Fund's "Currency Composition of Official Foreign Exchange Reserves" (COFER) data, in excess of 60% of the world's official foreign exchange reserves are held in USD and 20% in EUR.[4] The remaining 20% is scattered among more than seven different currencies—including the UKP, the JPY, and the CNY. Although the COFER data does not offer a breakdown of international reserves to individual countries for confidentiality reasons, other sources such as the central bank themselves do. At the end of 2019, five countries, i.e. China, Japan, Switzerland, Saudi Arabia, and Russia held around USD 6 bn of international reserves—representing nearly 50% of total.

Above, a reference was made to how the Swiss National Bank invests its large portfolio of international reserves, i.e. 81% in debt obligations of highly credit-rated issuers and 19% in public equities. This asset allocation is different from that held on average by central banks. According to a report by State Street Global Advisors and the Official Monetary and Financial Institutions Forum (Hentov et al. 2019), the aggregate Global Central Bank Reserve Portfolio invested 68% in fixed income instruments and 6% in equities.[5] Short-term deposits with private and public sector

[4] The International Monetary Fund (IMF) collects and disseminates a quarterly data-set from 149 different country contributors referred to as the "Currency Composition of Official Foreign Exchange Reserves" (COFER) here: https://data.imf.org/?sk=E6A5F467-C14B-4AA8-9F6D-5A09EC4E62A4&sId=1408202647052.

[5] The official foreign exchange reserves for the 149 reporting countries amounted to USD 11.9 tr at the end of 2019.

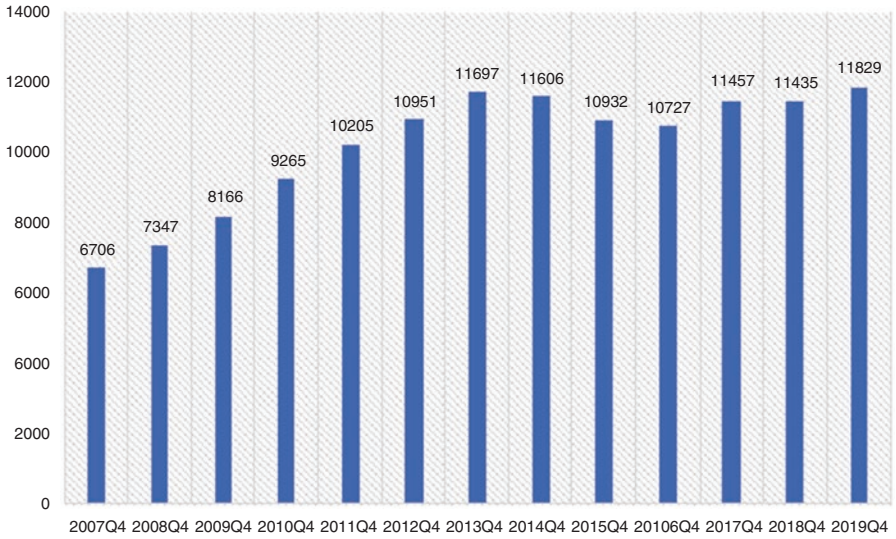

Fig. 1.3 Total foreign exchange reserves held by central banks and monetary authorities in USD bn. (See footnote 4)

institutions (12%), gold (9%), and IMF allocations (3%) are the largest following entries.

The idea behind this book is to ask the people and the organisations how they actively manage and control the large, growing and diversified pool of international reserves. The contributors to this edited volume are senior officials from central banks and monetary authorities in many counties across our continents. They have been carefully identified and selected by the editor, who over a number of years as the Head the Asset Management unit at the Bank for International Settlements (BIS) gained intimate knowledge of the various institutions, their key areas of expertise, and the staff in the respective reserve management functions. Besides the public sector investors, the editor has also, selectively, invited representatives from International Financial Institutions, such as the International Monetary Fund, the World Bank, the Bank for International Settlements as well as leading academics and private sector asset managers, to contribute with individual chapters.

This edited volume closes a gap in the existing literature on the management of international reserves assets. So far, only a few books of this nature have ventured into this space and none has been published since the Global Financial Crisis (Roger 1993; Nugée 2000; Bakker and van Herbt 2007; Borio et al. 2008). Others have taken a narrow focus and their contributions have mostly originated as conference proceedings (Berkelaar et al. 2010; Coche et al. 2011; Jones 2018; Bulusu et al. 2018). The book, therefore, brings an up-to-date coverage of best practices from central bank professionals, International Financial Institutions, and academic representatives. It will be useful for public sector asset owners and investors, regulatory and supervisory

authorities, private sector financial market participants and asset managers, academic bodies and research institutions, and external service providers and consultants.

The book is divided into six parts. While the first two, and shorter, parts are mainly sourced from experts with international financial and academic institutions, the latter, and longer, four remaining parts are predominantly filled with chapters from central banks and monetary authorities. Part I and II of the book set the stage for the remaining four. The book could therefore be read as a top-down effort that in its first two parts analyzes the central bank's public policy mandates, its balance sheet, the sources, uses and costs of accumulating and holding international and domestic reserves as well as how the assets that central banks hold as reserves are made or not just born. Having gained an understanding of these higher-level contextual topics, the book then moves down towards the specific aspects of central bank asset management activities. The first of the remaining parts, i.e. Part III, takes a close look at the management of domestic and foreign currency assets at three central banks from three different continents. In detail, each of them describes their investment decision-making process. Part IV sets out to analyze how a changing macroeconomic or financial market context influences the way central banks allocate their reserves between assets and currencies. The reader is exposed to specific answers from six different central banks. Part V is dedicated to the important topic of governance and risk management framework within which international assets are held and managed. Here, four central banks offer their insights to best practices, principles but also to challenges and even pitfalls. Finally, Part VI looks ahead and captures new trends within the asset management practice at central banks. We focus on how two central banks have embraced equities as a new asset classes for their international foreign exchange reserves, how responsible investments could be considered when managing reserves assets, and how to integrate factor-based portfolios and benchmarks into the management practice.

In the next paragraphs, we turn to a more detailed overview of the various individual chapters that are held within the six parts of the book.

Part I is labeled "Mandate, balance sheet and reserves." Following the COVID-19 monetary policy reactions by global central banks, balance sheets have again expanded and given this part a fresh urgency. The first content-chapter of the book, Chap. 2, is opened by Michael G. Papaioannou who takes a broad view of the role of central banks today. It is titled "Central Banks: Gatekeepers of monetary stability and guardians of public interest." In particular, the chapter presents the main elements of central banks' traditional functions as gatekeepers of monetary and broader financial and economic stability and outlines some emerging considerations relating to central banks' enhanced role as guardians of public interest. Chapter 3 takes the discussion into the central bank's balance sheet. Therein, Philip Turner and Srichander Ramaswamy ask the question "Larger central bank balance sheets: a new normal for monetary policy?" They answer by arguing that those who manage reserves for central banks should take account of the asset and liability choices of many other policy makers in their vicinity—those responsible for monetary policy, Treasury debt management and financial regulators. "How countries manage large central bank balance sheets" is the title of Peter Stella's contribution in the follow-

ing Chap. 4. Stella looks at central banks with small and large balance sheets—some of which have grown in size recently while others have been "large for longer." He demonstrates how experienced central banks have found that financing their balance sheets either directly or indirectly with a mix of government securities that are tradable among banks and nonbanks is generally more efficient than financing excess assets with bank reserves—fungible only among banks. Chapter 5 is titled "Reserve accumulation, sovereign debt and the exchange rate policy". Here Laura Alfaro and Fabio Kanczuk revisit sovereign debt sustainability, and the choice of the optimal exchange rate regime, under the assumptions that countries can accumulate reserves and borrow internationally using their own currency. They conclude that such reserves are not there to be depleted in "bad" times. Instead, countries issue domestic debt while accumulating reserves to hedge against external shocks. "The cost of holding foreign exchange reserves" is the heading of the last contribution in Part I, i.e. Chap. 6. Eduardo Levy-Yeyati and Juan Francisco Gomez argue that the costs of holding reserves have been at the center of the debate on reserve management, either for self-insurance against foreign exchange shortages or for leaning-against-the-wind exchange rate smoothing. In this chapter, the two authors show that this cost may differ significantly depending on the motivation, and, correspondingly, the way reserve purchases are funded.

Part II is named "Domestic and foreign currency assets." Its chapters change tracks but build on the previous, first part. The opening Chap. 7 is offered by Talal Al-Humoud from the Saudi Arabian Monetary Agency who asks "Why do central banks hold domestic and foreign currency assets?" Al-Humoud draws on Saudi Arabia's experience in accumulating foreign exchange reserves, considering the country's fixed exchange rate regime and broader macroeconomic backdrop. He concludes that the costs associated with holding a sizeable pool of liquid assets are outweighed by a number of key benefits, including having the capacity to service an evolving set of liabilities and providing access to a countercyclical spending buffer. In Chap. 8, Robert McCauley addresses a topic that many reserves managers debate: "Safe assets and reserve management". He describes what is meant by safe assets and argues that such instruments can be produced on demand so that reserve managers need not worry about a shortage of safe assets. When dealing in safe assets, central banks and monetary authorities engage with financial markets counterparts—the majority of which are commercial banks. Philip Turner and Srichander Ramaswamy address the topic of "Expansion and contraction of central bank balance sheets: Implications for commercial banks" in Chap. 9. Their discussion is set within the framework of unconventional monetary policies effectuated by central banks since the GFC. These measures have impacted the business models and activities of commercial banks. It is therefore prudent to ask whether the outcome enhances or inhibits bank's traditional credit intermediary role. In particular the co-authors consider what hidden risks might be building up in the commercial bank system as central banks accumulate assets.

Part III is called "The investment decision making process." It takes the reader directly to the core of the international reserve management practice. Three central banks explain in detail how they have organized their activities given their particular

circumstances. The first contribution goes to the Bank of Canada. Canada's foreign exchange reserves are owned by the federal government, but jointly managed under a relatively unique framework that is based on a partnership between the government and the central bank. Grahame Johnson examines this relationship in Chap. 10 under the title "Management of Canada's foreign exchange reserves" and explains that Canada manages its reserves using an asset and liability matching framework. Under this approach, every foreign currency asset is funded by a liability of the identical currency and term-to-maturity. The Monetary Authority of Singapore (MAS) is next. In Chap. 11, "How Singapore manages its reserves," Ravi Menon first points towards the three purposes of its reserves, i.e. act as a buffer against crisis, provide an endowment to finance current needs, and to maintain confidence in Singapore's exchange rate-centered monetary policy. Next, Menon explains MAS's approach to managing the official foreign reserves. He points towards three important topics: a robust risk management, balanced asset allocation, and an efficient investment process. In the next Chap. 12, the European Central Bank discusses "The investment decision-making process and its governance." Toto Silvonen and Etienne Port describe the foreign reserve management framework of the European Central Bank (ECB) and the related decision-making process. The ECB's decentralized foreign reserve management system is unique among central banks as it involves all national central banks (NCBs) that are part of the Eurosystem. The co-authors explain that this special characteristic influenced the design of the framework, as well as its functioning and governance. The distinctive features of and roles played by the three investment management layers (i.e. the strategic benchmark, the tactical benchmarks, the actual portfolios) are covered, including the decision-making structure of each level. All in all, the set-up has proven flexible as new central banks entered the Eurosystem and has also contributed to enhancing the absolute return on the ECB's foreign reserves.

Part IV is denoted "Asset allocation in a new context." Its chapters focus on different contextual situations that influence the way five central banks allocate their reserves across assets and currencies. Copenhagen is geographically speaking relatively close to Frankfurt. But Danmarks Nationalbank is not part of the Eurosystem reserves management set-up. They face other challenges as Jacob Wellendorph Ejsing, Morten Kjærgaard, and Rasmus Vahle portray in Chap. 13 "Reserve Management at Danmarks Nationalbank: Combining liquidity tiers with an adaptive risk management". The three authors show how the Global Financial Crisis gave impetus to a new reserve management framework aimed at handling large balance sheet fluctuations—a consequence of Denmark's fixed exchange rate policy—while aligning long-term exposure to investment risk with the primary policy objectives.

Not only Danmarks Nationalbank encountered unexpected challenges in the wake of the GFC. In Chap. 14, "The Swiss National Bank's investment decision-making process from a safe haven currency perspective" is addressed. Sandro Streit and Patrick A. Muhl demonstrate how the external environment has challenged its asset allocation process. The co-authors explain that the SNB reports in a safe-haven currency, i.e. CHF. We are told that this has far-reaching implications for investment policy: the SNB can hold a higher proportion of risk assets relative to

other central banks. The next Chap. 15 is denoted "The Strategic Asset Allocation framework of Banco de México." The authors Gerardo Israel García López, Rafael Jiménez Padrón, and Andrea San Martín Kuri Breña describe the evolution of the strategic asset allocation process to construct their benchmark for the investment of the international reserves portfolio. They argue that the focus on capital preservation or on return enhancement—usually two conflicting objectives—should be seen in the context of the economic and financial circumstances.

Chapter 16 takes a closer look at the National Bank of Belgium under the heading "Dynamic strategic asset allocation at the National Bank of Belgium: Why and how to implement in a central bank". Following a three-step implementation process, Etienne Lavigne concludes that a dynamic handling of the strategic asset allocation combines the advantages of quantitative methods and expert judgment while reducing usual behavioral biases often prevalent in more traditional approaches. The final Chap. 17 in Part IV goes to the Bank of Lithuania. In "Central Bank of Lithuania: Asset allocation in a risk parity framework", Jonas Kanapeckas presents how the asset allocation process at the central bank evolved from an historical data-driven capital preservation approach to a new risk parity framework rooted in a risk-budget setting. He concludes that the novel approach offered an opportunity to think beyond total portfolio volatility and integrate tail risk measures to support portfolio diversification. This better reflects the idea that international reserves are, in its essence, a portfolio for "rainy days."

Part V bears the title "Governance and risk management." Central banks and monetary authorities are, mostly, independent public sector institutions. But with independence comes accountability. In its opening Chap. 18 on "Good governance: principles, pitfalls and best practices", Jennifer Johnson-Calari and Isabelle Strauss-Kahn, highlight their practical experiences as World Bank RAMP officials. They claim that good governance is a holistic concept that extends beyond legislators and supervisors to encompass all central bank functions. Good governance takes the specific situation of the central bank into account and covers three main topics, i.e. the legal authorizing environment, the top-down delegation of authority, and bottom-up transparency and accountability for outcomes. From here, we move on to the experiences made by four central banks. In Chap. 19, on "Investment decision-making in an integrated risk management framework" Isabela Maia from the Central Bank of Brazil shows that the primary objective of the risk function is to create an environment that facilitates the achievement of the organization objectives, mitigating risks, controlling residual risks, and, consequently, improving resilience in case of incidents. She concludes that risk information properly intertwined in the decision-making process, combined with a robust governance can minimize decisions biases and, consequently, foster a better alignment between strategic objectives, risk appetite, and decisions. Ms. Maia passes the baton over to the Central Bank of Colombia and its Chap. 20 "Governance, risk management, reporting and control at the Central Bank of Colombia." Here Marco Ruiz reports that many factors lead to successful outcomes in asset management at central banks. He mentions, inter alia, having a robust asset allocation model, highly experienced portfolio managers, and sophisticated quantitative tools for implementing investment strategies. Nonetheless,

Ruiz argues that governance, risk management, reporting, and control can be even more important than any of the factors mentioned above.

The next contribution on good governance and solid risk management takes us to Poland. In Chap. 21, "Foreign exchange reserves – protection connected with financial risks". Ewa Szafarczyk explains that the concept of "reserves tranching," i.e. establishing purpose-bound sub-portfolios from the pool of international reserves, could support a well-structured financial risk management process and assure a more stable portfolio risk profile. But she warns that such a framework is not a panacea in avoiding potential financial losses. The final contribution in Part V goes to the Federal Reserve Bank of New York. In Chap. 22 denoted "Central banks as bankers to each other: Overview, trends, and future directions in global official sector service provision." Marc Choi, Matthew Nemeth, and Simon Potter point out that the major reserve currency central banks have long served as correspondent banks, transactional agents, and custodians for the safekeeping of foreign reserves for each other and the global central banking community. As official banking and custody service offerings continue to grow in volume and importance, central banks also need to adapt in order to better protect foreign reserve assets from criminal actors—as illustrated by a 2016 cyber fraud incident involving an inter-central bank account.

The final Part VI of this edited volume focuses on "New trends in asset management." Its chapters turn their attention towards what many reserves management teams in central banks and monetary authorities grapple with. John Nugée, a keen observer of central banks' reserves management practices over the past few decades, sets-off with Chap. 23 denoted "Modern central bank reserves management: Introduction and overview." He observes that the task of managing international reserves has become increasingly complex as central bank balance sheets now are larger in the context of more innovative financial markets, tighter regulations, and rapidly disseminating technologies. He concludes that the traditional trilogy of reserve management objectives, i.e. "security," "liquidity," and "return" that has guided reserves managers over the years is still valid but in need of updating. Bank of Israel proves its innovative powers in Chap. 24 under the title "Bank of Israel: Integrating equities into the foreign exchange reserves." Andrew Abir and Golan Benita present a case study on how this new, riskier, asset class was approached in the context of traditional reserves assets such as short-term fixed income instruments. The authors demonstrate that in the long term, investment in equities generates excess returns and contributes to a greater diversification of risk in the portfolio, but in the short term such investment is volatile and therefore relatively risky. A consequence: the capital preservation objective might not be completely met over a short time horizon. They advise that a clear definition of the underlying investment philosophy helped guide the process of gradually moving into equities. In Chap. 25, the Hong Kong Monetary Authority takes a pragmatic look at the Chinese domestic fixed income and equity markets. Martin Matsui argues under the heading "Renminbi securities in portfolios of official institutions: A perspective from the Hong Kong Monetary Authority" that there are a multitude of good reasons to include domestic RMB assets into a portfolio of international reserves: strong portfolio inflow into China's onshore markets as index inclusion progresses, added benefits of portfolio diversification and return enhancement.

In Chap. 26 we are exposed to yet another innovation, i.e. "responsible investments." Archie Beeching, Anna Georgieva, and Justin Sloggett from the UN supported organization "Principles for Responsible Investments" (PRI) demonstrate that, over the last decade, responsible investment, i.e. the consideration of environmental, social, and governance (ESG) issues in investment decision-making, has spread widely throughout the financial sector. This trend has also been picked up by several central banks and changed the way they approach investments of foreign exchange reserves. The three authors conclude that the adoption of ESG considerations is due to its perceived usefulness in identifying risks and opportunities, particularly among larger asset owners, its support from regulators, and the vigorous supply-side response from investment service providers. The final Chap. 27 in our book goes to BlackRock, the private sector asset manager under the title "BlackRock: Reserves management with factors and reference portfolios." Andrew Ang with his colleagues David Chua, Katelyn Gallagher, and Stephen Hull states that reserve managers must balance long-term and short-term investment objectives, require transparency in their actions, and have hierarchical governance structures. They argue that factors, defined as historically broad and persistent sources of return, are helpful at all levels of the investment decision-making process: A governing board can set the Reference Portfolio based on risk appetite or return needs; an investment committee can approve the Strategic Portfolio, which is a long-term strategic asset allocation that allocates to a broader array of factors for increased diversification; and the day-to-day portfolio managers have responsibility for the Implemented Portfolio, which could include short-term, tactical views, or active management.

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Part I
Mandate, Balance Sheet and Reserves

Chapter 2
Central Banks: Gatekeepers of Monetary Stability and Guardians of Public Interest

Michael G. Papaioannou*

Abstract This chapter presents the main elements of central banks' traditional functions as gatekeepers of monetary and broader financial and economic stability and outlines some emerging considerations relating to central banks' enhanced role as guardians of public interest. With regard to the central banks' emerging enhanced role, the analysis focuses on their (1) heightened policy coordination need with fiscal, regulatory, and debt management authorities to increase the efficiency of the monetary policy transmission mechanism and the overall efficacy of economic policy making, (2) principal role in the establishment of a sovereign asset and liability management framework to identify, monitor, and manage sovereign balance sheet risks on a consolidated basis, which also helps monetary policy through a more accurate estimation of sovereign risks and consequently a more appropriate interest rate setting, (3) active role in the development of domestic capital markets to enhance the country's funding sources and reduce its foreign exchange risk exposure, as well as to help the effectiveness of open market operations in targeting interest rates and in turn affecting the real economy, and (4) envisaged implicit role as protectors against emergent financial disruptions.

2.1 Introduction

As economies become more complex and less predictable, central banks are increasingly required to oversee the stability of domestic financial systems and to prevent economic downturns, in addition to maintaining inflation in line with set targets (Evanoff et al. 2013; IMF 2015; Lombardi and Schembri 2016). Especially after the global financial crisis of 2007–2009, central banks have been called to play a crucial

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role in ensuring a sustainable domestic economic growth rate and an acceptable level of prosperity (Asmussen 2012). Similarly, when domestic political and/or economic circumstances change drastically, central banks of countries or regions are expected to assume a crisis management role, such as the European Central Bank did during the European Sovereign debt crisis and the Bank of England after the Brexit vote. Further, central banks are customarily entrusted with safeguarding the integrity of their domestic financial systems from continually emerging financial challenges and innovations, e.g., shadow-banking, interconnectedness, distributed ledger technologies. In such a changing world, novel means of central bank monitoring, assessing, and managing financial conditions and risks, e.g., through a consolidated public balance sheet, instituted coordination of policies, and development of domestic capital markets, would be essential to avert unwarranted developments and ensure financial stability.

Conventionally, central banks' inflation and overall financial stability objectives have been attained by appropriate changes in their monetary policy instruments, e.g., short-term interest rates and exchange rates. The added explicit or implicit objective of ensuring robust economic growth, in particular after the recent economic and financial crises, may require implementation of unconventional monetary measures, e.g., quantitative easing (QE), in addition to applying central banks' traditional policy instruments. Addressing this additional objective through conventional monetary policy instruments could also create a determination issue in assigning the same instruments as before to achieve the old objectives plus an additional objective/target, as well as it may alter the monetary transmission mechanism (these important questions will not be analyzed here).

We present in this chapter some of the main elements of the traditional functions of central banks as gatekeepers of monetary and broader financial and economic stability and outline some emerging considerations relating to central banks' enhanced role as guardians of public interest, including (1) a heightened policy coordination role with fiscal, regulatory, and debt management authorities to increase the efficiency of the monetary policy transmission mechanism and the overall efficacy of economic policy making, (2) a principal role in the establishment of a sovereign asset and liability management framework to identify, monitor, and manage sovereign balance sheet risks on a consolidated basis, which will also help monetary policy through a more accurate estimation of sovereign risks and consequently a more appropriate interest rate setting, (3) an active role in the development of domestic capital markets to enhance the country's funding sources and reduce its foreign exchange risk exposure, as well as to help the effectiveness of open market operations in targeting interest rates and in turn affecting the real economy, and (4) an envisaged implicit role of protecting the financial and economic system from various emergent challenges, including the advent of crypto-assets, cybersecurity attacks, and other financial innovations.

This chapter is organized as follows: Sect. 2.2 outlines some of the main elements of ensuring central bank efficiency in its role as the gatekeeper of monetary stability, including a clear mandate, independence, well-defined policies and operations, and cooperation and coordination with foreign central banks in attaining global financial stability; Sect. 2.3 discusses additional functions that central banks

are expected to perform in their expanded role as guardians as public interest, including greater instituted coordination with other domestic economic policy entities, development of a comprehensive sovereign balance sheet, provision of an enabling environment for the establishment of domestic capital markets, and protection of the financial and economic system from potential financial disruptions; and Sect. 2.4 offers some concluding remarks regarding the design and focus of central banks.

2.2 Central Banks: Gatekeepers of Monetary Stability

2.2.1 Mandates of Central Banks

Central banks conduct their countries' monetary policies by controlling/managing the supply of money (often targeting a nominal interest rate) to promote economic growth and financial stability. Most developed economies' central banks, e.g., European Central Bank, Bank of England, Bank of Japan, have price stability, around a set inflation target, as their sole main mandate. However, other central banks, e.g., U.S. Federal Reserve System, have price stability and maximum employment as their dual main statutory mandates. Other traditional mandates of central banks include the maintenance of financial system stability, setting of short-term interest rates to manage the cost of credit, management of foreign exchange reserves, provision of lender-of-last-resort funds to financial institutions, and issuance of national currency (Bordo et al. 2014; Archer 2009).

By ensuring monetary stability, central banks help preserve the domestic (current and future) value of money, which in turn assures the external value of the currency. While central banks have to keep inflation, and inflation expectations, reasonably low and sensibly stable, they have also to maintain the safety and soundness of the banking system so that bank deposits' worth is ensured. In 2007, although central banks were successful in keeping inflation low, they had not apparently paid adequate attention to the resilience of the banking system. However, safeguarding the banking system does not imply that individual banks cannot fail, but that the whole system is not susceptible to a collapse. Further, the central banks' reactions to the global financial crisis, e.g., quantitative easing programs, had their own costs. While they rendered support to the recovery of the real sectors of their domestic economies and boosted asset prices, they adversely affected interest incomes of bank deposits.

2.2.2 Independence of Central Banks

Central banks' independence ascertains that they do not seek nor accept the intervention of respective governments in the exercise of their policies to achieve their mandates, including their monetary policy objective of inflation and broader financial and economic stability (IMF 2018a; Taylor 2016). In this context, there may be

explicit guarantees, e.g., for Eurozone central banks' independence from government interventions, the European Central Bank is mandated by EU treaties to take appropriate action in the EU Court in case of violation of a national central bank's independence and separation of powers. Further, to keep governments at arm's length, central banks' mandates are typically prohibiting the monetary financing of government's fiscal deficits. However, central banks can undertake macro-fiscal actions on their own initiative. This was the case during the recent global financial crisis where monetary authorities decided to get involved after realizing that the crisis could have detrimental effects on domestic economic activity and in turn the global economy. As a result, many central banks have now *de facto* expanded their traditional mandate to also include strengthening of economic activity and preservation of sustainable growth for their domestic economies.

2.2.3 Central Bank Policies and Operations

2.2.3.1 Monetary Policy: Interest Rate Setting

Until the 2007–2009 global financial crisis, the conventional rationale for most central banks' conduct of monetary policy was preservation of inflation stability, presuming that markets would be sufficiently self-regulating. However, the crisis helped monetary authorities to become aware of the need to expand the boundaries of their responsibility outside the traditional monetary policy objectives and include explicitly broader financial and production and employment considerations. In effect, this expansion/development may also reflect the realization of the crucial role of monetary transmission mechanism, as manifested by the increasing interconnections between the central bank monetary policy, financial markets, and the real economy (aggregate demand). As a consequence, central banks advocated interventions through purchases of sovereign and private sector bonds, "quantitative easing" and "credit easing," respectively, that would put an upper limit to interest rates (often targeting long-term rates) and in turn would help strengthen economic activity (Georgsson et al. 2015).

In conducting monetary policy through setting/targeting short-term nominal interest rates, along with deciding on their target range, central banks often set implicit or explicit inflation targets and assess regularly the outlook of the economy to form expectations about the underlying inflation (Friedman and Kuttner 2010; IMF 2018). Economic variables that are typically reviewed include the country's expected economic growth, fiscal situation/accounts, the state of the labor market, external trade conditions, and the stock-markets performance. If these variables indicate a building up of upward price pressures that could possibly push inflation above a set target, then rate rises are decided. Typically, interest rate policy is determined by future inflation, as implied in market prices, rather than current inflation.[1]

[1] Central banks may track the overall inflation or core inflation measure, which excludes food and energy from personal consumption expenditures.

Policy decisions on interest rate targets, e.g., the overnight interbank lending rate, serve as benchmarks for market interest rates paid by consumers and businesses. This has significant real economy implications as central bank changes of interest rates affect the flow of money into the financial system (i.e., the cost of credit) and the price of liquidity in the economy (via the deposits channel).

During normal times, central banks use four main conventional monetary policy instruments to implement monetary policy, i.e., effectively control the money supply (the total amount of money circulating in the country's economy) and interest rates: (1) open market operations (OMOs), i.e., purchases and sales of government securities in the open market, (2) the reserve requirement, i.e., a regulation that sets the minimum fraction of deposits that banks need to hold as reserves at the central bank, (3) discount lending/window that allows banks to borrow money from the central bank so that they can meet depositors' demand or reserve requirements, and (4) interest paid on reserves. Among the four instruments, OMOs are more widely used by central banks to affect the money supply and interest rates (with purchases of government securities intending to expand the money supply/lower interest rates and sales to contract it/prop up interest rates) and in turn inflation and the real economy.

2.2.3.2 Foreign Exchange Rate Policy: Adequacy of Reserves and Exchange Rate Market Interventions

A crucial function of a central bank is the explicit or implicit setting of the external value of its domestic currency, i.e., the exchange rate, along with a disclosed or undisclosed fluctuation range that is consistent with the country's prevailing and prospective economic fundamentals and interest rate policy. If the exchange rate is pushed outside such a fluctuation range, the central bank will typically defend it through foreign exchange market interventions. In this context, a central bank needs to determine an adequate level of foreign exchange reserves that can be used for monetary and exchange rate policy purposes (IMF 2013).[2] This part of the country's total reserves should exhibit ample liquidity characteristics and thus be able to swiftly be used in case of an intervention need (i.e., this constitutes the liquid part of the country's foreign exchange reserves). Any reserves above the liquid part (or excess reserves) could be managed/invested with an income objective (i.e., this constitutes the investment tranche of foreign exchange reserves).

Under a fixed exchange rate regime, central banks tend especially to hold adequate foreign currency reserves for intervention purposes in secure, high liquid, and short-term maturity foreign currency assets.[3] Thus, in such a pegged system, a central bank is obliged to preserve its currency's exchange rate by, e.g., conducting

[2] See also Chap. 14.

[3] Most central bank official reserves consist of foreign currency assets, gold, and Special Drawing Rights (SDRs) and claims against the IMF.

foreign exchange sales whenever its currency depreciates against the numeraire currency (typically the U.S. dollar, Euro, or Yen), or foreign exchange purchases whenever its currency appreciates against the numeraire currency. In recent years, multilateral foreign exchange swap lines among major central banks have also been contracted to enhance their capacity of foreign exchange liquidity and availability of funds for interventions in case of foreign exchange distress. This contingent source of foreign exchange availability for central banks helps diminish abrupt exchange rate fluctuations and consequent tensions in the financial system.

2.2.3.3 Management of Investment Tranche of Foreign Exchange Reserves[4]

By holding foreign exchange reserves in excess of the amount needed to defend their currency's exchange rate, central banks usually try to enhance market confidence in the stability of their currency, i.e., use of excess reserves as precautionary holdings (IMF 2013; Al-Hassan et al. 2015). As such, this part of reserves is invested with a longer-time investment horizon, i.e., differently than the short-term horizon of reserves intended for foreign exchange intervention purposes. For the portion of reserves with longer-investment horizons, many central bank reserve managers have recently explored alternative instruments and currencies, adding, e.g., non-traditional currency-denominated assets to their reserves, in an effort to enhance returns of their foreign exchange asset portfolios.

Globally, central bank foreign exchange reserves, after declining gradually since 2014, started recovering in 2017, at a pace of 8%, with this trend being relatively broad-based (IMF 2018b). While reserves are growing, central banks' strategic asset allocations and strategies for managing them are reported to have remained broadly conservative. For the liquid part of reserves, security and liquidity continue to be important criteria for defining their allocation strategies. The investment tranches of some central bank reserves are reported to have increased and to be managed less conservatively. In particular, these parts of reserve assets are diversified away from traditional allocation strategies focused on low-yielding, sovereign fixed-income instruments and expand into a wider range of riskier assets, including equities, real estate, and infrastructure assets. As the low bond-yield environment gradually vanishes, central banks are expected to pursue less-risky investment tranche asset management strategies.

2.2.3.4 Commercial Bank Regulatory Functions

In countries where there are no separate banking regulators, central banks also assume the role of regulator and supervisor of commercial banks. This role entails effective monitoring of the soundness (i.e., adequate capitalization) and well-functioning (i.e., transparency and accountability of transactions) of the domestic banking

[4] See also Chapters in Part II and III.

system so that the occurrence of banking crises is minimized and bank bailouts, which trigger rises of sovereign credit risk, are avoided. In this capacity, central banks have also to institute prudential policy measures to ensure the integrity of the operations and activities of commercial banks, as well as the efficiency of the utilized payment and settlement systems (IMF 2015).

For enhancing the stability and resilience (safety and soundness) of the banking sector, central banks often need to have in place regulatory systems in line with Basle III that (1) adequately prevent collapses of individual banks by requiring the strengthening of their capital adequacy (by imposing/instituting minimum capital requirements that ensure solvency) and the reduction of their vulnerability to liquidity shocks (by necessitating banks to hold more and higher quality capital through increased asset-risk weights, higher total loss-absorbing capital, lower leverage ratios—to reduce exposures, and larger liquidity requirements—sufficient buffers to protect against domestic and/or external shocks and ensure adequate liquidity), as well as by the heightening of prudential supervision, including the implementation of stress tests; (2) eliminate or limit contagion and negative spillovers to the rest of the financial system; and (3) enable the authorities to deal with a bank insolvency without endangering the financial system, e.g., taking appropriate measures to prevent a financial panic that could halt domestic credit markets and cause a financial crisis.[5]

2.2.3.5 Overall Domestic Financial Stability

In addition to the inflation-stability mandate and commercial bank regulatory function, central banks may also be entrusted with a wider role of safeguarding the country's overall financial stability. Such a role could include responsibilities for ensuring the stability of the domestic bond market and other capital markets, including that of derivatives markets. Admittedly, however, these responsibilities tend to be extensive and central banks do not, in principle, undertake them (Evanoff et al. 2013).

2.2.4 Cooperation and Coordination with Foreign Central Banks in Attaining Global Financial Stability

Central banks are engaged in different international and regional policy fora, including the Financial Stability Board, the BIS, the IMF, and the Executives Meeting of East Asia and Pacific Central Banks (EMEAP), in an effort to ensure that inflation stability in their domestic economies, as well as the global economy in general, is preserved (Cunningham and Friedrich 2016; IMF 2015). Such engagements have also been extended to include domestic, regional, and global financial market

[5] See also Ingves (2018).

stability initiatives, such as macroprudential policies, to contain capital markets' volatility. Further, global financial crises may prompt central banks to undertake unconventional monetary policy measures to ensure that their domestic economies and the global economy do not drift to recession.

Following the 2007–2009 global financial crisis, the instituted extensive central bank asset-purchasing programs were intended to alleviate the negative market impact of the crisis and its resulting deflationary pressures on domestic economies. In general, when domestic nominal interest rates get close to zero, central banks may resort to monetary policy easing by directly increasing the quantity of money. Most post-financial crisis programs primarily purchased government bonds, but some also purchased a wider range of assets, e.g., the U.S. Federal Reserve also purchased government-backed securities, while the European Central Bank's programs included corporate and asset-backed bonds and that of the Bank of Japan included corporate bonds, equities, and property funds. These quantitative easing programs, i.e., direct interventions by monetary authorities, have proved to be useful policy instruments in preserving low interest rates. When economic conditions normalize, especially when economic activity goals have been attained, central banks have to unwind their asset-purchasing programs and reduce their balance sheets by gradually selling/divesting their accumulated assets so that market volatility is limited.

In the USA, when inflation starts rising and the labor market tightens putting upward pressure on wage growth, the Federal Reserve is expected to proceed with its long-term plan to reduce its extraordinarily large balance sheet, along with increasing interest rates. After years of low interest rates and expansion of the Federal Reserve's balance sheet, both the former and current Federal Reserve chairs, Janet Yellen and Jerome Powell, have referred to the rise in inflation and tightening of the labor market as essential signs in the path towards policy normalization. At its quarterly meeting in September 2018, the Federal Reserve again raised the target range of the federal funds rate by a quarter point, to 2.0–2.25%.

The U.S. Federal Reserve's balance sheet started to grow in late 2008, following the decision for a quantitative easing program that entailed the acquisition of assets such as U.S. treasuries and government-backed securities on a large scale. This was initially undertaken to avoid a deepening of the financial disruption and default of illiquid but solvent financial institutions, as the U.S. housing (U.S. subprime) crisis was rapidly transforming into a U.S. and global financial crisis. Subsequently, this policy was continued to preserve easy monetary conditions and fight economic sluggishness and deflation risks as the private sector deleveraged markedly. On the liabilities side, bank reserves grew to exceed regulatory minimum requirements. In October 2014, then Federal Reserve chair Janet Yellen announced the conclusion of this program, while the Federal Reserve balance sheet had increased to around USD 4.3 trillion (around USD 2.5 trillion in U.S. treasuries and USD 1.8 trillion in mortgage-backed securities) from less than USD 900 billion before the financial crisis.

In October 2017, the Federal Reserve started a gradual contraction of its balance sheet by stopping the reinvestment of all proceeds received from maturing assets.

Further, as announced in June 2017, the initial monthly portfolio reduction of USD 10 billion is expected to reach USD 50 billion in October 2018, with no outright sales of assets being envisaged. Bank reserves have diminished accordingly.[6] The impact of the balance sheet unwinding, especially the release of U.S. treasuries, on short-term interest rates will depend on the pace of reduction of the level of banks' reserve balances on the Federal Reserve's liabilities, i.e., banks' deposits at the Federal Reserve. If the Federal Reserve has accumulated assets (U.S. treasuries) in its balance sheet that are more than the amount that markets, mainly banks, want to hold, then the Federal Reserve's unwinding will not induce massive reductions in banks' reserves at the Federal Reserve and consequent U.S. treasuries' purchases, and therefore will not have any significant impact on short-term interest rates.

Decisions with regards to central banks' exiting from asset-purchasing programs, e.g., quantitative easing, and reducing their bank balance sheets should ideally be taken in a cooperative and coordinated manner to maximize policy efficacy and minimize adverse exchange rate movements and capital market volatility. However, in such an international policy endeavor, the decision-making structures and dynamics among central banks and international financial policy entities need to be taken into consideration. For example, in setting U.S. monetary policy, the U.S. Federal Open Market Committee (FOMC), which consists of 12 members, often takes time to reach an understanding and vote on setting monetary policy and interest rates. Further, international financial entities, e.g., the Financial Stability Board (established in 2009 under the auspices of G20), that are delegated to examine from a global perspective monetary and financial policy issues, such as systemic risk and "too big to fail" strategies, may require considerable time for deliberations and recommendations.

2.3 Central Banks: Guardians of Public Interest

2.3.1 Role in Coordination with Fiscal, Regulatory, and Debt Management Policies

To attain macroeconomic policy objectives effectively, consistency of designed and instituted monetary, fiscal, regulatory and debt management policies must be ensured through enhanced coordination among corresponding policy entities (IMF

[6] If the non-bank private sector repays, at redemption, bonds held by the Federal Reserve using its bank deposits, then those deposits (and in turn, commercial bank reserves) fall and money balances are eliminated. Also, bank reserves may be reduced if the Federal Reserve sells bonds that it holds to Primary Dealers (PDs) the day before they mature and PDs pay the Federal Reserve with their reserves at the Federal Reserve. In this case, the Federal Reserve's liabilities (commercial bank reserves) are reduced in tandem with its assets (sold bonds). In this process, central banks engaged in QE need to ensure that the pace of their QE exiting guarantees a steady growth in the supply of money that is consistent with both low inflation and wider macroeconomic stability.

2018a). Coordination entails good communication channels and adoption of a well-thought out program of collaboration, while taking into consideration prevailing practices, idiosyncrasies, and constraints. In this context, communication among monetary, fiscal, debt management, and financial sector regulatory authorities needs to be established, with each authority retaining its independence and accountabilities. Close consultation and interaction among these policymakers could help in exchanging information and providing each other with valuable inputs on individual entities' policy perspectives and overall efficacy of economic policy. Nevertheless, policy-making coordination is often a major challenge, especially during periods of economic and/or financial distress.

In this context, the monetary authorities' role in a country's economic policy coordination should be part of their broad functions and responsibilities as guardians of public interest. Especially, information sharing and coordination meetings between monetary and fiscal policy authorities should take place on a regular basis, including for debt sustainability analysis (DSA) purposes where interest rate and exchange rate assumptions are paramount for growth and fiscal balance baseline projections and scenario analysis. As mentioned in Jonasson and Papaioannou (2018), such collaboration with debt managers is also crucial when monetary policy includes so-called non-standard measures, some of which are carried out directly in government bond markets. In regulating and supervising financial markets and institutions, it may happen that certain measures may unintentionally hamper the functioning of the primary and secondary markets. Consultations among monetary, debt management, fiscal, and financial regulatory authorities can promote solutions that facilitate proper functioning of public debt markets, while also meeting monetary and financial policy objectives (IMF and World Bank 2014).

The monetary policy regime, the instruments used for monetary policy operations, and the institutional setting have important implications for the extent and frequency of needed policy coordination. As the core objective of the monetary authority is price stability, the appropriate monetary-fiscal mix is one of the most crucial factors in the attainment of this objective. Targets for inflation, interest rates, monetary aggregates, or the exchange rate, which are managed through open market operations or through non-market controls, such as setting reserve requirements, have to also be discussed and coordinated with fiscal policy authorities for increasing their chance of successful realization. A monetary policy will be credible and more effective in taming inflationary expectations only if it has been deliberated and determined in an integrated monetary-fiscal policy framework. Under these circumstances future uncertainty will likely be contained and, in turn, the risk premium on domestic currency debt will be lowered.

Further, the central bank tends to be prohibited to lend money to (buy bonds from) the government, or, when the objective is to finance the government, the scope of this financing tends to be limited for inflation to be controlled. Under these conditions, any liability management operations between the central bank and the government should be transparent and cleared at market prices. For example, this may include implementation of transactions where the central government exchanges short-maturity bills and notes issued by the central bank for longer-maturity bonds

issued by the central government. In these cases, the central bank transfers cash (reserves) to the government (equal to the nominal value multiplied by the market price of the transaction). From the central bank's perspective, the transaction is equivalent to a buyback (with reserves), while from the government's perspective the transaction is a plain primary market issuance. If the central bank needs to issue its own bills for open market operations, the market should know the sections of the treasury-bill yield curve that are reserved for central bank-bills and government treasury-bills. This is important for the market to be able to distinguish between fiscal and monetary operations (see Jonasson and Papaioannou 2018).

Coordination of monetary and fiscal policies does not, however, diminish the need for clear and transparent monetary and fiscal policy objectives, mandates, and frameworks. Decision-making in a well-coordinated manner ensures that inconsistencies between these two policies are minimized and thus the effectiveness of each policy is improved. Further, the interplay between monetary and debt management policies should be recognized and accounted for possible unintended consequences. For example, Jonasson and Papaioannou (2018) state that the unconventional monetary policy instituted by some central banks in recent years, i.e., purchasing of long-term government bonds, has been pointed out to have important implications for public debt management.

In particular, Blommestein and Turner (2012) show that the U.S. Federal Reserve's QE is identical in its macroeconomic effects to shortening the duration of the U.S. Treasury debt issuance. Also, Chadha et al. (2013) indicate that the reduced average maturity of U.S. Treasury issuance lowered the long-term interest rates, while Greenwood et al. (2014) document that the U.S. Federal Reserve's attempts to reduce the supply of long-term bonds held by private investors through its QE policy were partially offset by the Treasury's decision to lengthen the average maturity of the debt. Thus, the U.S. Federal Reserve policies under the special circumstances of the Zero Lower Bound have taken direct action to shorten the duration of the government debt held by the public. In this context, if a central bank acts as a major buyer of government debt, its decisions on where on the curve is buying and on what maturities have significant impacts on the debt management office's planning. Yet, a government's objective for financing cost minimization, subject to a prudent level of risk, should not be viewed as a mandate to reduce interest rates, or to influence domestic monetary conditions. Neither should the cost/risk objective be seen as a justification for the extension of low-cost central bank credit to the government.

Nevertheless, when the domestic central bank is seen as a major market participant, e.g., preferring specific bonds and yield curve segments, this could have significant implications for foreign exchange reserve managers. For example, if reserve managers are duration targeters and the domestic central bank or debt management operations intend to lower the overall duration of outstanding sovereign debt, then they will be "forced" to buy longer-dated bonds. This, however, exposes them to interest rate risks, as longer durations tend to be more interest rate sensitive. Also, international reserve managers will face similar pressures if the central bank decides to manipulate the discount window borrowing or use selectively open market operations to control credit conditions.

At the same time, Jonasson and Papaioannou (2018) argue that debt management operations should be consistent with monetary and exchange rate policy objectives, e.g., an external debt buyback should not antagonize possible exchange rate strengthening policies. As monetary operations are often conducted using government debt instruments and markets, the choice of monetary instruments and operating procedures needs to be coordinated with debt management policies for effective overall policy implementation and well-functioning of the government debt markets. In countries with developed financial markets, central bank interventions usually take place in secondary markets, reducing the need for coordination between fiscal and monetary authorities at the operational level (IMF 1994). In countries with less developed financial systems, central banks start issuing their own securities or use government securities as their intervention instrument for open market operations that are often implemented in the primary market, raising the need for effective coordination on issues such as the tender volume, so as to allow the central bank to issue more securities than is strictly necessary for debt management purposes and decide on mechanisms to bear the cost of overfunding the government's budget (Gray and Pongsaparn 2015).

In cases that central banks do not assume the role of financial market regulators, they need to actively engage in discussions and closely coordinate their policy actions with financial, especially bank, regulators as changes in monetary policy conditions directly (balance sheet effects) and indirectly (real economy effects) impact the health and viability of financial institutions. Monetary policy changes that are not coordinated with appropriate regulatory actions may adversely affect the health of financial institutions. Given the usually high level of interdependence of financial institutions, the effects can have potential systemic financial stability implications. Understanding the risks and the channels of their transmission to financial stability is an essential element of formulating appropriate policies for strengthening domestic (and international) financial stability. For example, not well-thought out or untimely monetary policies and/or regulatory actions can, first, negatively impact financial institutions' balance sheets, incomes, and capital reserves and, ultimately, the sovereign balance sheet, thereby raising sovereign risks. This situation may be aggravated if foreign investors maintain significant holdings in the domestic market and decide to unwind their positions in local markets as a consequence of a perception or actual sovereign risk deterioration that often implies an exchange rate depreciation.

Finally, there are likely benefits to the smooth implementation of monetary policy if Treasury Single Account (TSA) cash balances are held by the central bank and attainment of a cash balance target is closely monitored and coordinated between cash management and monetary authorities. In such a case, it is ensured that any withdrawals do not upend the implementation of monetary policy, while temporary cash surpluses are remunerated by the central bank or placed in financial market instruments. Further, the efficacy of monetary policy is enhanced when foreign exchange reserve management is well-coordinated with other policies and, in particular, takes place within a consistent monetary policy implementation framework (i.e., is compatible with the overall interest rate policy setting).

2.3.2 *Role in Development of a Sovereign Asset and Liability Management Framework*[7]

It is widely recognized that the development and management of an integrated sovereign asset and liability portfolio helps monitor and manage sovereign portfolio risks efficiently and in a least-cost manner (Das et al. 2012; Koc 2014; Jonasson and Papaioannou 2018; Amante et al. 2018). In this scheme, the central bank is called to have a central role in the identification of items to be included in the portfolio, in the measurement of associated risks, and in the hedging strategies to be followed/adopted. In particular, a "sovereign asset liability management (SALM)" framework aims to identify and manage effectively the sovereign's key financial exposures based on the sovereign's balance sheet.[8] Jonasson and Papaioannou (2018) observe that sovereigns are susceptible to various risks and uncertainties relating to their financial assets and liabilities, depending on the country's level of economic and financial development. These risks, if realized, could cause a significant fiscal and financial drain and a consequent fall in the country's domestic absorption and potential output, besides affecting the balance of payments.

As the SALM approach helps detect sovereign risk exposures from a consolidated public-sector portfolio perspective, it allows one to analyze the financial characteristics of the sovereign's balance sheet by identifying sources of costs and risks and quantifying the correlations among these sources. This approach involves monitoring and quantifying the impact of movements in economic and financial variables, including exchange rates, interest rates, inflation, and commodity prices, on sovereign assets and liabilities, and containing other debt-related vulnerabilities in a coordinated way. In managing sovereign risk exposures, ALM techniques applied to government operations can uncover interest rate and currency mismatches between assets and liabilities and make clear the "cost-of-carry" of debt-financed financial assets. More broadly, ALM can help policymakers identify net risk positions requiring management and highlight cash flows available to service net debt, thus providing input for the design of monetary policies. In cases where the match of financial characteristics of the assets and liabilities is only partial, risk management could focus on the unmatched portions, i.e., net financial positions. In a short- to medium-term perspective, a financial risk management strategy could then be developed to reduce such exposures (see Jonasson and Papaioannou 2018; Amante et al. 2018).

To indicate net liability exposures in light of the characteristics of sovereign assets and government revenues, an analysis of the composition of public debt on a

[7] See also Chap. 10.

[8] A stylized sovereign balance sheet typically includes in the asset side (1) international reserves, (2) net fiscal assets (present value of primary fiscal balances), (3) value of money issuance (seigniorage, or zero for countries using another country's currency as a legal tender), and (4) other assets, including net pension and wealth funds, state-owned enterprises, infrastructure, and real estate, less explicit and implicit contingent claims, including guarantees, and in the liability side (1) external debt, (2) domestic debt, and (3) base money (Das et al. 2012).

net basis is required. The effects of implementing an ALM strategy should be carefully analyzed. In any effort to develop a comprehensive and meaningful sovereign ALM framework, the potential implications on macroeconomic objectives and policies should be assessed in parallel with the potential benefits from a consolidated sovereign portfolio management. Especially, the impacts of adopting an ALM strategy on policies to support the reduction of inflation, maintain financial stability, and enhance the resilience of the economy to external shocks should be taken into consideration. In this regard, the role of an ALM framework in developing appropriate monetary, fiscal, and debt management policies, including the development of local-currency debt instruments, to mitigate sovereign balance sheet risks and macroeconomic vulnerabilities should be encouraged.

Jonasson and Papaioannou (2018) maintain that the SALM approach is also utilized to facilitate a country's long-term macroeconomic and developmental objectives such as economic diversification, broadening of the export market, or reducing the dependence on key import products. Further, the SALM approach can help identify long-term fiscal challenges, such as unfunded social security liabilities, implying a future claim on resources. In this context, the SALM framework forms an integral part of an overall macroeconomic management strategy. Especially for commodity-exporting countries, the SALM approach can clarify the potential asset management challenges that stem from a medium-term fiscal strategy. In such framework, however, the interaction between monetary policy and the SALM strategy should be clear. Maintaining a well-articulated monetary policy, which explains the analysis and rationale for the chosen policy, is essential for such purpose. A forum for an open dialogue, such a SALM framework, helps secure support for the policy, as part of the central bank's overall approach to macroeconomic management and financial stewardship.

To establish an SALM framework, certain preconditions should be fulfilled, including availability of relevant sovereign asset and liability data and presence of a political will to undertake such a coordination-intensive project. Typically, governments do not compile a full statement of financial position in assets and liabilities. Also, adding to the complexity, prevailing institutional arrangements, including constitutional or statutory independence of participating entities, may segment policy decision-making, e.g., foreign reserves are usually managed by the central bank, while sovereign debt portfolios are managed by ministries of finance and debt management offices, each with different objectives and time horizons. Based on the experiences of countries that apply a consolidated sovereign portfolio risk management, the establishment of an SALM framework constitutes an effective policy innovation, with the achievement of intended results (i.e., providing the authorities with better monitoring of risk exposures and vulnerabilities and managing them in the most cost-effective way) depending on the (1) availability of adequate data for preparing a consolidated sovereign balance sheet, (2) development of a well-designed SALM framework, and (3) enactment of a comprehensive arrangement, perhaps in the form of a separate entity/formal body, for policy coordination among participating policy entities and adherence to agreed principles.

According to countries that employ an SALM approach, the SALM framework may be complex to implement due to a number of policy and institutional factors[9]:

- Monetary policy objectives have an impact on SALM strategies, by affecting either market (interest rate and exchange rate) risk management or directly the size to be managed. On the liability side of the consolidated sovereign balance sheet, they affect debt management strategy, as it typically aims at minimizing debt service cost subject to a prudent level of risk. On the asset side, they affect strategic asset management, as it aims primarily at accumulating an adequate level of net foreign assets, including foreign exchange reserves, to be used for conducting effective monetary and foreign exchange policies and as a buffer against external shocks. The latter entails the management of possible "excess" foreign currency assets (e.g., reserves above the adequacy level), either through the design and management of investment reserve portfolios so that returns on (excess) international assets can be enhanced or through the creation of sovereign wealth funds (SWFs) that can help offset the impact of domestic and external shocks on the fiscal position and/or pass on wealth to future generations.
- Additional difficulties in the design and implementation of an SALM framework may stem from fiscal policy objectives that aim at limiting annual debt service costs. This may put constraints on the duration and currency composition of public debt, since a high share of short-term debt may be perceived to lead to greater volatility in debt service costs.
- The structure of international and domestic capital markets also shapes SALM's design and implementation. Some developing countries cannot issue domestic debt because of illiquid and/or shallow domestic debt capital markets and a lack of a reliable local investor base. Often, attempts to issue domestic currency external debt have not been well-received in international markets owing, in part, to their vulnerability to shocks, restrictions on foreign investors to buy local-currency debt (e.g., on type of instruments, minimum holding period), poor transparency, and/or a lack of interest rate and exchange rate hedging instruments.

In view of these difficulties/constraints, some countries apply SALM concepts, at least partially, by adopting strategies to reduce vulnerabilities of the sovereign assets and liabilities without necessarily having explicit SALM identified objectives. Nevertheless, active engagement of central banks in the design of the structure and in the implementation of this framework can diminish potential operational difficulties, and in this way, benefit not only the overall sovereign portfolio management but also the design and conduct of monetary policy. For example, central banks that may need to accumulate sizable volumes of liabilities on their balance sheets for sterilizing the build-up of foreign currency reserves during periods of strong capital inflows, which can create significant balance sheet mismatches that can undermine a central bank's capital, can address this challenge more effectively

[9] See Jonasson and Papaioannou (2018) and Togo (2007)—a discussion of the coordination challenges among sovereign participating entities is also presented in Section II. C.

in an SALM framework by undertaking coordinated debt buybacks or debt prepayments financed by reserves (e.g., Brazil, Mexico, and Russia).[10]

Finally, as Maziad and Skancke (2014) note, a flexible SALM framework that integrates various macroeconomic and financial trade-offs with the aim of containing financial risk to the sovereign balance sheet requires, at the very least, coordination of the reserve and debt management decisions in terms of currency mix and duration. This fundamental premise should apply to the central bank reserve management. To the extent that sovereign assets/reserves exceed levels needed for shorter-term liquidity purposes, this excess could be invested in less-liquid/higher yield instruments to preserve wealth for future generations (preferably through a dedicated savings fund subject to appropriate institutional safeguards), provided that such investments help reduce the overall sovereign balance sheet risks. To this end, the investment objectives and strategies of sovereign assets could be informed by the structure and nature of sovereign liabilities, including contingent claims. This will be reflected in the associated investment horizon, mandate, and risk profile and, in turn, in the type of savings fund.

2.3.3 Role in Development of Domestic Capital Markets[11]

The development of domestic government bond markets has recently become a matter of growing policy interest in many countries, independently of the stage of their capital markets advancement. The benefits of a deep and liquid domestic debt market go beyond providing a reliable source of financing for fiscal deficits. They include diversification of funding sources, avoidance of the limitations of banking sector financing and inadequate availability of foreign aid and concessional foreign loans from the official sector (i.e., foreign governments and multilateral institutions), enhanced ability to respond to volatile capital flows and commodity prices, and reduction of the risks associated with borrowing in foreign currencies (Jonasson and Papaioannou 2018). Experience of advanced and emerging market economies has shown that well-regulated, predictable, stable, and liquid domestic debt markets can play a critical role in supporting economic growth and in helping the development of the financial sector, especially its efficacy and flexibility with regards to monetary policy conduct and resilience to financial shocks.

In particular, well-developed government bond markets could help finance budgetary deficits through the issuance of longer-term treasury bonds. In comparison with treasury bills or shorter-term treasury bonds, long-term bonds minimize refinancing risk in the government debt portfolio and, by lengthening the average time to interest rate resetting, its exposure to interest rate risk. Investors are willing to buy longer maturities only if they are confident in their ability to sell these securities if

[10] For a discussion of Mexico's case, see Ortiz (2007).

[11] See also Chap. 8.

they need to liquidate them. Also, they are willing to pay a higher price for a security with this advantage, which implies a lower yield and consequently a lower cost of funding for the government. As the secondary market develops, market prices of longer-term bonds are the basis of the yield curve, against which corporate bonds can be priced and market risk be hedged.

Establishing and developing domestic debt markets is a long and complex process that requires certain key preconditions to be in place (IMF et al. 2013; Amstad et al. 2016; IMF and the World Bank 2016; BOJ–BIS 2012). Many issues can inhibit the development of the market, such as macroeconomic or political instability; financial controls; low domestic savings rate; paucity of institutional investors; proliferation of government agencies issuing securities causing market fragmentation; unpredictable issuance policy; and absence of the required market infrastructure. Potential obstacles to the development of a domestic bond market depend, therefore, on a country's overall degree and stage of development. Accordingly, in building a deep and liquid bond market, countries typically develop their own reform plans suited to their conditions.

In particular, the credibility of the government as an issuer of securities and rational policymaker is an essential precondition in the development of an efficient domestic bond market. Government credibility implies that the size of the public debt allows investors to be confident about the government's ability to meet its financial commitments (i.e., to service and repay its borrowings). A prudent fiscal policy will typically mitigate concerns about debt sustainability. Another significant condition is the commitment of the government to pay market interest rates, i.e., not to enact regulations to create a captive investor base by compelling some institutions to buy debt instruments (i.e., by obliging banks to invest in instruments a certain percentage of their deposits), thereby enabling the government to issue at artificially low rates. Further, predictability and transparency of the government's annual issuance plan to meet its gross borrowing requirement is essential in enabling investors to plan their own portfolios and building the government's credibility.

Further, the establishment of a well-functioning primary domestic government bond market depends critically on developing sufficient secondary market liquidity, with a high turnover and great price transparency. This helps create a liquid yield curve, which is critical for an efficient bond pricing and market risk hedging. To enhance secondary market liquidity, governments issue benchmark securities of chosen tenors, including through liability management operations, e.g., bond buybacks or exchanges. Additionally, a well-functioning money market is crucial for the development of an efficient domestic bond market to ensure a competitive and efficient system of market-based financial intermediation and support an active secondly bond market by reducing liquidity risk. Besides, it facilitates monetary policy operations, with market-based instruments anchoring the short end of the yield curve and promoting the development of the foreign exchange market.

A sound banking system is similarly vital for the development of a domestic bond market, as it provides adequate appetite to invest in securities and thus helps

increase secondary market liquidity.[12] Moreover, a large and heterogeneous investor base with different risk preferences, investment maturity horizons, and trading motives ensures a strong and stable demand for government debt securities in a range of market conditions. Another precondition is the existence of appropriate technical and regulatory infrastructure, which is also of relevance to foreign exchange reserve managers of central banks. In general, there is no need for a sophisticated, high-capacity infrastructure in the initial phase, but as the market develops and the number of participants increases and diversifies, a more efficient system for the registration, custody, clearance, settlement of, and payment for debt instruments should be put in place.

The responsibility for ensuring that these preconditions for a macroeconomic and generally conducive environment are met should be shared among fiscal, monetary, and debt management authorities. In particular, an inter-agency consultative process would be required for establishing the preconditions within the scope of a plan for overall macroeconomic prudency and reforms. Experience has shown that policy interventions are effective and reforms are best-enacted in countries where an empowering institutional framework exists (i.e., suitable legal, tax, and governance structures are in place) and commitment begins with the heads of the institutions and is conveyed to the principals of the agencies that participate in this endeavor.

Central banks could first and foremost help in the development of the domestic government bond market, as well as of equity markets, by maintaining a stable macroeconomic environment and well-regulated financial system. Central banks could also help in such development by coordinating with fiscal and debt management authorities the issuance of possible central-bank bonds and government bonds, especially with regard to maturities, so as (1) a liquid yield curve is established (which in turn will assist in the development of the country's money markets and derivatives instruments for interest rate and exchange rate hedging operations by domestic and foreign market participants and will serve as a benchmark for private sector, banks and corporates, borrowing), and (2) amble liquid bond instruments are generated, which could facilitate in the efficient exercise of monetary policy operations.

In this regard, uncertainty about future macroeconomic conditions, particularly about the course of inflation, will prevent the government from extending the yield curve beyond very short-term securities. If inflation is rapidly increasing and interest rates are high and volatile, investors will at best buy only very short-term securities with maturities no longer than a few weeks. High inflation and high interest rates are perceived as indicators of economic and/or political instability. Extension of the yield curve under persistent inflationary conditions may require issuance of inflation-indexed bonds or variable-rate bonds in the initial stage. Though a domestic government bond market can begin with a relatively high inflation rate, it needs government commitment to contain inflation in order to develop.

[12] See also Chap. 8.

2.3.4 Facing Other Emerging Challenges

2.3.4.1 Central Bank Digital Currencies, Cryptocurrencies and Distributed Ledger Technologies (e.g., Blockchain)

Central bank digital currencies (CBDCs), Cryptocurrencies, such as Bitcoin and Ethereum, and distributed ledger (DL) technologies, in particular Blockchain, are among the latest innovations in the financial system (Jagtiani et al. 2018). Cryptocurrencies, as digital currencies with an open, distributed ledger, could alter the structure of global transactions and offer significant efficiencies in global markets. The public's long-standing efforts to avoid registration and scrutiny of ensuing transactions are cited as principal reasons for the creation and proliferation of these private currencies. However, the use of cryptocurrencies has raised a number of concerns, including high price volatility and safety of corresponding assets, money laundering and terrorist financing risks, financing illicit activities, promoting tax evasion, and financial stability considerations. The main advantages of the DL technology relate to the ensured higher designed decentralization and extend to the broader financial system. Advances in the DL technology, especially with regards to digital identities and "smart" contracts, are expected to help in the wider spread of digital currencies as efficient means of transactions, such as payments, transfers, investment, trading, peer-to-peer lending, and crowdfunding.

As cryptocurrencies can offer an alternative to national currencies as a medium of exchange for transactions and store of value, irrespective of any regulations that may be imposed, their existence will be determined by their functionality and the efficiency of the technology that will support them.[13] Although the current small use of cryptocurrencies is not envisaged to pose any monetary policy transmission or financial stability concerns, central banks and regulators need to remain vigilant about the resultant risks from their evolving uses and be ready to introduce regulation to curb hazards stemming from possible payment and clearing system disruptions and from transactions of questionable integrity. At the same time, monetary authorities should usefully take advantage of any new DL technologies that could improve the efficiency of the existing payment and clearing systems, as well as of the overall financial apparatus. The short- and medium-term benefits and associated risks to their users, central bank managers of foreign reserves, and the financial system as a whole are widely debated among policy makers, international financial institutions, and markets, with various proposals being currently deliberated on how to move forward both in local monetary systems and the global economy.

2.3.4.2 Cybersecurity Attacks

Given the increasing cybersecurity risks for financial institutions, central banks have recently been proactive in implementing measures to prevent or minimize cyberattacks. For example, the European Central Bank (ECB) has designed a

[13] Some analysts argue against the store-of-value function of cryptocurrencies, e.g., Shin (2018).

simulation test for cyberattacks on banks, stock exchanges, and other critical entities for the functioning of the financial system. This action is the result of a series of cyberattacks on financial institutions and central banks during the past few years, including those on the three biggest Dutch banks earlier in 2018. The ECB initiative aims at creating an integrated framework for the tests that assess the resilience of the European Union financial entities against cyberattacks. The European framework "Threat Intelligence-based Ethical Red Teaming" (TIBER-EU) is intended to function as a roadmap for such tests in financial institutions.

2.3.4.3 Environmental, Social, and Corporate Governance (ESG) Responsible Investments[14]

In its effort to help create an economically efficient, sustainable global financial system for long-term value creation, the UN-supported Principles for Responsible Investment (PRI) group developed six voluntary environmental, social, and corporate governance (ESG) principles for long-term institutional investors (PRI 2016, 2018). As many investors have already subscribed to the PRI principles, central banks, as managers of the investment tranche of their foreign exchange reserves, need also to commit to them as part of their fiduciary duty to act in the best long-term interests of their beneficiaries, i.e., the citizens of their countries. By adopting the principles, investors recognize that ESG issues can affect the performance of investment portfolios (to varying degrees across companies, sectors, regions, asset classes and through time) and their application may better align them with broader objectives of society. These principles, provided that they are consistent with the respective investors' fiduciary responsibilities, require that investors (1) incorporate ESG issues into investment analysis and decision-making processes; (2) will be active owners and incorporate ESG issues into their ownership policies and practices; (3) seek appropriate disclosure on ESG issues by the entities in which they invest; (4) promote acceptance and implementation of the principles within the investment industry; (5) work together to enhance their effectiveness in implementing the principles; and (6) report on their activities and progress towards implementing the principles (PRI 2015). By adopting such principles and helping in their implementation, central banks can contribute to the development of a financial system that will reward long-term, responsible investment and also benefit the environment and society as a whole.

2.4 Concluding Remarks

In modern times, central banks are called to play multiple roles, including the traditional one of monetary and financial stability and the more contemporary ones such as ensuring overall financial stability and adequate and sustainable economic

[14] See also Chap. 26.

growth, i.e., safeguarding employment and prosperity. The wider role of central banks in their respective economies is now more generally accepted, primarily as a result of the global authorities' successful reaction to the recent financial crisis and aversion of a global depression. Such reaction followed the timely realization of central bankers that monetary policy cannot stay in the traditional confines of ensuring inflation stability and not pay due attention to the general state of the economy. This expanded role of central banks is likely to last far beyond the period that economic activity and labor market conditions have returned to normalcy (proxied by respective levels observed before the financial crisis). The adaptive stance of major central banks and maintenance of quantitative easing measures, as needed, is another indication that they are serious about their guardian role of the public interest.

Further, with the advent of new domestic or international macro-financial challenges, central banks need to (1) strengthen their coordination role with other policy-making institutions to enhance the overall efficacy of domestic economic policy making, (2) develop a consolidated sovereign balance sheet to monitor and manage better sovereign portfolio risks, and (3) promote the establishment of domestic capital markets, including local-currency bond markets, to increase the availability of financing sources and reduce foreign exchange exposures, thus serving as a diversifier for foreign reserves. In addition, central banks should be prepared to face technological innovations, as well as novel domestic or international financial developments and risks, including the current spread of CBDCs, cryptocurrencies and distributed ledger technologies in the financial system, cybersecurity-attack concerns, and environmental, social, and corporate governance considerations in their reserve-investment decisions.

In this context, central banks' communication strategies need careful attention. Especially, as many important decisions relating to the state of the economy and the well-being of citizens are increasingly taken by central bankers and regulators, respective parliaments have to oversee the design of central banks, including as regulatory institutions, so that their roles are kept sufficiently clear and focused. Central banks need to inform their parliaments and the public about their actions and policies to avoid suspicions, wrong impressions or adverse perceptions. This is even more so after the recent global financial crisis, as central bankers (and financial regulators in general) have gained more influence and authority as a result of their actions to prevent a global financial system collapse. In a recent book, Tucker (2018) examines the enhanced role of central bankers and regulators and lays out principles needed to ensure that they remain stewards of the common good.

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Chapter 3
Larger Central Bank Balance Sheets: A New Normal for Monetary Policy?

Srichander Ramaswamy and Philip Turner

Abstract In the "new normal" for monetary policy, central bank balance sheets are likely to be larger and used more actively than before the Global Financial Crisis. Those who manage assets for central banks should take account of the asset and liability choices of many other policy-makers—those responsible for monetary policy, Treasury debt management and financial regulators. Large, diversified and less traditional central bank balance sheets have advantages.

3.1 Introduction

Since the Global Financial Crisis (GFC), the central bank balance sheet in advanced economies has assumed greater importance for policy. Balance sheets have become much larger, and have become more actively managed. The range of assets has widened, with a lengthening in the average maturity of assets. At the same time, new financial regulations require commercial banks to hold larger stocks of "safe" liquid assets—usually reserves held with the central bank and government bonds.

These changes have had a major impact on the balance sheets of domestic banks. How this will affect bank business models in the future is an important unknown, and its implications are likely to vary between jurisdictions.[1]

This chapter argues that central bank balance sheet policy will probably remain important for monetary policy for years (Sect. 3.2). One lesson to be drawn from the great range of assets acquired during the past decade is that pre-conceptions about what sort of asset a central bank can rightfully buy should be abandoned (Sect. 3.3). Circumstances should determine how to make complex pragmatic choices. Section

[1] See also Chap. 9.

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3.4 underlines the importance of the nature of the liabilities a central bank incurs when it buys assets. Section 3.5 addresses a key question for all investors as quantitative easing (QE) gradually unwinds: what will happen to the "world" long-term interest rate over the next few years? Conclusions follow in Sect. 3.6.

3.2 Monetary Policy and Central Bank Balance Sheets[2]

Before the mid-1980s, quantity variables had pride of place in the analysis of monetary policy. How central bank purchases or sales changed the market prices of financial assets depended on the substitutability between money and other assets in investors' portfolios. Many central banks imposed liquid or reserve asset ratios on banks for prudential reasons but also for monetary control. Changes to the central bank balance sheet forced balance sheet adjustments in banks and the private sector more generally. Such portfolio rebalancing effects were seen as key in monetary policy transmission. Yet theory would suggest that such effects are likely to be unstable over time (stronger, for instance, when markets are illiquid). A large amount of research produced no agreement about the average size of such rebalancing effects.

But this quantity-focused theory of central banking was progressively undermined by the rise of rational expectations models associated with the New Classical Macroeconomics which, applied to monetary economics, developed into the New Keynesian model. Curiously this model took account of imperfections in goods and labour markets, but assumed perfect financial markets. Hence major contemporaneous advances in microeconomics, which had shown how financial markets were imperfect, were simply ignored.[3]

This model instead took, at least as its point of departure, the rational intertemporal choices of a single representative agent who has perfect foresight for each future state of nature (or who could trade in complete markets). The central bank has only to set the short-term rate and markets would determine the shape of the yield curve according to expectations of future short rates which followed from expectations of macroeconomic prospects and knowledge of the policy rule followed by the central bank.

This framework had several strong implications for policy. One was that the long-term interest rate was determined by expectations of future short rates. Various "irrelevance theorems" were devised for government budgets or central bank balance sheets. Households would understand the implications for their future taxes of decisions about the government's or the central bank's balance sheet, and would

[2] This section draws on a fuller discussion of the history of monetary theory in Turner (2014).

[3] Hahn and Solow (1995) pointed this out almost 20 years ago: "In a decade that has seen vast progress in our study of asymmetric information, 'missing markets', contracts, strategic interaction and much else precisely because those aspects are regarded as real phenomena that require analysis, macroeconomics has ignored them all".

react in ways that neutralize the putative effect of such official action (Ricardian equivalence). This New Keynesian perspective incorporating rational expectations and perfect asset substitutability shaped what has been called the pre-crisis "doctrine" of monetary policy (Aglietta 2013) in a way that was very convenient for policy-makers in central banks.

Three "dogmas" are of interest for the purpose of this paper:

1. *Open market operations do not change relative prices*. Ricardian equivalence applies to the central bank: any purchase or sale of particular assets would lead only to offsetting changes in private demands, with no impact on prices. One corollary of this is that government debt management (that is, the relative supply of short-dated and long-dated bonds by the Treasury) can be separated from monetary policy.
2. *The short-term policy rate is the unique instrument of monetary policy aimed at macroeconomic objectives*. The impact of policies on other core financial market prices—such as the long-term interest rate—was neglected. Developments in monetary quantities (e.g. M2, bank reserves, etc.), seen as reacting endogenously to policy rate decisions, had little or no influence on policy. And the Taylor rule linked only the short-term rate to macroeconomic developments.
3. *The "liquidity" of the balance sheets of commercial banks is irrelevant*. If adequate capital standards are in place to ensure the viability of a bank, there was no additional need for bank regulators to worry about the liquidity of banks because a sound bank could borrow readily in interbank markets to meet any "temporary" liquidity shortage. Hence the failure of international regulators in the 1980s to develop common measures of the overall liquidity of a bank (and the decline in liquid asset ratios) seemed of limited practical significance.

These dogmas spared central banks from some awkward choices. The central bank did not need to intervene in government bond markets if the long-term rate was too high or too low. It could ignore the often erratic movements in monetary aggregates. There was no need for the central bank to force commercial banks to hold larger reserve balances.

The crisis showed these dogmas were illusory. The model was indeed virtually devoid of macroeconomic content because coordination failure among private agents—surely the essence of macroeconomics—is ruled out by assumption. Liquidity constraints and many other interesting macroeconomic/monetary/financial questions were in effect side-stepped. Several articles in BIS (2012) explore these issues in more detail. Fischer (2016) shrewdly observed that the New Keynesian simplification of monetary policy as being a matter of interest rates alone—with no "money"—was an assumption (not incidentally shared by Wicksell) and not a theorem.[4]

[4] Wicksell (1907) showed the importance of bank interest rates even in a gold standard world. But he did not assume the central bank balance sheet did not matter: "the Quantity Theory cannot just be thrown overboard".

The latest central bank consensus summarized in a recent BIS Working Party report vindicated the radical post-GFC changes to central bank balance sheets (BIS 2019). It found that such policies had proved to be very effective additions to the tool-kit of central banks. The report also argued that the secular decline in equilibrium real interest rates could require further active policy use of central bank balance sheets in the years ahead. Thus quantity variables have once again become crucial in the analysis of monetary policy.

3.3 Choice of Assets[5]

Figure 3.1 shows the size of central bank balance sheets relative to GDP. The scale of balance sheet expansion differed substantially between central banks: over 90% of GDP in the case of Japan, over 40% of GDP in the euro area and a high of over 25% of GDP in the case of the Federal Reserve.

There were several objectives of balance sheet expansion by advanced economy central banks after the GFC. One was to offset a crisis-induced flight to liquidity/safety by the private sector. Another was to help liquefy the balance sheets of banks. A third (and most important) was to provide further macroeconomic stimulus once the policy rate had been cut to near zero. In some cases, the aim was to counter exchange rate appreciation.

There was a wide range in the assets acquired to effect balance sheet expansion: government bonds, corporate bonds, mortgage-related bonds, equities and ETFs based on equities and many more. Longer-term loans were made to banks in several jurisdictions, sometimes made contingent on the recipient bank increasing lending.

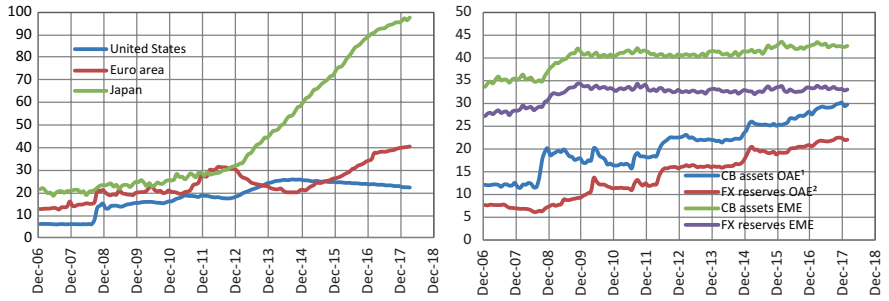

Fig. 3.1 Central bank balance sheet size and foreign exchange reserves, in percent of GDP. Central bank total assets (left panel). Central bank balance sheets and FX reserves as simple average across economies (right panel).[1] Central bank assets of other advanced economies excluding euro area, Japan and the USA.[2] Foreign exchange reserves of other advanced economies excluding euro area, Japan and the USA. Source: BIS Annual Economic Report, June 2018

[5] See also Chap. 4.

Such diversity in objectives and in instruments suggests caution in generalizing about the balance sheet policies followed. When balance sheets were much smaller, and were not an active tool of policy, simple rules of thumb would guide what central banks did or did not buy. Such rules often embodied a preference for liquid, short-term and government-issued paper. Asset allocation rules could be simplified. But such simplification was always a little illusory. As Fanari and Palazzo (2018) argue, central bank investment managers have to face the risk that their investment choices might run counter to the macroeconomic and financial stability objectives of the central bank.[6]

It has been a key tenet of central banking since the time of Bagehot that such rules cannot apply after a financial crisis. Remember Bagehot's criticism of the too-conservative Bank of England in the nineteenth century.[7] Sometimes the central bank will have to lend or to buy assets when no one else will. After all, central banks can in principle be more risk-tolerant than private investors: as Castelli and Gerlach (2019) point out, a central bank with the government behind it can operate with negative capital and there is no limit to its ability to execute payments in domestic currency.[8]

Artificial constraints on what central banks can do would weaken their ability to act decisively in periods of exceptional risk aversion. Paradoxically, too-feeble responses early in a crisis may ultimately lead to the central bank assuming even greater risk exposures after a subsequent deepening of the crisis. Geithner (2016) rightly worries that new post-crisis limits on the powers of the Federal Reserve and the US Treasury could make future crises much harder to manage.

The use of central bank balance sheets to achieve macroeconomic goals reinforces the case for keeping the potential asset choice of central banks as wide as possible. Purchases of just one asset class (for example, government bonds) tend to concentrate the price "distortion" on that asset class. This can be a serious drawback for banks and other regulated financial firms which have in effect been made captive investors in government bonds. More granular policies can target more efficiently those private sector asset holders (and private sector debtors) whose portfolios are heavily weighted to a particular asset class. A large and varied portfolio of assets

[6] A broader question (beyond the scope of this paper) is to what extent a central bank should consider how their investment policies have broader *international* macroeconomic consequences. Reserve managers as a whole took actions which added to the stabilization burden of central banks in reserve currency-issuing countries. For instance, they cut exposures to foreign commercial banks and sold US agency debt and similar products: see Jones (2018), Morahan and Mulder (2013) and Pringle and Carver (2008).

[7] He wrote in Lombard Street (1896/1873) that "an idea prevails at the Bank of England that they ought not advance during a panic on any kind of security on which they do not commonly advance. But the ordinary practice of the Bank of England is immaterial. In ordinary times the Bank is only one of many lenders, whereas in a panic it is the sole lender".

[8] This is not to deny the management challenge of larger balance sheets composed of less familiar assets. The mark-to-market value of the balance sheet can become more volatile. Limits on the central bank share of market segments will have to be considered in order to preserve market functioning.

puts the central bank in a better position to "fill in the cracks" by acting on many specific risk spreads.

In a summary way, some key choices are as follows:

3.3.1 Foreign or Domestic Assets

When domestic financial intermediation or monetary transmission is impaired, the natural choice is to buy domestic assets. But in some cases, the domestic financial market is too small for the central bank to rely only on purchasing domestic assets. When the shock takes the form of heavy capital inflows, creating a risk of currency over-valuation, it makes sense to buy foreign assets.

Note that even the purchase of domestic assets can depress the exchange rate. This can happen through a reduction in yields on fixed-income securities forcing private investors to seek assets of other currencies. Figure 3.1 shows that the balance sheets of the major central banks expanded and contracted at quite different times. The evidence is that the exchange rate implications of such monetary policy divergence were sizable.

3.3.2 Long-Term or Short-Term Assets

The long-term interest rate may not move in the direction intended by monetary policy even in liquid and well-functioning markets. Recall the "Greenspan conundrum": between June 2004 and June 2005, the Fed funds rate was increased by 2 percentage points but the yield on 10-year Treasuries fell by almost one percentage point. When the Fed funds rate was cut aggressively after the Lehman bankruptcy, long-term rates actually increased. Term premia (that is, the difference between the 10-year rate and the average of expected future short-term rates over the life of a 10-year bond—see the decomposition in Fig. 3.2) rose as indeed did all other risk premia.

For this reason, central banks need tools to affect the long-term rate directly even when there is still room to change the policy rate. Hence there is a case for central bank purchases or sales of bonds which is independent of the zero-lower bound (Friedman 2014).

3.3.3 Public or Private Assets

There are of course good political or governance reasons for central bank caution about the purchase of private assets. As a matter of economics, however, there are many good arguments for buying private assets.

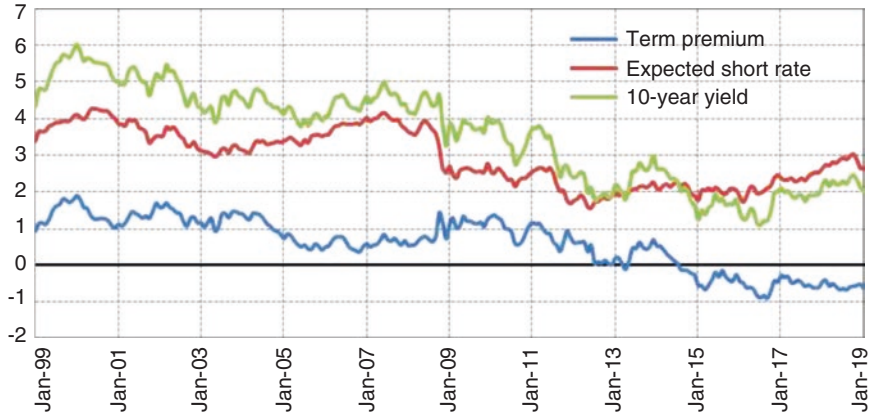

Fig. 3.2 Decomposition of the 10-year world bond yield, in percent. Source: Hördahl et al. (2016)

One is that it can counter an unwarranted flight from private assets which has been a feature of many financial crises in the past (Farmer 2017). Even in less extreme circumstances, such purchases can target those areas which monetary expansion is not reaching.

Another reason for including private assets is that buying only government bonds may exacerbate the shortage of safe assets. Caballero et al. (2017) argue that, over the past 20 years, the supply of safe assets has not kept up with the global demand for such assets. This is because of the strong demand coming from the high-saving emerging economies, especially in Asia, which has out-stripped growth in the advanced economies which produce the safe assets. Remember that this shortage of safe assets has been aggravated by new liquidity regulations forcing banks to hold much higher levels of government bonds than before the crisis (Allen 2013).

A third reason is that private assets add diversification to the central bank's balance sheet and the larger the balance sheet, the greater the need for diversification. For instance, the Swiss National Bank diversified by adding foreign shares to their already large holdings of foreign bonds.

3.3.4 Lending to Domestic Banks

Longer-term central bank lending to banks (or favourable collateral provisions) became a major instrument of policy. The ECB has put great weight on medium-term loans to banks. One reason for this is that it had to grapple with a fragmented money market in the euro area. Euro deposits in banks in weaker countries when shifted to banks in other euro area countries would result in funding liquidity problems. At an earlier stage of the crisis, the bond spreads of Italy, Spain and others over German bunds widened sharply. This has led banks in countries hardest hit by

Table 3.1 Trends in central bank approved asset classes

Asset class	2018	2011	2007	1998
Supranationals	95	76	72	60
Sovereign eurobonds	86	64	66	66
US agencies	76	55	86	54
Inflation protected bonds	62	44	33	NA
Covered bonds	43	30	58	12
Bank debt	43	20	44	4
Corporates	57	31	41	10
MBS/ABS	57	37	52	2
Emerging market debt	24	22	10	NA
Equities	24	18	22	NA
Private equity	5	NA	NA	NA

In percent of total respondents
Castelli and Gerlach (2019)

the crisis to use longer-term funding from the ECB to increase the purchase of domestic government bonds. Valla (2014) says the central bank thus supported a profitable carry trade which helped bank recapitalization.

In other cases, policy aimed at stimulating bank lending to certain parts of the private sector. In the case of the Bank of England's funding for lending scheme and the ECB's Targeted Long-term Refinancing Operations, the conditionality applied to such lending was key.

Finally, central banks can purchase debt paper backed by bank loans. In some markets, a public sector institution stands behind such securitized debt paper notably in household mortgage markets. One policy issue is the choice between direct lending to banks and indirect support via securitized bonds.

Castelli and Gerlach (2019) show how the range of approved asset classes for investing foreign currency reserves has widened over the past 20 years: see Table 3.1. Many now invest in emerging market government debt, bonds with non-sovereign credit risk and in equities. A final word on asset choice in conclusion: dogmatism is best avoided. Central banks need to think hard about the macroeconomic case for buying any specific asset class. Tradition should not constrain this choice. But there will be times when political/governance/moral hazard considerations will outweigh macroeconomic arguments.

3.4 Choice of Liabilities

No analysis of central bank policies on asset purchase would be complete without consideration of the liability side of the central bank's balance sheet. What is also often overlooked is that changes to the central bank balance sheet usually have as

Table 3.2 The banking system

Central bank		Commercial banks	
Assets	Liabilities	Assets	Liabilities
Foreign assets	Currency	Currency	Deposits
Loans to banks	Bank reserves	Bank reserves	Loans from central bank
Government securities – bonds – bills	Government deposits	Government securities	Bank bonds
Gold	Non-monetary liabilities	Bank loans	Commercial paper
Other assets	Equity	Other assets	Equity

their counterpart a change in the balance sheets of domestic commercial banks. For this reason, Table 3.2 shows these two balance sheets side-by-side.

In most cases, central bank asset purchases (or loans) were in effect financed in large part by the increase in commercial bank reserves with the central bank—an expansion in what used to be called the monetary base or high-powered money. Table 3.2 shows that there is nothing intrinsic or inevitable about the link between central bank asset purchases and monetary expansion. The government could have prevented any expansion in the monetary base either by injecting equity capital into the central bank or by increasing its own deposits with the central bank. But financing such deposits by issuing government bonds would tend to drive up the benchmark long-term rate. Other reasons for government reluctance to increase its own borrowing included electoral sensitivities ("borrowing to help big banks"), the assessment methodologies of credit rating agencies (which do not typically include gross central bank liabilities in public debt) and the difficulty of securing rapid parliamentary approval.

The link between central bank balance sheet expansion and the commercial banks is considered in more detail in Chap. 9. The main point is that increased central bank liabilities have made the balance sheets of commercial banks more liquid. Part of this increase in reserves may be permanent, reflecting a stronger bank demand for liquid assets. The crisis taught banks that they need to hold more liquid assets even in normal times. New international bank regulation is reinforcing this orientation. It is, however, too early to tell what banks' new liquidity preference will be in the medium term. Nor is it clear how banks will meet their liquidity needs. Gagnon and Sack (2014), Sack (2017) and others suggest bank reserves will be much higher. However, Goodhart (2017) points to alternatives to bank reserves (e.g. Treasury bills).

Moreover, there is no consensus on the impact of more liquid balance sheets on future bank lending. One argument is that banks with adequate capital will lend more mainly when the prospective returns are attractive, with liquidity acting only as a constraint (that is, liquidity has a binary, on/off nature). The counterargument is that liquidity effects may be continuous. After all, the larger the stock of liquid

assets, the smaller the tail risk of sudden illiquidity and bank runs and so lending can be increased.

We have argued that the central bank can influence the long-term rate by changing the maturity of its assets or liabilities. But the central bank does not have sole jurisdiction over policy aimed at the long-term rate. This is because government debt management policies affect the maturity of government debt held by investors outside the central bank—that is, the private sector and foreign official investors—just as much as central bank market operations. Both the government and the central bank have the capacity through their transactions to alter the portfolios of assets held by the market. Wheeler (2018) notes that, as the challenges facing all economic policy makers have become more complex, public debt managers "should seek to become more active in key areas".[9]

Treasuries in most advanced economies have been lengthening the maturity of their issuance during much of the post-GFC period and therefore countering part of monetary expansion that quantitative easing was meant to achieve.[10] It is not difficult to see why this might happen. The prospect of much higher government debt to finance makes prudent debt managers want to lengthen the maturity of their issuance. Moreover, a temporary change to the yield curve induced by central bank action may lead the debt manager to alter its issuance policy to take advantage of what it might view as a temporary interest rate "distortion". Or it may move quickly to attain a pre-existing maturity-extending objective thanks to favourable market conditions created by the central bank.

3.5 Whither the "World" Long-Term Interest Rate?

Current benchmark long-term interest rates from key government bond markets are exceptionally low. Until recently, driving down such yields was a major objective of the QE policies of all major central banks. As Ramaswamy and Turner (2018) argue, regulatory policies have been working in exactly the same direction.

Take the new international banking rules—Basel III. Two provisions have induced banks to build up massive stocks of government bonds. The first is the requirement to hold liquid assets to meet new liquidity rules. In a significant break from earlier periods when central banks enforced similar rules, long-term

[9] In addition to the need to engage with central banks on balance sheet policy, he argues that public debt managers "need to partner with the finance ministry to ensure the government is well-informed about its … contingent liabilities … and should readily engage with" financial regulators.

[10] Greenwood et al. (2014) estimated that the Fed's QE policies reduced dollar long-term interest rates by 1.37 percentage points while the increase in the average maturity of Treasury debt issuance added back 0.48 percentage points. See also Blommestein and Turner in BIS (2012). The average maturity of JGBs rose from 5 years in FY 2000—before Japan's first QE policy—to almost 8 years in 2013. See Iwata and Fueda-Samikawa (2013) for an analysis of Japanese evidence.

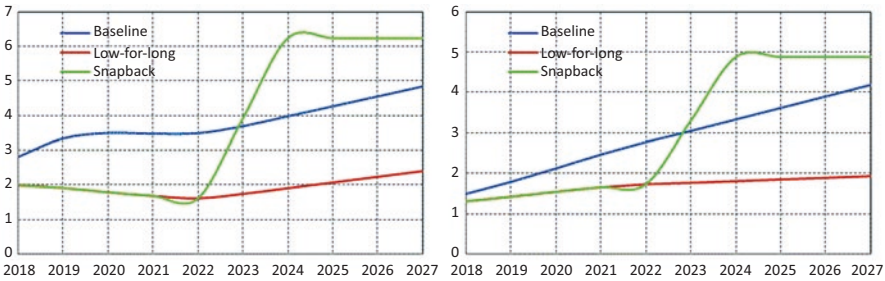

Fig. 3.3 Projection of 10-year interest rates under different scenarios, in percent. United States, left panel. Euro area, right panel. Source: BIS (2018)

government bonds now qualify as a liquid asset. In the past, liquid assets had to be short-dated paper in order to avoid the interest rate risk from holding bonds. The second is the lack of a global Pillar 1 capital charge on interest rate risk on bonds held in the banking book (that is, bonds not for trading but intended to be held to maturity).

Arbitrage between bond markets in the major international currencies ensures that yields tend to move together. As a first approximation, therefore, it makes sense to think in terms of a "world" long-term interest rate. Figure 3.2 (Decomposition of the 10-year world bond yield) is based on a computation of the common factor behind 10-year bond yields in dollars, the euro and sterling. The decline in the "world" long-term rate so computed after 2010 reflected a decline in the term premium into negative territory. The interpretation of this is that, at present, the yield on a 10-year bond is lower than the sum of expected returns from rolling over a sequence of three-month paper during the life of the bond.

The world long-term rate seems to have reached its nadir (of about 1%) in the third quarter of 2016. By 2017, however, it was clear that the global economy had improved, and a cyclical rise in short-term rates has begun. It remains to be seen how far this will go (depends on observed inflation). A significant start has been made to reversing QE. In addition, the regulation-driven increased demand for long-term bonds can be expected to diminish as banks and others complete their transition to meeting the new rules. And a major fiscal expansion in the USA, implying much heavier Treasury borrowing, is expected to add upward pressure on long-term rates. By May 2018, the world long-term rate had risen to over 2%. But slower global growth from September 2018, followed by the FOMC's decisions in early 2019 to hold off on further near-term rise in the Federal funds rate and to moderate the pace of balance sheet reduction, put renewed downward pressure on the long-term rate. The world term premium remained negative.

No one knows how far, or how quickly, long-term rates will rise. Many believe that strong structural forces such as population ageing and slower productivity growth will keep long-term rates low for the next decade. Given this inevitable uncertainty, scenario analyses can help investors understand their exposures and

help them to monitor them over time. A recent report by a special group established by the world's major central banks provides a good starting point BIS (2018).

This report considers three scenarios for how far long-term rates will rise over the next 10 years. It does so for the interest rates of all major advanced and many emerging market economies. The scenarios published cover, in addition to long-term interest rates, three-month rates, GDP growth and CPI inflation in each country. The long-term interest rates for the USA and the euro area under each scenario are shown in Fig. 3.3.

The baseline scenario is the most reassuring. Interest rates rise gradually, permitting "a smooth portfolio rebalancing out of longer-duration assets" and a repricing of credit risks. The 10-year yield on US Treasuries rises gradually to 4.8% by 2027, which is 3 percentage points above its 2016 base of 1.8%. The interest rate rise in the euro area is a little larger.

Second, there is the low-for-long scenario. Structural factors hold long-term interest rates well below their historical averages for a long time. The yield on the 10-year Treasury is stuck in the range of 1.6–2.4% until 2027. This would be a challenge to business models of many financial firms, and the report underlines that this scenario "presents considerable solvency risk for insurance companies and pension funds (ICPFs)". It warns that the "outright failure of particular ICPFs could be transmitted to the rest of the financial system and to the broader economy though financial sector counterparties" and through households or non-financial firms hit by such failures.

Third, there is the snap-back scenario. There is a run-up in inflation which leads to a rapid increase in both short and long rates. The 10-year dollar yield rises to over 6% with inflation in the 3–4% range. Under this scenario, banks would hard hit by "valuation losses on their longer-term securities, higher funding costs, increased delinquencies on their loans and reduced credit growth". The report admits losses to financial firms could be even greater than envisaged under this scenario—because other asset prices are likely to fall if bond yields jump. The repricing of other assets (e.g. property held as collateral, equity prices) and mark-to-market losses associated with a decline in bond prices are very hard to capture well.

The future path of interest rates will naturally be much more erratic than any scenario. The end-point envisaged in the snap-back scenario, for instance, may well come sooner than 2027. Markets may well anticipate the ultimate impact of the underlying macroeconomic forces.

Nevertheless, these scenarios provide a convenient benchmark which can be updated as interest rate developments unfold.

3.6 Challenges for those Who Manage Central Bank Assets

Central bank balance sheets are likely to have a bigger role in the "new normal" for monetary policy in the advanced economies over the foreseeable future than they had before the GFC (Ball et al. 2016, IEO 2019, Kiley and Roberts 2017). Larger

balance sheets mean that "traditional" rules on the nature of assets or liabilities held by the central bank (or a sovereign wealth fund) no longer apply. Hence it is important for central banks to think hard about these choices. Echoing Hawtrey's famous phrase about central banking being an art, Panetta (2016) says "monetary policy is not a mechanical exercise carried out by wooden technocrats".

The second main conclusion is that the policy environment for central bank reserve managers has become more multidimensional. The asset and liability choices of other policy-makers (e.g. monetary policy setters; Treasury debt management) now matter more. The decisions of bank and other regulators will affect the investment choices of banks and others, and this may have implications for public investment managers. This means that those who manage central bank assets have to consider how to respond to shocks created by the actions of other policy-makers. For instance, does the lengthening of central bank holdings of domestic bonds mean that foreign exchange reserves managers should choose shorter-dated foreign paper? The reserves manager may also need to be aware of spillovers from investment decisions on the policy objectives of reserves-issuing central banks—although in practice that may be difficult.

The third conclusion is the nature and timing of the future exit from very stimulatory monetary policies in the core currency countries matters a great deal. What should those who manage assets in smaller countries do as this exit gets underway? At least three dimensions of the balance sheet are relevant: its size; its composition; and last but not least its elasticity. The ability to grow or shrink the balance sheet quickly as global financial conditions change could be of first order importance and for that a large, diversified balance sheet has advantages.

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Chapter 4
How Countries Manage Large Central Bank Balance Sheets

Peter Stella

Abstract Central banks often hold far more assets, and issue more liabilities to finance those assets, than is necessary to provide their domestic payments systems with adequate liquidity. That is to say, their balance sheets are "large" (See Stella (2010) *Minimising monetary policy* (BIS Working Paper 330)). Frequently central banks are large owing to their holdings of foreign reserves. Yet there is an interesting heterogeneity in how central banks finance large balance sheets. Those with lengthy experience managing large balance sheets almost invariably finance "excess assets" with non-monetary liabilities while those who are relative novices have relied heavily on monetary liabilities—bank reserves. This chapter examines a variety of practice managing large balance sheets since the global financial crisis (GFC). We argue that the recently expanded balance sheet countries may benefit from adopting the policies of their more experienced colleagues who have already "learned by doing." In financial terms, experienced central banks have found that financing their balance sheets either directly or indirectly with a mix of government securities that are tradable among banks and non-banks is generally more efficient than financing excess assets with bank reserves—fungible only among banks. That is, over time, as central banks gain experience managing a large balance sheet, they tend to adopt more sophisticated and efficient financing strategies. Those financing strategies provide central banks greater scope for managing the risk and duration of their assets.

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4.1 Introduction

Central banks are "central" to the operation of national payments systems. They issue paper currency on demand at par to facilitate retail payments and operate real time gross settlement (RTGS) systems based on reserve balances banks hold with them to facilitate interbank wholesale payments.

Prior to the GFC the size of advanced country central banks was driven primarily by market demand for banknotes and reserves, that is, by payments system considerations and, to a lesser extent, by the monetary operations regime employed to guide the targeted operational interest rate. Central banks provided banknotes in exchange for reserves while the quantity of reserves was determined by banks' demand in the context of the rules, regulations, and operational parameters of the domestic RTGS and subsidiary payments systems. Demand for end-of-day reserve balances was small.

Empirically, the composition of the liability side of an advanced country central bank prior to the GFC approximated 90+ percent banknotes, 5± percent reserves, and 5± percent equity.[1] On the asset side, a typical central bank portfolio consisted of 90± percent government securities, 5± percent reserve providing repurchase agreements, and 1± percent physical assets. The maturity composition of the government securities portfolio generally matched that held by the private sector. The ECB and SNB were atypical, the former held no Eurozone government securities while the latter held comparatively large foreign exchange assets.

Intra-year fluctuations in the amount of physical currency outstanding were largely predictable and until very recently central banks could be virtually guaranteed a secular increase in nominal demand for notes. For example, during the entire post-war era the end-year stock of Bank of Japan notes fell only once, in 2000, after an unprecedented precautionary spike in demand in advance of Y2K. Thus, central banks could safely take duration risk on the corresponding assets "backing" paper notes.

Monetary operations took place in the market for bank reserves, the overnight money market. Interest rate policy was effected through operations designed to ensure that the supply and demand for reserves equilibrated at an interbank unsecured lending rate equal to the policy target. Since the supply of bank reserves is significantly influenced by relatively unpredictable treasury actions (revenues and net domestic debt sales withdraw reserves, expenditures contribute reserves)[2] central bank monetary operations needed to be agile. Consequently, assets "backing" reserves tended to be short duration repurchase operations.

The composition of central bank liabilities and the corresponding investment policies meant that the preponderance of central bank assets were passively managed to an index broadly matching the distribution of government securities in the

[1] Pattipeilohy (2016) provides an analysis of central bank balance sheet composition pre and post GFC.

[2] Assuming the treasury keeps its accounts in the central bank.

market, with the small remainder comprising very short duration assets actively managed for "policy related" purposes.[3]

Central bank assets were invested in longer duration liquid securities when an increase in liabilities was deemed "permanent" and in short-term repos when the increase in liabilities was seasonal or temporary. Repos were structured to expire coincident with the end of the temporary reserve demand.

Central banks with large foreign asset holdings also tended to hold highly liquid asset portfolios—even in the presence of a freely floating exchange rate policy—in part owing to inertia, in part to stand ready to intervene as necessary, and in part owing to the asymmetry of the risk/reward incentives. In most cases with the marginal increase in return accruing fully to the national treasury and the marginal damage to reputation associated with losses falling immediately on central bank management, incentives were skewed to a conservation of principal strategy.

Apart from the foreign exchange asset issue, the size variation among central bank balance sheets relative to the size of the domestic economy was largely determined by the preferences, policies, and technology of the domestic payments system. These determined the long run demand for banknotes and settlement balances—reserves. There was also some variation in size owing to differences in central bank equity (usually property of government) and in the quantity of government deposits held at the central bank although the global trend toward adopting a single treasury account (STA) and tight cash management policies has tended to make the central bank's role as "government's bank" much less significant quantitatively. For example, prior to the GFC, US Treasury kept approximately USD 5 billion in its STA at FRBNY, a tiny amount given the size of the US economy.

Institutional arrangements governing the disposition of national foreign exchange reserves also impact the relative size of central bank balance sheets. Countries where foreign reserves are held on the *government* balance sheet, e.g. Canada, Japan, UK, have smaller balance sheets, inter alia, than countries where foreign reserves have traditionally been large and held by the central bank, e.g. Brazil, Israel, Mexico. It is those latter cases that are particularly interesting for our purposes here. Those central banks must fund their asset holdings with quantities of liabilities far exceeding what is needed for domestic payments purposes—that is, far in excess of the demand for monetary liabilities.

We consider central bank balance sheets to be "large" when the size of asset holdings requires the issuance of a quantity of liabilities that significantly exceeds the sum demanded by the private sector for payments purposes, by government for cash management/treasury purposes, and central bank equity.

Prior to the GFC, advanced country central banks were sized to purpose or "small." They are now "large." Interestingly, many emerging market central banks have been "larger for longer." We examine those central banks to assess the lessons their experience holds for advanced country central banks considering remaining "larger for longer."

[3] Stella (2010) discusses this in some detail.

Sect. 4.2 considers countries that started the GFC with small balance sheets that remain small. Not every country engendered a balance sheet expansion to navigate the GFC. Section 4.3 considers those countries whose balance sheets expanded greatly during the GFC, illustrating how heavily they relied on excess reserves as a financing tool. Section 4.4 considers countries who have managed large balance sheets for a long period of time. Section 4.5 concludes.

4.2 Small Balance Sheets—Norway and Canada

Compared with the size of its economy, *Canada* has one of the smallest central bank balance sheets in the world (See Table 4.1). Apart from banknotes in circulation and the government securities they finance, the balance sheet is virtually "zero-sized." Members of the Canadian Payments Association (CPA) hold almost no balances at the Bank of Canada (BOC) overnight and the government's operational account is quite small. Even after the Bank adopted International Financial Reporting Standards and obtained an equity injection to hedge mark-to-market risk on its securities portfolio,[4] BOC equity rounds to zero.

During the GFC the Canadian authorities provided liquidity assurances to the financial system. The BOC "…aggressively expanded its provision of liquidity by transacting more frequently with a broader range of counterparties, for longer terms, and against a wider range of eligible securities".[5] In particular, the Bank provided term liquidity—quite rare pre-crisis.

At end-2008 term lending exceeded C$40 billion although by the end of spring 2009 participation in the program was abating. The expansion of the BOC's balance sheet was less than the increase in term lending as holdings of Government treasury

Table 4.1 Bank of Canada balance sheet

December 31, 2007			
(in percent of GDP)			
Assets		Liabilities	
Canadian government securities	3.2	Bank notes in circulation	3.2
Liquidity providing repos	0.3	Financial institution deposits	0.0
		Government operational deposits	0.1
Loans to CPA members	0.0	Prudential liquidity management plan	N/A
		Other liabilities net	0.0
		Equity	0.0
Total assets	3.4	Total liabilities	3.4

Sources: Bank of Canada Financial Statements Annual Report 2007, IMF WEO Database (March 2016) and Author's calculations

[4] See Johnson and Zelmer (2007)

[5] See Bank of Canada (2009a, b).

bills fell by C$9 billion during 2008. An increase in Government deposits held at BOC financed the net increase in assets. The Bank did create a small quantity of excess reserves in the financial system, "i.e. significantly more aggregate balances than required by direct participants in the LVTS (Large Value Transfer System). The Bank's target for daily settlement balances increased from C$25 million to C$3 billion."[6] This C$3 billion expansion in reserves amounted to approximately 6% of the pre-crisis balance sheet.

The increase in target settlement balances was associated with a change in the overnight rate target from the midpoint to the bottom of the corridor range and a narrowing of the interest rate corridor when the corridor bottom reached the effective zero lower bound—25 bps. The target for settlement balances was raised to provide assurance the interbank rate would remain at the corridor floor.[7]

Neither of these two decisions had a significant lasting impact on the Bank of Canada's balance sheet as may be seen in Tables 4.2 and 4.3 illustrating the "before" and "after" crisis balance sheets.

The only GFC trace on the current balance sheet is the government's account "Prudential Liquidity Management Plan" (PLMP). The Government of Canada decided to establish and fund this account in the 2011 budget to acquire liquid assets (deposits at the BOC) that would enable the Government to wait out any inability to raise market funding for a period of at least 30 days.

It is noteworthy that the largest Canadian liquidity provision program was undertaken through the *government* balance sheet. The Insured Mortgage Purchase Program (IMPP) authorized the Canada Mortgage and Housing Corporation (CMHC) to purchase up to C$ 125 billion in mortgage backed securities "… from Canadian financial institutions between October 2008 and March 2010 as a temporary measure to maintain the availability of longer-term credit in Canada. A total of $69.3 billion in NHA MBS was purchased by CMHC through a competitive auction

Table 4.2 Bank of Canada balance sheet

December 31, 2007			
(in C$ billions)			
Assets		Liabilities	
Canadian government securities	50	Bank notes in circulation	51
Liquidity providing repos	4	Financial institution deposits	1
		Government operational deposits	2
Loans to CPA members	0	Prudential liquidity management plan	N/A
		Other liabilities net	1
		Equity	0
Total assets	54	Total liabilities	54

Source: Bank of Canada Financial Statements Annual Report 2007 and Author's calculations

[6] Bank of Canada (2009a), p. 10.

[7] See Bank of Canada (2009b) for a concise discussion of these changes and their motivation.

Table 4.3 Bank of Canada balance sheet

December 31, 2015			
(in C$ billions)			
Assets		Liabilities	
Canadian government securities	94	Bank notes in circulation	75
Liquidity providing repos	6	Financial institution deposits	1
		Government operational deposits	3
Loans to CPA members	0	Prudential liquidity management plan	20
		Other liabilities net	1
		Equity	0
Total assets	100	Total liabilities	100

Source: Bank of Canada Financial Statements Annual Report 2015 and Author's calculations

Table 4.4 Change in Bank of Canada balance sheet

12/31/2015 minus 12/31/2007			
(in percent of GDP)			
Assets		Liabilities	
Canadian government securities	1.5	Bank notes in circulation	0.5
Liquidity providing repos	0.0	Financial institution deposits	0.0
		Government operational deposits	0.0
Loans to CPA members	0.0	Prudential liquidity management plan	1.0
		Other liabilities net	0.0
		Equity	0.0
Total assets	1.6	Total liabilities	1.5

Source: Tables 4.2 and 4.3 and Author's calculations

process. The IMPP matured in March 2015 at which time all loans and borrowings from the Government were repaid.[8]

Had the MBS purchases been financed by the BOC, its pre-2008 balance sheet would have more than doubled in size. Since the operation was carried out through the CMHC balance sheet, there was no accounting impact for BOC.

The difference between the pre and post crisis BOC balance sheet is small and was driven by an increase in the demand for the Bank's liabilities not by Bank policy.

The maturity distribution of the Bank's government securities holdings mirrored that of the private sector throughout the period (Table 4.4).

The *Norges Bank* (NB) balance sheet is considerably larger than BOC's but is the second smallest of our sample.[9] NB's assets are three times the size of BOC's owing to the presence of foreign exchange reserves. Canada's foreign reserves are held on

[8] Canada Mortgage and Housing Corporation (2015).

[9] In discussing Norges Bank balance sheet we exclude the sovereign wealth fund elements of the balance sheet. That is, we exclude the "Government Pension Fund Global" account on the asset side and the corresponding equal value liability account due to the Government.

the Government's, not the BOC balance sheet and, in any event, amounted to only 3.1% of GDP at end 2015.

NB also has a significantly higher quantity of bank deposit (reserve) liabilities than does BOC. NB operates a "floor" liquidity management system,[10] typically associated with a higher deposit rate—and higher reserves—than a "corridor" system which incorporates a deposit rate below the policy target. In a corridor system, banks usually leave few funds overnight at the central bank, preferring to lend them out at a higher rate in the interbank market.

Most of NB net foreign reserves are financed by the government—either in the form of deposits (5.5% of GDP) or equity (3.5% of GDP). Were we to conceptually consolidate the NB and Government balance sheets over these items it would be apparent the consolidated sovereign is financing its holdings of net foreign reserves primarily with government issued debt securities. Thus, Norway and Canada finance the bulk of their foreign reserves through the issuance of government debt, though in Norway this is evident on the central bank balance sheet while in Canada foreign reserves and their financing are on Government's accounts.

The structure of the NB balance sheet as of end-2005 may be seen below in Table 4.5:

The end-2015 NB balance sheet is similar (See Table 4.6).

Net foreign assets rose by 2.5% of GDP while loans to banks fell by about ½ that amount. The increase in assets was financed by government—treasury deposits plus government's equity in NB rose from 9 to 11% of GDP, while banknotes and coins in circulation fell by 1% of GDP[11].

The increase in NB's balance sheet over the ten crisis years was small and financed by government.

Table 4.5 Norges Bank balance sheet

December 31, 2005			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets	12.8	Bank notes and coins in circulation	2.6
Loans to banks	1.3	Bank deposits	2.1
Other assets	0.2	Treasury deposits	5.5
		Other liabilities	0.5
		Equity	3.5
Total assets	14.2	Total liabilities	14.2

Sources: Norges Bank Annual Report 2005, IMF WEO Database (March 2016), Author's calculations

[10] NB modified its floor system in autumn 2011. Bank deposits remain higher than a conventional corridor system.

[11] Nominal average banknotes and coins outstanding in 2017 were more than 6% lower than in 2015.

Table 4.6 Norges Bank balance sheet

December 31, 2015			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets	15.2	Bank notes and coins in circulation	1.7
Loans to banks	0.0	Bank deposits	1.9
Other assets	0.2	Treasury deposits	3.2
		Other liabilities	0.9
		Equity	7.8
Total assets	15.5	Total liabilities	15.5

Sources: Norges Bank Annual Report 2015, IMF WEO Database (March 2016) and Author's calculations

Table 4.7 Norges Bank balance sheet

December 31, 2005			
(in NOK billions)			
Assets		Liabilities	
Net foreign assets	255	Bank notes and coins in circulation	52
Loans to banks	25	Bank deposits	43
Other assets	3	Treasury deposits	110
		Other liabilities	10
		Equity	69
Total assets	283	Total liabilities	283

Source: Norges Bank Annual Report 2005 and Author's calculations

During the crisis, NB lengthened the terms of its liquidity financing, expanded the scope of the collateral it accepted and allowed excess reserves in the system to rise from a pre-crisis average of about NOK 30 billion to NOK 70–110 billion during the first part of 2009. Nevertheless, by August 2009 the size of the balance sheet had returned to that obtaining in January 2008.

Like Canada, the *government* engendered a significant term liquidity intervention. At the outset of the crisis, on October 24, 2008, the Norwegian Parliament approved a Ministry of Finance swap arrangement whereby banks received government securities in exchange for covered bonds.[12] Banks could sell the treasury notes or use them as collateral for repo financing to replace the borrowing that was no longer available from the market against covered bonds at that time.

Treasury notes totaling NOK 230 billion were allotted in 2008 and 2009. As may be seen in Table 4.7, that amount was roughly the amount of NB non-equity liabilities pre-crisis.

Although the swap arrangement was administered by NB, the government assumed the risk of these extraordinary liquidity operations onto its own balance sheet: "…funding support for banks came from the government's balance sheet, not

[12] See Norges Bank (2009), p. 89 {Annual Report}.

as loans from Norges Bank. This provided transparency…The Norwegian measures were designed in such a way that Norges Bank's balance sheet has not increased to the same extent as that of a number of other central banks."[13]

The reactions of the central banks and governments in Canada and Norway were similar. Central banks provided increased term liquidity against a broadened collateral pool without a lasting impact on the size of their balance sheets. "Larger for longer" interventions were undertaken by government or government owned entities. Thus, the challenges of managing a newly enlarged balance sheet did not arise for these countries.

4.3 Newly Large Balance Sheets—USA, Switzerland, UK

In this section we consider countries that experienced large expansions in the central bank balance sheet. Although they all began the GFC sterilizing the liquidity expansion associated with innovative lending programs (term duration lending against expanded collateral), once the zero lower bound was reached efforts, at containing balance sheet size were largely abandoned and balance sheet expansion became part of official policy. Ten years later it seems large balance sheets will be with us for some time longer and almost certainly longer than was anticipated at the outset of their expansion.

The composition and size of the consolidated balance sheet of the Federal Reserve Banks (FRBs) have undergone dramatic changes since 2006[14] (See Tables 4.8, 4.9, 4.10, and 4.11).

The pre-crisis Fed balance sheet is shown in Table 4.8. US Treasuries and banknotes outstanding constituted about 90% of total assets and liabilities, respectively. Overnight bank deposits at the Fed, bank reserves, comprised less than 2%. Reserves, compared with total US commercial bank assets at end 2007, were

Table 4.8 Consolidated balance sheet of the Federal Reserve Banks

December 5, 2007			
(in US$ billions)			
Assets		Liabilities	
US treasuries	780	FR notes outstanding	782
Liquidity providing repos	47	Bank deposits (overnight)	16
Net other assets	50	Reverse repos	37
		US Treasury deposits	5
		Equity	37
Total assets	876	Total liabilities	876

Sources: Federal Reserve Board Release H.4.1 and Author's calculations

[13] Gjedrem (2009).

[14] This balance sheet will be denoted the "Fed" balance sheet elsewhere.

Table 4.9 Consolidated balance sheet of the Federal Reserve Banks

September 10, 2008			
(in US$ billions)			
Assets		Liabilities	
US treasuries	480	FR notes outstanding	798
MBS and Federal Agencies	0	Bank deposits	32
Term auction credit	150	Reverse repos	44
Liquidity providing repos	127	US Treasury deposits	5
Foreign exchange swaps	62	Equity	40
Net other assets	101		
Total assets	920	Total liabilities	920

Sources: Federal Reserve Board Release H.4.1, swap data from FRED database FRB St. Louis, and Author's calculations

Table 4.10 Consolidated balance sheet of the Federal Reserve Banks

December 31, 2008			
(in US$ billions)			
Assets		Liabilities	
US Treasury, agency and GSE securities	502	FR notes outstanding	853
Foreign exchange swaps	554	Bank deposits (overnight)	860
Term auction credit	450	Bank deposits (term)	0
Commercial paper funding facility	335	Reverse repos	88
Other loans	194	US Treasury deposits	365
Liquidity providing repos	80		
Maiden lane LLC holdings	77		
		Equity	42
Net other assets	17		
Total assets	2209	Total liabilities	2209

Source: Stella (2009), Table 4.5

miniscule—0.15%.[15] Treasury deposits, at $5 billion, reflected a long-standing effort by US Treasury to minimize disruptions its cash management activities might otherwise have had on the supply of bank reserves.

Prior to the crisis, the only actively used policy instruments were short-term liquidity supplying repos. The Fed operated like its advanced country counterparts—keeping the market "short" reserves and influencing the overnight rate via lending operations. In the aggregate, banks relied on small amounts of Fed credit to obtain their desired reserve balances.

At the outset of the GFC, the Fed provided a significant amount of credit against somewhat illiquid collateral. New lending programs, including 28-day

[15] Total US bank assets at end-2007 were $10.888 trillion. (FRB Release H.8).

Table 4.11 Consolidated balance sheet of the Federal Reserve Banks

October 15, 2014			
(in US$ billions)			
Assets		Liabilities	
US treasuries	2567	FR notes outstanding	1252
MBS and agencies	1832	Bank deposits (overnight)	2821
Net other assets	53	Bank deposits (term)	0
		Reverse repos	221
		US treasury deposits	101
		Equity	56
Total assets	4452	Total liabilities	4452

Source: Federal Reserve Board Release H.4.1 and Author's calculations

single-tranche liquidity providing repos,[16] were added without expanding the size of the balance sheet owing to compensating sales of US Treasury securities held by the FRBs. The euphemism in the market for this period was "treasuries for trash."

The Fed increased lending to banks (assets) and bank reserves (liabilities) with one hand and immediately reduced excess reserves by selling Treasuries with the other. This altered only the *asset composition* of the FRB balance sheet, not the *size*. From the vantage point of the banking system, collateralized borrowing from the Fed replaced collateralized borrowing from non-banks (who no longer found the quality of collateral offered acceptable). Non-banks switched from lending to banks to holding high quality liquid securities, i.e., the US Treasury securities that were being sold be the Fed. Thereby the Fed provided liquidity to markets and institutions *without creating reserves*.[17]

Table 4.9 shows the last pre-Lehman published Fed balance sheet. Compared with Table 4.8, liquidity providing repos rose with the introduction of $80 billion in single-tranche 28-day repos. The Term Auction Facility (TAF) contributed $150 billion to the increase in assets, while the ECB and SNB swap lines and Maiden Lane facilities contributed $62 billion and $29 billion, respectively. Fed holdings of Treasury securities fell by $300 billion, largely counteracting the new instruments introduced.

The liquidity injection associated with the turmoil surrounding the Lehman insolvency and AIG rescue could not be absorbed by sales of US Treasuries. The Fed simply did not hold enough freely available Treasuries to do so. FRBs held only $480 billion in Treasuries on September 10, 2008 compared to the increase in non-conventional assets by over $850 billion by October 22, 2008 (Table 4.10). Furthermore, the Fed had earmarked $200 billion of Treasuries for securities lending (the TSLF[18]).

[16] The Fed announced its Term Auction Facility and ECB and SNB swap lines on December 12, 2007.

[17] Hrung and Seligman (2015) conclude "…the proper policy response to a financial crisis can involve options beyond an increase in the level of bank reserves."

[18] See FRBNY (2009), p. 28.

The FRBNY considered issuing its own debt instruments to absorb liquidity but decided against this option to avoid fragmenting the US money market—similar Treasury and Fed instruments would have been circulating simultaneously. However, it knew that failure to absorb the excess reserves would undoubtedly lead the fed funds rate to fall below the then 2% target. Consequently, the Fed requested assistance with liquidity absorption from the US Treasury.

On September 17, 2008, the Wednesday after the Lehman insolvency, Treasury announced its Supplementary Financing Program (SFP). The idea behind the SFP was for the Treasury to auction short-term debt instruments—cash management bills—in excess of what was needed to finance the fiscal deficit, and to deposit the proceeds into a special account at the FRBNY. This drained bank reserves from the system.

Despite the effort of the Treasury to assist the Fed with absorbing the liquidity created after the Lehman and AIG event, bank reserves expanded markedly, over 2500% in 3 months, and the fed funds rate consistently traded below target (See Fig. 4.1). The new market euphemism was "cash for trash."

Coincidently the Fed adopted a target range for the fed funds rate with the lower bound being zero. It then became unnecessary to absorb reserves to "attain" the target.

The pricing of the new Fed liquidity programs was designed so that their use would become unattractive once markets stabilized. Apart from very small balances remaining from the Maiden Lane facilities and central bank liquidity swaps,[19] by 2015 there was little trace of these programs. Fed lending programs shrank, as they were designed to do, and their place on the balance sheet was taken by a more than compensating increase in securities held as a consequence of Large-Scale Asset Purchase (LSAP) programs—comprising Fed purchases of US Treasury and Government Sponsored Entity (GSE) guaranteed mortgage backed securities (MBS) and GSE and Agency debt.[20]

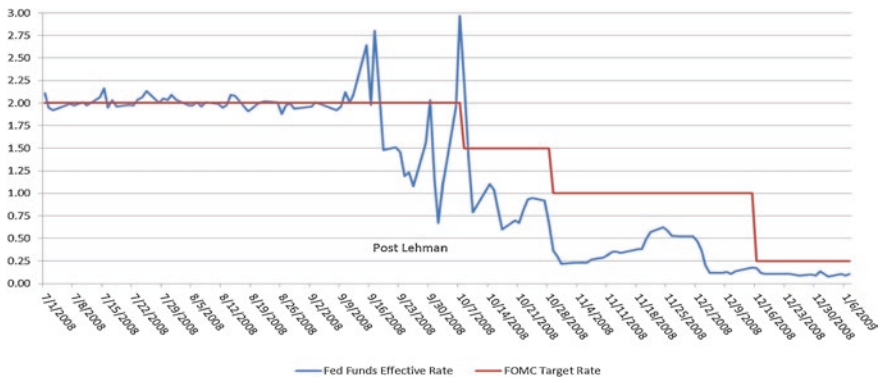


Fig. 4.1 Federal Reserve loses control of the fed funds rate post-Lehman

[19] As of 1 November 2018, these amounted to US$7 million and US$80 million, respectively.

[20] For ease of exposition I will refer to these securities simply as "MBS." MBS constitute the vast bulk of the total. The FOMC announced purchases of MBS and GSE debt in November 2008 and, on March 18, 2009 a longer-dated Treasury securities purchase program. The US Treasury had established a program to purchase agency MBS beginning in September 2008.

LSAP ended in October 2014. Their impact on the balance sheet may be seen by comparing Tables 4.8 and 4.11, the December 2007 balance sheet. The Fed's holdings of US Treasuries and MBS toward the end of the LSAP were $1787 billion and $1832 billion, respectively, higher than December 2007. Reserves rose by $2805 billion during this time. The residual financing—$814 billion, comprised increases in banknotes outstanding ($470 billion); reverse repos ($184 billion); and Treasury deposits ($96 billion).

Eight years after the Lehman insolvency, the Fed's assets had increased by 17.4% points of GDP of which 12.4% points had been financed by excess bank reserves (2/3rds of the increase). Bank reserves then financed 54% of the balance sheet. Eight years prior, bank reserves comprised 3% of Fed financing,[21] banknotes 87%.

Prior to the GFC, the *Swiss National Bank* (SNB) operated in a money market orchestrated to be in a significant structural liquidity deficit. Repo lending amounted to over 5% of GDP whereas financial institution deposits were about 1% of GDP. The somewhat large holdings of foreign reserves—compared to Canada, UK, USA, ECB, and BOJ—were financed by a high ratio of currency to GDP, 8%, and equity equivalent to over 11% of GDP. Thus, one might say the SNB had a solid, durable, and low-cost financing structure (Table 4.12).[22]

In late 2007 and more profoundly in 2008, the SNB provided considerable liquidity to the market, including in foreign exchange. It regularly provided banks with USD liquidity and in conjunction with the ECB and Polish central bank it conducted coordinated auctions for EUR/CHF foreign exchange swaps.[23] Balances from forex swap transactions against Swiss francs rose from zero at end-2007 to CHF 50 billion at end-2008. The stock of liquidity provided by the SNB in Swiss franc repo operations rose by CHF 31 billion over the same period. The SNB

Table 4.12 Swiss National Bank balance sheet

December 31, 2005			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets and gold	14.8	Currency in circulation	8.2
Repo lending	5.2	Financial institution deposits	1.2
CHF securities	1.1	Government deposits	0.6
		Other nonbank sight deposits	0.0
Other assets net	0.4		
		Equity	11.4
Total assets	21.5	Total liabilities	21.4

Sources: Swiss National Bank Financial Report 2005, IMF WEO Database (July 2016) and Author's calculations

[21] At end-1951, bank reserves comprised 40% of Fed liabilities but only 2% of Fed liabilities were excess reserves. This state of affairs reflects a "pre-modern" view of required reserves.

[22] See also Chap. 14.

[23] See 2008 SNB Annual Report.

balance sheet also rose in connection with a financial stability operation associated with the acquisition of a considerable quantity of assets from Swiss bank UBS.

In 2008, the SNB set up a subsidiary (the Stabilization Fund) to which it made a loan to finance the acquisition of assets from UBS. Amounts outstanding under the loan were CHF14 billion and CHF20 billion at end 2008 and end 2009, respectively. Over time, proceeds from the sale of the acquired assets were used to fully repay the loan as of 15 August 2013.[24]

Total SNB assets rose by 69% during 2008. Financial institution deposits at the SNB rose from CHF 9 billion at end-2007 to CHF 41 billion at end-2008 despite the issuance of CHF 24 billion in SNB bills starting on 22 October 2008.

As in other countries, once market conditions improved, the liquidity providing operations were wound down but subsequently were more than compensated by LSAP. Switzerland and Israel are the only countries studied here that made large-scale foreign exchange purchases.

The liquidity operations discussed above and the purchase of foreign exchange since March 2009 turned the Swiss market's structural liquidity deficit into a surplus despite the use of SNB Bills to absorb liquidity.[25] This surplus grew enormously following the SNB decision to temporarily set a minimum exchange rate against the euro from September 2011 until January 2015 which led to an extraordinary expansion in SNB foreign exchange assets and sight deposit liabilities.

Financial institution deposits at the SNB grew by over 7000% during the 10 years ending in 2015, from slightly more than 1% of GDP to almost 67% of GDP. SNB net foreign assets and gold rose from 15% of GDP to 93 ½% of GDP during the same time. The expanded balance sheet is provided in Table 4.13 and the growth of balance sheet in Table 4.14.

Unlike the other LSAP discussed in this section, the quantity of reserve expansion was not set by the central bank but by market demand—in light of the SNB's policy stance to prevent further appreciation of the franc against euro. Essentially, the SNB

Table 4.13 Swiss National Bank balance sheet

December 31, 2015			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets and gold	93.5	Currency in circulation	11.4
Repo lending	0.0	Financial institution deposits	66.9
CHF securities	0.6	Government deposits	1.7
		Other nonbank sight deposits	4.7
Other assets	0.1		
		Equity	9.5
Total assets	94.3	Total Liabilities	94.3

Sources: Swiss National Bank Financial Report 2015, IMF WEO Database (July 2016) and Author's calculations

[24] 2013 SNB Annual Report page 178.

[25] See 2010 SNB Accountability Report, p. 41.

Table 4.14 Change in the Swiss National Bank balance sheet

12/31/2015 minus 12/31/2005			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets and gold	78.7	Currency in circulation	3.2
Repo lending	−5.2	Financial institution deposits	65.7
CHF securities	−0.5	Government deposits	1.1
		Other nonbank sight deposits	4.7
Other assets net	−0.2		
		Equity	−1.8
Total assets	72.8	Total liabilities	72.9

offered to buy an unlimited amount of euro for francs at a fixed price. It then "taxed" the capital inflows by imposing a negative interest rate on the franc bank reserves created. In contrast with the ECB, where negative rates were intended to spur domestic economic activity, the purpose of SNB negative rates was to stem the tide of capital flows and thus retain a semblance a monetary control despite the unlimited commitment to the peg. Thus, it matched the logic employed at the same time by the Danish central bank who employed negative deposit rates to assist in the maintenance of their longstanding commitment to a fixed peg against the euro. Notwithstanding, the SNB witnessed a truly stunning transformation of its balance sheet.

The rapid, massive, and somewhat uncontrolled expansion of the balance sheet stressed SNB reserve management operational capacity particularly as it coincided with LSAP of euro-denominated sovereign debt by the ECB—effectively the SNB and ECB were competing to purchase many of the same bonds. Though the SNB was the smaller bank, it could be more agile since it was not constrained by the policies adopted by the ECB in its purchases, e.g. aligning proportions bought with the ECB capital key.

SNB also came under considerable political pressure from popular referenda, though both were eventually rejected. The first would have required SNB to invest at least 20% of its assets in gold, (rejected November 2014), the second would have created an SNB monopoly on "money creation"—the "sovereign money" referendum (rejected June 2018). These initiatives, which would have seriously restricted SNB's operations, and pressures to establish a sovereign wealth fund to manage SNB "excess" reserves occupied significant management and staff time and resources.

The *Bank of England* balance sheet was quite small prior to the GFC[26] as can be seen in Table 4.15.

[26] Since the Bank Charter Act of 1844, the Bank of England has been required to separately account its banknote issuance activities. This is reflected in the accounting designations "Issue Department" and "Banking Department." The Issue Department balance sheet reflects the banknote issuing operation of the Bank. Its liabilities are the bank notes in circulation. For ease of comparison with other central banks I have here consolidated the two accounts.

Table 4.15 Bank of England balance sheet

February 28, 2007			
(in percent of GDP)			
Assets		Liabilities	
Loans and advances to banks	4.0	Bank notes in circulation	2.7
Sterling securities	1.2	Financial institution deposits	1.5
		Government operational deposits	0.1
Other	0.1	Deposits from central banks	0.8
		Other liabilities	0.1
		Equity	0.1
Total assets	5.3	Total liabilities	5.3

Sources: Bank of England Annual Report 2007, IMF WEO Database (March 2016), and Author's calculations

At the outset of the GFC the Bank of England provided conventional lender of last resort financing to Northern Rock (NR) and other financial institutions some of which subsequently were nationalized or recipients of capital infusions from Government. Eventually the claims on banks and the underlying collateral was passed on to UK Asset Resolution Limited (UKAR). UKAR was established to "…facilitate the orderly management of NR's assets and those of another bailed-out bank, Bradford and Bingley".[27]

HM Treasury owns UKAR and the latter is consolidated into the Government balance sheet. The establishment of the UKAR provides an interesting contrast with the experience in the USA. Although the US Treasury expressed in March 2009 its intent to remove the "Maiden Lane" facilities from the Fed's balance sheet or to liquidate them, this was never accomplished—the Fed managed the facilities on its own balance sheet for their duration.[28]

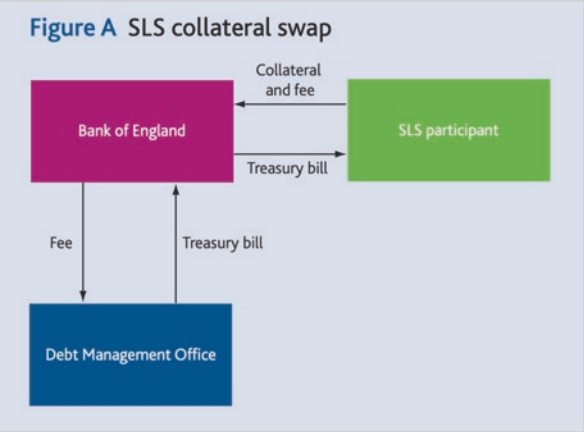
In 2008 the Bank of England and HM Treasury designed the Special Liquidity Scheme (See Box 4.1).

Box 4.1 The UK Special Liquidity Scheme (SLS)

- The Bank of England, acting as an agent for the UK Treasury (HMT), swapped treasury bills borrowed from HMT for mortgage backed securities held by the market. The duration of the swaps was 3 years. HMT indemnified the Bank for any losses that might result. The swaps were off balance sheet. The flows are illustrated below. (Source: John et al. (2012)).

[27] UK National Audit Office (2016).

[28] See, *The Role of the Federal Reserve in Preserving Financial and Monetary Stability Joint Statement by the Department of the Treasury and the Federal Reserve*, March 23, 2009, available online at the FRB website.



- The drawdown period for the SLS ended on 30 January 2009 and the Scheme was closed as of end-January 2012. On closure, the accumulated net profit was transferred to HM Treasury in April 2012.

The SLS is similar to the scheme adopted by Norway, discussed above, though the SLS was structured as a collateral swap with the intention that it would supply banks with assets they could use for repo financing yet expand neither the Treasury nor BOE balance sheet. After considerable discussion, Eurostat agreed to accept the UK authorities' argument that the transaction was merely a loan of securities to the Bank of England and consequently neither deficit financing nor additive to the Treasury's marketable debt outstanding.

In March 2009, the BOE Monetary Policy Committee decided to begin an asset purchase program that, as with the SNB and Fed, explains virtually the entire balance sheet expansion. Asset purchases were conducted through a UK company established especially for that purpose.

The Bank of England Asset Purchase Facility Fund (APFF) is a separate company established by the Bank of England in agreement with HM Treasury (HMT) to purchase private sector assets (and later government debt in the secondary market) to support market liquidity. Although the APFF is a wholly-owned group subsidiary of the Bank of England its operations are fully indemnified for loss by HM Treasury, and any operational surplus is due to HMT. "Because of the Indemnity and any profit being due to HM Treasury, the Company [APFF] will never show a profit or loss".[29]

Originally, APFF's purchases of corporate bonds, commercial paper, syndicated loans, and asset backed securities were to be financed by issuance of Treasury bills

[29] See Bank of England Asset Purchase Facility Fund Limited Annual Report 2009/10, p. 2.

Table 4.16 Bank of England balance sheet

February 28, 2017			
(in percent of GDP)			
Assets		Liabilities	
Loans and advances to banks	0.8	Bank notes in circulation	3.6
Loan to APFF Ltd.	23.8	Financial institution deposits	20.4
Foreign and sterling securities	1.0	Government operational deposits	0.2
Other assets	0.3	Deposits from central banks	0.7
		Other liabilities	0.8
		Equity	0.2
Total assets	25.9	Total liabilities	25.9

Sources: Bank of England Annual Report 2017, IMF WEO Database (October 2018), and Author's calculations

and government cash deposits since BOE lending to the APFF was initially not envisaged to entail money creation. Later, authority was given to finance purchases of private sector and UK government debt with central bank money.

As of end-February 2018, the APFF held £464.3 billion in UK gilts, £9.5 billion in corporate bonds, and £127.1 in Term Funding Scheme (TFS) loans. At that time, the loan from BOE was £572.2 billion.

The BOE currently finances the entire loan to the APFF with central bank reserves.

The balance sheet impact of the purchases undertaken by the APFF is shown in Table 4.16. Loans to the APFF have risen from zero in 2007 to almost 24% of GDP. On the liability side, banks' deposits as a ratio of GDP have risen 19% points. In nominal terms, financial institution reserves held at the Bank of England rose 1876% between 2007 and 2017.

4.4 Balance Sheets that Had Already Been Larger for Longer: Mexico and Israel

Central banks with longer experience financing large balance sheets have not relied on increases in bank reserves to finance their expansion.

Although Banco de México (BdM) has adopted a floating exchange rate regime, by law it must buy all foreign exchange earned by the state petroleum company, PEMEX. Thus, BdM assets reflect oil-related foreign exchange inflows and its liabilities the resultant peso liquidity injection. In the past, BdM issued its own bonds, "BREMs," to absorb the excess liquidity caused by foreign exchange purchases. This led to a fragmented domestic sovereign debt market, high sterilization costs, and BdM losses.[30]

[30] See also Chap. 15.

In 2006, the Mexican government and BdM engaged in a coordinated sovereign asset liability management operation to address several issues simultaneously and end domestic market fragmentation. In June the Ministry of Finance (MOF) bought US$12.4 billion from the BdM using pesos that it obtained from a special auction of its main domestic financing instrument (BONDES D). The MOF used the foreign exchange obtained to prepay debt owed to the World Bank, the Inter-American Development Bank and to buyback sovereign debt.

Simultaneously, the Banco de México used the pesos obtained from MOF to buy back an equivalent amount of its BREMS. Furthermore, BdM announced that going forward it intended to use only government debt in its monetary operations.

Although the Mexican operation resolved the bifurcation of the domestic debt *stock*, a mechanism was required to prevent future issuance of BREMs while allowing BdM an unfettered ability to sterilize future foreign exchange purchases. The scheme is outlined below.

The BdM is provided with Treasury bonds and bills to conduct sterilization operations. Every quarter the Treasury and BdM hold a joint meeting announcing their issuance strategy. BdM issues bonds when sterilizing "long term" foreign exchange purchases while bills are used for short-term liquidity management. The Treasury issues bonds and bills to fund debt amortization and to finance the deficit. BdM and Treasury hold auctions on alternating weeks in the calendar.

The proceeds of BdM auctions of government debt are deposited in a special government account at BdM known as the "Treasury Monetary Regulation Account" (TMRA). The TMRA is "frozen," i.e. cannot be used to finance expenditure… only to redeem the corresponding government debt when it matures. The TMRA accrues the same interest paid on government debt issued by BdM for monetary purposes.

The objective of this arrangement is to enable Mexico to finance its balance sheet with conventional Treasury bills and bonds which enjoy a liquid market, rather than with undesired excess bank reserves.

Table 4.17 shows BdM's balance sheet prior to the major asset liability operation. BREMS outstanding were 2.7% of GDP.

Although BdM assets rose by 275% during the subsequent 10 years, outstanding BREMs fell by over 2% of GDP and compulsory bank deposits fell by more than 1% of GDP as BdM relied on sales of government securities and the corresponding growth in Mexican treasury deposits (as well as an increase in currency in circulation) to finance 93% of the growth in liabilities. The BdM balance sheet as of April 2016 is shown in Table 4.18.

In *Israel*, the Short Term Debt Law allows the government to issue short-term treasury bills (Makam) to the Bank of Israel (BOI) for use in monetary operations. When sold by BOI, the entire proceeds must be deposited in a special account at the BOI. The funds may be used only to redeem Makam. In 2002, the ceiling imposed on the volume of Makam that could be issued was removed thereby enabling the BOI to rely primarily on this instrument for liability management.

The duration of Makam ranges from one to 12 months and they form the short end of the Israeli sovereign yield curve. The BOI pays interest on the government's deposit equal to the interest government must pay on the Makam. Since Makam are

Table 4.17 Balance sheet of Banco de México

April 21, 2006			
(in percent of GDP)			
Assets		Liabilities	
Net international reserves	7.3	Currency	3.3
Credit extended through repos	1.5	Bank deposits (current account)	0.0
		Bank deposits (required account)	2.6
Credit to IPAB (deposit insurer)	0.6		
		Treasury operational account	1.6
		Monetary regulation bonds	2.7
		Monetary regulation bonds L	N/A
		Treasury monetary regulation account	N/A
		Other liabilities and equity	−0.8
Total assets	9.4	Total liabilities	9.4

Sources: Banco de México, IMF WEO Database (July 2016), and Author's calculations

Table 4.18 Balance sheet of Banco de México

April 22, 2016			
(in percent of GDP)			
Assets		Liabilities	
Net international reserves	15.9	Currency	6.1
Credit extended through repos	3.1	Bank deposits (current account)	0.0
		Bank deposits (required account)	1.4
		Treasury operational account	4.9
		Monetary regulation bonds	0.0
		Monetary regulation bonds L	0.3
		Treasury monetary regulation account	4.7
		Other liabilities and equity	1.8
Total assets	19.1	Total liabilities	19.1

Sources: Banco de México, IMF WEO Database (July 2016), and Author's calculations

short-term discounted instruments, the BOI merely credits the government account with the difference between the par value of the debt and the proceeds received at auction.

As can be seen in Table 4.19 Makam financed 70% of net foreign assets in 2007.

During the GFC, BOI lowered its policy target to the effective zero lower bound (deemed to be 10 bps) and engaged in significant foreign exchange intervention to prevent undue appreciation of the NIS. Rather than rely on increased Makam to absorb the liquidity created over the last decade of foreign exchange intervention, BOI has relied instead on term deposits (See Table 4.20). Although both Makam and term deposits are auctioned, Makam are done so only once a month and thus are less flexible than term deposits whose auction can be arranged quickly for weekly

Table 4.19 Bank of Israel balance sheet

December 31, 2007			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets	14.8	Banknotes and coins	3.9
NIS tradable securities	0.4	Bank deposits	2.0
		o/w time deposits	0.0
		Operational government deposits	1.2
		Makam	10.3
Net other assets	0.7		
		Equity	−1.5
Total assets	15.9	Total liabilities	15.9

Sources: Bank of Israel (2008) Financial Statements for 2007, IMF WEO Database (April 2016), and Author's calculations

Table 4.20 Bank of Israel balance sheet

December 31, 2015			
(in percent of GDP)			
Assets		Liabilities	
Net foreign assets	30.3	Banknotes and coins	6.4
NIS tradable securities	0.9	Bank deposits	14.9
		o/w time deposits	12.5
		Operational government deposits	2.0
		Makam	10.1
		Net other liabilities	0.4
		Equity	−2.6
Total assets	31.2	Total liabilities	31.2

Sources: Bank of Israel (2016) Financial Statements for 2015, IMF WEO Database (April 2016) and Author's calculations

or daily absorption. Issuing more Makam would have implied higher short-term yields than was the case which would, in turn, have contributed to greater NIS appreciation pressure, precisely the force BOI was acting to counter. BOI has chose to impose a non-negative floor on overnight deposits rates while limiting the expansion of Makam.

4.5 Conclusions

The recent massive expansion of some central bank balance sheets during the GFC has raised both management and broader political economy questions.

Some countries, such as Canada and Norway, managed to provide liquidity primarily through government operations or institutions. In those cases, although the interventions were sizeable and novel, central banks managed to navigate the choppy political waters with relative ease. Nor were they required to take on novel risk management tasks.

Other countries, such as Mexico and Israel, experienced a balance sheet expansion but had in place well tested and long understood mechanisms for managing large balance sheets. Although not completely seamless, the expansion of those balance sheets was very much a homogenous one—a "more of the same" transition that raised neither questions about the proper role of the central bank nor about the nature of the assets and liabilities newly created.

A third class of central banks witnessed a major change in the *quality* as well as the size of their balance sheets in the absence of a well-established system to manage either.

The purchase of novel types of assets—corporate debt, MBS, equities, claims on emerging market sovereigns in the foreign reserves and, in the case of the ECB, Eurozone sovereign debt—raised serious political economy questions centered on the proper delimitation of monetary and fiscal policy; appropriate governance and accountability structures for central banks and government treasuries; and the fundamental political legitimacy of central banks. These questions have come about against the backdrop of a worldwide reconsideration of the reliability of expert judgment, opinion, and institutions.

Central banks in the third class, such as Switzerland, who financed their asset acquisitions with the creation of bank reserves, also unintentionally unveiled a widespread and profound misapprehension of the workings of monetary policy and operations among the public, journalists, and many economists. Even some respected academics who had served on central bank policymaking bodies were seen at the outset of the GFC claiming that the supply of bank reserves would have to be reduced quickly or accelerating uncontrollable inflation would result. Though this was nonsense, the ultimate impact of the continued repercussions attending the misguided notion that central banks have exercised wanton unlegislated power through "money creation" has yet to be fully realized. Although some researchers, central bankers, and the BIS, clearly articulated the error of those views quite early during the GFC, those voices were few and not widely heard nor understood. Continued confusion about the essential difference—if there is one—between "central bank money" and "treasury bills," and the role of each in money markets is at the core a question about the delimitation of fiscal and monetary powers—who is responsible for providing liquidity for what. How these outstanding questions are answered will determine the future structure of sovereign and supra-sovereign regulatory and policy institutions.

Many of the complicated political economy questions bedeviling central banks might have been avoided had countries not employed those institutions' balance sheets to finance unconventional—and in some cases—quasi-fiscal operations for an extended period. Though it is too late to close Pandora's box it is possible to remedy the situation by establishing more robust mechanisms for managing those

newly enlarged balance sheets. Countries such as Mexico and Israel exemplify solutions that are possible.

Those countries who have best grasped the lessons of long experience with large balance sheets have adhered tightly to the concept of fiscal financing of delegated monetary and quasi-fiscal tasks. This brings a broader more integrated sovereign asset liability management perspective to issues frequently segregated in central bank and treasury "silos" and enables policy costs and benefits to be compared within a united budgetary framework. Securing the benefits of this perspective in no way requires the formal financial consolidation of the central bank within the public sector—although such consolidation in Brazil has facilitated the design and execution of a holistic fiscal policy sometimes quite absent in countries where both treasury and central bank are significant debt issuers.

Many of the operations undertaken by central banks during the GFC could have been, and in some cases (Norway, UK, USA), were undertaken or subsequently financed by treasuries. In such cases the financing of the interventions was seamlessly integrated into the government's overall financing plan and the entire financing cost, risk, and return on assets was transparently evident in the government accounts rather than filtered through the central bank profit and loss account and financial results distribution rule. This averted the political economy costs of financing sovereign operations with "money creation," the angst associated with central bank losses—and the assignment of blame for those losses—as well as the dread of central bank "insolvency."

A further consideration is the customary difference in accounting between central banks and treasuries. Asset revaluations rarely are prominent in fiscal accounts and are not incorporated in flow measures of the fiscal balances. In contrast, when central banks are exposed to significant foreign exchange risk, revaluations owing to changes in the local currency value of foreign assets frequently overwhelm the underlying operational financial result, easily swinging central bank equity from positive to negative and back again within a short space of time making nonsense of central bank accounts for either financial accountability and macroeconomic analysis purposes. In order to cope with this issue—spurious volatility in the accounts related to the currency mismatch of central bank liabilities and assets—some countries lay the responsibility for financing foreign reserves on the treasury even though the reserves are "owned" by the central bank. New Zealand, Denmark, and Sweden are a few such countries. In most cases the government borrows in the currencies requested by the central bank or hedges its cross-currency exposure with derivatives. The result for the central bank is a hedged forex position despite a positive net foreign asset position.

Although in the long term we may very well conclude that the best central bank balance sheet is a very lean balance sheet, it seems that many countries are currently determined to remain "larger for longer." The structure of central bank financing is material to the scope and flexibility of asset management as well as for bearing the political economy costs of expansion. Countries that have managed large balance sheets for extended periods of time have gradually converged on a solution that emphases the employment of government debt securities directly or indirectly to finance the majority of assets.

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Chapter 5
Reserve Accumulation, Sovereign Debt, and Exchange Rate Policy

Laura Alfaro and Fabio Kanczuk

Abstract In the past decade, foreign participation in local-currency bond markets in emerging countries increased dramatically. Additionally, emerging countries are increasingly deviating from inflation targeting regimes, managing their exchange rate and engaging in exchange-rate accumulation. In light of these trends, we revisit sovereign debt sustainability, and the choice of the optimal exchange-rate regime, under the assumptions that countries can accumulate reserves and borrow internationally using their own currency. As opposed to traditional sovereign debt models, asset valuation effects occasioned by currency fluctuations act to absorb global shocks and render consumption smoother. Countries do not accumulate reserves to be depleted in "bad" times. Instead, issuing domestic debt while accumulating reserves acts as a hedge against external shocks. We propose that a "pseudo-flexible regime," to be the best policy alternative for emerging nations that face international shocks. A quantitative exercise suggests this strategy to be effective for smoothing consumption and reducing the occurrence of default and obtains that optimal reserve holdings turn out to be as large as those presently observed.

5.1 Introduction

Domestic government bond markets in many emerging market economies (EMEs) have seen impressive developments. Markets have increased in volumes, scope, and depth, maturities have extended, and participation has broadened, including now

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active foreign engagement and participation in these markets. During this time, government has also engaged in active accumulation of reserves.

In this chapter we incorporate debt sustainability issues into optimal reserve management. However, we take into account changes in the structure of emerging market economies and their borrowing constraints. Eichengreen and Hausmann (1999) advanced the original sin hypothesis, that is, the limitation governments in developed countries faced in terms of issuing debt abroad in their own currencies. However, the gradual redemption of emerging markets economies (EME) debt sins observed in the last two decades, together with the substantial reserve accumulation, one might suspect, can affect these countries' incentives to default and repay. For example, what role do reserves play if a government decides to inflate away domestic debt? Do they increase or decrease the incentives to do so if the economy does not face major liquidity risks? Why does the government not use the foreign reserves to reduce vulnerabilities by paying foreign debt? Are international reserves affecting the sustainability of foreign debt? How are reserves affecting the exchange rate determination? Is the reserve accumulation implicitly changing the exchange-rate regime?

We start by revisiting the incentives to accumulate reserves when debt is denominated in foreign currency. For that, we construct a dynamic equilibrium model of a small open economy subject to foreign shocks as in Alfaro and Kanczuk (2009). We then modify the main framework to understand the joint determination of debt denominated in local currency and foreign exchange reserve accumulation, as in Alfaro and Kanczuk (2018). In our model we find that default is rare while optimal reserve accumulation is substantial. In contrast to standard mechanisms, in our model, asset valuation affects consumption smoothing. That is, in our findings, foreign currency reserves and local-currency bonds jointly as a hedge against international shocks.

Another possibility, which we consider here, is that the reserves are a mechanism for managing exchange rates and net debt positions. Calvo and Reinhart (2002) coined the term "fear of floating" to describe authorities' reluctance to allow free fluctuations in the nominal (or real) exchange rate. Emerging markets—including Brazil, Chile, Colombia, and Turkey—with announced inflation targeting regimes, have engaged in substantial intervention of the exchange rate following the Global Financial Crisis. As documented by the IMF, the number of countries actively managing the exchange rate has increased over the last decade.

We use our framework to investigate the optimality of different exchange-rate regimes subject to different external and domestic shocks. We show that the question of selecting an optimal exchange-rate regime looks similar to the problem of optimal debt management, whereby sovereigns choose a debt denomination. As such, the sustainability or viability of the exchange-rate regime becomes an explicit part of the analysis. As in other studies of optimal exchange-rate regime, the choice depends crucially on the type of shock to an economy. However, we further contribute to this literature by showing that under a flexible exchange-rate regime, a sovereign can reduce volatility by issuing local-currency bonds, a policy we dub a "pseudo-flexible regime." Additionally, we show that welfare levels are higher if a pseudo-flexible regime is implemented in conjunction with reserve accumulation.

The chapter is organized as follows. In Sect. 5.2, we present an overview of the main stylized facts. Section 5.3 presents the main framework and an analysis of a sovereign decision to hold debt and reserves. Section 5.4 introduces the role of local-currency debt. Section 5.5 discusses the relationship between exchange rate management and decisions about debt and reserves. Section 5.6 concludes this paper.

5.2 Stylized Facts

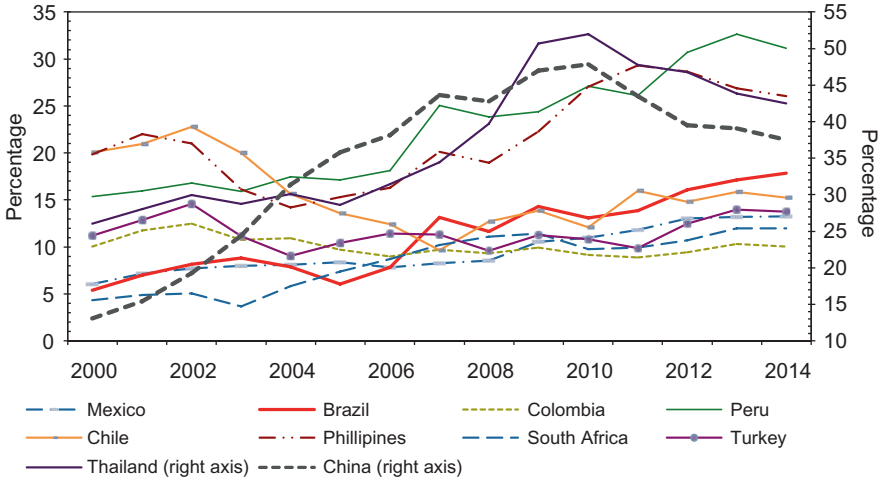
Two important trends distinguished capital mobility and portfolio holdings during the 2000s. Emerging countries engaged in substantial international exchange reserves accumulation, which spurred interest over the optimal level of reserves EMEs should accumulate. The size and pace of accumulation of foreign reserves have been unprecedented. Middle- and low-income developing economies hold close to 20% of their output in foreign reserves compared to 5% in high-income countries. Nations have engaged in reserve accumulation in amounts greater than their IMF quotas, with coverages greater than four months of foreign imports above four months and more than one year of short-term debt, (Greenspan–Guidotti rule) and broad money. This is also the case even in nations with large amounts for foreign debt (see Fig. 5.1). Estimated to represent more than one percent of GDP, the cost of this accumulation of foreign assets is substantial (Rodrik 2006). A common justification for this cost relates to the possibility of economies insulating and insuring themselves gains external shocks, through increased foreign currency liquidity (see Fig. 5.1).

Foreign participation in local-currency markets of EMEs is the second important trend of the last two decades, in particular in bond markets. Countries that used to mainly borrow in foreign currency (close 85% of their foreign debt) now manage to issue more than half debt in local one with foreign participants increasingly engaging in this market (see Fig. 5.2).

In fact, borrowing constraints for emerging countries are quite different from what they used to be. Eichengreen and Hausmann (1999) noted what they would call "origin sin": the inability of emerging markets to issue abroad in their local currencies. The ability to now issue in local currency to foreign participants is likely to have changed EME's sovereign debt incentives to issue, repay, and default.

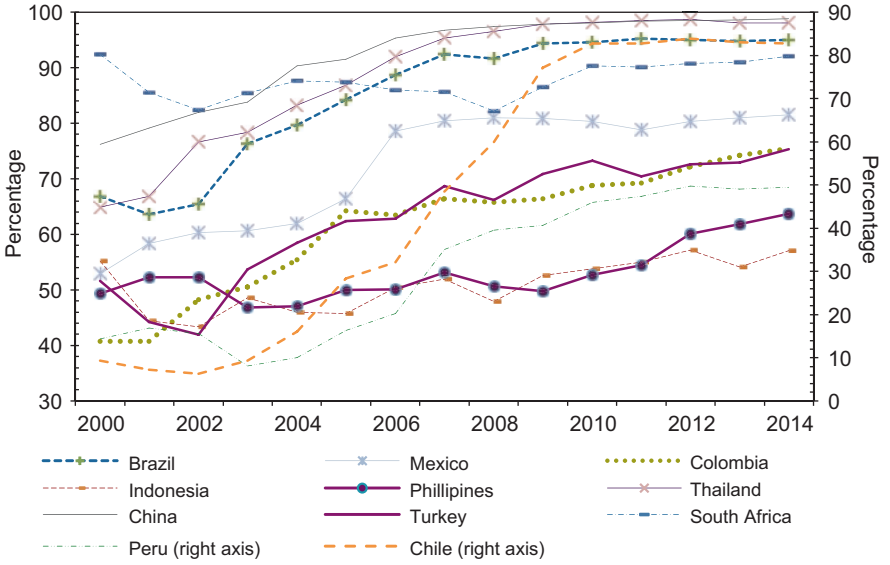
We argue that it is crucial to consider the joint decision to hold debt and international reserves. The traditional role of international debt is to have an insurance mechanism that allows more consumption smoothing (Eaton and Gersovitz 1981; Alfaro and Kanczuk 2005). However, given the willingness-to-pay incentive problems, international reserves holdings can reduce the sustainability of foreign debt.[1]

[1] The cost of not accessing foreign markets is that the sovereign must use other methods to smooth (self-insure via stock piles) or accept larger consumption fluctuation. This cost is higher if the penalty of not being able to access foreign capital markets is great, allowing to sustain higher levels of debt. Lower international interest rates also imply lower cost of smoothing fluctuations via access to international financial markets.



Source: Moody's Statistical Handbook, 2016.

Fig. 5.1 International reserves (% GDP). Source: Moody's Statistical Handbook, 2016



Source: Moody Statistical Handbook, 2014.

Fig. 5.2 Domestically denominated debt as a fraction of total government debt (%). Source: Moody Statistical Handbook, 2014

Moreover, a puzzle remains. Reducing the level of foreign debt allows to reduce the probability of a sudden stop and the cost of an external crisis. In other words, even in the case where foreign reserves may allow to reduce liquidity risks and the cost of a crisis, reductions in foreign debt can allow for the same net asset position.

5.3 Sovereign Debt and Reserves Accumulation

We build on the now standard argument for studying sovereign debt (Aguiar and Amador 2014). In particular, we model a small, open economy, populated by a representative agent and a government. The economy is subject to exogenous shocks to output, which can be considered endowment or productivity shocks. There is an international financial market, which has full commitment to financial contracts, where the final good can be traded inter-temporally, using a full set of state-contingent assets. When the economy is small and its shocks are uncorrelated with the rest of the world's consumption, standard diversification arguments imply risk-neutral pricing.[2]

Government's preferences are defined in terms of the representative agent, by a standard utility function, which is strictly increasing and concave in tradable good consumption. By assumption, government has sufficient instruments to control the representative agent's decisions, subject to the resource constraints. That is, for a given output level, the government choice of debt and reserves levels determines household consumption.

The critical assumption is that the government has limited commitment; that is, at any point in time, the government can decide to change its policy. In this simple setup, this means that the government can decide not to repay its debt to foreigners (i.e., default). After defaulting, the sovereign is temporarily excluded from issuing debt. In addition, the country may suffer some output costs, due to default disruption.

The model described is a stochastic dynamic game. We focus on the Markov perfect equilibria. In these equilibria, the sovereign does not make commitments, and players act sequentially and rationally. In practice, international investors are passive, as they must be indifferent between holding risky or riskless bonds. In contrast, the government behaves strategically, and its maximization problem must be written recursively, with value functions describing whether the sovereign decides to maintain a good credit history or to default.

To grasp how the model works, consider a sovereign's choice to default. On the one hand, defaulting allows for a lower cost (instantaneous reduction in the need to roll-over debt). This allows for higher levels of consumption. The gain is greater the larger the debt level and in particular the larger the debt service. On the other hand, defaulting leads to possibilities of consumption smoothing consumption in the future and lower output associated with the loss of access to the international

[2] See also Chap. 10.

financial markets. But it is precisely in such cases that reserves play a role. They allow for liquidity to smooth consumption even when the sovereign is not allowed to issue debt in foreign credit markets. That is, even though our model stresses the role of issuing debt, there is still a role for reserves; defaultable debt is not contingent enough. And the question becomes a quantitative one: does reserve accumulation allow enough smoothing of consumption to compensate for the cost of not accessing international credit markets. We turn to the calibrated version of our economy to answer this question.

We calibrate our model so that each period corresponds to 1 year. We use data available since 1965 for 28 countries that were classified as "emerging economies" by The Economist. To calibrate technology (the endowment), we estimate an AR(1) process for the (logarithm) GDP for each country.

We set the probability of redemption from default punishment such that it implies an average stay in autarky of 2 years, in line with estimations. In the benchmark case, the output cost is set equal to 10%, but we experiment with other values as well. We follow the Real Business Cycle literature to calibrate the parameter of preference curvature and the risk-free rate. Finally, we set the impatience parameter so that the model generates features of the data such as the high debt levels and reasonable default in equilibrium.

We recursively solve the model by discrete state approximation, and calculate the invariant distribution of the states. We obtain that the sovereign is excluded from the market 1.29% of the time, the average debt is 46.0% of output, and the average reserve level is zero. Indeed, the main lesson from this experiment is that it is optimal not to hold reserves at all.

To dig deeper into the implications of this finding, let us analyze the costs and benefits for holding reserves. As mentioned above, reserve holdings allow for consumption smoothing when the country reneges on their debt. But notice there is a cost of accumulating reserves: the economy has to consume less to stock pile foreign assets (recall the impatience parameter). Moreover, the stock of reserve endogenously affects the willingness to default. Thus, reserve accumulation reduces the sustainable debt levels. In particular, reserves increase debt services for a given level of debt increasing the cost of debt.

From this point of view, holding reserves may appear to be a suboptimal. As mentioned, an alternative is to reduce the levels of foreign debt as both are ways to smooth consumption. When faced with negative shocks, the government can increase the amount of debt to its maximum sustainable level in order to smooth consumption. But in the case when the sovereign has outstanding debt levels lower than the maximum sustainable level, there is "more room" to borrow before debt becomes unsustainable. Since default is less likely when outstanding debt is smaller, borrowing is relatively cheaper.

However, it is not as simple as this as developed in Alfaro and Kanczuk (2009). Reserves allow to smooth consumption even after the country has defaulted—a circumstance in which the country cannot increase debt. Second, reserves affect the sovereign's willingness-to-pay in complex ways. There is no reason for the amount of sustainable debt to vary linearly and uniformly with the amount of reserve

holdings. In other words, there is no guarantee that reducing outstanding debt by, say, X dollars increases the ability to smooth the same amount that holding X dollars as reserves does. As Grossman and Han (1999) show, smoothing consumption by increasing debt is less effective than smoothing consumption through defaulting. Or, using their typology, "contingent service" generates more consumption smoothing than "contingent debt." And since reserves are useful even after defaulting, they can be even more so when the sovereign opts to pay service contingently.

Taking all these together, one can conclude that there are many reasons why reserves holdings and less debt outstanding are not perfect substitutes. Consequently, it is not possible to say, a priori, that the optimal reserve holding is zero. Our result is, therefore, a quantitative one, which depends on the model and calibration. As a direct consequence, it becomes crucial to understand the robustness of our method to model specification and parameter calibration.

We changed the model specification to consider the existence of "contagion effects," or shocks to the international interest rate. The idea of this specification being that in nervous times there is some type of "irrational" contagion, which makes the emerging market face a high international rate, regardless of the risk of default. As a result, we obtained the sovereign optimally responds to the existence of contagion by reducing the outstanding debt and defaulting less frequently instead of defaulting more often. Consequently, reserves play no role. We also considered the possibility of sudden stops, which we model as output costs associated with abrupt reversals in the current account. However, once again, we obtained that reserve holdings are equal to zero.

Then we simulated the existence of contingent reserves, and the possibility that reserves could potentially be used to mitigate the output costs of default. Both devices should be seen as additional reasons to hold a reserve buffer, as they increase its benefits. However, paradoxically, adding a new role for reserves implies fewer defaults and, thus, no need for reserves.

Lastly, we simulated the model using many different parameters, and especially with various impatience levels. In doing so, we finally obtained solutions in which the sovereign chooses to hold reserves, but not for a reasonable parameter calibration. Reserve holdings are positive only if (1) the endowment process is much more volatile than what we observe in emerging countries, or (2) the impatience parameter is set to values that imply zero debt, which is inconsistent with what we observe in emerging markets and conflicts with the consumption front-loading that we expect from fast-growing economies.

5.4 Local-Currency Debt and Reserves

The previous section investigated the case in which debt and reserves were both denominated in foreign currency. We now revisit the question about the optimal level of debt and foreign reserves under the recent developments: increased foreign

participation in local bond markets that has allowed EMEs to borrow internationally in local-currency bonds.

We modify our analysis to quantitatively to fit these developments. As before, the economy is populated by a benevolent government, and a continuum of international, risk-neutral investors. Preferences are concave, implying that households prefer a smooth consumption profile. But in contrast with this last section, households consume both tradable and non-tradable goods. The price of the tradable good in relation to the non-tradable good defines the exchange rate.

A government may optimally issue foreign debt in local-currency markets and accumulate foreign reserves in order to smooth fluctuations in consumption. That is, debt and reserves are denominated in different prices. As before, the government may choose to default on foreign debt, in which case we assume it to be temporarily excluded from borrowing in international markets. The decision to default, an optional one, can be thought of as surprise inflation or as an outright default.

Debt and reserve accumulation interact with a country's incentives to default. Large levels of local-currency debt can help hedge foreign shocks, but may also not be sustainable. That is, once a country has accumulated large levels of foreign currency assets, it may not resist the temptation to inflate away the local-currency debt or simply stop paying (default). Accumulating large amounts of foreign reserves may also not be optimal. International reserves that are not pledgeable may not increase the sustainability of debt. In fact, these reserves may reduce sustainability when debt is denominated in foreign currency (Alfaro and Kanczuk 2009). Additionally, because holdings of international reserves shift consumption to later dates, they may be excessively costly.

We obtain that optimal reserve holdings turn out to be as large as those presently observed, and default almost never occurs. In the benchmark calibration, optimal reserve holdings amount to 24% of GDP, and the probability of default is only 0.4%. Unlike the traditional model, here most of the consumption smoothing is achieved by asset valuation effects. Joint issuance of domestic denominated debt and international reserves act as a powerful hedge against external shocks. In fact, our model also matches many features of recent emerging countries' economic fluctuations, remaining consistent with the reduction in exchange rate volatility.

The logic for our model goes back at least to Bohn (1990). Accumulating positive net foreign currency positions (assets in foreign currency and debt in local one) is optimal when faced against external disturbances (as to the endowment of tradable goods). The logic is as follows: the asset valuations effects due to depreciations or appreciations of the currency depreciation have a negative correlation with the international shock, and thus act to smooth consumption.

As quantitative insight from our simulations, we obtain that reserves accumulation does not negatively affect sustainability of debt when debt is in local currency. The calibration simulations we performed underscore the proposed scheme to be, in fact, sustainable in the sense that the government (almost) never defaults.

In other words, in both the foreign-denominated and local-currency debt scenarios, foreign reserves play a role when a country is excluded from capital markets. However, this role reduces the amount of debt that is sustainable, triggering defaults,

which are costly. When debt is foreign-denominated, as in the previous section, we obtained that the optimal level of reserves is zero. However, when debt is domestically denominated, reserves are very useful, owing to their valuation effect, which helps smooth consumption.

EMES accumulation policies could appear not to be optimal when realizing that the interest earned on reserves is much lower than that paid on their debt. Consider that in 2011, for example, Brazil central government's domestic and international debt was close to 60% of GDP with annual interest rate payments of close to 12% of its GDP. Brazil's level of foreign exchange reserve holdings reached close to 15% of GDP earning interest returns of close to 2% of GDP per annum. As a consequence, many experts claimed that Brazil should rather utilize the foreign exchange reserves to redeem its accumulated obligations instead of pursuing a negative carry, hence costly, asset-liability activity.

The rationale for pursuing a double accumulation policy, i.e. build foreign exchange assets and issue domestic currency debt obligations, is exactly that it is costly through good economic times and states. When an international shock is favorable, debt service is higher and consumption is reduced; when unfavorable, debt service is reduced and consumption increases. When the whole invariant distribution of shocks is taken into account, a country will enjoy more stable consumption (see Alfaro and Kanczuk 2009, 2019).

In this example, the level of reserves remains high during negative periods. The logic is not to use the reserves to buy consumption goods, but instead to maintain a constant level of foreign exchange reserves that serves as a hedge by stabilizing effect of local-denominated debt. Contrary to the usual argument in policy circles, reserves are thus not insurance that can be "used" in bad times.

To better grasp the intuition behind the consumption smoothing without changing debt and reserve holdings, consider the household budget constraint:

$$c_t = y_t + r_t^R R - r_t^D \frac{D}{e_t}$$

The above term considers the non-tradable goods market clearing condition, and assumes constant levels for assuming debt and reserves levels, where c_t is the consumption of tradables, y_t is the endowment of tradable goods, R and D are respectively the stocks of international reserves and domestic debt, r^R and r^D are the rate of return on these assets, and e_t is the exchange rate.

In good states of nature, endowment yt is higher, which makes consumption also higher. However, even if reserves and debt holdings (and interest rates) are constant, the valuation effects of the exchange rate can also affect consumption levels. The valuation effects of exchange rate appreciation in good times (depreciation in bad times) offsets the endowment effect. Exchange rate is determined, then, by the relative marginal utility of tradables to non-tradables to their relative prices.

Note that in this case, reserves were held constant, as were debt levels in local-currency units. However, debt holdings in foreign currency change, what affects the

consumption of tradeable goods. In other words, it is the change in debt holdings in foreign currency that offsets the endowment shock, and makes consumption smoother.

The results that debt and reserve levels do not change with the state of nature are worth highlighting. We analyze how generalizable this result may be and considering different parameterizations and model specifications. This invariance finding is extremely robust seeming more qualitative than quantitative. The logic for this finding is that the stabilization effect of issuing local-currency debt provides sufficient consumption smoothing so that there is no need to change the levels of debt and reserves. It can be seen as a reincarnation of the finding that only contingent service is used for consumption smoothing.

5.5 Exchange Rate Management

In the previous two sections, we analyzed the government problem of choosing the optimal amount of debt and reserves. The equilibria characterization resulted in consumption allocations and the exchange rate determination. We now look at the same problem from a different perspective. We analyze the government choice of optimal exchange-rate regime, and take the accumulation of reserves (and debt) as an equilibrium result.

As before, to smooth consumption, a government optimally issues foreign debt in both domestic and international currencies, and accumulates reserves. Domestic and international interest rates may differ, and we explicitly model the risks inherent in those differences. As a technical consequence of these assumptions, the exchange-rate determination in our model, rather than being the price of money, is such that the portfolio allocation is satisfied. The question of selecting an optimal exchange-rate regime then looks much like a problem of optimal debt management whereby sovereigns choose a debt denomination. As such, the sustainability or viability of the exchange-rate regime becomes an explicit part of the analysis.

Ahead of discussing the implementation of exchange-rate regimes via different types of debt, we explore which exchange-rate regime is consistent with optimal allocation. For this purpose, we examine the optimal allocation when the economy is subject to different types of shock and obtain the exchange rate in each situation.

As in many studies of optimal exchange-rate regime, we find that the choice depends crucially on the type of shock to an economy. In our framework, a flexible exchange-rate regime is optimal for domestic shocks and a fixed exchange-rate regime is optimal for external shocks. This result is reminiscent of Mundell's (1968), with respect to nominal versus real shocks, obtained using a model with money and only domestic shocks. We then focus on the case of an economy subject only to international shocks, as they are quantitatively much more relevant, especially for emerging countries.

The first possibility we analyze is the "traditional fixed exchange rate." In this regime, the sovereign assets must change in order to keep the exchange rate

constant, and the sovereign issues debt only in international currency. We show that these assumptions imply an unbound distribution of debt. In other words, debt can grow to values that contradict any sustainability constraint.

This result has an important and widely recognized implication for the traditional fixed exchange-rate regime. Although it may be optimal, as in the case of international shocks in our model, it is not sustainable. A sequence of bad shocks would imply that debt exceeds its sustainability ceiling. Sensing this and anticipating default on the sovereign's obligations, international investors would not lend more resources. As the debt cannot increase, the sovereign is forced to abandon the fixed exchange-rate regime.

We then consider the possibility that rather than issuing internationally denominated debt, the sovereign issues domestically denominated debt and accumulate reserves. As in the previous section, we obtain that this policy is very effective for smoothing consumption, because debt services are negatively correlated with the endowment shock. Another consequence of this arrangement is a strong reduction in the exchange rate volatility.

What should we call the policy of holding debt and reserves constant while letting the exchange rate fluctuate? Traditionally, because sovereign assets are held constant, it is termed a flexible exchange-rate regime. But, as discussed, the exchange rate under this policy is less volatile. We thus refer to it as a "pseudo-flexible exchange regime."

One should expect that exchange rates, despite the regime's smoothing effect, will tend to fluctuate somewhat. As a consequence of the exchange rate risk, interest rates of domestically denominated bonds will differ from the riskless rate. Although the exchange rate appreciates when the technology state is good (high), it is expected to devaluate under a revert-to-mean argument. Consequently, an emerging country's "contractual" yields of local-currency bonds should be higher than the international rate.

Our results have normative implications. The new consensus in policy circles seems to be that textbook exchange-rate regimes are impractical (Calvo and Mishkin 2003). Fixed exchange-rate regimes, though they may have desirable features in some contexts, have been historically condemned by speculative attacks. Freely floating exchange rates, which are subject to large currency misalignments despite the absence of any shocks that might conceivably have justified them, impose substantial economic costs. We find that as emerging nations develop their local-currency markets, a "pseudo-flexible regime," whereby a country accumulates reserves in conjunction with debt, is the best policy alternative under real external shocks.

5.6 Conclusions

Two new trends characterize international capital flows to emerging markets: (1) increase access to local-currency denominated bond markets, and (2) substantial accumulations of foreign reserves. These trends can be explained through the eyes

of sovereign debt management strategies. Issuing local-currency debt can help nations against international shocks through valuation effects that result from changes in the value of currency with negative correlation to the shock, an intuition that dates to Bohn (1990).

We revisit sovereign debt sustainability under the assumptions that countries can accumulate reserves and borrow internationally using their own currencies. Countries do not accumulate reserves to be depleted in "bad" times. Instead, they issue domestic debt while accumulating reserves to hedge against external shocks. Asset valuation effects due to currency fluctuations act to absorb global shocks and smooth consumption. Our quantitative study of how reserve accumulation affects governments' decisions to default finds that optimal holdings turn out to be as large as those presently observed. Our results match some of the characteristics of emerging countries' business cycles, suggesting this strategy to be effective for smoothing consumption and reducing the occurrence of default.

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Chapter 6
The Cost of Holding Foreign Exchange Reserves

Eduardo Levy-Yeyati and Juan Francisco Gómez

Abstract Recent studies that have emphasized that the costs of accumulating reserves for self-insurance purposes have overlooked two potentially important side effects. First, the impact of the resulting lower spreads on the service costs of the stock of sovereign debt, which could substantially reduce the marginal cost of holding reserves. Second, when reserve accumulation reflects "leaning-against-the-wind" sterilized interventions, the actual cost of reserves should be measured as the sum of valuation effects due to exchange rate changes and the local-to-foreign currency exchange rate differential (the inverse of a carry trade profit and loss total return flow), which yields a cost that is typically smaller than the one arising from traditional estimates based on the sovereign credit risk spreads. We document those effects empirically to illustrate that the cost of holding reserves may have been considerably smaller than usually assumed in both the academic literature and the policy debate.

6.1 The Case for and Against Reserve Accumulation

The accumulation of international reserves is not new, but became a topical subject—and an area of academic and policy research—in the 2000s, due to two unrelated phenomena: the Chinese effort to counter the appreciation of its exchange rate as a result of its growing trade surplus, and the buildup of a precautionary stock of reserves, primarily in South East Asia, after the currency crises of the late 1990s. This pattern of reserve accumulation and hoarding, however, has not been exclusive of Asian countries, as leaning-against-the-wind (LAW) exchange rate intervention has been common in most emerging economies, particularly in financially open commodity exporters where reserves reflected the ups and downs of the twin commodity and financial cycles.

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As a result, the active policy of hoarding a substantial stock of international reserves has been attributed to three main motives:

1. A commercial or *"neo-mercantilist"* motive to keep the currency undervalued to promote faster growth.
2. A self-insurance or *"precautionary"* motive to create a dollar liquidity buffer to cope with—and ultimately discourage—self-fulfilling liquidity runs in economies with substantial dollar liabilities.
3. An exchange rate smoothing or *"leaning against the wind"* motive to prevent cyclical real exchange rate fluctuation, which in turn may be related to a mercantilist objective (to prevent temporary losses of competitiveness) or precautionary objectives (to avoid temporary overvaluations that may introduce downside exchange rate risks and excessive volatility).[1]

A number of papers (Prasad et al. 2006; Rodrik 2008; Levy Yeyati et al. 2012; Levy Yeyati et al. 2013) examined the mercantilist motive. From another point of view, Jeanne and Ranciere (2006) remark that there are others who point out that reserves buildup may be related more to an *unintended* consequence of policies oriented to achieve and maintain large current account surpluses.[2] That said, the literature on international reserves has centered primarily on motives 2 and 3. While in the early 2000s it tended to focus on the precautionary motive, the evidence from most economies—and recent empirical tests—have been increasingly pointing to exchange rate smoothing as the main driver of the stock of reserves. More precisely, whereas earlier work has highlighted that reserves are positively correlated with past balance of payments crises (Aizenman and Lee 2005) and with the degree of financial dollarization (Levy Yeyati 2006a, b), latest additions to the literature have focused on the link between overvaluation and development and the costs and consequences of LAW interventions.

The arguments *against* reserve accumulation by emerging economies have been often predicated based on three premises:

- *reserves introduce negative externalities:* they perpetuate global imbalances and depress interest rates, stimulating asset bubbles;
- *precautionary reserves are not efficient:* inasmuch as they are purchased to build a liquidity war chest to prevent or cushion sudden capital flow reversals, they can be optimally substituted by centralized financial safety nets; and

[1] Indeed, one could see leaning-against-the-appreciation-wind during expansions as the countercyclical prudential response to procyclical capital flows and real exchange rates, the goal of which is to avoid current account deficits in good years and prevent a dollar squeeze in the downturn. Such a strategy would be related to precautionary motives, although it would differ from the simple hoarding of liquid assets typically associated with the precautionary story.

[2] A typical figure here is a country that maintain a constant current account surplus with a tradable sector net bidder of local currency, who sells its foreign currency net export proceeds to the central bank in order to not restring its domestic absorption. By this token, the consolidate government can accumulate reserves without the necessity of incurring in new borrowing.

- *reserves are costly:* to the extent that precautionary reserves are purchased with dollar debt, reserve holders pay a carrying cost roughly proportional to the sum of their sovereign credit risk premium and (because reserves are typically held in short-term instruments) the term premium in the reserve currency of choice.

Of these three criticisms, the first one reflects a complex coordination problem that exceeds cost-efficiency considerations by individual countries, and the second one ignores the practical limits of a fully functioning international lender of last resort or the correlation risk of portfolio flows in the event of a systemic shock.[3]

But it is the third aspect of the debate on reserve policy that is the subject of this chapter. More specifically, we will discuss the costs of hoarding reserves and will argue that the correct way of computing these costs depends crucially on the underlying motives. In the case of self-insurance, the marginal cost of carrying reserves is proportional to the marginal cost of the debt that implicitly funds (alternatively, that could be cancelled with) reserves, net of the returns obtained on reserves—which typically amounts to the sovereign spread over the risk-free rate plus the term premium if there is a duration mismatch between reserves and debt. If the purchase of reserves is aimed at countering exchange rate variations, reserves are funded essentially by issuing local currency-denominated debt,[4] which pays the local-to-foreign currency interest rate differential (a quasi-fiscal cost) and incurs valuation losses due to changes in the nominal exchange rate (in other words, takes the other side of a "carry trade"). As we document empirically, the cost of reserves in these two cases differs substantially.

Our route map is as follows. In the following Sect. 6.1 and 6.2, we explore in more detail the pros and cons of hoarding international reserves according to their motives and argue that the costs may have been overstated. In Sect. 6.3 we use a simple model of the determination of the sovereign risk spreads to show how the traditional measure of the cost of precautionary reserves should be corrected to account for the impact of reserves on spreads. Section 6.4 estimates empirically the cost of reserves in the LAW case, and shows how these costs depend essentially on the interest rate differential: for countries with modest differentials, the cost of exchange rate intervention through the purchase of reserves may be minimal (or there may even be a small profit). Section 6.5 summarizes the main findings.

[3] On the high cross-country correlation of reserve needs displayed during episode of global distress, see Cordella and Levy Yeyati (2010).

[4] Since intervention is geared to offset the demand for the local currency, the issuance dollar debt would not do the trick in this case.

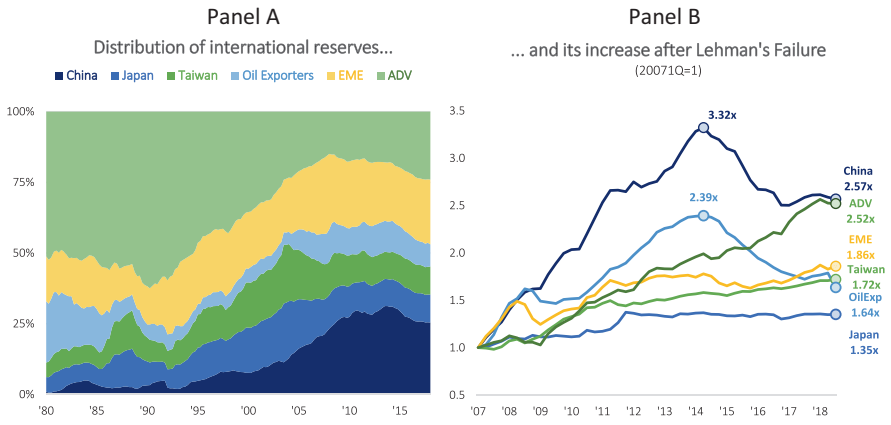
6.2 Motives and Costs[5]

The unrest as a result of the currency crises of the late 1990s—a combination of a global financial downcycle and self-fulfilling liquidity runs—coupled with the reluctance of developing economies to put themselves in the hands led emerging economies to embrace a debt de-dollarization and self-protection strategy through, respectively, the development of domestic financial markets and the buildup cushion of liquid international reserves.[6]

This approach reflected the view expressed by many observes about the sources of financial stress in the emerging world by the end of the century. As Martin Feldstein puts it regarding the stream of crises in South East Asia: "*Liquidity is the key to self-protection. A country that has substantial international liquidity large foreign exchange reserves and a ready source of foreign currency loans—is less likely to be the object of a currency attack"* (Feldstein 1999).

This view was only confirmed in the Great Recession that followed the failure of Lehman Brothers in September 2008, as many governments and central banks, including in the developed world, rushed to obtain greater "liquidity assurance," that is, the assurance of having access to international liquidity in any future crisis (Moessner and Allen 2010)—including, most notably, through bilateral currency swap arrangements with the U.S. Federal Reserve.

Figure 6.1 panel A, which describes the composition of global international reserves from the last 30 years, shows the massive increase in emerging economies' share in the global distribution, peaking at 68% in the aftermath of the global crisis.



Source: IMF' International Finantial Statistics and authors calculations. ADV stands for Advanced Economies (IMF, code XR29) excluding Japan, EME stands for Emerging and Developoing Countries (IMF code XR43) excluding China , Taiwan and Oil Exporters (Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates, Venezuela).

Fig. 6.1 Evolution and composition of international reserves

[5] See also Chap. 15.

[6] See, Fernandez-Arias and Levy-Yeyati (2010).

Figure 6.1 panel B shows an important increase in reserves after the failure of Lehman Brothers, especially in China (reaching a peak of more than three times of increase in 2014). Ten years after that traumatic episode, emerging countries as a group almost have doubled (1.9 times) its international reserves, and, as a puzzle, that number is less than the buildup registered in the advanced countries (2.5 times). Interestingly for our purposes is the fact that, since the mid-1990s, the evolution of global international reserve stocks are largely explained by a few countries (China, Japan, Taiwan, and oil exporters accounts for a 10-year-average of 56% of world reserves), which did not suffer currency crises nor faced a shortage of hard-currency liquidity: To what extent, then, is reserve accumulation driven by liquidity insurance?

The precautionary motive evolved as the depth and nature of financial globalization developed in the 2000s. As Rodrik (2006) recalls, before financial globalization, the main driver to hoard reserves came from the current account side of the balance of payments: to keep a stock of foreign exchange to meet trade deficits. Because of that, central banks used to follow the rule of thumb of holding reserves equivalent to 3 months of imports (see Fig. 6.2), as reserves were treasured as an insurance against current account reversals. In the 1990s, the hoarding of reserves accelerated, and the stock started to be measured against *financial* magnitudes, more specifically, flows in the financial account of the balance of payments: reserves work as an insurance against sudden stops in capital markets.

It was with this in mind that the 1991 "Guidotti-Greenspan rule" was postulated to hold liquid reserves equal to the country's foreign currency liabilities due within a year, a criterion that was at the time formally embraced for policy guidance by the IMF. In a more recent contribution, Obstfeld et al. (2010) argued that reserve

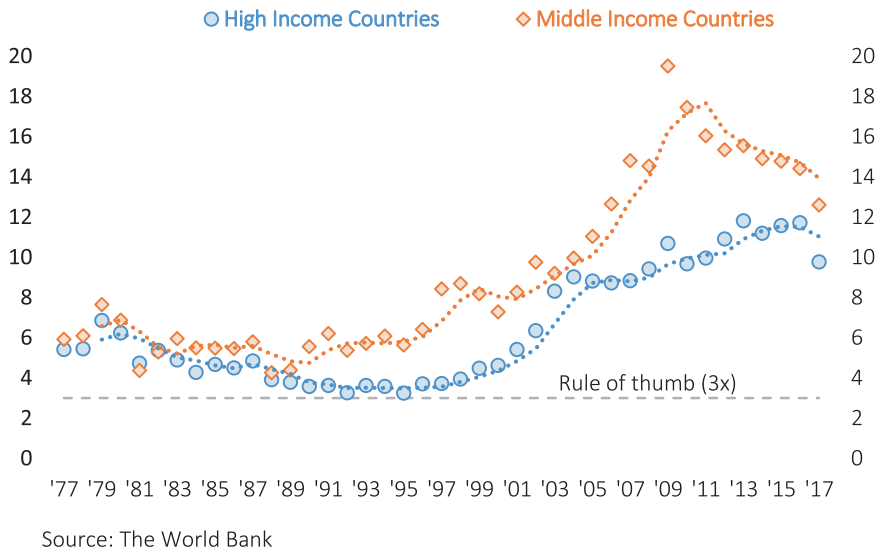


Fig. 6.2 Total reserves in month of imports

adequacy should be judged relative to the broad monetary aggregate, M2, a proxy for financial development, due to its good tracking of the potential pressure on reserves resulting from a fight out of domestic-currency bank deposits. The intuition is simple: in the event of a run, it is not the transactional monetary base but savings (quasi moneys) that go to the foreign currency for protection.

6.2.1 Are Reserves Suboptimal?

The literature on the "*optimal level"* of reserves is often rationalized in terms of their insurance value against balance of payments crisis, relative to their cost, which is typically assumed to be proportional to the credit risk spread of the country (a point to which we come back below).[7]

Following Moessner and Allen (2010), satisfactory techniques for providing liquidity assurance should: (1) reassure that the international liquidity needs will be met, (2) avoid excessive moral hazard, and (3) avoid placing an unreasonable burden on liquidity providers. In Moessner and Allen's analysis, three types of arrangements fit these criteria: a multilateral pool of liquidity, bilateral arrangements, and unilateral actions. A priori, it is known that self-insurance is more costly and less efficient than a pool of savings that benefit from risk diversification. For the same reason, the centralized holdings of precautionary reserves by an international agency have two potential advantages:

1. It requires a *smaller stock* than individual self-protection for a given risk exposure; and
2. It is *less costly*, to the extent that the pool might benefit from peer control and face a lower credit risk premium than individual countries (as is the case for many real-life reserve pools and regional multilateral credit institutions).[8]

In a broader sense, multilateral agreements mitigate the "psychological" negative effect of selling reserves: whereas reserves help ex ante to dissuade a foreign exchange run, their use (more precisely, the sight of a rapidly falling reserve stock) is often seen by market agents as a signal that confirms the fears of a dollar shortage that trigger a run in the first place, thereby reducing their ex-post effectiveness. Thus, reserves work better to prevent a run that to contain it.

Examples of reserve pools include the Chiang Mai Initiative (CMI) in East Asia, the Latin American Reserve Fund (LARF), the European Stability Mechanism (ESM), and, of course, the IMF.[9] However, the increase in the correlation risk in the

[7] Readers interested in this model might look at Jeanne and Ranciere (2011), Jeanne and Sandri (2016), and the references therein.

[8] See, for example, Levy Yeyati (2014).

[9] Fernandez Arias and Levy Yeyati (2010) explore the relationship between a reaction to the traditional IMF approach and the emerging in the 2000s of regional safety nets (CMI and LARF) as alternatives. It is also worth noting that emerging members of the G20 are main promotors of

event of a systemic event (namely, the fact that all insured countries are likely to draw liquidity at the same time) should largely erode the diversification gains. At the same time, moral hazard considerations, coupled with political constraints, have led some of this reserve arrangements (CMI, EBRD) to fall back on some version of the IMF conditionality as a pre-condition for full access. Ultimately, only the issuer of a reserve currency favored by the flight to quality in the event of a global liquidity crunch could retain the systemic liquidity risk without a hefty carrying cost. Thus, the diversification argument against self-insurance is considerably weakened: only these "issuers of last resort" (the Fed, the Bank of Japan, to a lesser extent the ECB) or big-pocket lenders such as China could provide liquidity in a systemic event, and they would typically do that under conditions that often deter the preventive use of the facility, leaving the country best served by its own reserves.

6.2.2 Are Reserves Precautionary?

Official exchange rate intervention in the foreign exchange market has been the subject of a vast academic and policy-related literature.[10] Its link with the accumulation of international reserves is usually established through the goal of keeping the exchange rate undervalued for mercantilist reasons. However, there is plenty of evidence indicating that intervention is primarily geared to limiting what policymakers may see as unwarranted (and possibly harmful) deviations from equilibrium levels.[11] In many cases, this countercyclical exchange rate stabilization policy appears to account for reserve accumulation in recent years better than the precautionary motive.

As a final note, exchange rate smoothing does not require that reserves be held in short, low-yielding liquid assets. Even precautionary reserves—unlikely to be used in full—can afford to be partially invested in higher yielding long-run saving instruments as in the case of sovereign wealth funds: the bias towards short-run assets seems to reflect more the objective to minimize short run valuation changes than to maximize liquidity; in other word, it may be the solution to an agency (the reserve manager) rather than a financial problem.[12]

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global financial safety nets, having achieved reforms aimed at enhancing financial resources and renewing instruments for emergency liquidity provision, but failed at accomplishing reforms concerning the governing structure of International Financial Institutions. For a review, see Cheng (2016).

[10] Sarno and Taylor (2001) provide an early survey for advanced countries, and Levy Yeyati and Sturzenegger (2010) provide a review with a focus on developing economies.

[11] See, among others, BIS (2005, 2013), Levy Yeyati (2010), Adler and Tovar (2011), and Daude et al. (2014).

[12] Perhaps in the realization of this inconsistency between goals (precautionary exchange rate smoothing) and instruments (short-run reserve assets) lies the hope to reduce the excessive demand for the latter that triggered the quest against reserve accumulation in the first place.

6.2.3 *Are Reserves Costly?*

In the self-insurance story, part of the proceeds of capital inflows in good times are purchased and saved by the central bank for the rainy days. To the extent that part of these inflows are associated with past or current sovereign hard-currency debt issuance, one could think of the opportunity cost of reserves as the cost of serving such debt; after all, by consolidating the government and the central bank into one balance sheet, the relevant leverage concept should be net debt, namely sovereign debt minus reserves. Indeed, to the extent that reserves could be swapped in exchange for debt, the cost of reserves should be proportional to the interest rate differential between the two. Hence, the use of the sovereign premium (the difference between the yield on the sovereign debt and the risk-free returns on international reserves) as a proxy for the cost of reserves. Because reserves are held in short rate risk-free assets, this gap is, in turn, a function of the sovereign risk spread *plus* the hard-currency interest rate premium (Jeanne and Ranciere 2011; Rodrik 2006).

However, the cost of reserves tends to differ from this simple formula for at least two reasons:

- First, to the extent that the availability of liquid reserves affects credit risk (and the interest rate) paid on the total (public and private) debt stock, the marginal cost of carrying reserves for indebted economies may be significantly lower than the sovereign spread. If, for a given net debt stock, a larger stock of liquid foreign currency assets tightens the sovereign spread, the resulting fiscal gain in rollover costs should be net out from the spread (Levy Yeyati 2011)—the gains would be larger for the country as a whole (and, indirectly, for the Treasury) if we take into account the rollover costs on private debt. We elaborate on this argument in Sect. 6.3.
- Second, and more important, if reserve purchases follow a LAW pattern, the central bank would sustain important valuation losses only to the extent that appreciation pressures are permanent. By contrast, if they are due, for example, to cyclical inflows or short-lived term of trade shocks, the reversion of the exchange rate to its earlier, more depreciated level would eliminate much of the valuation losses, and, in some cases, may even result in central bank profits. Section 6.4 explores this second argument more in detail.

6.3 Self-insurance and the Marginal Cost of Reserves[13]

When a central bank is embraced in a self-insurance reserve accumulation policy, the acquisition of the foreign currency is fulfilled by borrowing abroad.[14] The debt may be issued by a private firm in the form of capital inflows purchased by the central bank or directly by the Treasury. In either case, the result is the same: the

[13] The section is based on Levy Yeyati (2011).

[14] As stated before, we do not consider the case of hoarding reserves due to current account surplus.

economy as a whole borrows abroad and invests the proceeds in international reserve assets.

The maturity of both debt and reserves are critical to a complete assessment of the cost of reserves: for instance, Rodrik (2006) assumes that the central bank invests the foreign currency in U.S. Treasuries and that the private firm borrows at short maturities, so that there is no maturity mismatch. From this perspective, the appropriate cost of reserves is approximately equal to the spread between the cost of the borrowing abroad and the yield that the central bank earns on its reserves. For the latter term, the yield on the U.S. Treasury securities is a good proxy; for the former, the private debt often takes place in the commercial bank sector where rates are often priced at the sovereign yield plus a spread. The computation is more straightforward if the borrower is the central government, since in this case the opportunity cost of reserves would be the yield differential between the country and the USA, that is, the sovereign credit risk spread, for which there is reliable high frequency data.

To account for the fact that sovereign borrowing often has a longer duration than reserves allocation, the cost of reserves has been often estimated as the sovereign risk spread plus the hard-currency interest rate term premium[15]: if a country issued debt with an average 5-year duration (close to the average duration of JP Morgan's EMBI) to purchase 2-year U.S. Treasury bills, the cost could be proxied by the sum of the EMBI spread and the difference between the 5-year and the 2-year Treasury yields. Depending on the country's perceived credit risk, the level of global risk aversion and the slope of the risk-free yield curve, this cost could be significant, suggesting that other designs of liquidity insurance may be more cost-efficient.

There is, however, an additional term that should be taken into account when computing the fiscal cost of self-insurance: the impact of liquid reserves on the sovereign risk and, through this channel, on the debt service. Since the credit risk premium echoes the assessment of the investors about the possibilities of debt to be honored, and that assessment usually takes into account the stock of liquid reserves, a rise in the latter reduces the likelihood of a liquidity crisis, and therefore compresses the spread paid on the debt, becoming this an additional marginal benefit of hoarding reserves.

Assume for simplicity that the U.S. Treasury yield curve is flat, so that there is no term premium (alternatively, assume that both reserves and debt are issued with the same one-period maturity), that reserves are fully funded by new hard-currency debt (so that one unit of reserves entails one additional unit of debt: $D = Do + R$, where R is the stock of reserves and Do stands for the debt stock at the beginning of the period), and denoting the sovereign risk premium as $\rho(R, D)$, we can express the government's fiscal cost of holding reserves as:

$$L(R,D) = \left[r^f + \rho(R,D)\right]D - r^f \cdot R \tag{6.1}$$

[15] See Jeanne and Ranciere (2006).

from which, recalling that $\frac{\partial D}{\partial R} = 1$, the marginal cost of reserves is

$$\begin{aligned} \frac{\partial L(R,D)}{\partial R} &= \left[\rho_R(R,D) + \rho_D(R,D)\right]D + \rho(R,D) < \rho(R,D) \\ &\Leftrightarrow \left[\rho_R(R,D) + \rho_D(R,D)\right] < 0 \end{aligned} \tag{6.2}$$

This tells us that to the extent that an increase in the reserve buffer more than compensates the negative impact of the corresponding increase in the stock of debt on the credit risk premium (that is, $[\rho_R(R, D) + \rho_D(R, D)] < 0$), then the marginal cost of reserves is less than the sovereign spread usually used as a proxy, as stated in Eq. (6.2).

Is this the case in practice? We rely on González Rozada and Levy Yeyati's (2005) model of emerging market spreads as determined by international factors (essentially, global risk-free and risk aversion rates) by adding the stock of sovereign external debt, reserves, and credit rating (to control for other country-specific, time-varying characteristics).[16] In addition, either because private debts could be seen as implicitly guaranteed by the government or because private demand of foreign currency to repay those debts adds to the exchange rate pressure and the risk of a sovereign credit event, we control separately for private foreign currency debt. Table 6.2 shows the relevant summary statistics, Annex Table 6.3 the countries and periods covered, and Table 6.7 the variable definitions and sources.

Estimation results for the full sample are reported in Table 6.4. The first regression replicates the original model of global factors (risk aversion, credit rating, and international rate), and we include reserves and both sovereign and private debt as ratios over GDP. In the second regression we control for consistency by dropping private debt ratio. The semi-elasticity with respect to the reserve ratio, ρ_R, is stable at roughly 1.7, meaning that, ceteris paribus, a unit increase in the reserve ratio leads to a 1.7% decline in spreads, while the same with respect to the sovereign debt ratio, ρ_D, is significantly lower at about 0.7.

Naturally, part of the benign effect of growing a liquidity buffer is captured by ratings, which usually include measures of reserves stocks in their calculations. Because of that, we estimate the direct impact of reserves on ratings in column 4: as can be seen, the reserve ratio improves credit ratings more than the concomitant increase in debt ratios worsens them. It follows that the estimated total (direct plus indirect) effect of reserves on spreads without controlling for ratings (column 3), measured by the difference between the coefficients of reserves and debt, is even larger before. To isolate the results from the effect of the Great Recession of 2008–2009, we perform the same regressions for two subsamples, one for the period

[16] All variables are in logs. All regressions controls are based on monthly data, include country fixed effects and exclude observations for countries in default, for which the spread can no longer be interpreted as a measure of credit risk. Regressions also exclude cases in financial distress (spreads above 1000 basis points) and the crisis years 2008 and 2009, as they are likely to exhibit a qualitatively different relation between reserves and credit risk. We used splines interpolation to turn debt and GDP (originally yearly data) into monthly data.

before the crisis and the other after it. Both are reported in Table 6.5 and 6.6. While the results are comparable, the differential effects of reserves relative to debt narrow in the latest period.[17]

In sum, in the case in which the cost of hoarding reserves, under the assumption that each dollar of reserves is ultimately funded with government debt, is estimated as its sovereign spread, the standard proxy often overstates the cost, as it ignores the benign effect of liquid reserves on spreads. To the extent that liquid reserves reduce credit risk (and the interest rate) paid on the total (public and private) debt stock, the marginal cost of carrying reserves for indebted economies may be lower than the sovereign spread—even more so if we take into account the gains from lower spreads on private debt as well.[18]

6.4 Leaning Against the Wind and the Cost of Reserves

In recent years, reserve accumulation has been motivated not exclusively (and probably not primarily) by the self-insurance motive, but rather by a LAW exchange rate policy aimed at containing what the central bank may perceive as excess market volatility in foreign exchange markets.[19] While it is beyond the scope of this chapter to assess when and to what extent one motive dominates the other, the distinction between self-insurance and leaning against the wind is essential to the cost analysis.

LAW intervention can be conducted in an unsterilized form, simply by purchasing or selling reserves against the local currency, with the corresponding change in base money, or by sterilizing changes in base money through the sale or purchase of local currency paper. Since the latter is monetary neutral, it is the mechanism preferred by banks concerned with inflation and has been the most frequent case in recent years.

Faced with appreciation pressures, a LAW central bank accumulates foreign currency reserves against local currency debt. Note that, in essence, this mirrors the position of a carry trader that short the foreign currency betting on further appreciation: in the absence of transaction costs (including Tobin-type taxes on cross-border flows), the loss of the central bank should equal the profit of the carry trader.

As noted, the main concern about sterilized intervention has been the cost of carry, namely the frequently large local-to-foreign currency interest rate differential

[17] Additionally, we find that the international rate (proxy for international liquidity) performs as expected before the crisis, but as the interest rates reach the so-called zero lower bound in the aftermath, the elasticity becomes negative, meaning that low level of rates in advanced countries started to increase the cost of borrowing for emerging markets.

[18] We could also add that, since the fact that reserves are held in short-dated instruments is related less to liquidity than to central banks' agency problem associated with reserve management practices (for example, the manager's fear of short-term mark-to-market losses), the term premium is in most cases an unnecessary cost.

[19] See Levy Yeyati and Sturzenegger (2010) for a discussion.

that the central bank has to pay on its local currency-funded reserve position. In effect, this situation might lead central banks to deal with quasi-fiscal losses associated with steep interest rate differentials. These differentials may reflect either a decline international rates (for example, due to the spillovers of the U.S. expansionary monetary policy, as highlighted in the financial cycle literature) or a tightening of domestic monetary policy that triggers speculative capital inflows (which the exchange rate intervention tries to offset).

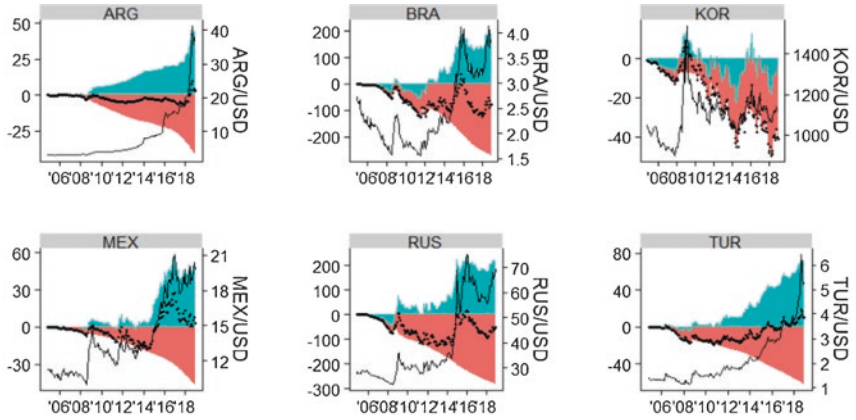
However, the conventional wisdom that relates intervention costs with interest rate differentials ignores another critical aspect of the process of hoarding reserves: the countercyclical nature of LAW intervention and the cyclical valuation effect that might work in its favor. If official intervention in the foreign exchange market delays appreciation, the central bank purchases reserves at a relatively low price level, and when the exchange rate finally moves back towards its more depreciated equilibrium, it gives the bank a positive valuation gain.[20]

This has a trivial but often overlooked implication: the cost of LAW reserve accumulation must be measured over the long run (to include the full cycle). More specifically, in floating exchange rates regimes, participation of central banks in the foreign exchange markets is expected to have at times positive and negative valuation effects. It follows that LAW reserve accumulation would sustain important valuation losses only to the extent that the appreciation pressures are permanent, in which case the intervention would be closer to the mercantilist motive that aims at gaining price competitiveness by preserving an undervalued currency. By contrast, if they are due to cyclical speculative inflows due to a differential monetary policy stance, or to short-lived terms of trade shocks, the reversion of the exchange rate to its earlier, more depreciated level would eliminate much of the valuation losses, and may even be greater than the carry effect (i.e., a net profit scenario), since it benefits from the fact that the bank purchases reserves when they are cheap and sells them when they are expensive in term of the local currency.

If the uncovered interest rate parity (UIP) condition holds, the interest rate differential should equal the expected exchange rate variation (if the differential favors the local currency, the latter should depreciate, and vice versa) so that the cost of sterilized purchases should ultimately be, on average, similar to purchases directly funded by dollar debt (the only difference being that, in the first case, it is the central bank that bears the currency risk). However, as UIP seldom holds in the short run, the central bank could arbitrate cyclical deviations from UIP. Ultimately, both the amplitude of these deviations and the intensity of interventions are critical to assess the fiscal costs of LAW.[21] At any rate, in the absence of taxes on foreign exchange

[20] While not strictly related to the focus of this chapter, the same is true for the opposite case of a temporary depreciation pressure: the bank sells at a depreciated exchange rate reserves that were purchased or are later replenished at a lower parity.

[21] Can the central bank intervene in a way that maximizes valuation gains? While that purpose is not often written in official documents, Sarno and Taylor (2002) suggest that the information available to, and used by market agents is often less accurate that the authorities provide. Along the same lines, Blinder et al. (2008) argues that "central banks may have, or may be believe to have,



Note: Blue area stands for valuation result, red area for 'carry' result and the black dots are the sum of both, the total result for the country. The solid line in the secondary axis is the nominal exchange rate.
Source: Reserves and Nominal Exchange Rates are from IMF's *International Financial Statistics* and carrying rates are three-month implied yields derived from the covered interest rate parity condition build by Bloomberg, L.P.

Fig. 6.3 LAW, Cumulative Profits and Losses (P&L) from reserve purchases. All numbers in billion dollars, unless otherwise noted. *Note*: Blue area stands for valuation result, red area for 'carry' result and the black dots are the sum of both, the total result for the country. The solid line in the secondary axis is the nominal exchange rate. *Source*: Reserves and Nominal Exchange Rates are from IMF's *International Financial Statistics* and carrying rates are three-month implied yields derived from the covered interest rate parity condition build by Bloomberg, L.P

transactions or other relevant sources of transaction costs, the stream of profits and losses of a sterilized LAW central bank intervention, should be the reverse of the one received by a carry trade speculator.

Figure 6.3 shows back-of-the-envelope empirical estimates of the cumulative valuation and carry cash flows for a few central banks known to have intervened actively in foreign exchange markets (see Levy Yeyati and Sturzenegger 2010, for details). On the one hand, the cost of carry (red area) is positive and accumulates steadily over time. On the other hand, valuation losses (blue area) accumulate during the appreciation phase and decline during an exchange rate correction (see, for instance, Brazil prior to and after 2012s), and a LAW central bank tends to buy

superior information on the economic outlook [because they] usually devote many more resources than private sector forecasters to forecasting and even to estimating the underlying unobservable state of the economy." By this token, the central bank with its powerful research department may use its more accurate data to intervene in a profitable way by hoarding reserves, while its price is perceived to be low, and selling when it is perceived to be high. A similar argument has been proposed and tested to explain why an unanticipated interest rate hike by the central bank typically shifts the yield curve upwards despite the fact, whereas it is expected to reduce inflation over the long run (Romer and Romer 2000).

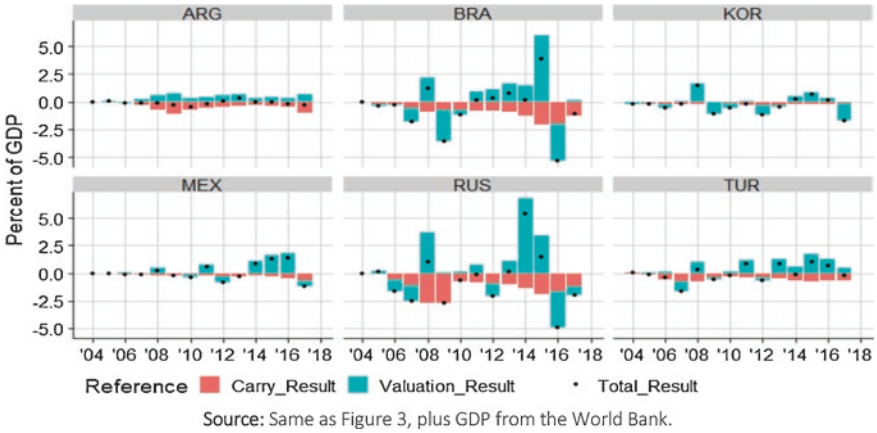


Fig. 6.4 Annual P&L from reserve purchases as percent of GDP. *Source*: Same as Fig. 6.3, plus GDP from the World Bank

cheap reserves that it sells later on at a higher price in times of currency stress, a "market maker" gain that partially offsets the cost of carry. As a result, while the total return from intervention (black dots) tended to be negative for countries with steep interest rate differentials (the so-called curry currencies like Brazil or Russia, characterized by liquid foreign exchange markets and wide interest rate differentials often unrelated with exchange rate expectations), many central banks faced modest costs or even minor gains as they benefitted from large valuation gains in risk-off periods such as the global crisis of 2008–2009 or the euro crisis) and reserves were sold at higher parities to contain the currency run.

How economically important are these costs? In Fig. 6.4, we perform the same analysis, this time computing quasi-fiscal intervention results and losses relative to GDP over each fiscal year. Again, "carry currencies" such as Brazil and Russia display the largest P&L numbers in the panel, reaching quasi-fiscal profit and losses of almost 5 percent of the GDP. In contrast, in normal cases, the incidence of the carry effect looks at first glance less important than the valuation effects, and the total annual cost of holding reserves looks fairly small.

If we look at the average of these numbers over the period of analysis, countries of the sample exhibit average valuation gains of 0.35 of GDP, and average carrying costs of 0.59% of GDP for an average total loss of 0.24% of GDP (see Table 6.1). We can compare these estimates with those arising from the traditional sovereign-spread-plus-term-premium proxy discussed in the previous section (abstracting, for simplicity, from the marginal effect of reserves on spreads). As shown in the last column of Table 6.1, the traditional measure would overestimate the cost of holding reserves under LAW.

Table 6.1 Average Cost of Reserves (2005–2017)

	Leaning against the wind			
	Valuation (%)	Carry[a] (%)	Total (%)	Self-insurance[b] (%)
Argentina	0.37	−0.47%	**−0.10**	−0.32
Brazil	0.40	−0.90	**−0.50**	−0.43
South Korea	−0.10	−0.18	**−0.28**	NA
Mexico	0.31	−0.24	**0.07**	−0.22
Russian Federation	0.59	−1.20	**−0.61**	−0.66
Turkey	0.47	−0.49	**−0.02**	−0.23
All Countries Average	0.35	−0.59	−0.24	−0.38

Source: Same as Fig. 6.4, plus EMBI from The World Bank and the UST Term premium is 5-Year Treasury Constant Maturity Minus Federal Funds Rate, both from the Federal Reserve Bank of St. Louis

[a]Proxied by the Covered Interest Rate Parity

[b]Proxied by EMBI + UST Term Premium (5 years-Fed Funds)

In sum, while realized intervention costs depend crucially on the timing and nature of intervention, and tend to vary considerably over the cycle (particularly for LAW interventions), the conventional view that reserves are costly due to wide sovereign spreads or heavy quasi-fiscal losses associated with interest rate differentials and permanently misaligned exchange rates appears to have been overstated.

6.5 Why Do Central Banks Intervene (and at What Cost)?

Recent studies of the costs of accumulating reserves for self-insurance have overlooked two potentially important side effects.

First, the benign effect of holding reserves on credit risk spreads and, in turn, on the cost of issuing and servicing debt, should be subtracted from the marginal cost of holding reserves. As we show here, these gains could be substantial. Estimates in this paper should be seen as a lower bound, as they ignore externalities for the corporate sector (private financing costs are often bounded below by the sovereign) and the positive impact on fiscal accounts from improved activity and lower contingent liabilities. While self-insurance is costly and should be regarded as a second-best solution in an imperfect international financial architecture, taking this side effect into account certainly makes its cost-benefit balance look more appealing.

Second, traditional studies seem to ignore the fact that reserve accumulation increasingly reflects sterilized, LAW central bank interventions. While the way in which intervention is conducted should be irrelevant under perfect markets, in reality they change the actual cost of holding reserves significantly. Under LAW, these costs should be measured as the sum of valuation effects due to exchange rate changes and the local-to-foreign currency exchange rate differential (which, in the absence of capital controls, is simply the inverse of a carry trade position).

This yields a loss that is often smaller than that estimated under based on the sovereign credit risk spread and, as we showed here, can indeed be positive, if the intervention is countercyclical.

While the estimates presented in this chapter can be refined to take into account country-specific characteristics (the currency and maturity composition of debt, or the impact of downward reserve changes in perceived risk and volatility), they help illustrate the fact that the cost of holding reserves may be considerably more modest than it is often suggested.

Statistical Annex

Table 6.2 Summary statistics of selected variables

Statistic	N	Mean	St. Dev.	Min	Max
Sovereign spread	3149	337.605	213.240	21.200	998.524
US 10-year yield	3149	3.669	1.339	1.500	6.660
Risk aversion	3149	519.289	175.745	257	1068
Credit rating	3149	17.308	2.357	8	21
Reserves ratio	3149	0.157	0.082	0.012	0.409
Sovereign debt ratio	3149	0.199	0.111	0.009	0.590
Private debt ratio	3149	0.111	0.106	−0.001	0.624

Sources: See Table 6.7

Table 6.3 Countries and period covered

Country	Obs.	Begins	Ends
Bulgaria	157	1998-12-01	2013-12-01
Brazil	194	1997-12-01	2017-12-01
Colombia	217	1997-12-01	2017-12-01
Dominican Republic	155	2001-11-01	2017-12-01
Egypt Arab Rep.	174	2001-07-01	2017-12-01
Indonesia	140	2004-05-01	2017-12-01
Morocco	164	1998-04-01	2017-12-01
Mexico	217	1997-12-01	2017-12-01
Nigeria	97	2006-03-01	2017-12-01
Pakistan	140	2002-02-01	2017-12-01
Peru	216	1998-01-01	2017-12-01
Philippines	217	1997-12-01	2017-12-01
Russian Federation	183	1997-12-01	2017-12-01
Thailand	100	1997-12-01	2006-03-01
Tunisia	83	2002-05-01	2011-03-01
Turkey	214	1997-12-01	2017-12-01
Ukraine	153	2002-01-01	2017-12-01
Venezuela RB	111	1997-12-01	2014-07-01
South Africa	217	1997-12-01	2017-12-01

Sources: See Table 6.7

Table 6.4 Elasticities of emerging market spreads to reserves and debt ratios full sample

	Dependent variable			
	log(spread)			log(rating)
	(1)	(2)	(3)	(4)
Risk aversion	0.663***(0.033)	0.663*** (0.035)	0.689*** (0.034)	−0.012*** (0.003)
Credit rating	−2.153*** (0.081)	−2.063*** (0.081)		
International rate	−0.095*** (0.024)	−0.160*** (0.025)	−0.062** (0.026)	−0.015*** (0.003)
Reserve ratio	−1.694*** (0.080)	−1.599*** (0.084)	−2.443*** (0.079)	0.348*** (0.015)
Sovereign debt ratio	0.732*** (0.027)	0.709*** (0.029)	1.023*** (0.028)	−0.135*** (0.006)
Private Debt Ratio	0.663*** (0.034)		0.609*** (0.032)	0.026*** (0.007)
Observations	3149	3149	3149	3149
R^2	0.790	0.762	0.735	0.754
Adjusted R^2	0.788	0.761	0.733	0.752
Residual Std. Error	0.130 (df = 3124)	0.138 (df = 3125)	0.146 (df = 3125)	0.031 (df = 3125)

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$
Robust t statistics in parentheses. Default observations are excluded and also spreads of more than 1000 basis points. All regressions include country fixed effects. Errors robust to heteroskedasticity clustered by time. All variables are expressed in logs, except Reserve Ratio, Sovereign Debt Ratio, and Private Debt Ratio, which are ratios of GDP

Table 6.5 Elasticities of emerging market spreads to reserves and debt ratios: before great recession of 2008–2009

	Dependent variable		
	log(spread)		log(rating)
	(1)	(2)	(3)
Risk aversion	0.633*** (0.036)	0.664*** (0.036)	−0.017*** (0.004)
Credit rating	−1.901*** (0.121)		
International rate	0.507*** (0.075)	0.522*** (0.077)	−0.008 (0.007)
Reserve Ratio	−1.919*** (0.173)	−1.990*** (0.170)	0.038** (0.019)
Sovereign debt ratio	1.079*** (0.060)	1.554*** (0.054)	−0.249*** (0.016)
Private debt ratio	0.835*** (0.071)	0.607*** (0.065)	0.120*** (0.009)
Observations	1701	1701	1701
R^2	0.855	0.836	0.820
Adjusted R^2	0.852	0.833	0.818
Residual Std. error	0.123 (df = 1676)	0.131 (df = 1677)	0.023 (df = 1677)

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$
Robust t statistics in parentheses. Default observations are excluded and also spreads of more than 1000 basis points. All regressions include country fixed effects. Errors robust to heteroskedasticity clustered by time. All variables are expressed in logs, except Reserve Ratio, Sovereign Debt Ratio, and Private Debt Ratio, which are ratios of GDP

Table 6.6 Elasticities of emerging market spreads to reserves and debt ratios: after great recession of 2008–2009

	Dependent variable		
	log(spread)		log(rating)
	(1)	(2)	(3)
Risk aversion	0.420*** (0.045)	0.431*** (0.041)	−0.009** (0.004)
Credit rating	−1.264*** (0.173)		
international rate	−0.123* (0.066)	−0.100 (0.061)	−0.019*** (0.005)
Reserve ratio	−0.881*** (0.142)	−1.322*** (0.160)	0.349*** (0.034)
Sovereign debt ratio	0.987*** (0.098)	1.370*** (0.072)	−0.303*** (0.017)
Private debt ratio	0.041(0.134)	−0.009 (0.135)	0.040*(0.023)
Observations	1448	1448	1448
R^2	0.803	0.787	0.892
Adjusted R^2	0.800	0.784	0.890
Residual std. error	0.101 (df = 1424)	0.105 (df = 1425)	0.023 (df = 1425)

Note: $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$

Robust t statistics in parentheses. Default observations are excluded and also spreads of more than 1000 basis points. All regressions include country fixed effects. Errors robust to heteroskedasticity clustered by time. All variables are expressed in logs, except Reserve Ratio, Sovereign Debt Ratio, and Private Debt Ratio, which are ratios of GDP

Table 6.7 Variable definitions and sources

Name	Description	Source
Sovereign spread	JP Morgan EMBI global index blended spread, in bps	The World Bank
Risk aversion	Merrill Lynch High Yield Master II, in bps	Federal Reserve Bank of St. Louis
International rate	US Treasury notes, 10-year constant maturity yield, bps	Federal Reserve Bank of St. Louis
Credit rating	S&P rating, long term debt, end of period, foreign currency. We construct an index starting in 1 at "Not Rated (NR)" up to the top in 29 at "AAA"	Standard & Poor's
Reserves	Total international reserves	IMF's *International Financial Statistics (IFS)*
Sovereign Debt	Public and publicly guaranteed debt from private creditors	The World Bank's *International Debt Statistics (IDS)*
Private debt	External debt stocks, private nonguaranteed	The World Bank's *International Debt Statistics (IDS)*
GDP	GDP, current US dollars	The World Bank

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Part II
Domestic and Foreign Currency Assets

Chapter 7
Saudi Arabian Monetary Authority: Why Do Central Banks Hold Domestic and Foreign Currency Assets?

Talal Al-Humoud

Abstract This chapter explains how domestic and foreign exchange reserves are accumulated and why they are held by central banks. Following a summary of trends in global foreign exchange reserves, this chapter provides a brief review of the benefits and costs associated with holding reserves. It then describes recent IMF work in refining traditional reserve adequacy frameworks. For practical illustration, the author draws on Saudi Arabia's experience in accumulating foreign exchange reserves, considering the country's fixed exchange rate regime and broader macroeconomic backdrop. The author sheds light on the pivotal role played by the central bank's holding of foreign exchange reserves in maintaining monetary and financial stability for Saudi Arabia. He concludes that the costs associated with holding a sizeable pool of liquid assets are outweighed by a number of key benefits, including having the capacity to service an evolving set of liabilities and providing access to a countercyclical spending buffer, not least, during the country's ongoing economic transition.

7.1 Introduction

In a fractional reserve system, preserving confidence becomes the ultimate raison d'être for holding reserve assets, regardless of the economic state of the world. This is a tautology of principle rather than quantum. Depending on the role and risks faced by a financial agent, the implications of sustaining an asset-liability mismatch

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can be structurally different. Intuitively, for example, if the implications of a systemically important financial institution (SIFI) going 'belly up' will be damaging to an economy, then those of a central bank failing to act as lender of last resort (LOLR) must be of eschatological magnitude. Somewhat similar, if less dramatic, comparisons can be made amongst different types of financial institutions, or even countries with different foreign exchange rate regimes. After all, the concept of financial stability is multi-layered, and is today the subject of a vast corpus of policies and regulations, as well as an ever-evolving risk management ethos. Hence, for the national authorities of relevance it has become standard practice to have capital adequacy, liquidity and resiliency of the banking system as primary purposes of macro- and micro-prudential regulation. However, for the LOLR itself, the standard is less clear, let alone ordained by a higher authority. Indeed, owing to the heterogeneity of the liabilities and risks faced by countries, the question of foreign exchange reserve adequacy cannot be fully addressed using a rules-based approach.

The accumulation of reserves by central banks has, and by a wide stretch of time, outlived the Bretton Woods System (BWS), whereby currencies were convertible to the US dollar (USD) at fixed rates. Just between 2000 and 2017, global foreign exchange reserves rose sharply from around $1.9 trillion to $11.4 trillion, growing at a compound annual growth rate of 11.0%. As a percentage of global GDP, reserves rose from 5.7% to 14.3%, more than doubling over the same period (Fig. 7.1). In various contexts, the desires to safeguard against external vulnerabilities, to support the conduct of monetary policy, and to help honour external obligations have been secular forces behind central banks' accumulation of reserves. In many cases, however, the accumulation of foreign exchange reserves happens not at the whim of the central bank, but by virtue of an involuntary build-up of foreign exchange that results from the country's execution of export-oriented growth strategies. This has

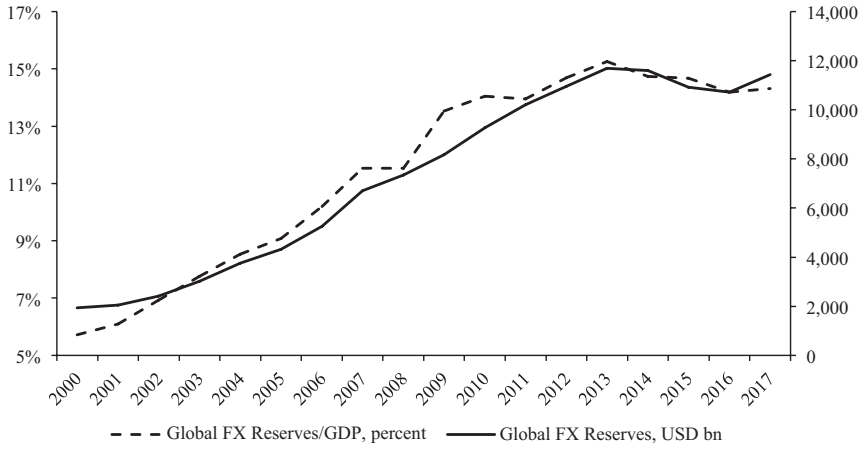
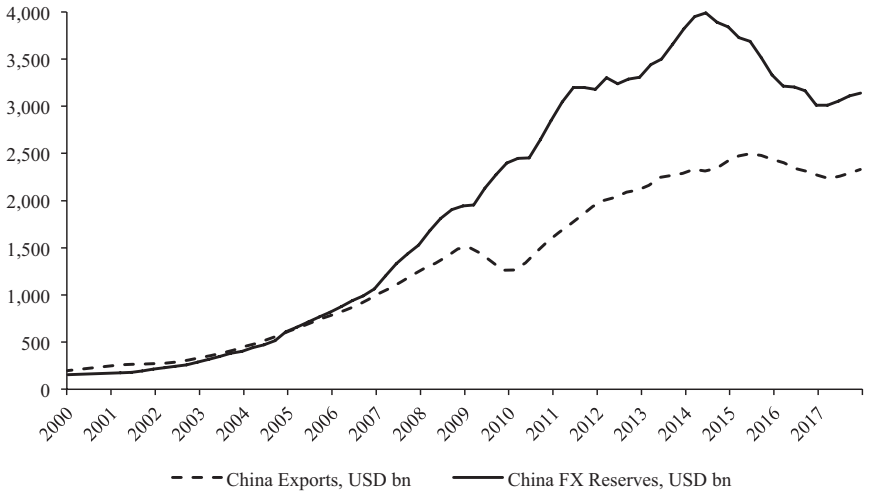


Fig. 7.1 Growth in global foreign exchange reserves. Sources: IMF, Reserve Bank of Australia, Saudi Arabian Monetary Authority

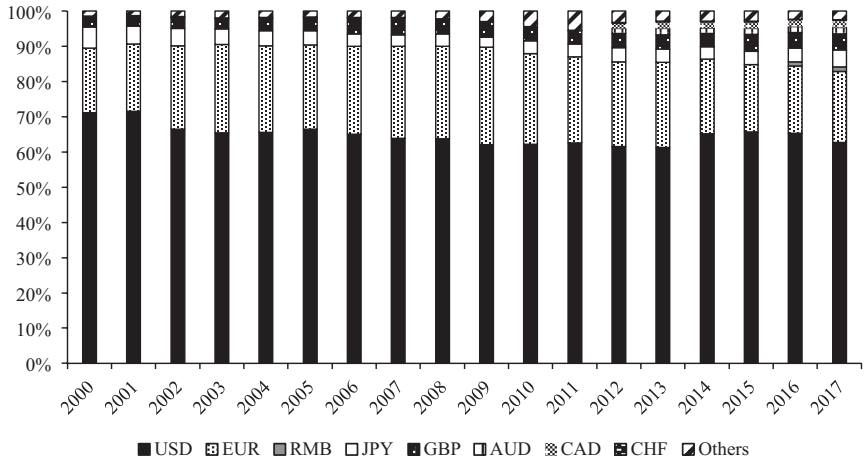
been a discernable feature of emerging economies, especially those in Asia. In China alone, foreign exchange reserves increased from around $155 billion at the turn of the millennium to $3.14 trillion at the end of 2017, growing by 19.4% annually. In parallel, the value of China's exports to the rest of the world surged from around $195 billion to $2.3 trillion, growing by 15.5% per annum over the 17-year period. Despite increased divergence between China's foreign exchange reserves and exports post the Global Financial Crisis (GFC), the correlation between them has been close to 1 (Fig. 7.2). Of course, China's economic structural rebalancing saga may change this dynamic going forward.

That said, global foreign exchange reserves have endured intermittent declines, most notably since 2014. On aggregate, such declines can be explained by developments in the global economic cycle, trade activity and capital flows. At a level disaggregated, declines in foreign exchange reserves can be explained by a country's net trade receipts, coverage of capital outflows, government spending or a combination thereof. Foreign exchange reserves can decline for compositional and investment reasons as well. It is customary for central banks to hold diversified portfolios of currencies, notwithstanding the USD's continued dominance as a global reserve currency (62.7% as of 2017, Fig. 7.3). Based on performance measurement calculus, periods of broad USD strength will reduce the portfolio return of USD-based investors, all else being equal. Similarly, asset prices can impinge on portfolio return, and reserve managers have become most cognizant of this risk after the introduction of quantitative easing (QE) policies by major central banks in the aftermath of the GFC. With negative bond yields having affected as much as $10 trillion of the sovereign debt space in June 2017 (Central Banking 2017), the spectre of policy normalization—particularly how it threatens capital preservation—was unsettling to



Sources: Bloomberg.

Fig. 7.2 China's exports and foreign exchange reserves. Sources: Bloomberg



Sources: IMF COFER Data.

Fig. 7.3 Currency composition of allocated global foreign exchange reserves: 2000–2017. Sources: IMF COFER Data

many reserve managers at the time. As that theme still holds to some degree, some reserve managers have (perhaps much intendedly) elevated up the risk spectrum. A recent study of reserve management trends affirms that some central banks have expanded their investment universes in pursuit of risk diversification (Invesco 2018). Whether this will improve portfolio risk and return characteristics over the long term is something to be seen. More important will be if the proverbial liquidity presents itself when called by capital owners.

7.2 Motivations, Sources and Uses

Looking at fixed exchange rate regimes is instructive for understanding why countries hold reserve assets. Bouchet et al. (2003) show that reserve depletion has been an invariable feature of financial crises. In their synopsis of crisis models, the authors note that the first-generation models of financial crises focused on fiscal imbalances as the cause for reserve depletion, whereas the second-generation models focused on the use of real interest rates to defend exchange rate parity as reserves fell in fending off currency speculation. Furthermore, the third-generation model alluded to in their typology of crises incorporated the role of financial intermediation in triggering capital outflows. Whether it was the Latin American debt crisis of the 1980s, the Mexican crisis of 1995, the Asian crisis of 1998, the Russian crisis of 1998 or the Argentinian crisis of 2001, the authors remind us that financial crises culminate in balance of payment disequilibria. Such imbalances naturally weigh on

foreign exchange reserves as an adjustment mechanism, more starkly in fixed exchange rate regimes.

Cyrille (2015) reviews several studies of the general determinants of demand for reserves, beginning with the buffer-stock model, which suggests that the optimal level of reserves is reached when the macroeconomic costs a country would sustain without reserves balance against the opportunity cost of holding them.[1] Ex ante, such costs are difficult to calibrate with precision and are likely easier to estimate using heuristics-based approaches. The author then refers to the precautionary and mercantilist theories as providing partial explanations for foreign reserve accumulation, where the former addresses the need to self-insure against financial crises, and the latter suggests export promotion via artificial currency undervaluation as being what drives the accumulation. Other uses of foreign reserves cited by the author include currency management and the support of confidence (ostensibly that of foreign investors) in the domestic economy. Reflecting on a number of sources, the author also discusses positive evidence that holding higher foreign reserves relative to a number of macroeconomic aggregates was associated with a greater ability to mitigate the adverse economic impact of the GFC.

With nominal interest rates constrained by the zero-bound, major central banks were tipped into the realm of unconventional monetary policy given the sweeping ramifications of the GFC. By embarking on large-scale asset purchase programs (LSAPs) of various guises, more central banks followed the footsteps of the Bank of Japan (BoJ) in widening the sphere of control over yield curves, often using reserves as ammunition or amassing reserves as a boon in the process. The end-purposes were diverse, ranging from bolstering asset prices, lowering costs of borrowing,[2] enhancing the transmission of credit and fighting consumer retrenchment as a formidable deflationary force. Since the GFC, currency management has indeed been a dimension of reserves usage, conventionally and otherwise.

Traditionally, intervention in the foreign exchange market is either sterilized or non-sterilized, depending on whether the central bank utilizes its balance sheet in neutralizing interest rate or liquidity conditions. Non-sterilized sales (purchases) of domestic currency against foreign currency will increase (decrease) domestic money supply. When sterilized, sales and purchases of domestic currency against foreign currency will have no effect on domestic money supply as the central bank engages in offsetting open market operations (OMO). In countries such as India and China, issuing sterilization bonds has been a common measure[3] for keeping the money supply intact following purchases of foreign exchange.

Competitive devaluation, i.e., selling domestic currency against foreign currency to boost export competitiveness, will increase foreign exchange reserves, and would be executed on a sterilized basis if inflation—and, particularly, expectations

[1] See also Chap. 6.

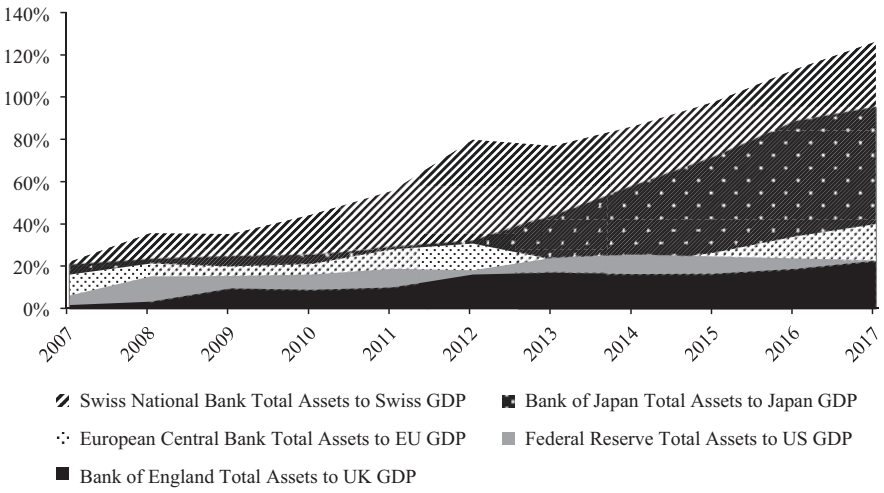
[2] By letting the central bank be the marginal—and, indeed, price-insensitive—buyer of sovereign bonds.

[3] Other sterilization measures can occur in the foreign exchange swap markets Domanski et al. (2016).

thereof—are to be restrained over the medium term (Beckington and Amon 2011). This has been an occasional development in some emerging markets. In contrast, sales of domestic currency à la the BoJ are non-sterilized for the very aim of raising domestic inflation, which in recent years has been abstrusely inert in reaction to easing measures across many developed economies. In a similar vein, and without following a systematic sterilization process, the Swiss National Bank (SNB) has expanded its balance sheet assets from around CHF163 billion at the start of the GFC to CHF836 billion as of June 2018, marking a 411% increase over the period. This is more than 120% in GDP terms, dwarfing the G4 central banks in this respect (Fig. 7.4). How this has been achieved is through significant purchases of foreign exchange-denominated assets, coupled with a corresponding expansion of domestic currency-denominated liabilities. The main aim has been to stem the appreciation of the Swiss franc.

The broad array of sources and uses of foreign exchange reserves justifies why the trend of accumulation remains extant, even years after the collapse of the BWS. Based on its studies, the IMF (2016) argues that reserve buffers can alleviate balance of payments shocks in emerging market economies. External vulnerabilities can transpire in the current account, as characteristic of countries with limited access to market financing; in the capital account, as observed in some advanced market economies that experienced shortages of foreign currency funding during the initial stages of the GFC (Fender and Gyntelberg 2008) or in the current and capital accounts simultaneously, as typified by emerging markets with access to market financing.

The IMF (2014, 2016) has published a number of reserve adequacy frameworks to be considered in different economic and financial market settings, including mature markets, deepening financial markets and constrained market access. Notably, the IMF classifies the motives for holding reserves through the



Sources: Bloomberg, World Bank.

Fig. 7.4 Central bank assets relative to GDP. Sources: Bloomberg, World Bank

'precautionary' and 'non-precautionary' prisms common in the literature. These motives, meanwhile, are not always agnostic as to why reserves are accumulated under different economic regimes. de Beaufort and Sondergaard (2007) distinguish between countries that have grown their reserves to self-insure against financial crises, and those that have accumulated reserves by means of following export-led growth models. They argue that reserve levels in several emerging countries can be seen as excessive relative to estimates of self-insurance needs. In extension to the non-precautionary view, they conclude that domestic policy considerations might outweigh the concomitant costs of holding excess reserves. The costs can be macroeconomic (measured as opportunity costs) or financial (reflecting central bank financial accounting losses), whereas the benefits perceived can be purely political. Hence, for some countries that do not enjoy an 'exorbitant privilege' or some derivative thereof, reserve accumulation becomes imperative ahead of potential shutdowns of capital market access.

An important corollary of the self-insurance argument is that reserves should be invested in highly liquid assets, where portfolio return typically takes a lower precedence. It is also for this reason that a demarcation of adequate versus excess reserves should be made, so the latter can be invested with a higher degree of freedom to compensate for the cost of carry. Fundamentally, foreign exchange reserves better not be illusory, not only for them to be economically utile, but also for accounting and, potentially, legal considerations. According to the IMF's Balance of Payments and International Investment Position Manual (2009), '[r]eserves assets are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes…'. In other words, reserves must pass the 'control' and 'availability' tests for them to count.

The yardstick for reserve adequacy in emerging markets has often been inspired by traditional metrics, such as the Greenspan–Guidotti rule (100% coverage of short-term debt), import coverage (commonly, of 3 months) and some percentage of broad money. More recently, the IMF has developed the revised ARA EM metric,[4] a composite benchmark comprising four components: export income (risk of loss), broad money (risk of resident outflows), short-term debt (rollover risks) and other liabilities (risk of non-resident portfolio outflows). For economies with fixed and floating exchange rate arrangements, the IMF suggests that foreign exchange reserves provision for these components using the respective weightings shown in Table 7.1. (Each weight represents the tenth percentile of observed outflows from emerging markets during episodes of exchange rate pressure.) Now, looking at the case of Saudi Arabia is also illustrative of certain practicalities.

Table 7.1 Suggested IMF weightings for foreign exchange reserves

	(In percent)	Short-term debt	Other liabilities	Broad money	Exports
Revised weights	Fixed	30	20	10	10
	Float	30	15	5	5

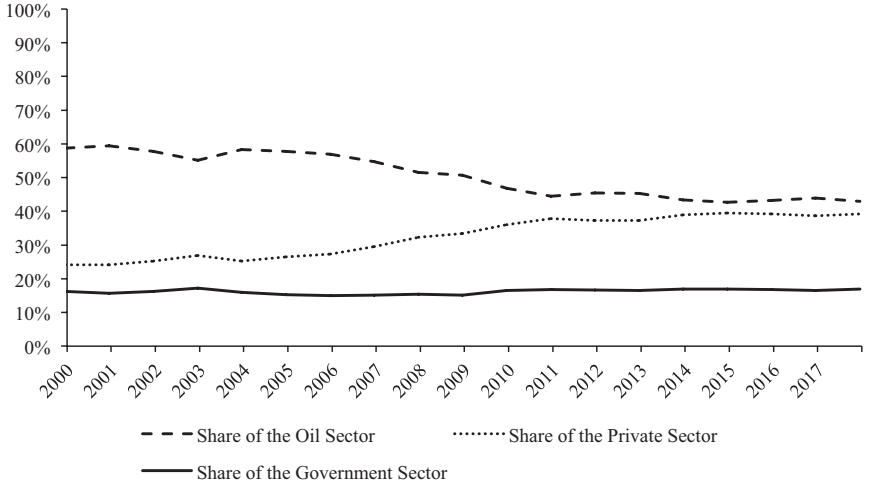
Source: IMF (2014)

[4] Assessing Reserves Adequacy for Emerging Markets (IMF 2013).

7.3 Saudi Arabia: A Case Study

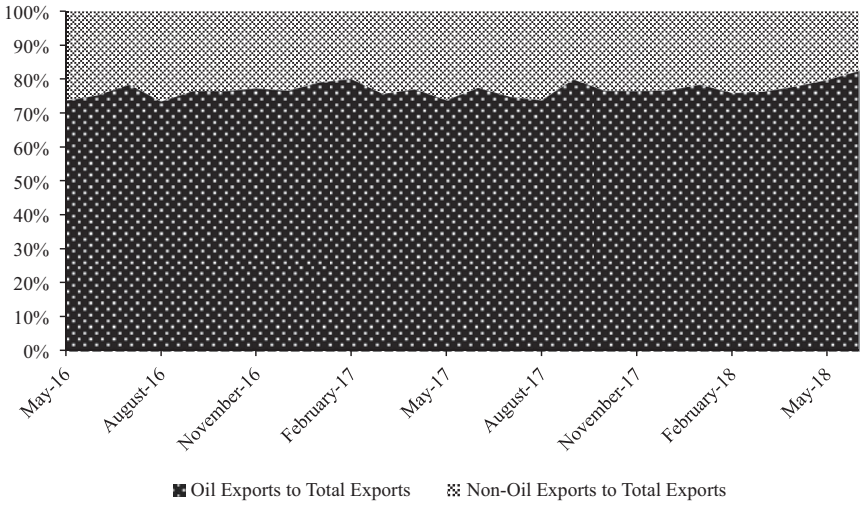
Saudi Arabia maintains a fixed exchange rate regime, having the Saudi Arabian riyal (SAR) pegged to the USD. The peg traces its genesis to the 1970s and has continued since then for multiple reasons. The Saudi economy remains resource-based, with oil and oil-related products making up the bulk of its exports (Figs. 7.5 and 7.6). At the same time, the USD is the numeraire for oil and the Saudi economy shows a high propensity to import goods and services. Although the scope for import substitution is growing, it remains largely limited. Thus, it follows that altering the exchange rate will be of no added benefit to Saudi Arabia's terms of trade. Government spending remains a dominant feature of the economy (Fig. 7.7), to a large extent, eclipsing the role of interest rates in influencing domestic credit activity. The peg has served well for currency matching purposes, as the country's foreign exchange receipts and payments are primarily in USD; the former being principally to the government and the latter made principally by the private sector. Functioning as an anchor of stability, the peg can also help attract the foreign investment needed in diversifying the Saudi economy. By way of charter, the Saudi Arabian Monetary Authority (SAMA), the Kingdom's central bank, is designated as the guardian of the exchange rate.

By virtue of the currency peg, SAMA's liberties are limited in managing domestic interest rates as compared to managing domestic liquidity conditions. In a classic case of the 'Impossible Trinity', SAMA must often replicate USD interest rates to preserve exchange rate parity in the absence of capital controls. Sustaining a misalignment with USD interest rates will bring about a number of first order implications, including



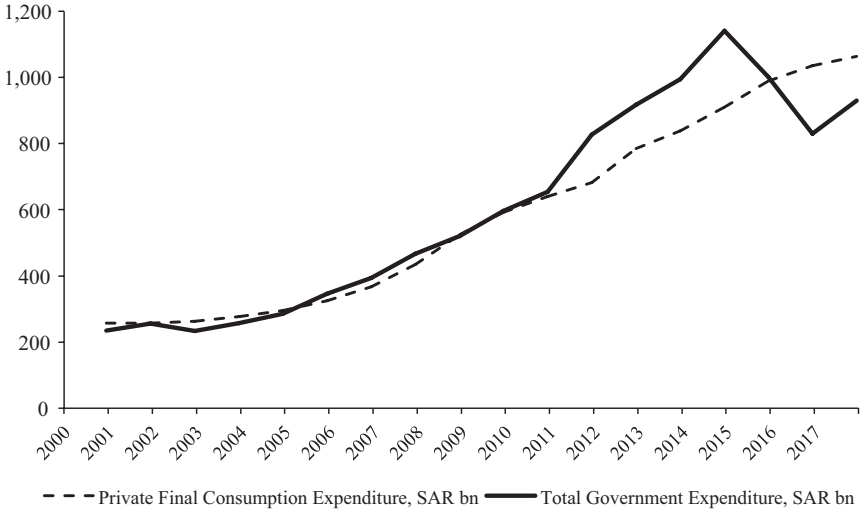
Sources: Bloomberg, General Authority of Statistics.

Fig. 7.5 Contribution of the oil, private and government sectors to GDP in Saudi Arabia. Sources: Bloomberg, General Authority of Statistics



Sources: Bloomberg, General Authority of Statistics.

Fig. 7.6 Shares of oil and non-oil exports in Saudi Arabia. Sources: Bloomberg, General Authority of Statistics



Sources: Saudi Arabian Monetary Authority.

Fig. 7.7 Saudi government and private sector spending. Sources: Saudi Arabian Monetary Authority

heightened speculative activity, elevated capital (inflows or) outflows and, potentially, asset substitution. All of these would increase exchange rate volatility and impose a strain on foreign exchanges reserves. Separately, the timing and choice of market intervention is a delicate one, as dollars must be judiciously spent to avoid vicious cycles of currency speculation. Historically, SAMA has sterilized neither its interventions nor its build-up of foreign exchange.

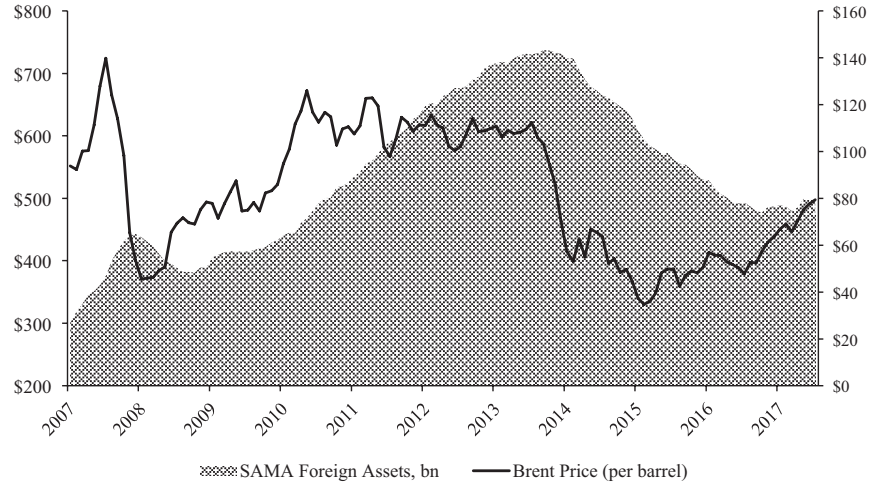
Credit intermediation is predominantly bank-driven in Saudi Arabia. Combining this feature with the peg-related constraints predicates that the liquidity transmission mechanism is more effective via credit channels. To date, SAMA's modus operandi in managing system liquidity has been through several OMO tools, e.g., conducting repo and reverse repo transactions, and issuing SAMA Bills and Murabahas.[5] In extremis, macro-prudential and stopgap measures can be provided, such as the easing of the loan-to-deposit ratio (LDR) and the outright placement of deposits with domestic banks, respectively. SAMA's reserves can therefore be instrumental in managing the exchange rate as well as domestic liquidity. When liquidity shortages are beyond cyclical, more permanent measures, such as lowering bank reserve requirements, can be used. As of June 2018, SAMA's Cash Reserve Ratio (CRR) was 7% for demand deposits and 4% for time and savings deposits.

Saudi Arabia's stock of foreign exchange reserves has fluctuated over time, reflecting involuntary accumulation and decumulation in response to changing oil prices (Fig. 7.8). Reserves are generated when SAMA receives dollars, which, for the most part, represent oil revenue accruals to the government. Being the central bank, SAMA exchanges the dollars to SAR, crediting the government's account with SAR and adding the dollars to its foreign exchange reserve coffers. Though primarily made in SAR, government expenditure consumes reserves in two ways: directly when it is made in dollars, and indirectly as the private sector pays for imports and funds dollar remittances by foreign labour. The latter effect is larger and is indicative of the private sector's dependence on government spending. In general, government spending has been highly correlated with foreign exchange outflows, and as such, the fiscal multiplier in Saudi Arabia has been modest.

7.3.1 The Spending-Liquidity Nexus

Domestic liquidity does not expand merely by exchanging the government's dollar earnings to SAR and crediting the proceeds to its account with SAMA. Only until the proceeds are injected into the private sector through government spending does domestic liquidity expand. To date, oil receipts have formed the preponderance of

[5] In conjunction with conventional Bills, SAMA issues short-term securities in the form of Murabahas as a Sharia-compliant option for Sharia-compliant banks. The basic mechanism of a Murabaha transaction involves a sale-and-buyback of an asset at a pre-agreed profit margin, as opposed to interest rate.



Sources: Bloomberg, Saudi Arabian Monetary Authority.

Fig. 7.8 Foreign exchange reserves and the price of oil. Sources: Bloomberg, Saudi Arabian Monetary Authority

Table 7.2 Causative factors for changes in M3 (SAR bn)

	2014	2015	2016
Change in M3	184.2	43.9	14.1
Causative factors			
Net domestic government expenditure in riyals[a]	935.3	758.6	523.8
Change in banks' claims on the private sector	132.6	115.7	33.5
Change in banks' claims on non-financial institutions to the public sector	1.7	−7.0	10.2
Deficit in the private sector's balance of payments[b]	−838.0	−919.2	−643.4
Other items (net)	−47.3	95.8	89.9
Total	184.2	43.9	14.1

[a]Domestic government expenditure less local revenues in riyal
[b]Estimated
Source: SAMA Annual Report (2017)

government revenue, and government spending has been the primary source of liquidity to the Saudi economy; ergo, government spending exceeds its domestic receipts. Government spending in SAR effectively creates the non-oil economy, generating rounds of activity in the private sector through the multiplier process. However, the fiscal multiplier is low due to the high propensity to import, which is suggestive of a negative external position of the private sector, i.e., its payments for external transactions exceed its receipts. Domestic banks exchange SAR for USD with SAMA as the private sector transacts with the rest of the world, at which point liquidity leaves the system.

Table 7.2 shows an attribution of changes in M3 in terms of these factors. From 2014 to 2016, M3 growth slowed markedly, rising by 2.5% in 2015 and only by 0.9% in 2016. As expected, the dominant source of liquidity was government spending, that is, by spending from the government's outstanding SAR balance with SAMA.

Domestic interbank rates (SAIBOR) tend to rise in response to system liquidity imbalances. Under such circumstances, SAMA can exercise its discretion to ease liquidity conditions via instruments such as repos and foreign exchange swaps, or even through easing the restrictions on the loan-to-deposit ratio as done in recent years.

7.3.2 Reserve Adequacy

One structural difference between developed and emerging economies lies in the relative importance of consumption and exports, which might affect relative foreign exchange reserve levels differently in each case. In emerging markets, the export sector is the prime growth engine and the main supplier of foreign exchange to the economy. By contrast, developed economies are more driven by consumption, which is naturally not a source of foreign exchange. As a normative point, therefore, emerging markets should exhibit higher foreign exchange reserves relative to GDP than developed economies, all else being equal. Saudi Arabia is one such example, where dollar receipts from oil-related exports finance most of the government's spending, which spurs private sector activity in turn.[6]

Like many other commodity-intensive economies, Saudi Arabia's exports and imports are relatively price inelastic, implying that terms of trade are positively correlated with the trade balance. Hence, foreign exchange reserves exhibit a procyclicality that necessitates holding a larger reserve buffer than otherwise needed to counter possible economic or financial downturns. Indeed, owing to the null duration dependence of oil prices (McDermott et al. 1999),[7] blindly relying on a prognosis of the actual buffer need may well end in dismay. The failure of the futures market to predict major oil price shifts over time provides cogent evidence to that effect. It therefore bears more fruit to over-insure by way of accumulating reserves in times of oil price strength to satisfy liquidity needs in times of oil price weakness, as has certainly been the case for Saudi Arabia.

[6] See also Chap. 15.

[7] For a large cross section of commodity prices, the authors calculate the Brain-Shapiro statistic for duration dependence, with the null hypothesis being that the probability of ending a boom or slump is independent of a commodity's persistence in that phase. For oil prices, the Brain-Shapiro statistic shows that the null hypothesis (independence) cannot be rejected at a 5% significance level. In other words, booms and slumps in oil prices are neither 'self-perpetuating' nor implying a greater likelihood of ending. Oil prices follow a random walk and, hence, are unpredictable.

The Asian financial crisis of 1997–1998 was a particularly testing time for Saudi Arabia. The price of oil (WTI) fell by more than 40% peak-to-trough, leading to a current account deficit of almost 9% relative to GDP in 1998. It had been well established that fiscal policy is the mainstay of economic activity in Saudi Arabia, and so government spending continued, albeit at a contracted pace. The result was the burgeoning of government debt to more than 100% of GDP and a fiscal deficit of close to 9%. Furthermore, SAMA's foreign exchange reserves fell to historical lows of sub-$40 billion (Banafe and MacLeod 2017), or 27% of GDP. That said, reserves were sufficient to cover more than 50% of M3,[8] more than 90% of exports and 80%[9] of short-term debt at the time, respectively, exceeding the IMF's suggested weightings for countries with fixed exchange rate regimes. Importantly, over-insuring as such helped extend the lifeline of the economy until the oil market recovered in 2003. Had the oil market recovery not occurred by then, Saudi Arabia would have fallen into crisis.

Today, SAMA's reserve adequacy is determined on the basis of several time varying factors, including mandatory import cover (a number of months), currency backing (100%), M3 (a certain percentage), foreigners' remittances and short-term debt cover. In provisioning against the unforeseen, as witnessed during the Asian crisis, amounts in excess of the adequacy threshold are invested in longer maturity instruments, with the aim of enhancing portfolio return whilst remaining within SAMA's tolerance for credit and liquidity risks. That said, the exigencies that may arise from being exposed to the vagaries of the oil market can render the reserve adequacy threhold a mere nominal concept.

The fact that SAMA's foreign exchange reserves represent export proceeds obviates the need to consider funding costs, but having excess reserves will certainly bring the opportunity cost aspect to the limelight. The IMF (2013) suggests that countries with market access such as Saudi Arabia should consider the differential between the yield to maturity of their sovereign external debt and the return on their foreign exchange reserves. This differential represents the marginal cost of holding reserves: a negative differential implies that the cost of external debt exceeds the return on foreign exchange reserves, i.e., borrowing is expensive and it is more worthwhile paying down the marginal dollar of debt using the marginal dollar of reserves. As excess reserves are invested in a longer-term investment portfolio, the return on SAMA's foreign exchange reserves is generally higher than Saudi Arabia's sovereign external borrowing cost.

A country should also account for, and determine its risk aversion to, the possibility of capital market shutdown, when reserves might be needed to intervene in the foreign exchange market and stabilize domestic liquidity conditions. The Saudi economy remains heavily dependent on government spending, meaning that the consequences would be dire should there be no recourse to liquid reserves during

[8] The broadest measure of domestic liquidity comprising currency in circulation and aggregate bank deposits.

[9] For data quality considerations, short-term debt is assumed to have been $50 billion.

protracted oil price routs. Today, almost half of the government's budget is spent on public servants' salaries and the rest on military procurement and infrastructure projects. Therefore, viewing reserve adequacy through this lens, holding reserves with a margin of safety becomes the more prudent approach.

7.3.3 Reserves Management

SAMA shares the classic trilogy of objectives in reserve management with many of its peers: preserving capital, maintaining liquidity and achieving an investment return compatible with its risk appetite. It follows a dual tranche approach in managing its foreign exchange reserves, separating the reserves portfolio (RP) from the investment portfolio (IP). As a matter of policy, SAMA does not disclose its reserve adequacy threshold nor composition by asset type or currency.

The RP is intended to meet domestic demand for foreign exchange at the official rate. It comprises bank deposits and other money market instruments, as well as liquid developed market government bonds. The benchmark is a composite of money market and short-term government bond indices. Meanwhile, the IP is a more aggressive portfolio, covering a mix of growth, real and hedge assets. It holds only financial assets, employs no leverage and holds no property or other physical assets. The policy benchmark is weighted by asset roles and the long-term return objective is linked to a real rate of return exceeding inflation. The investment process is set within a quarterly timeframe, and the investment committee is chaired by the Governor of SAMA. In times of asset rundown, reducing portfolio risk exposure becomes the main challenge. Net withdrawals from the RP entail asset liquidation, and the RP must be replenished with assets from the IP if it falls below a minimum acceptable level. The implication is that the smaller the IP is relative to the RP, the lower the overall investment returns tend to become.

7.3.4 Exchange Rate Management[10]

SAMA provides spot dollars to the domestic banking system without applying restrictions on capital inflows or outflows. This demands a relatively high level of foreign exchange reserves. Importantly, SAMA's foreign exchange reserves must be perceived as being more than adequate to ride out speculative activity, which takes place principally in the forward market. Subject to its discretion, SAMA can intervene verbally (e.g., by means of press release), or in the spot or forward market to restore exchange rate stability. Two relevant examples come to mind.

First is the 2014–2017 period, when lower oil prices, the start of an interest rate tightening cycle in the USA and contractionary credit conditions domestically

[10] See also Chap. 5.

painted much of the macro backdrop. Speculative activity intensified given perceptions that the SAR was overvalued on a real effective exchange rate (REER) basis, and SAMA had little choice but to raise interest rates in response to rates decisions made by the Federal Open Market Committee (FOMC). By so doing, SAMA reacted counter-cyclically relative to domestic conditions. A mix of foreign exchange swap intervention, verbal intervention, macro-prudential measures and liquidity injection helped restore stability in the spot SAR market. However, normalization in the forward SAR market was more manifest once the outlook for the Saudi economy and liquidity conditions improved. This was attributed to the government's announcement of payment disbursements to contractors, a successful debut foreign debt issuance by the government and, importantly, stability in oil prices. A key takeaway is that exogenous macro factors can overwhelm exchange rate stability, though this is not to be interpreted in a self-serving sense. The dominant strategy for a central bank is to commit all its wherewithal to restoring stability, especially when the means are available.

The second example is during late 2007 and early 2008, a period characterized by falling US interest rates and high Saudi inflation, the latter partly a symptom of the commodity super-cycle. Whilst following the US Federal Reserve Bank's (FRB) interest rate moves, SAMA matched almost all of its own rate cuts with tighter macro-prudential measures to rein in inflation. Speculation that the SAR will be revalued intensified before SAMA intervened verbally and via spot dollar purchases, causing volatility in the spot and forward markets to eventually subside. In hindsight, the eventual normalization in the forward SAR market was aided by a stronger USD, which itself faced a huge safe haven bid in 2008. One might therefore ask if the spot USD purchases in late 2007 were necessary, but doing so would be debating the counterfactual.

A further aspect of the use of foreign exchange reserves in Saudi Arabia lies in fiscal policy, which can be deployed counter-cyclically to stabilize growth, or more broadly, to stimulate investment in value-added sectors with the aims of creating local employment, encouraging import substitution and diversifying the export base. By and large, inflows of foreign exchange depend on oil prices, whereas outflows of foreign exchange depend on domestic government spending, which spurs import demand and foreigners' remittances as highlighted previously. As the government pursues a medium-term fiscal policy, a fiscal surplus (deficit) and a net inflow to (outflow from) foreign exchange reserves will be realized when the price of oil is higher (lower) than the fiscal breakeven price.

7.3.5 SAMA's Balance Sheet

SAMA's domestic currency liabilities arise from its role as (1) issuer of the SAR, (2) regulator of banks as well as insurance and finance companies, and (3) banker to the sovereign government. As customary for central banks, SAMA holds bank notes, statutory and other deposits and short-term liquidity obligations towards the domes-

tic banking system (e.g., reverse repo and SAMA Bills). Meeting these liabilities has been enabled by, of course, SAMA's asset base. In June 2018, SAMA's total balance sheet assets amounted to SAR1.94 trillion ($517 billion), of which foreign exchange reserves were around SAR1.87 trillion[11] ($498 billion), or 74% of GDP. For added perspective, the FRB's balance sheet amounted to around 5% of GDP for many years, until QE was undertaken in 2008. By 2014, the FRB's balance sheet had expanded to over 25% of GDP.[12]

In terms of balance sheet capital, SAMA currently has none. When established in 1952, it had SAR10 million in paid-in capital, which was later revoked to give SAMA greater operational autonomy. Having financial autonomy fosters the independence accorded to SAMA by its charter. Of course, independence is the cornerstone of central bank credibility and is a necessary condition for monetary policy to be effective. Long-term, a credible monetary policy should lead to price and financial stability.

Unlike commercial banks, central banks can operate without (or even with negative) capital, given their monopoly to print money at will, though, conceptually, this is more conceivable under a floating exchange rate regime. However, central bank independence may be threatened if a severe shortfall of capital triggers a need to be recapitalized by the government (Stella 1997). In the case of SAMA, the absence of capital has not hindered its ability to perform its operational mandates, and, given currency backing considerations, printing money 'at will' is surely incompatible with maintaining a fixed exhange rate regime. SAMA is authorized to cover its operational expenses from investment income and fees derived from rendering dollar sales-to-banks and payment-related services.

SAMA has not taken part in the sort of massive balance sheet expansion witnessed in some developed economy central banks over the last decade. The size of its balance sheet is reflective of a passive rather than active build-up of foreign exchange reserves. Whilst reserves management is one of SAMA's central mandates, one practice that is strictly forbidden by its charter is lending to the government[13] directly or indirectly (i.e., through conduits), in foreign exchange or otherwise. Central bank orthodoxy censures such practice, as lending to the government would be tantamount to debt monetization.[14] In the context of a currency peg, monetizing government debt would be catastrophic for the stability of the SAR. Hence, preserving central bank credibility is of paramount importance to ensuring policy effectiveness.

[11] Excludes balances of gold and Special Drawing Rights (SDR).

[12] See also Chap. 4.

[13] Article 6(c) of SAMA's charter (Bureau of Experts at the Council of Ministers 1957).

[14] This is not to be confused with purchases of government debt by central banks under QE programs. Such purchases typically take place in the secondary markets.

7.4 Conclusions

Saudi Arabia has been no different from many emerging markets in terms of experiencing a commodity-driven rise in foreign exchange reserves. Before qualifying this further, one must concede that assessing a country's reserve adequacy requires a perceptive understanding of its economic and liability structures. In the case of Saudi Arabia, the choice of exchange rate arrangement is rooted in an economic status quo where oil revenue, government spending and a high import propensity are dominant. The liabilities borne of this reality are significant in a number of ways. SAMA has to be particularly mindful of potential current account shocks when oil markets appear to have entered a new paradigm. Furthermore, the risk of capital flight can be threatening as the trajectory of monetary policy normalizes in several advanced economies. The strategic efforts to diversify the Saudi economy will require enormous capital expenditure that SAMA should also be prepared to meet, despite the government's capability of accessing local and international debt markets. Easing foreign investor access into the Saudi equity market will unveil new sources of capital for local companies as well as new risks for the capital account. In addition to managing the cyclical booms and busts in domestic liquidity, SAMA remains vigilant in matters related to exchange rate stability. Amid structural developments in the global and local domains, therefore, liquid reserves become an indispensable part of SAMA's war chest.

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Chapter 8
Safe Assets and Reserve Management

Robert Neil McCauley

Abstract Managers of official dollar reserves are bound to pay attention to the debate over safe assets: their investment portfolios operationally define such assets. This chapter argues that reserve managers need not worry about a shortage of safe assets. The debate turns first on whether demand for dollar safe assets is likely to grow as rapidly as emerging market economies. Second, it turns on whether the supply of dollar safe assets can only grow with US fiscal deficits. Neither holds. On the demand side, emerging market economies' growth does not require dollar reserves to grow at the rate observed in the early 2000s. In retrospect, rapid dollar reserve growth reflected emerging market economies' response to dollar depreciation. When the dollar cycle turned to appreciation, foreign exchange reserves stopped growing. On the supply side, law and policy extend state backing to various IOUs and thereby make safe assets. US government support for the housing agencies Fannie Mae and Freddie Mac makes their debt into safe assets, albeit with wobbles. US government support for banks, including Federal Reserve liquidity, Federal Deposit Insurance Corporation insurance, and, in 2008, Treasury equity can make US bank liabilities safe. In the rest of the world, government support of non-US banks allows ones from well-rated countries to compete with US banks in selling safe dollar deposits. Moreover, international and interregional organizations, non-US sovereigns and agencies all compete with the US Treasury in selling safe dollar bonds. In allocating their dollar foreign exchange reserves, central bank reserve managers make room for all such competitors. In particular, they invest more than a third of their dollar reserves outside of US Treasury securities.

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8.1 Introduction

Influential voices argue that the demand for safe assets by reserve managers in emerging market economies (EMEs) is on course to overtake their supply by advanced economy governments. Such a shortfall would complicate the work of reserve managers in a big way. After all, their investments in highly rated and liquid fixed income obligations provide a working *operational definition* of the universe of safe assets.[1] In the face of such a shortage, reserve managers would have to accelerate their diversification away from the safest government securities in the key currencies. Should official foreign exchange (FX) reserve managers worry about a shortage of safe assets?

To answer this question, it helps to understand the safe assets story as an extended analogy to the dilemma originally stated by Triffin (1960) some 60 years ago. Triffin saw monetary gold stocks growing more slowly than booming global trade and US dollars filling the gap. The US dollars arose as US IOUs to the rest of the world. Triffin worried that demand for US international IOUs would outgrow the US gold *stock*, the bedrock US, and global monetary asset of the age. If the US authorities allowed US IOUS to accumulate to meet the demand, then holders would eventually stage a run on the US gold stock. This would lead US authorities to hike interest rates and thereby to plunge the world economy into sudden deflation. If the US authorities did not allow US IOUs to meet the demand, then the world economy would endure a grinding deflation. Without enlightened collective action, Triffin argued, the world faced a Hobson's choice between sudden deflation and grinding deflation.

The safe asset dilemma Farhi et al. (2011) and Obstfeld (2011) is summarized as follows[2]: "As international reserves are primarily composed of US government debt, and the share of the US in the global economy is shrinking, the US progressively loses its fiscal capacity to satisfy the rest of the world's demand for international liquidity [i.e. demand for US Treasury securities]. Thus, there is a dilemma between the objective of satisfying the global demand for international liquidity, which requires a secular increase in the ratio of US government debt to US GDP, and the objective of maintaining US government debt safe, which requires stabilizing this ratio."[3]

The analogy is far from perfect. Triffin's dilemma concerns two stocks, US external IOUs and US gold. As Mr. Micawber might have put it: gold greater than IOUs, stability; IOUs greater than gold, instability. The safe assets dilemma, by contrast, focuses on the stock demand for US Treasury debt and the danger of its outgrowing the US economy's debt servicing capacity, a *flow*. The safe asset

[1] He et al. (2016) give "the portfolios of many central banks" as prime cases of "safe asset portfolios."

[2] Jeanne (2012). See also Obstfeld (2013). Gorton (2009), Gorton and Metrick (2012), Gorton et al. (2012), Gorton and Ordoñez (2013), Krishnamurthy and Vissing-Jorgensen (2013), Carlson et al. (2016) and Gorton (2017) consider safe assets in the US economy.

[3] See also Caballero and Krishnamurthy (2009), Gourinchas and Jeanne (2012), Caballero and Farhi (2013), Caballero et al. (2017a, b).

shortage story flags the US fiscal risks of a fast-growing world's need for the US Treasury's special debt.

Following Portes (2012) and drawing heavily on Bordo and McCauley (2019), this chapter suggests that official reserve managers need not worry about a safe asset shortage, especially in the dollar. On the demand side, EMEs do not require holdings of FX reserves to grow with their nominal GDP. And on the supply side, the US government does not enjoy a monopoly in producing safe assets, even those denominated in the US dollar. In fact, the US government backstops the production of dollar safe assets by government-sponsored enterprises (GSEs or US agencies) and US banks. Other credit-worthy governments both produce dollar safe assets themselves and back their production by non-US agencies, non-US banks, and supranational organizations. US Treasury securities amount to just two-thirds of identified and estimated fixed income dollar assets of central banks.

The rest of this chapter draws out these themes. Section 8.2 questions whether EMEs have accumulated reserves in a purposive manner as interpreted by the safe assets story. Instead, evidence points to reserves' accumulating as a by-product of currency management over the dollar cycle. Section 8.3 argues that US government backing allows US agencies and US banks to supply safe assets. Bail-outs of both during the Great Financial Crisis (GFC) amply demonstrated their fiscal risks, but equally the strength of their backing by the US government. Section 8.4 argues that non-US governments also compete to supply safe US dollar assets, both directly and indirectly. Reserve managers hold something like one-sixth of their dollar assets in the liabilities of obligors outside the USA. Section 8.5 concludes.

8.2 Reserve "Demand": Precautionary or By-product?

Two stories compete to explain the rapid growth of official FX reserves in the years before the GFC. The precautionary account posits a coherent demand for reserves on the part of EMEs seeking to insure themselves against the costs of a sudden stop—actually a sudden reversal—of private capital flows. The second recognizes some such demand but holds that the bulk of reserve acquisition arises from policies to manage the exchange rate. This in turn is seen as part of a larger policy to shield the traded goods sector from swings in demand associated with an appreciated exchange rate.[4]

On this latter view, the pace of reserve accumulation would depend on the dollar cycle. Reserves grew rapidly during its depreciation phase from 2002 to 2011. Its shift to appreciation after then led to a sharp slowdown in EMEs' reserve accumulation. Perhaps the safe assets shortage story mistook *cyclically* rapid reserve accumulation in the twenty-first century's first decade for a *secular* trend.

[4] See also Chap. 3.

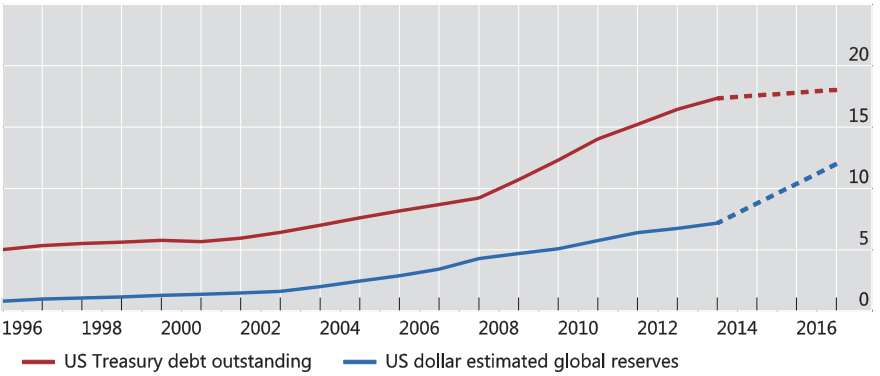

Fig. 8.1 US Treasury debt and US dollar official FX reserves, 2013 (Dashed lines represent projections). Outstanding amounts, in trillions of US dollars. Sources: IMF, Currency Composition of Official Foreign Exchange Reserves and International Financial Statistics; US Department of the Treasury; author's calculations

The simplest rendition of the safe asset shortage is to juxtapose the stock of US Treasury securities with the holdings of them in official FX reserves (Fig. 8.1). The early work on the safe assets story drew on the evidence of the early 2000s. Then dollar FX reserves were indeed closing the gap with outstanding US Treasury securities.

The GFC broke that trend, but 5 years later one could imagine the trend reasserting itself. US recession and the fiscal stimulus in response resulted in large US deficits after 2008. Thus, through 2013, US Treasury debt grew faster than US dollar FX reserves. But could this go on? Between the end of 2007 and 2013, the consolidated US government debt (at nominal value) rose from 57.8% of GDP to 96.9% of GDP. A normalization of US fiscal policy would bend the red line in Fig. 8.1 down to a growth rate below the US economy's 4% nominal growth rate. A shortage could threaten if EMEs, growing at 6% per annum, kept their FX reserve to GDP ratio stable or even raised it.

Indeed, the IMF (2012) projected a 61% rise in global FX reserves by end-2016, lending plausibility to a shortage. Such double-digit growth would have well exceeded global growth, much less US growth. This projection would have carried global official FX reserves to near $18 trillion and US dollar reserves to about $12 billion. Back on Fig. 8.1, if the red line had flattened out and the blue line had risen smartly, a safe asset shortage might well have threatened.

The seemingly inexorable rise in reserves proved, well, exorable. In retrospect 2014 may prove to have been "peak reserves." Dollar appreciation in 2014 led to intervention to support emerging market currencies, drawing down FX reserves (Fig. 8.2). In the event, global reserves only approached $12 trillion at their peak in 2014 and stand at writing in December 2019 to $11.8 trillion, not far from the level at writing of IMF (2012).

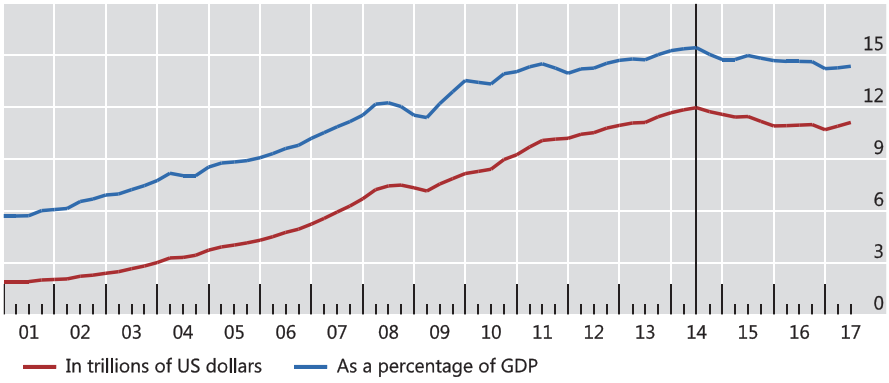

Fig. 8.2 Global foreign exchange reserves (The vertical line represents the maximum level of FX reserves in the last 18 years): "peak reserves"? Sources: IMF, Currency Composition of Official Foreign Exchange Reserves, International Financial Statistics and World Economic Outlook

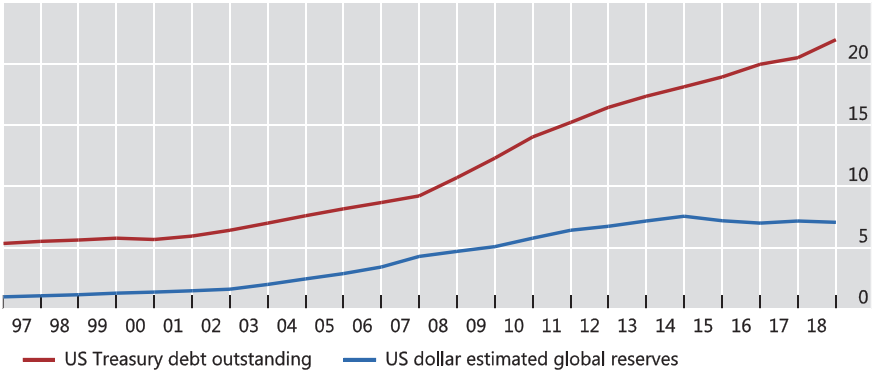

Fig. 8.3 US Treasury debt and US dollar global official FX reserves (Reserves information up to 2018Q4 and US Treasury data up to December 2018). Outstanding amount, in trillions of US dollars. Sources: IMF, Currency Composition of Official Foreign Exchange Reserves, International Financial Statistics; US Department of the Treasury; author's calculations

Meanwhile, US fiscal policy returned to large deficits even before the pandemic. There is no shortage of US Treasury debt for FX reserve managers to buy (Fig. 8.3).

The decline of global reserves in the face of dollar strength favors the currency management story over the intentional precautionary accumulation story. Indeed, when Bordo and McCauley (2019) divide the period from 1973 to 2018 into three cycles of dollar depreciation and appreciation, they find that reserves grew much faster in periods of dollar depreciation (Fig. 8.4). In particular, the world accumulates dollar reserves at a rate of ½–1% of US GDP when the dollar is appreciating, and at

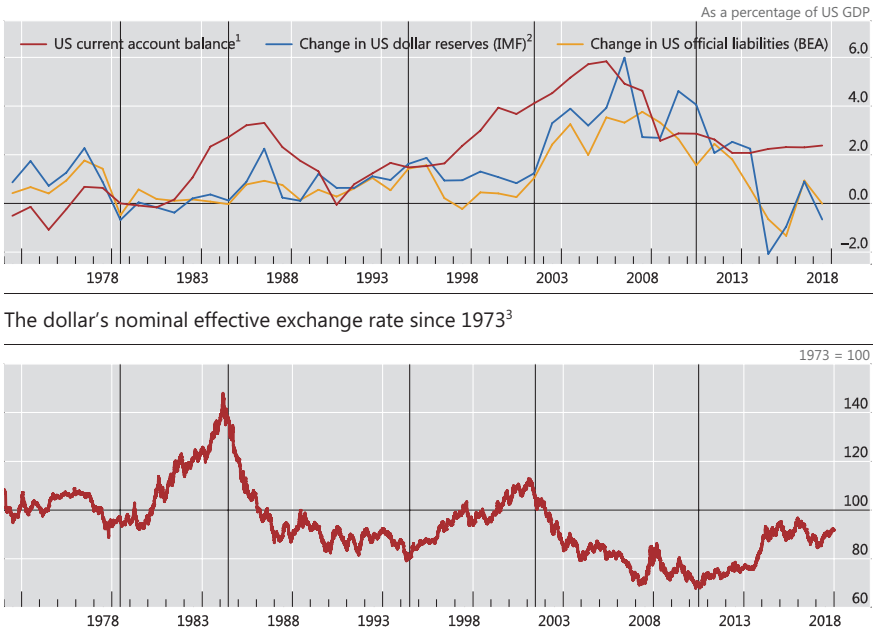

Fig. 8.4 Dollar reserve growth and the US dollar cycle. Top panel: US current account deficit, change in US dollar reserves (IMF) and change in US official liabilities (BEA), as a percentage of US GDP. Bottom panel: The dollar's nominal effective exchange rate since 1973[3]. [1] Positive values indicate deficit. [2] The sum of the allocated reserves in USD and the unallocated reserves multiplied by the share of USD in the allocated reserves. For data before 1995, the last printed revision in the IMF Annual Reports.[3] Trade-weighted US dollar index, major currencies. Sources: Federal Reserve Bank of St Louis (FRED); IMF, *Annual Reports (1979–2004)* and *Currency Composition of Official Foreign Exchange Reserves (COFER)*; US Department of Commerce, Bureau of Economic Analysis (BEA); author's calculations

2 ½–3 times that rate when it is depreciating. Those worried about a shortage of safe assets look to have taken cyclic strength of reserve accumulation for secular strength.

8.3 Supplying US Safe Assets Without Fiscal Deficits

The safe assets story gives the US Treasury a monopoly and assumes that only fiscal deficits lead to net increases in their supply. Neither of these is strictly correct.

Even on its home turf, the US Treasury faces competition in the supply of safe assets. In particular, both government-sponsored enterprises (GSEs) and banks compete for investments by managers of official FX reserves. The safety of these obligations depends on the quality of the GSEs' and banks' assets in the first instance and on their capital bases in the second instance.

Ultimately, however, the US Treasury backs these obligations. In 2008 the US Treasury took the GSEs into conservatorship, a form of receivership, and recapitalized major US banks. In this ultimate sense, the Treasury may have monopoly control over the production of safe assets. It implicitly extends its credit to GSEs and banks in normal times and did so explicitly in extremis in the GFC.

Implicit Treasury support turns bundles of private assets and private equity into safe assets. In the process, safe assets come into being without any immediate counterpart in the US federal government's cash borrowing requirement.

If the investment habitat of official reserve managers in the USA serves as a measure of safe asses, then the domestic competitors have a substantial share of the market. At mid-2017, central banks held almost $4 trillion in US Treasuries, over $400 billion in agency securities, almost $500 billions of claims on banks in the USA and another $200 billion in corporate paper, mostly bonds (Table 8.1, first column).

Portfolio shares are best conceived in relation to fixed income instruments. The substantial holdings of equities, which approached $1 trillion in mid-2017, or about a sixth of the portfolio in the USA (Table 8.1, second column), at first seems surprising. After all, central banks that hold equities as part of their reserves, such as the Swiss National Bank, are exceptions rather than the rule. Nugée (2015, p. 66) counts just 25. But many other central banks also hold equities as part of the investments for their employee pension funds.[5]

US Treasury securities predominate among central bank holdings of US fixed income. Their share was 78% in mid-2017 (Table 8.1, third column). Bank deposits, agency securities, and corporate securities comprise the balance, in that order.

Do big reserve managers prefer US Treasury securities because "few spread markets will be large enough to absorb more than a small fraction of their assets", as asserted by Nugeé (2015, p. 68)? This view can be questioned in view of the size of the nonfinancial US corporate bond market at $6 trillion, according to the Federal Reserve Financial Accounts. The sum would accommodate more than the $200 billion that officials have invested in US corporate obligations.

The small share that officials have invested in US corporate bonds may reflect more their (lack of) quality, than any lack of size. Only a tenth of the Bloomberg Barclays US corporate index consists of bonds rated AAA (only about $100 billion in mid-2017) or those rated AA (less than $400 billion). Central banks have little taste for the risks of BBB-rated bonds, which nowadays form the largest part of investment grade US corporate bonds. Many such bonds are just a notch or two downgrades away from non-investment grade, or junk-bond status, a no-go for almost all reserve managers.

[5] In addition, the US Treasury data include holdings by sovereign wealth funds; see Annex.

Table 8.1 Holdings of foreign official institutions of US dollars, June 2017

	In billions of US dollars	%		
		Share in the USA	Share in fixed income in the USA	Share in global fixed income
In the USA				
US Treasury	3993	66%	78%	65%
Coupon	3663	60%		
Bills	330	5%		
US agency	427	7%	8%	7%
Mortgage-backed securities	384	6%		
Notes	43	1%		
Bills	0	0%		
Corporate	204	3%	4%	3%
Bonds	157	3%		
Asset-backed securities	14	0%		
Commercial paper	33	1%		
Bank deposits[a]	494	8%	10%	8%
Equity	954	16%	0%	0%
Total in the USA	6072	100%	100%	84%
Outside the USA				
Non-US bonds[b]	477	48%		8%
Bank deposits[c]	514	52%		8%
Total outside the USA	1099	100%		16%
Grand total	7170			100%
Memo:				
Total $ reserves[d] (estimated from IMF)	*7097*			
"Agency" share of global fixed income				*15%*
Bank share of global fixed income				*16%*
Long-term share of global fixed income[e]				*78%*

Sources: US Department of Commerce, Bureau of Economic Analysis (2018), Table 3.1, US international investment position for liabilities to foreign official agencies; US Treasury et al. (2018); IMF, COFER data; ICE Bank of America Merrill Lynch; BIS international banking data by location; author's calculations.

[a]Includes currency and deposits, loans and trade credit and advances

[b]Sovereign, sub-sovereign, agency and supranational; estimated as one-half of the AAA- and AA-rated bonds in the ICE Bank of America Merrill Lynch Foreign Government and Supranational and ICE Bank of America Merrill Lynch Index

[c]Estimated as cross-border US dollar liabilities less such in the US plus two-thirds of unallocated by currency (from BIS LBS Table A8-F) plus local liabilities in dollars (unpublished)

[d]Estimated as total reserves times the US dollar share of allocated reserves

[e]By original maturity; bank deposits assumed to be short-term

8.3.1 US Agencies

The changing balance of official investment in US Treasury and agency securities points convincingly to the role of credit, not size. The share of US Treasury securities in the official portfolio in the USA rose in response to the losses by the privately owned US GSEs, Fannie Mae and Freddie Mac in 2008. In the US Treasury et al. (2008) survey of June 2007, officials had invested half as many dollars in agency securities as in Treasury securities. The agencies had emphasized in investor presentations abroad their key role in US mortgage finance as well as their credit line with the US Treasury. Both hinted, and events bore out, that the agencies would enjoy government support in the event that their equity were impaired. Reserve managers watched the agencies disclose losses and followed with care the Congressional legislation to provide what the Secretary of the Treasury, a former Marine, termed a "bazooka." At the BIS bimonthly meeting on 8 September 2008, the Governors of the People's Bank of China and the Bank of Japan as well as the Chief Executive of the Hong Kong Monetary Authority all welcomed the firing of this weapon, that is, US Treasury conservatorship (in effect bankruptcy) for the two agencies, according to Vidaillet et al. (2008).

Notwithstanding the seeming success of this moral hazard bet, central banks as a group disinvested in US agency paper. Still in mid-2008, officials held more than half as many dollars in US agency securities as in US Treasury securities; a year or two later, a third or a quarter as much (McCauley and Rigaudy 2011, pp. 24–25). Fortuitously, they found themselves selling into Federal Reserve and US Treasury bids for this paper (see below). In 2017, with the agencies still in conservatorship, foreign officials owned only about a tenth as many US agency as Treasury securities.

Why did central banks buy on the rumor (of government support) and sell on the news (of support and its ongoing existence)? Bernanke (2015, p. 231) recalls:

> The implicit guarantee did keep most investors from abandoning the companies' MBS [mortgage-backed securities] and debt, but even there [in the bond market] confidence was waning, notably overseas. Foreign central banks and sovereign wealth funds (such as those that invest the earnings of oil-producing countries) had loaded up on Fannie and Freddie MBS because they were considered close substitutes for U.S. government debt and were highly liquid—easily bought and sold…As doubts grew about the GSEs, both Hank Paulson and I received calls from central bank governors, sovereign wealth fund managers and government officials in East Asia and the Middle East. Were the companies safe? Would the U.S. government stand behind them? Several of my callers had not realized that the government did not already guarantee the GSEs. News coverage had alerted them to the risk.

In countries as diverse as Brazil and Russia, news that the central bank held US agency paper led to difficult public discussion (see Box 8.1). It was easier to sell than to explain why the spread over US Treasury yields came with little or no credit risk.

In addition, the conservatorship did not put the "full faith and credit" of the federal government behind the agencies. Instead, the government entered a keep-well agreement to cover losses in order to keep their debt off the US Treasury's balance sheet and to keep it from counting towards the debt limit. With the ultimate

Box 8.1: Bank of the Russian Federation and US Housing Agency Debt
One central bank shifted in the course of 2008 from a large holder of the debt of the US housing agencies to a very small holder. The story epitomizes the buy on the rumor, sell on the fact behavior of official investors with regard to US Treasury support for these agencies. The story also reportedly involves mooted great-power hardball.

The initial holding at the end of 2007 was in many respects typical, but in one respect unusual, if not unique. The Central Bank of the Russian Federation (2008, p. 130) reported holdings of Federal Home Loan Bank, Fannie Mae, and Freddie Mac securities of $101 billion. These holdings had recently risen smartly, up from just $38 billion in 2006. The $101 billion represented 22% of overall reserves, which was on the high side. Even more unusual was that with 83% of the paper had a maturity of less than one year. Most official holdings of US agency debt carried medium- to long-term maturities.

"In early May, Fannie announced a first-quarter loss of $2.2 billion—its third straight quarterly loss—cut its common stock dividend, and announced plans to raise $6 billion through an equity offering" recalled Paulson (2010, p. 134). In May 2008, First Deputy Chairman of the Bank of Russia Alexey Ulyukaev reported losses on holdings of US agency securities. After the *New York Times* headlined, "U.S. weighs takeover of two mortgage giants" (Labaton and Weisman (2008), on 11 July—a correct report judging from Paulson (2010, p. 145)—the Russian Finance Ministry described the debt as "de-facto not inferior to U.S. sovereign debt obligations in their credit quality…," according to *Reuters* (Bryanski (2008). Most investment professionals would find little to disagree with in this statement.

In Beijing for the Olympics in early August, Treasury Secretary Paulson (2010, pp. 160–161) "learned…[that] Russian officials had made a top-level approach to the Chinese suggesting that together they might sell big chunks of the GSE holding to force the U.S. to use its emergency authorities to prop up these companies. The Chinese had declined to go along with the disruptive scheme…." Such hearsay passes in the memoir genre, but it is worth a moment to recognize how asymmetric any such joint move would have been. As noted, the Russian holdings of US agency debt were concentrated in the bills of the mortgage agencies, so disinvestment could take the form of not rolling over maturing paper. Like most official investors, the Chinese had invested in long-term agency securities, so any disinvestment into stressed markets could well have required taking sizeable losses.[6]

[6] The size of the Chinese holdings is not clear. Bernanke (2015, p 231) reports that "in 2008, China alone had more than $700 billion in GSE mortgage-backed securities, slightly more than it held in long-term U.S. Treasuries." The US Treasury et al. (2009, p 8), however, reported mainland China holdings of US agency long-term debt at end-June 2008 at $527 billion, of which $369 billion was mortgage-backed securities. It is possible that Bernanke is citing Board staff estimates that included Chinese holdings that were showing up in other countries owing to the Treasury survey not having penetrated through custodial layers.

After the US Treasury Secretary Paulson fired what he had described to Congress as a "bazooka" on 7 September 2008, placing the two GSEs in conservatorship, Ulyukaev told *Reuters* that Russia had reduced its holdings to less than $60 billion and "most likely we will continue to decrease the share a little" Fabrichnaya and Bryanski (2008). As the crisis worsened, public discussion of the holding intensified. The Central Bank of the Russian Federation (2009, p. 140) reported holdings of $3 billion at the end of the year 2008.

government backing of the two agencies unresolved—indeed the Obama administration never proposed legislation—some official investors judged it wiser to steer clear. In particular, officials disproportionately reduced their holdings of agency debentures, official holdings of which had exceeded official holdings of agency MBS in 2007 and 2008. Reserve managers thereby signaled more confidence in the mortgages cum agency guarantees (i.e., MBS) than in uncollateralized agency debt.[7]

Much official selling of agency securities took place in a market with the US Treasury and the Federal Reserve on the bid side. The US Treasury, using power under the Housing and Economic Recovery Act of 2008, employed State Street to buy $220 billion in Fannie and Freddie MBS starting in October 2008 and ending in December 2009.[8] To fund the purchases, the US Treasury sold more of its securities than required by the federal government's excess of spending over revenues. In effect, the Treasury accommodated the demand by official reserve managers to replace agency securities with US Treasury securities. The US Treasury grossed up its balance sheet to offset the effect on mortgage rates of the official run from lower to higher grade safe assets.

The Federal Reserve took a longer to come in on the bid side, but unconstrained by any debt limit, brought more chips to the table. Tellingly, its first purchases were of Fannie, Freddie, and Federal Home Loan Bank debentures in December 2008. Its purchases of $172 billion between December 2008 and March 2010 amounted to most of the reduction of official holdings from $532 billion in June 2008 US Treasury et al. (2009, p. 8) to $276 billion in June 2010 US Treasury et al. (2011, p. 9). The Federal Reserve purchase of agency MBS started in January 2009 and reached trillions of dollars, which bear no relation to official disinvestment from the rest of the world.

[7] By contrast, Gorton et al. (2012) attach safe asset weights (where 1 is equivalent to US Treasuries) to agency debentures of 1 and agency MBS of only 0.85.

[8] See https://www.treasury.gov/press-center/press-releases/pages/tg1111.aspx for the announcement of the orderly wind-down of the portfolio in 2011 and, for monthly data on the Treasury and Federal Reserve purchase, https://www.fhfa.gov/DataTools/Downloads/Pages/Treasury-and-Federal-Reserve-Purchase-Programs-for-GSE-and-Mortgage-Related-Securities.aspx.

The upshot is ironic. Reserve managers' revealed judgment is that US agency securities do not enjoy as strong a status as safe assets once US government support shifted from implicit to explicit. This irony arises from a combination of factors. First, official investors do not seem to judge safety in a purely professional way but rather to some extent give heed to less informed domestic opinion. Second, an absence of a political settlement on the terms of government support for the US agencies has undermined even very strong de facto support.

8.3.2 Banks in the USA

Officials held almost a half-trillion dollars of bank deposits in the USA as of mid-2017. This represented about 8% of their holdings in the USA.[9]

The Great Financial Crisis shook official investors' faith in the safety of bank deposits. Their response was to cut back on holdings of bank deposits, as related by Pihlman and van der Hoorn (2010), McCauley and Rigaudy (2011), and Jones (2018). Subsequently, they rebuilt their holdings. More persistent has been the shift from unsecured deposits to repos. This reflected, among other experiences, that of some official counterparties in repos with Lehman Brothers, who emerged whole from the bankruptcy.

US Treasury data allow us to distinguish outright deposits with banks in the USA from reverse repos in which the officials take a security as collateral, generally for very short periods. These data show that just almost two-thirds of placements with banks in the USA are reverse repos.[10]

In general, it is best to aggregate deposits in the USA and outside the USA in assessing the contribution of bank deposits to the de facto safe assets chosen by central banks. This is done in the first subsection of the next section.

8.4 Supplying Dollar Safe Assets Outside the USA

Both banks and high-quality bond issuers outside the USA provide safe assets to reserve managers. Thus, the US Treasury faces competition in producing safe assets in dollars not only from the agencies and banks at home, which it supported in extremis in 2008–2009. In addition, it faces competition in producing safe assets in dollars from banks abroad as well as supranational, sovereign, sub-sovereign, and

[9] See also Chap. 9.

[10] The TIC data for June 2017 show $272 billion in repos with foreign official institutions, $104 billion in non-negotiable deposits, $39 billions of CDs and $12 billion other, giving a repo share of 64% (https://www.treasury.gov/resource-center/data-chart-center/tic/Documents/bltype_history.csv). See Jones (2018, Fig. 2) for the time series of repos at banks in the USA with foreign official institutions.

agencies that issue dollar bonds.[11] Judging from the estimated portfolio of reserve managers, this competition amounted to about $1 trillion in mid-2017.

8.4.1 Offshore Dollar Bank Deposits

Central banks have placed dollar on deposit with banks outside the USA since the 1960s for reasons of country risk, convenience and, not least, yield. Since the early 1980s, dollar money market arbitrage has generally kept yields in the USA and abroad in line, leaving country risk and convenience as the determinants of the onshore/offshore choice. BIS international banking data have cast light on this choice since the 1960s.

According to BIS data, official deposits in banks outside the USA amounted to about one-half a trillion dollars in mid-2017. Most of these were cross-border, but a small amount were local deposits by central banks into banks located in the same country.

Taking bank deposits in the USA and offshore bank deposits together, officials held about $1 trillion in mid-2017. This was about a sixth of the fixed income portfolio. By mid-2017 they had almost restored their share of mid-2007, before central banks disinvested massively; see Pihlman and van der Hoorn (2010), McCauley and Rigaudy (2011) and Jones (2018).[12] At first blush, this reading appears inconsistent with the finding of Jones (2018, Figure 8), who finds that bank deposits have fallen to just 3% of overall reserve holdings at the end of 2017. The source is the IMF's Special Data Dissemination Standard (SDDS) for FX reserve holdings, which uses a reporting template that distinguishes repos from uncollateralized (or "naked") deposits.[13] In contrast, BIS-reported data do not distinguish these two. So the apparent conflict is resolved if today the overwhelming share of central bank placements with commercial banks is collateralized.[14]

8.4.2 Offshore Dollar Bonds: Supranationals, Sovereigns, and Agencies

Reserve managers' investment in dollar bonds issued by non-US borrowers has to date eluded measurement. Dollar bonds issued by high-quality sovereigns, provinces, non-US agencies, and supranational organizations have all attracted

[11] See Flandreau (2013) for the Commonwealth and colonial bonds as safe assets in Nineteenth Century Britain.

[12] Central banks cut back their claims on banks over quarters rather than in days, as did US money market funds. See Baba et al. (2009).

[13] See Euro-currency Standing Committee (1999) for the design of this template.

[14] That said, the 3% seems low in relation to the observation above regarding dollar deposits in banks in the United States. It may be that uncollateralized working balances are atypically large in the dollar and with banks in the USA, e.g. for clearing purposes.

investment by central bank reserve managers for 40 years or so. These sell bonds in the US domestic bond market ("Yankee bonds") or offshore in the Eurobond market. Many seek the widest distribution and the keenest pricing by selling the so-called global bonds that are both registered with the US Securities and Exchange Commission (SEC) and sold through eurobond channels. Often they offer the so-called benchmark bonds in the billions of dollars, sizes an order of magnitude larger than the minimum for index inclusion.

No official data on reserve managers' holdings of such bonds exists. However, a commercial bond index provider, ICE Bank of America Merrill Lynch, has aggregated the most preferred of such bonds into two indices (see Annex). Index inclusion requires a bond to be issued in a minimum amount of and to bear a fixed coupon. The index is made up of the bonds, in order, of non-US sovereigns, supranationals, government-guaranteed issuers, agencies, and local authorities.

While the indices contain bonds of a minimum rating of BBB, central banks' investment habitat focuses on the highest rated, AAA- and AA-rated bonds.[15] Excluding BBB and A-rated bonds reduces the indices by $458 billion from $1.392 trillion to $934 billion in December 2018. The total for June 2017 was $953 billion.

How much of these high-quality bonds issued by non-US governments or supranational organizations are held by central banks? The best approach to answering this question is to ask the issuers what their bond underwriters report regarding the distribution of issues in the primary market. Their responses, drawing on material in investor presentations, are shown in Table 8.2. An important qualification is that the concept of official investors is broader than central banks, including not only sovereign wealth funds but also the treasuries of the issuers represented on Table 8.2. Putting aside the brand-new dollar issuer, the European Stability Mechanism, the reports from the underwriters of central bank share of benchmark dollar issues in the primary market cluster around 50%. Taken together, the issuers represent more than a third of the AAA- and AA-rated bonds in the indices (Table 8.2, memorandum item).

Using this share, we estimate the holdings of these bonds by central banks at just shy of one-half trillion dollars (Table 8.1). Even though the universe of US corporate bonds is three times larger the universe of supranational, sovereign, and non-US agency dollar bonds, holdings of the latter are three times that of the former. This reflects the relatively weak credit profile of the US corporate bond market as compared to these international dollar bonds.

8.5 Conclusions

This chapter reassures managers of US dollar reserves at central banks that they need not worry about a shortage of safe assets. This runs counter to the argument that a shortage of safe assets is key to understanding international finance. In that

[15] This is a conservative cut-off. Morahan and Mulder (2013) find that 29.9% of respondents use an AA rating as a minimum. 50.7% use a single-A rating.

Table 8.2 Dollar bonds of selected issuers and estimated official purchases

Issuer	In billions of US dollars[a]	% purchased by official accounts
European Investment Bank	117	45.5[b]
European Stability Mechanism	0	73[c]
KfW	137	52.4[d]
OeKB	11	53.6[e]
World Bank	96	53.5[f]
Grand total	361	
Memo: AAA- and AA-rated bonds in Foreign Government and Supranational indices	*953*	

Sources: EIB, ESM, KfW, OeKB; World Bank; author's calculations

[a]Face value of bonds from named issuer in ICE Bank of America Merrill Lynch Foreign Government and Supranational indices

[b]Estimated as the simple average of issues of benchmark dollar bonds in the years 2015–2018 inclusive

[c]ESM's second dollar bond in 2018

[d]Estimated as the simple average of issues of benchmark dollar bonds in the years 2013–2018 inclusive

[e]Estimated as the simple average of issues of benchmark dollar bonds in the years 2014–2018 inclusive

[f]Average of two examples of global dollar benchmark bonds given in World Bank Treasury investor presentation downloaded on 5 January 2019

thesis, emerging market economies (EMEs) need to accumulate such assets in line with their own growth. But if advanced economy governments were to issue debt on a scale likely to meet this demand, they risk becoming over-indebted and losing their creditworthiness. Such a hypothetical shortage of safe assets could make managing foreign exchange reserves very difficult. After all, official reserve managers focus on safe assets.

This safe assets story relies on very restrictive assumptions. On the demand side, EMEs evidently do not need to add to their holdings of safe assets in line with output growth. Indeed, the world reached at least a local peak of reserves in 2014 as the dollar appreciation quickened. In retrospect, the proponents of the safe asset's shortage may have mistaken the cyclically strong reserve accumulation during a period of dollar depreciation for a secular trend.

On the supply side, the US Treasury does not have a monopoly in the production of safe US dollar assets, when these are measured by the official dollar reserve portfolio. This chapter constructs this portfolio drawing on three sources. First, a US Treasury and Federal Reserve annual survey gives holdings of securities and bank deposits in the USA. Second, BIS international banking data show holdings of eurodollar bank deposits (mostly repurchase agreements). Third, a novel estimate of official holdings of offshore bonds comes from indices of US dollar bonds of AAA- and AA-rated sovereigns, subsovereigns, supranationals, and non-US agencies, along with information on the official bid in the primary market.

It is hard to be sure what He et al. (2016) mean when they say that US government bonds are a "large fraction" of the "portfolios of many central banks." However, this chapter finds that they are about two-thirds of global US dollar reserves. Since dollar reserves are about two-thirds of total FX reserves, the "large fraction" looks to be less than half, without taking into consideration any domestic assets of central banks.

This current two-thirds share of US Treasuries in the dollar portfolio represents a rise over the share observed before the GFC. Genberg et al. (2005, p. 42) put the share at about half in 2003. By mid-2008, the share had fallen to 44%, only to jump to 64% in 2009 (McCauley and Rigaudy 2011).[16]

If reserve managers fled to the quality of US Treasuries during the GFC, it was not because they had lost vast sums on the AAA-rated, "super-senior" tranches of private mortgage-backed securities. In June of 2008, the US Treasury et al. (2009) identified official holdings of private asset-backed securities of only $18 billion. These pseudo-safe assets in fact caused losses to a striking extent to the underwriters, including European banks' US securities affiliates; see Erel et al. (2014) and McCauley (2018).

Instead, the US Treasury faces competition at home that broadly enjoys US government support. Likewise, it faces competition abroad that enjoys foreign government support.

At writing, the risk of an excess of US Treasury securities well exceeds that of any shortage. Even before the pandemic of 2020, strains in the repo market in late 2019 reflected the underlying lack of demand by US institutional investors for the burgeoning supply of US Treasuries and brought the Federal Reserve back into the market as a buyer. And it would be hard to blame central banks for the US federal government's trillion-dollar deficits, much less 2020's multi-trillion dollar deficit. Global FX reserves have not grown over the last 5 years, so the surge in the US federal government's debt in recent years owes nothing to official demand.

Annex: Sources for the Instruments Held in Dollar Reserves

This chapter draws on four sources to assemble the official portfolio of US dollar investments as of June 2017. Three are official and straightforward; one depends on a combination of data compiled by a market source and informed estimation.

The Treasury International Capital (TIC) annual survey of portfolio investments in the USA (US Treasury et al. (2018)) provides the bulk of dollar investments in the USA. In addition, TIC data on the own and custody liabilities of banks in the USA to foreign official institutions form the basis of the Bureau of Economic Analysis compilation of bank-related liabilities.

[16] The 2009 US Treasury share was back to that of 20 years earlier in 1989 Fung and McCauley (2000). Note that the 2008 and 2009 estimates make no allowance for foreign government and supranational dollar bonds, and thus, on the evidence of Table 8.1, 5–10% too high.

Similar liabilities of banks outside the USA are reported by the Bank for International Settlements (BIS). These data cover both cross-border liabilities to the official sector and local foreign currency liabilities. The latter would capture, for instance, a dollar deposit of the Bank of England in a (foreign or domestic) bank in the UK.

While the official sector provides these three sources, the final one is market-based. ICE Bank of America Merrill Lynch compiles an index of dollar bonds issued by various official obligors outside the USA of which central banks hold about half. The larger index, the ICE Bank of America Merrill Lynch Foreign Government and Supranational index, contains all such bonds with more than one year of remaining maturity, a fixed coupon and more than $250 million outstanding. These numbered 716 in early December 2018, with an aggregate value of $1.176 trillion. Its short-term counterpart contains such bonds with a year or less to maturity, with $150 million or more outstanding. These numbered 128 in early December 2018, with an aggregate value then of $216 billion. These indices are marketed separately to allow portfolio mandates to exclude the shortest-term bonds.

These sources come with various limitations. On the one hand, the TIC data include sovereign wealth funds like the Norwegian Government Pension Fund in their definition of official investors. As a result, the decomposition of official investments by instrument should add up to more than the estimated global dollar reserves from the IMF, which exclude the holdings of sovereign wealth funds. On the other hand, the US Treasury et al. (2018) survey has difficulty in pinning down the ultimate beneficial owner of US securities that are held by custodians, particularly those outside the USA. This difficulty could lead to an undercounting of officially held US securities.

The estimate of officially held bonds issued by obligors outside the USA is new to this chapter and comes with several caveats. First, the sovereign, supranational, and other official issuers in the index certainly do not exhaust the universe of bonds issued by non-US obligors that are held by central banks. For instance, judging from the TIC data, central banks must hold dollar corporate bonds issued by firms incorporated outside the USA. Second, the proportion of the bonds in the index that are held by central banks is estimated with no great precision based on reports from underwriters in the primary market placement of such bonds, which are provided to the issuers themselves. The author asked the treasuries of some of the most prominent supranational and agency issues for summaries of such reports. Such data were generally publicized in investor presentations.

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Chapter 9
Expansion and Contraction of Central Bank Balance Sheets: Implications for Commercial Banks

Srichander Ramaswamy and Philip Turner

Abstract Reserves and institutional asset managers have to constantly monitor and assess risk-return trade-offs in the markets where they invest. Among the various tools and indicators that they employ, understanding the balance sheet strength of commercial banks is indispensable. This is because of the role of banks as credit intermediaries for financing economic activity and their important function in the payment and market infrastructures for financial transactions. As central banks have embarked on many, new unconventional monetary policy measures, it is important to ask what the impact on commercial banks is, and whether this enhances or inhibits their traditional credit intermediary role. This chapter examines these questions and considers what hidden risks might be building up as central banks accumulate assets.

9.1 Introduction

Commercial banks play an important role in the transmission of monetary policy and in the payment and financial market infrastructures. Further, lending to the private sector in many advanced economies and in most emerging economies is bank-based. Strong bank balance sheets are therefore essential for credit creation and for boosting economic activity. Consequently, monitoring the soundness of the banking system of a country is not only the prerogative of central banks and regulatory authorities but it is also an important due diligence activity for investors and asset managers. A lack of understanding of the costs and risks faced by the banking system in an environment where monetary policy frameworks are becoming less conventional could lower investment returns.

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One way of assessing these costs and risks is by examining the linkages between central bank and commercial bank balance sheets. Such linkages arise because central bank liabilities typically become assets of commercial banks. Durable expansions in central bank balance sheet tend to make commercial bank balance sheets more liquid. Even if holding central bank assets does not require additional capital, new forms of bank regulation such as the leverage ratio can become binding as commercial bank balance sheets expand. What constraints and issues arise for commercial banks from such policies? And how do actions or responses to address those constraints by commercial banks affect and propagate risks to the financial system?

This chapter examines these questions and considers what risks might be building up as central banks accumulate assets. First, the different ways foreign and domestic currency assets are acquired are reviewed. Second, we examine the impact on commercial bank profits depending on how bank reserves are remunerated. Third, commercial bank net interest income from traditional maturity transformation will be reduced by the flattening in the yield curve caused by central bank purchases of bonds. Such effects may alter the business models of commercial banks and their risk preferences (BIS 2018). These effects are analyzed. Fourth, a reduction in domestic currency assets held under quantitative easing (QE) may lead commercial banks to take more risks. We discuss the incentives for such actions by banks and the channels through which risks to financial stability can be amplified. The final section concludes.

9.2 Central Bank Balance Sheet[1]

In order to analyze the direct impact of central bank asset purchases on commercial banks, we begin with a stylized version of a central bank's balance sheet as laid out in Chap. 3. The asset side of the central bank balance sheet consists of foreign and domestic currency assets, gold and government securities (Table 9.1). On its liability side, they comprise currency in circulation, bank reserves (taken together as monetary liabilities), its own securities, government deposits and other non-monetary liabilities and equity capital (Rule 2015).

9.2.1 Acquisition of Foreign Currency Assets

How does a central bank acquire FX reserves? Suppose a private investor transfers foreign currency from abroad to buy domestic assets through a commercial bank. The commercial bank will exchange the foreign currency for domestic currency to credit the private investor's local currency account. When the central bank buys the

[1] See also Chap. 4.

Table 9.1 The banking system

Central bank		Commercial banks	
Assets	Liabilities	Assets	Liabilities
Foreign assets	Currency	Currency	Deposits
Loans to banks	Bank reserves	Bank reserves	Loans from central bank
Government securities – Bonds – Bills	Government deposits	Government securities	Bank bonds
Gold	Non-monetary liabilities	Bank loans	Commercial paper
Other assets	Equity	Other assets	Equity

foreign currency, it will credit the reserve account of the commercial bank in the domestic currency at the prevailing exchange rate. The foreign currency acquired, assuming it is US dollars, can then be used to buy US Treasury bills or bonds, which will be held under FX reserves.

The crediting of the commercial banks' reserves account increases the monetary base. This tends to drive down interest rates in interbank markets. Such asset acquisitions fall under unsterilized FX intervention. They tend to make the balance sheet of the commercial bank more liquid and may increase credit supply. If the central bank wishes to counter this effect and make clear that the stance of monetary policy has not changed, it may raise the reserve requirements ratio or sell longer-dated government or central bank securities to the commercial banks.

9.2.2 Acquisition of Domestic Currency Assets[2]

Since the crisis, many advanced economy (AE) central banks have purchased domestic currency assets on a large scale—including government securities, mortgage-backed securities, corporate bonds, and even corporate equities.

How does a central bank implement a domestic asset purchase program? Assets that a central bank wants to buy are sourced through commercial banks. The sale of an asset held on the commercial bank balance sheet entails an increase in reserves held at the central bank. The balance sheet size of the commercial bank does not change. But if the asset is acquired from an institutional or retail investor, then the commercial bank simply acts as an intermediary. As the asset is sold to the central bank, it receives the sale price in the form of bank reserves. At the same time, the investor deposit held with the bank is credited with the proceeds of the asset sale. In this transaction, the commercial bank balance sheet (assets and liabilities) increases by the sale price of the asset.

[2] See also Chap. 7.

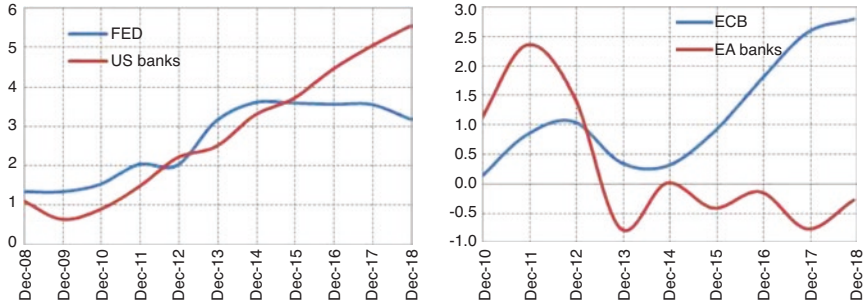

Fig. 9.1 Cumulative changes in balance sheet size. In trillions of local currency. Cumulative changes since 31 December 2007 for the USA and since 31 December 2009 for the euro area. Source: Board of Governors of the Federal Reserve; FDIC; ECB

It is instructive to examine how the QE program affected commercial bank balance sheets in different jurisdictions. This will depend on how aggregate demand and commercial bank lending to the private sector respond to monetary policy stimulus. If QE succeeds in stimulating a sustained rise in bank lending, then commercial bank assets would expand even after central bank assets are no longer expanding. This is what happened in the USA: see Fig. 9.1, which shows the cumulative changes in total assets held by the central bank and commercial banks. In the euro area, by contrast, commercial banks continued to reduce bank lending and the private sector deleveraged. The different outcomes in the two jurisdictions may stem from bank capital constraints being binding in the euro area particularly when bank profitability has remained low compared to US banks. The next section explores the potential sources for the lower profits.

9.3 Impact on Commercial Bank Profits

Central bank balance sheet expansion will affect bank profits, and how commercial banks respond may have financial stability implications. Specifically, the acquisition or sale of assets (foreign or domestic) by a central bank will force a change in the balance sheets of commercial banks. A question of interest is how banks respond to limit any negative consequences for their profits. This will depend very much on how the balances held at the central bank are being remunerated, and what the scope is for commercial banks to generate a positive carry income net of funding these asset holdings. For example, if reserves held with the central bank are not remunerated, or worse attract negative rates, it will impose a negative carry cost depressing bank profits if these costs cannot be passed on to holders of bank liabilities.

Remuneration practices on bank reserves vary widely across central banks and may also depend on whether they are part of minimum reserves requirement or fall under excess reserves. Many central banks in Europe during the last few years have

Table 9.2 Reserve balances held by depository institutions at the central bank

Central bank	2007	2011	2014	2017	2018
Bank of Japan	7476	30,716	162,113	326,559	337,510
ECB	196.8	212.2	185.4	1309.7	1379.4
Federal Reserve	5.7	1534.1	2574.8	2201.4	1661.2
Riksbank[a]	0.1	16.9	49.8	418.5	456.6
Swiss National Bank[b]	5.3	178.4	319.4	470.4	480.6

In billion local currency units
Source: National central banks
[a]Includes holdings of central bank certificates
[b]Sight deposits held by domestic banks

imposed negative interest rates on bank reserves, and bank reserves themselves have increased dramatically following QE or foreign currency asset purchases (Table 9.2). Some portion of reserves balances can be exempted from negative rates (e.g. as in Switzerland) so that the average cost will be below the marginal cost. At the Federal Reserve (Fed), reserve balances were not remunerated before the crisis. But this changed in October 2008, and the Fed now remunerates reserve balances, including excess reserves, at the top of the Fed funds target band (Ihring et al. 2015). The decision to remunerate reserve balances was based on challenges that would arise in keeping the Fed funds rate at its target range as banks may try to lend below the target range if reserves were unremunerated.

Generating a positive income from holding reserves balances will require banks to fund such assets at a lower cost. The increased reserves balances are mainly funded by an aggregate increase in bank customer deposits (retail and non-financial corporation). Holding customer deposits imposes a cost on banks, both through deposit insurance payments and any interest payment on these deposits (Choulet 2015). But in addition, banks in Europe are confronted with negative remuneration rates on the excess reserves held at their respective central banks. Yet they have continued to keep retail deposit rates at zero. In doing so, they have been absorbing the negative carry income as well as the deposit insurance costs on their balance sheet with the consequence that their profits are depressed.

The ECB has tried to address this challenge by introducing targeted longer-term refinancing operations (TLTRO). This allows banks to borrow at the deposit rate facility provided their net lending over a succeeding two-year period exceeds a certain threshold. Because the borrowing rate is linked to net increase in lending, banks can only benefit if they have excess capital that they can deploy for increasing loan supply. Coming at a time when bank capital requirements have been strengthened and demand for bank loans has been weak, euro area banks have not been able to fully benefit from the TLTRO scheme as they have been reducing loan supply. The Fed's decision, on the other hand, not to take the policy rate below zero and to remunerate commercial bank reserves has had a very positive effect on US banks' capital positions over the years by allowing them to generate additional carry income on the reserve balances.

To put some numbers in perspective, between 2013 and 2017 the estimate of the total income for US commercial banks from reserves remuneration has been around $50 billion assuming deposit funding costs were negligible (deposit rates were indeed close to zero over most of this period). By contrast, the ECB imposes a negative interest rate for excess reserves held, which since March 2016 has been −40 basis points (deposit facility rate). With average excess liquidity (excess reserves and funds held by domestic banks in the deposit facility) in the euro area amounting to around €1.8 trillion in 2017 and 2018, euro area banks have incurred a loss of about €15 billion in these 2 years as the negative cost of holding the excess liquidity cannot be fully passed on to deposit holders (see European Parliament 2018).

The Swiss National Bank (SNB), in contrast to the Fed and the ECB, has purchased mainly foreign currency assets to counter FX appreciation pressures, and has allowed the monetary base to expand. This has resulted in large increase in bank reserves (sight deposits) at the SNB, the stock of which for domestic banks as of end-2018 amounted to CHF 480 billion. With the remuneration on these sight deposits at −75 basis points, the Swiss banking system would face a significant negative carry cost due to the FX reserve asset purchases. To reduce this burden, the SNB exempts 20 times required reserves before applying the negative rates on sight deposits. As a result, the effective negative rate on sight deposits is only about 30 basis points (Danthine 2017). The important takeaway is that the combination of central bank balance sheet expansion and remuneration policy on reserves has important bearing on commercial bank profits (Fig. 9.2).

The balance sheet expansion of emerging market economy (EME) central banks resulting from acquisition of foreign currency assets is more likely to have a positive impact on profits of commercial banks. This is because FX reserves acquisition tends to be largely sterilized, and consequently, commercial banks will show increased holdings of longer-dated government or central bank securities (Mohanty and Turner 2006). When the yield curve is upward sloping, banks earn profits from this maturity transformation. With the general level of interest rates in EMEs well above zero, banks can price their deposit funding such that a net interest margin is earned on the sterilization securities held. Alternatively, commercial banks can sell

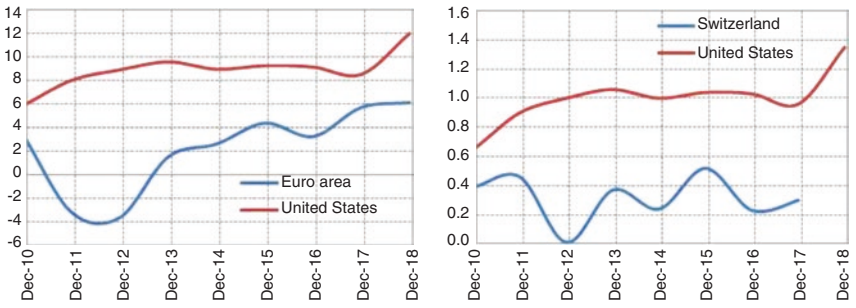

Fig. 9.2 Profitability of domestic banks, in percent. Return on equity, left panel. Return on total assets, right panel. Source: ECB; FDIC; SNB

these securities to the private sector and reduce their balance sheet size. But the incentives to do this tend to be low because there is a positive carry income to be earned without requiring additional capital.

Acquisition of foreign currency assets by an EME central bank can have a negative impact on commercial bank profits if excess liquidity is drained by raising the level of required reserves and not remunerating them. A survey of central bank remuneration practices on reserve balances by the IMF suggests that more than two-thirds of central banks do not pay interest on reserves (Gray 2011). In the past, many EME central banks have raised the level of minimum reserve requirements not only to drain excess liquidity from FX intervention but also as a macroprudential policy tool to dampen excess bank credit supply. If the level of required reserves is used as an additional tool to control money supply when buying foreign currency assets, then EME central banks will be shifting the cost of buying the low-yielding foreign currency assets to the banking system if the reserves are not remunerated.

9.4 Impact on Bank Business Models

An important function of banks is to provide liquidity and maturity transformation to the financial system. In performing this function, banks earn an interest spread over their borrowing costs by charging a credit risk premium and a term premium for lending longer term. Market-determined term premium on government bonds embeds an inflation risk premium, a real interest rate risk premium, and a liquidity preference premium.

In early 2000 two fundamental changes altered the supply and demand dynamics for US Treasury securities. On the one hand, the USA was pursuing tighter fiscal policies and its deficits shrank. On the other hand, China and commodity-exporting countries were generating large current account surplus, which was then transformed into reserve currency assets and held in central bank balance sheets. As a consequence of these developments, the official institutions' holdings of US Treasuries rose sharply while outstanding amounts of these securities shrank or rose only modestly (Table 9.3).

The supply-demand imbalance for US Treasury securities caused by rapid accumulation of reserve currency assets contributed to a sharp fall in term spreads (defined as difference between 10-year bond yield and 3-month interest rate) for the US Treasury yield curve (Fig. 9.3, left-hand panel). The flattening of the risk-free

Table 9.3 Marketable US Treasury securities, in billions of US dollars

Central bank	March 2000	June 2002	June 2004	June 2006	June 2007
Total outstanding	2508	2230	2809	3321	3454
Official institutions holdings	465	560	912	1213	1452
Percent held by official sector	18.5	25.1	32.4	36.5	42.0

Source: US Treasury

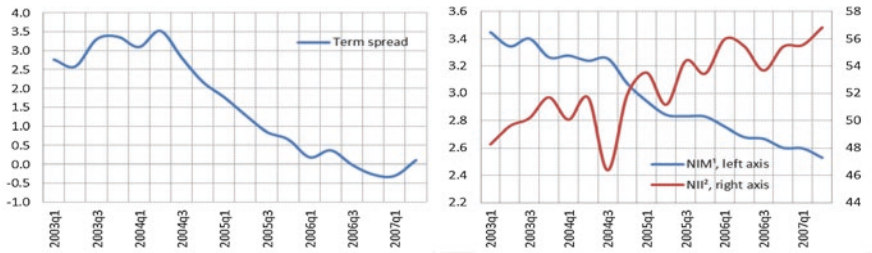

Fig. 9.3 US Treasury term spread and US banks interest and non-interest income, in percent.[1] Annualized net interest income as percent of interest earning assets for bank holding companies greater than $500 billion in total assets. [2] Non-interest income as percent of net operating revenue. Source: FRB New York

yield curve was detrimental to the traditional business model of banks as the size of the term spread is a critical element that influences net interest margins banks can earn, and in turn their profitability. Indeed, US banks' net interest income fell precipitously in this period forcing them to look for non-interest income sources for revenue generation (Fig. 9.3, right-hand panel). The search for non-interest income sources for revenue generation was one factor leading to the now infamous originate-and-distribute business model.

Given the shortage of "safe" dollar assets such as US Treasuries, the originate-and-distribute business model seemed to offer alternative safe assets through pooling and securitization. Such assets proved to be anything but safe. Badly designed bank regulation had allowed off-balance sheet exposures to be ignored when calculating risk capital charges. Reliance on unstable wholesale funding using securitized assets as collateral increased. Such repo-based funding was supported by a general increase in the prices of risk assets driven by a compression of credit spreads. Rising collateral values led to complacency and poor monitoring of risks by market participants, all of which contributed to the Global Financial Crisis.

These risk propagation mechanisms did not come directly from expansion in central bank balance sheets. Rather, the linkages were indirect. Markets were impacted both by the central bank asset purchases and by the business model changes of commercial banks. In an interconnected financial system, the amplification of risks in response to balance sheet changes made by one or a group of central banks can be very complex. And once entrenched into the financial system, such risks may be difficult to mitigate.

What we discussed above was the international risk spill-over from FX reserves accumulation due to changes in commercial banks' intermediation functions. But domestic commercial banks in FX reserves accumulating countries may also alter their intermediation role that can amplify risks to the domestic financial system. For example, large-scale FX intervention in the face of sustained capital inflows tends to create the impression among domestic corporates that the central bank has the stock of foreign currency assets to contain domestic currency depreciation when an economic shock hits. This encourages the large corporates to seek cheaper and

unhedged foreign currency debt financing as domestic interest rates are generally higher in EME economies. Commercial banks which lend to these entities also become complacent of the FX risks held by their borrowers for the same reasons noted above. If the central bank is not committed to supporting the domestic currency against an adverse shock, risks taken by the private sector will materialize on commercial banks' balance sheet. The banking crisis in Korea in the late 1990s was linked to such poor risk management practices among commercial banks (Kwan 2000).

9.5 How Might Commercial Banks Respond to Central Bank Asset Sales?

The balance sheets of many AE central banks have increased substantially. US banks have allowed their balance sheets to expand under the QE program to benefit from the positive carry income they could earn on the reserve balances held at the Fed. This has helped US banks to substantially improve their capital ratios to comply with strengthened Basel III regulation. At the same time, they have also increased loan supply as a share of GDP since 2013—that is, they improved capital ratios despite increasing loan supply. This is in stark contrast to banks in the euro area which until recently faced much weaker domestic economies. Euro area banks have reduced loan supply as a share of GDP to strengthen capital positions (Fig. 9.4). The reduction in loan-to-GDP ratio from its peak to 2018 has been 15.5% points in the euro area versus a reduction of only 3.5% points in the USA. Euro area banks have also carried out portfolio rebalancing in their own balance sheets—unlike US banks—to accommodate the QE program.

The different responses of commercial banks in the USA and in the euro area reflect many factors. Earlier and stronger monetary expansion in the USA helped strengthen US banks—and US regulators ensured a more rapid recapitalization of US banks while European regulators lagged behind. An interesting open question is at what point the benefits of QE to the economy will be constrained by a "reversal rate"—the rate at which accommodative monetary policy "reverses" its intended effect and becomes contractionary for the economy (Brunnermeier and Kolby

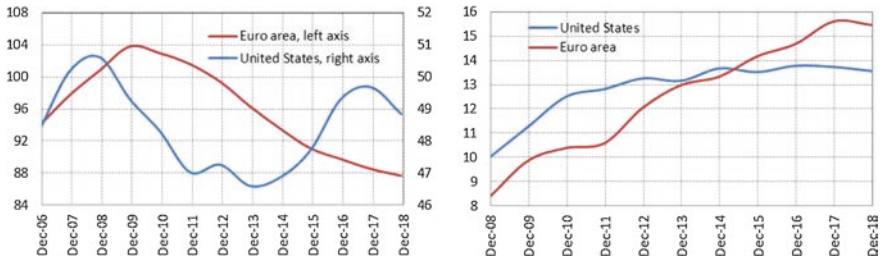

Fig. 9.4 Loan to GDP and Tier 1 capital ratios, in percent. Source: FRB New York; ECB; IMF

2019). When combined with QE, negative policy rates may have had a contractionary effect on bank lending in the euro area. This effect has been magnified by the strengthening of bank capital requirements under Basel III regulation (Ramaswamy 2018). On the other hand, stronger aggregate demand and lower medium-term funding costs under the TLTRO have had an expansionary effect on bank lending.

By the end of 2018, the planned reduction of the Fed's balance sheet was well advanced and the asset purchase program of the ECB was being progressively reduced. Yet the stock of assets held under the QE program will provide monetary stimulus. For example, the reserve balances at the Fed will generate additional net interest income to banks without requiring either capital to be allocated or credit decisions to be made. This will further boost capital ratios incentivizing banks to loosen credit conditions and supply more loans. Reducing this stimulus will require a reduction in the central bank balance sheet through asset sales.

How commercial banks and markets might react to asset sales is a key policy question for central banks. A reduction in central bank balance sheet does not automatically imply that commercial bank balance sheets will have to shrink. This will largely depend on growth and investment—a buoyant economy will engender larger commercial bank balance sheets assuming banks can raise capital to support increased lending. Central bank balance sheet policies also have a role. For example, if the Fed does not reinvest the proceeds of maturing bonds, then bank reserves will fall correspondingly. This is because the proceeds received from the US Treasury will be used to repay liabilities towards commercial banks that will result in a fall in reserves balances held by banks with the Fed. To the extent that banks become the marginal buyers of new issuance volumes of bonds that offset the Fed balance sheet reduction, banks will be exchanging bank reserves for Treasury securities. But banks are unlikely to do this as central bank asset sales will be followed by higher policy rates that will push bond yields higher leading to capital loss on bond holdings.

A reduction in the Fed balance sheet will result in a loss of net interest income that banks have been earning at zero regulatory capital cost. To compensate this, banks are more likely to increase credit supply coming from a stronger capital position that has been engineered by the Fed through its policy of paying interest on reserves even if the reason to do it was to keep control of the Fed funds rate. If demand is strong, US banks will be incentivized to lend more as monetary policy tightens and Fed balance sheet is progressively reduced. Expansionary fiscal policy and tax cuts may also justify banks to intermediate more credit. Alternatively, if Fed balance sheet reduction is slowed while monetary tightening takes place mainly through interest rate increases, US banks will be able to generate even higher net interest income on their reserve balances. As capital ratios strengthen further, competition to increase lending to reduce excess capital can drive up credit and lower lending standards.

Once economic activity strengthens in the euro area, a tightening of monetary policy either through raising short-term rates or through a reduction in the stock of domestic currency assets purchased under QE would tend to improve bank financial conditions. It will reduce the negative carry on the reserve balances held at the

Eurosystem central banks and improve bank profitability. In other words, a tightening of monetary policy will lead to an easing of financial conditions for commercial banks. Yet, banks in some euro area jurisdictions may be held back by the continued high level of non-performing loans (NPLs). In addition, with the share of variable rate loans in total loans to household and non-financial corporates in the euro area at 65%, higher interest rates will lower the debt service coverage ratio on outstanding loans. Banks may therefore be keener to use improved profits to reduce their legacy NPLs before increasing credit supply.

So far, we analyzed how commercial banks' risk preferences and financial conditions are likely to be affected when AE central banks try to normalize their balance sheet size. From a global financial stability perspective, such normalization can have unwelcome consequences for EMEs. The main channel through which such risk amplification can take place is the exchange rate. Very low policy rates and large-scale asset purchases by AE central banks have helped keep the major reserve currencies competitive against EME currencies while boosting global asset prices (Santiprabhob 2017). As growth in advanced economies rises and as monetary accommodation is progressively removed, capital outflows from EMEs may rise. A stronger dollar and higher US rates would make unhedged foreign currency debt of the private sector in EMEs more expensive to service (Chui et al. 2018).

An important destination for the capital outflows from EMEs is likely to be assets intermediated by US banks. For example, they could be securitized assets if they are shifted off-balance sheet or bank liabilities if these assets are held on bank balance sheets. A stronger dollar will make commodity imports expensive and cause inflation expectations to rise in commodity-importing countries. Even if domestic macro and financial conditions dominate monetary policy decisions, AE central banks will find it challenging to reduce their balance sheet size even at a measured pace given its implications for global financial markets. Will large central bank balance sheets become the new normal for policy? Finding arguments to dismiss this proposition is hard. Against this backdrop, US commercial banks may benefit most from the policy dilemma that is likely to unfold as to whether and how central bank balance sheet size can be restored to their pre-crisis levels.

9.6 Conclusion

No credible assessment of central bank balance sheet policies can ignore the impact it has had on commercial banking. A fall in loan supply as well as the combination of negative interest rates and QE has played a role in depressed bank profits in Europe. However, both the Bank of England and the ECB took targeted measures to increase bank lending by offering banks cheap long-term loans—with some measure of success. Yet, as borrowing rates on these refinancing operations were linked to the growth in net new lending at a time when bank capital requirements strengthened substantially under Basel III, banks have not been able to fully benefit from these measures.

This paper has shown the massive impact on commercial banks of years of low policy rates and sizable central bank balance sheet expansion. How commercial banks will react to a gradual reversal of these policies as economies strengthen is unknown. Central banks need to watch reactions of commercial banks in order to fully understand the implications of exceptional central bank balance sheet policy. Asset managers, on their part, have to assess how the policy reversal will affect commercial bank profits, and consequently, their capacity and willingness to increase lending to spur economic activity.

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Part III
The Investment Decision Making Process

Chapter 10
Management of Canada's Foreign Exchange Reserves

Grahame Johnson

Abstract Canada's foreign exchange reserves are owned by the federal government, but jointly managed under a relatively unique framework that is based on a partnership between the government and the central bank. This partnership is supported by a well-defined governance structure that ensures that the reserve portfolio is appropriately structured to meet its strategic objectives, that the government's risk tolerances are respected, and that associated costs and risks are carefully managed. Canada's reserves are primarily held to help meet the government's prudential liquidity objectives. The foreign currency holdings also support the market's general confidence in Canada. Given these objectives, Canada's focus is on liquidity and safety of principal. Return, while important, is a secondary focus. To help manage risks in the portfolio, the asset structure is guided by a number of strategic portfolio parameters. These parameters ensure that the reserve assets support the strategic priorities of liquidity and safety of principal while also striving to minimize the cost of holding reserves. To better manage interest rate and foreign exchange risks, Canada manages its reserves using an asset and liability matching framework. Under this approach, every foreign currency asset is funded by a liability of the identical currency and term-to-maturity. This effectively hedges the portfolio's foreign exchange and interest rate exposures, although significant basis risk can remain. The asset and liability matching framework has served Canada extremely well, effectively eliminating foreign exchange and interest rate risk at relatively low cost. There are a number of factors that explain this. First, Canada has a floating exchange rate with very infrequent intervention. As a result, the reserve portfolio stays hedged. Second, Canada's high credit quality and well-developed capital markets mean that it can fund the foreign exchange reserves relatively cheaply, both directly and synthetically. This allows the portfolio to meet its liquidity and capital preservation goals and, typically, earn a positive net return.

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10.1 Introduction

The Government of Canada's foreign exchange reserves have grown steadily in size since the great financial crisis, with total official international reserves increasing from approximately USD 40 billion in 2007 to over USD 80 billion in 2016, a level at which they have remained relatively stable since. The objectives of the reserves, as defined by statute, are to aid in the control and protection of the external value of the Canadian dollar and to provide a source of liquidity to the federal government.

Unlike many other countries, Canada's foreign exchange reserves are owned by the federal government, but jointly managed under a relatively unique framework that is based on a partnership between the Government of Canada and the Bank of Canada. This partnership is supported by a well-defined governance structure that ensures that the reserve portfolio is appropriately structured to meet its strategic objectives, that the government's risk tolerances are respected, and that the associated costs and risks are carefully managed.

10.2 Objectives of Reserve Management

Any review of the management of a country's foreign exchange reserves should start by identifying what the purpose of the foreign reserve portfolio is. The underlying objective of the portfolio should play a primary role in determining both the management approach and the portfolio structure. Sovereign countries can have different rationales or objectives for holding reserves. Almost all reserve portfolios are, however, held for one or more of the following three reasons: policy purposes, market liaison, and financial management (Fig. 10.1).[1]

As well, most reserve managers adhere to the classic three strategic priorities of reserve management: liquidity; safety of principal; and return. The relative emphasis placed on each priority will, however, depend on the manager's objectives.

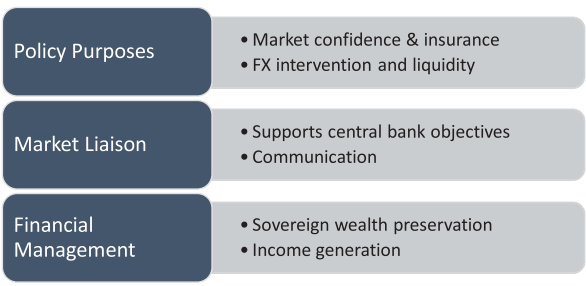

Fig. 10.1 Reserve management objectives

[1] See Nugée (2015).

Reserves held for policy purposes are, in general, a form of insurance against both macro-economic and financial stability shocks. These policy purposes could include, among other objectives, the maintenance and defense of the external value of the domestic currency,[2] defense of the sovereign's credit rating, and ensuring sufficient foreign exchange resources to service external debt loads. More broadly, holding an adequate quantity of foreign assets can provide the government with liquidity that can be used to address a wide range of possible crisis. These can include current account stresses, loss of market access, and runs on the domestic banking system. Foreign exchange reserves are not just useful for dealing with a crisis ex-ante. There is also a pre-emptive component. If the financial markets know that a government has access to a sufficient amount of reserves, there may be a lower probability of a speculative attack on the domestic currency. Reserves held for policy purposes tend to be concentrated in safe, highly liquid assets. Given that the reserves are there for insurance purposes, they need to be usable in a crisis. This tends to mean "flight to safety" assets such as highly rated government bonds that perform well (both in terms of price appreciation and liquidity conditions) in times of economic or financial stress.

The activities associated with the management of a large foreign exchange reserve portfolio can also perform a market liaison function and provide a valuable source of market intelligence to the central bank. This information can inform and support the central bank's other objectives, including monetary policy and financial stability policies. In particular, this market intelligence can support market communication strategies and financial system oversight duties. Reserves held for purposes of market liaison tend to prioritize the safety of principal. These activities do not require the same degree of liquidity in stressed periods that policy-driven reserves do, so managers do not need to pay the liquidity premium necessary to buy the safest assets. Nonetheless, there is generally little appetite for permanent losses in this portfolio.

Finally, some reserves may be held for financial management purposes. These are large reserve portfolios that have an investment-oriented mandate (some combination of income generation, capital appreciation, and long-term wealth preservation). Whether explicitly labeled as such or not, these types of reserve portfolios are economically equivalent to a sovereign wealth fund. Given their objective, these reserves prioritize return above either liquidity or safety.

10.3 Canada's Strategic Objectives

In the case of Canada, the legislative objectives of the foreign reserves, as specified in the *Currency Act*, are to aid in the control and protection of the external value of the Canadian dollar and to provide a source of liquidity for the Government of

[2] It could be at levels either above or below what the domestic currency would trade at if left to freely float.

Canada if required.[3] The reserves are held to provide general foreign currency liquidity to the Government of Canada and to help meet the government's prudential liquidity objectives. Significant foreign currency holdings also add to the market's general confidence in Canada both on the domestic and international level. Given these objectives, Canada's focus is on liquidity and safety of principal. Return, while important, is a secondary focus. In terms of the primary objectives described above, Canada's focus is on reserves for policy purposes. The market liaison function, while valuable, is a secondary objective. Conditional on meeting the policy objectives, financial management factors are taken into account through trying to maximize the return (or minimize the cost) of the portfolio (Fig. 10.2).

The focus on liquidity is necessary to ensure that reserves are sufficient to meet the government's intervention policy and the requirements of the prudential liquidity plan. The intervention policy states that the Bank of Canada may intervene (on behalf of the government) to counter disruptive short-term movements in the Canadian dollar. This could either be due to a significant market breakdown and lack of liquidity or extreme movements in the value of the CAD that seriously threaten economic growth. Canada has not intervened in support of its currency since 1998 (although there have been two incidents of concerted intervention—supporting the euro in 1997 and selling yen in March 2011).

The prudential liquidity plan was launched in 2011 in response to the financial crisis. Under this plan, the government holds sufficient liquid financial assets (in the form of both domestic cash deposits and foreign exchange reserves) to meet financial requirements in situations where normal access to funding markets is disrupted or delayed.[4] Specifically, the government's overall liquidity levels cover at least 1 month of net projected cash flow, including coupon payments and debt refinancing costs.

In both of these cases, the reserves are first and foremost a form of insurance. The portfolio needs to consist of assets whose collective market value and liquidity will

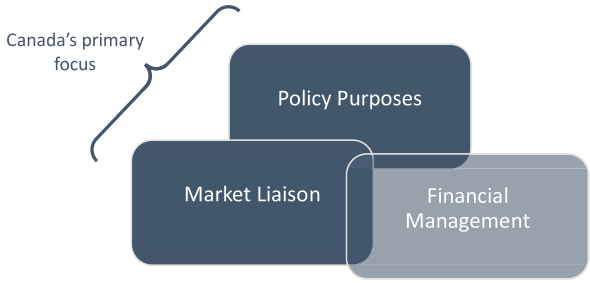

Fig. 10.2 Canada's objectives

[3] http://laws-lois.justice.gc.ca/eng/acts/C-52/.

[4] Domestic cash is held in the form of a demand deposit at the Bank of Canada. The deposit is cost-neutral (it earns a rate of interest roughly equal to the cost of funding). This deposit complements the foreign exchange reserves as it represents a source of domestic currency liquidity that can be easily accessed without the need for any financial market transactions (i.e., no need to sell or repo foreign exchange reserves).

be relatively well-preserved during times of market stress. As such, the portfolio should hold assets that perform relatively well in bad economic and financial circumstances (when the insurance needs to be drawn on). These are often the traditional "flight to quality" assets, such as high-quality sovereign bonds.

Subject to meeting the two primary objectives of liquidity and safety, Canada's reserve portfolio should be prudently managed to either maximize return or minimize cost. There is no need to overpay for the insurance you hold.

10.4 Composition of Canada's Foreign Exchange Reserves

Given Canada's strategic objectives for the reserve portfolio and the associated emphasis on safety and liquidity, the portfolio holds high credit quality, liquid assets denominated in major currencies (Fig. 10.3). Specifically, eligible currencies are restricted to US dollars, euros, Japanese yen, and UK pound sterling. Given the strong linkages between the Canadian and US economies, as well as the role of the US dollar in the global financial system, US dollars make up a majority of the reserve assets. Other liquid currencies are included for asset diversification and return enhancement purposes.

Eligible assets are restricted to fixed-income securities issued by sovereigns, sub-sovereigns,[5] government agencies, and supranational agencies. The reserve portfolio also holds cash in the form of deposits held at foreign central banks or the BIS. Reflecting on the underlying objectives of the portfolio, the assets are of very high credit quality. As of March 31, 2018, 77% of the investments were rated AAA and 85% were rated AA+ or higher.[6] The reserve portfolio does not invest in any structured assets such as collateralized debt obligations (CDOs) or collateralized loan obligations (CLOs). While derivatives are used for funding purposes, they are not used as investments in the asset portfolio.

10.5 Governance of Canada's Reserves

An effective governance regime is essential for the reserves to meet their objectives. A country's foreign exchange reserves can either be owned by the central bank or directly by the sovereign, although the central bank generally is the reserve manager irrespective of asset ownership. Either arrangement can work effectively, what is

[5] Sub-sovereign debt refers to obligations issued by hierarchical tiers below the ultimate governing body of a nation, country, or territory. This includes debt from bond issues made by states, provinces, cities, or towns.

[6] Based on the second-highest rating among those provided by Moody's Investors Service, Standard & Poor's, Fitch Ratings, and Dominion Bond Rating Service.

Fig. 10.3 Portfolio composition. Source: Finance Canada (2017)

important is that the allocation of responsibilities between the government and the central bank be clearly defined and supported by a robust governance structure.[7]

In Canada, the reserves (and the associated liabilities that fund them) are owned by the Government of Canada and appear on the government's national balance sheet. Official liquid reserves are held primarily in an account referred to as the Exchange Fund Account (EFA). As part of its responsibilities as the government's fiscal agent, the Bank of Canada administers and conducts all transactions for the EFA. In practice, however, the reserves are jointly managed through a close and well-specified partnership between the Department of Finance and the Bank of Canada. No external managers are employed in the management of the reserves.

The governance of the EFA is subject to the provisions of a number of different pieces of legislation. These include the *Currency Act*, the *Financial Administration Act*, and the *Bank of Canada Act*.[8] Activities with regard to the EFA assets are

[7] See also Part V: "Governance and Risk Management."

[8] *Financial Administration Act* is available at http://laws-lois.justice.gc.ca/eng/acts/f-11/.
Bank of Canada Act is available at http://laws-lois.justice.gc.ca/eng/acts/B-2/.
Currency Act is available at https://laws-lois.justice.gc.ca/eng/acts/C-52/.

governed by the *Currency Act*, which provides the legal framework for the investment activity and management of the reserves. The liabilities that fund the reserve assets are subject to the precepts of the *Financial Administration Act*. Finally, as part of its responsibilities as fiscal agent, as defined in the *Bank of Canada Act,* the Bank administers and conducts all transactions for the EFA on behalf of the Minister of Finance.

Based on this well-defined legal framework, the EFA is managed jointly through a close partnership between the Bank of Canada and the Department of Finance. The EFA is held in the name of the Minister of Finance, and the Minister must approve the general policies for managing the account. This is primarily done through establishing a set of investment guidelines that are deemed appropriate and consistent with the *Currency Act*. The Department of Finance reports on a monthly basis the level and currency composition of the official international reserves and the Minister also must provide an annual report on the operations of the Account to Parliament.

The actual management of the EFA is conducted though a well-articulated governance process that is based on a number of joint committees. The Funds Management Committee (FMC), which is composed of senior officials from both the Department of Finance and the Bank of Canada, oversees the overall management of the EFA. This includes making policy recommendations to the Minister where necessary. The FMC is supported by a Foreign Reserves Committee (FRC) and a Risk Committee (RC), both of which are again joint-membership committees. The FRC oversees the funding and investment of the foreign reserves and provides strategic and policy advice to the FMC. The RC is an advisory body to the FMC that reviews and reports on risk exposures in the Account, highlights any strategic risk issues that the FMC should be aware of, and identifies and recommends measures to mitigate those risks. The actual day-to-day management of the reserves, including conducting the buying and selling of assets and the execution of funding transactions, is carried out by the Bank of Canada.

10.6 The Costs and Risks of Holding Reserves[9]

Foreign exchange reserves can be expensive to hold. This is because, while they represent an asset for the central bank (or government), they must be funded by an associated liability. In the case of borrowed reserves, this funding is done by explicitly borrowing foreign currency in the financial markets and investing the proceeds in a foreign asset. In the case of reserves that are created by sterilized intervention, the central bank must sell a domestic currency liability (typically a central bank bill or domestic government security). Even unsterilized reserve purchases have an

[9] See also Chap. 6.

associated liability—in this case excess bank reserves. These liabilities carry a cost, either explicitly (having to pay interest on the foreign borrowings or domestic sterilization securities) or implicitly (the impact on domestic monetary policy conditions). As well, there are more indirect costs of excessive reserve accumulation. National wealth that is invested in foreign assets is not available for (potentially) higher-yielding domestic uses.

Each of the three strategic pillars (liquidity, safety of principal, and return) presents a unique cost/risk trade-off. For liquidity, the focus is on the most liquid and safe assets. These are typically short-term government bonds issued by highly rated sovereigns. Given the nature of these reserve assets, they are typically relatively low-yielding. The reserve manager must pay both the liquidity premium and the safety premium. As such, the return on those assets is typically lower than the cost of the sterilization instrument. This results in an ongoing and regular fiscal cost—often referred to as "negative carry." There is also the risk of capital losses as the assets are exposed to changes in foreign exchange rates and interest rates.

If the strategic focus is more tilted towards the safety of principal, the reserve manager does not need to pay the full liquidity premium. While this can allow a shift towards somewhat higher-yielding securities, it is still necessary to pay the safety premium. Very safe assets, even if somewhat less liquid, are still relatively low-yielding. And, they too have exposure to capital losses driven by their mark-to-market exposures.

Finally, trying to maximize returns on reserve assets is difficult, particularly in a low interest rate environment. Shifting the portfolio towards riskier, higher-return assets (or "reaching for yield") may increase the portfolio's expected return, but it also introduces a range of risks into the portfolio, including credit, equity, and potentially even commodity risk. While assuming these risks provides a higher expected return ex-ante, the ex-post realizations can be very volatile, with the chance of suffering a large financial loss.

10.7 Canada's Approach to Managing Costs and Risks

The appropriate approach to managing (or mitigating) the costs and risks associated with reserves again depends on their strategic objectives. Reserves held for policy purposes are typically meant to act as a form of insurance (either against financial stability or macro-economic shocks). Insurance carries a cost, and holding foreign exchange reserves that are appropriate for policy purposes may have this same property. Therefore, for at least some part of the reserve portfolio, the manager may have to accept a fiscal cost.

Reserves held for market liaison purposes also provide some benefits to the central bank. Specifically, the information and insights gathered through the market liaison function can help inform the other functions of the central bank, notably the monetary policy and financial stability (including oversight) functions. As well, the market activities can help inform an effective market communication strategy.

Given the value of these benefits, it may still be appropriate that the central bank "pay" for these benefits through holding relatively safe assets. Given that the market liaison objective does not require the same amount of liquidity as does the pure policy objective, the costs should, however, be somewhat lower (the manager does not need to pay the full liquidity premium).

If return is a primary focus for some or all of the reserves, then it may be necessary to focus a portion of the portfolio's investments into higher-yielding and potentially less-liquid assets. It is important not to overpay for the policy and market liaison functions. The reserve manager should determine the quantity of reserves that needs to be held to support those objectives, but should avoid "over-insuring" by holding more highly liquid (and low-yielding) assets than is required. This could be accomplished by splitting the portfolio into two components that each have a distinct strategic focus. For example, a sub-portfolio of reserve assets could be held with a clear focus on the objectives of liquidity and safety of principal, while a separate sub-portfolio could be focused on maximizing return (and therefore offsetting some of the cost of the first sub-portfolio).

As discussed earlier, Canada's focus is primarily on policy purposes (supporting the prudential liquidity policy and supporting foreign exchange intervention capability) and, to a lesser extent, market liaison (providing market intelligence to the Bank's other functions). As such, the government has little appetite for fiscal losses. The composition of the portfolio is conservative. The costs associated with holding such a liquid and high-quality portfolio are managed through both the asset structure of the portfolio and the associated funding strategy. Given Canada's high credit rating and relatively low borrowing rates, the EFA can typically earn a positive return.

10.8 Portfolio Structure

The asset structure of the EFA is guided by strategic portfolio parameters.[10] These parameters have been established to ensure that the assets held in the portfolio meet the primary objectives of maintaining liquidity and capital preservation. The parameters include, but are not limited to, the absolute level of reserves, the criteria for currency and asset class eligibility (which are based on liquidity and capital preservation considerations), and overall portfolio risk limits. The parameters also define the universe of eligible assets, which include fixed-income securities issued by sovereigns (including central banks and government-related entities), sovereign-supported issuers, sub-sovereign entities, and supranational institutions.

The following three categories of issuers have been defined for the EFA:

[10] See the Statement of Investment Policy for the Government of Canada (August 2018).

- *Reference issuers*: These are government issuers of securities that are deemed by Canada to have reserve currency status and are actively traded. Given the policy focus of Canada's reserves, this category must make up at least 35% of the EFA.
- *High credit quality issuers*: These are government issuers of securities that are deemed by Canada to be of very high credit quality.
- *Other issuers*: other issuers, both sovereign and other entities, that meet Canada's credit, liquidity, and capital preservation standards.

A relatively high allocation to reference issuers and other liquid sovereigns ensures that Canada's liquidity and capital preservation objectives are met. Some limited exposure to other issuers helps to provide an incremental return.

The strategic portfolio parameters also identify the government's liquidity risk tolerances. They specify the minimum size for the EFA (at or above 3% of Canada's nominal gross domestic product) and, reflecting the nature of Canada's economic and financial exposures, require at least 50% of the EFA's assets to be denominated in US dollars. As well, at least 6% of the EFA must be held in US Treasury bills or US dollar cash.

These parameters also establish the capital preservation tolerance by defining both the maximum term-to-maturity of the investments and the range of currencies that are eligible. The maximum permitted maturity of any individual asset is 10.5 years. Limiting the maximum term-to-maturity of the assets helps in preserving the liquidity and capital value, allowing them to be readily deployed if necessary. With regard to currency risk, a minimum of 50% of the EFA must be denominated in US dollars. Other currencies may be held where their reference issuers satisfy the liquidity and capital preservation constraints. Specifically, other currencies eligible to be held in the EFA include euros, British pounds, and the Japanese yen.

The capital preservation objective is further strengthened by requiring a minimum credit rating (as deemed by Canada of "A-" equivalent or higher) for issuers. Reference issuers of securities that are deemed to have reserve currency status are exempt from these minimum credit rating requirements.

While not explicitly characterized as such, the use of these strategic portfolio parameters effectively creates a "liquidity" portfolio and an "investment" portfolio. The parameters specify a minimum allocation to highly liquid securities issued by reference issuers. They also specify a minimum US dollar weighting. This ensures an appropriate amount of liquidity will be available in the event of an economic or financial shock (the portfolio will be able to meet its insurance objectives). Once those requirements have been met, the parameters allow diversification into other securities as a means of enhancing returns.

10.9 Asset and Liability Matching

The limits and constraints embedded in the EFA's strategic parameters can help manage asset risk, but the reserves still face a significant risk of capital loss associated with an interest rate of foreign exchange volatility. The diversification and asset quality standards that are specified in the portfolio parameters are less effective at controlling interest rate and foreign exchange exposures. Interest rate and foreign exchange volatility and correlations are extremely unstable and are not conducive to the more traditional mean–variance optimization strategies of maximizing the risk and return trade-off of a portfolio. These risks are best addressed through managing the EFA on an asset and liability matched (ALM) basis. This approach materially reduces both interest rate and foreign exchange risk, as well as providing increased clarity around the costs associated with hedging those risks.

As described earlier, all reserve assets have an associated liability. This liability can be denominated in either the domestic or foreign currency and can have a term-to-maturity ranging from overnight (for central bank reserves) to 10 years or longer (for market-based sterilization instruments). The goal of Canada's asset and liability matching framework is to align the assets and liabilities of the EFA as closely as possible in terms of both their currency and interest rate exposures (duration). We explicitly transform the funding of the reserves into foreign currency liabilities of the same currency and duration as the underlying assets. This is done through either direction foreign issuance or cross-currency swaps of domestic debt. The swap program is conducted with both domestic and foreign financial institutions and is supported by a robust risk management framework. Swap transactions are only conducted with financial institutions having acceptable credit ratings. Credit risk is also managed through collateral provisions in swap and foreign exchange forward contracts. Counterparties must pledge collateral to the Government, which, in the event of default, could be liquidated to mitigate credit losses. The Government of Canada participates in a two-way collateral program in accordance with Credit Support Annex (CSA) agreements for its cross-currency swap portfolio.

There are several benefits to this strategy. First, it has proven very effective at mitigating the EFA's exposure to adverse changes in interest rates and foreign exchange rates. In the case of Canada, the residual foreign exchange and interest rate risk in the EFA portfolio is negligible. For example, as of 31 March 2018, the asset Value at Risk (VaR) of the portfolio was just under CAD 1 billion. The combined asset and liability portfolio, however, had an interest rate and foreign exchange VaR of less than CAD 20 million. This is a reduction of roughly 98%. The ALM framework also provides clarity around the direct costs of holding reserves. Funding costs are directly observable—they are simply the difference in yield between the reserve asset and its term and currency matched liability.

The ALM framework is not without its challenges, however. Credit risk is not hedged in this framework. Foreign-issued securities are hedged with the Government of Canada issued liabilities. The market values of these assets and liabilities can diverge and there can be significant basis risk present. For example, as of 31 March

2018, the total market VaR of the EFA (which measures all sources of market risk—foreign exchange, interest rate, and credit) is approximately CAD 500 million. Assuming adequate credit quality, however, this basis risk should be both relatively contained and mean reverting over time. This is not necessarily the case for foreign exchange and interest rate risk. Furthermore, any intervention that is conducted would open an unhedged foreign exchange position in the reserve portfolio. This approach, therefore, may not be suitable for a country with an active intervention policy. Finally, managing the reserves under a strict ALM framework is relatively expensive. Countries have a comparative advantage in borrowing in their own domestic currencies. Direct foreign borrowing can be expensive (certainly vis-à-vis the yield on foreign assets) and a liquid cross-currency swap market (required to turn domestic liabilities into foreign currency) may not exist at relevant maturities.

10.10 The Risk Management Framework[11]

While the combination of the portfolio structure of the EFA and the associated ALM framework materially reduces the amount of financial risk taken in the portfolio, the EFA is nevertheless still exposed to a range of risks, including market, credit, liquidity counterparty, and operational. Reflecting this, the government and the Bank have developed a comprehensive risk management framework. Under this framework, EFA officials are responsible for measuring, monitoring, and reporting the key performance and risk exposures of the portfolio. These exposures are tracked relative to a benchmark.

Much of the framework involves measuring and reporting on key criteria specified in the key portfolio parameters, including ensuring that currency and security composition has not deviated outside of the approved ranges and that liquidity and credit tolerances are respected. Market risk in the EFA is measured and reported on using a range of quantitative tools and associated limits. These include stress tests, scenario analysis, and standard statistical measures of risk such as VaR and Expected Shortfall (ES).

Stress tests are carried out to gauge the EFA's sensitivity to relatively large shocks to both interest rates and foreign exchange rates. This is supplemented with scenario analysis, which examines what the portfolio's performance would have been during a number of previous extraordinary events over the past 25 years.[12] While there are no formal limits based on the results of these tests, they are used by the various governance committees in a subjective manner to better understand the risk profile of the EFA.

[11] See also Chap. 19.

[12] These include, among others, events such as the 1997 Asian Financial Crisis, the 1998 Russian debt default, the 2008 global financial crisis, and the 2010 European debt crisis.

A number of VaR and ES measures are used to track the portfolio's sensitivity to changes in interest rate, foreign exchange rates, and credit spreads over a given holding period. In particular, the EFA makes use of a Total Market VaR measure which estimates the possible loss in portfolio value within a 10-day holding period that can arise from the combined effect of change in interest rates, foreign exchange rates, and credit spreads. This measure is one of the key risk tolerance thresholds for the EFA and is regularly reported for both the assets only and the combined asset and liability portfolio.

Credit risk in the EFA is mitigated by requiring that both eligible investments and funding counterparties be of acceptable credit quality. This determination, while informed by external ratings, is based on a comprehensive and robust internal credit rating process. Counterparty risk is further mitigated through the use of a collateral management framework that mitigates credit exposures arising from any swap-related funding activity. Under this framework, initial margin is pledged by the swap counterparties to the EFA at the initiation of the swap. In addition, variation margin is received or paid based on the fluctuations in the market value of the swap. Unlike a number of other sovereigns and supranational institutions, Canada's collateral management framework is two-way. Canada, while not posting any initial margin, will post variation margin as required.

10.11 Conclusion

Canada's foreign exchange reserves, the majority of which are held in the EFA, are owned by the Government of Canada, but managed through a partnership between the Department of Finance and the Bank of Canada. This partnership structure is supported by a well-articulated governance structure, including a number of joint decision-making committees. The reserves are largely held for policy purposes, namely to provide liquidity to the Government of Canada and to help meet the government's prudential liquidity objectives. The foreign currency holdings also support the market's general confidence in Canada. Given these objectives, Canada's focus is on liquidity and safety of principal. Return, while important, is a secondary focus.

Foreign currency reserves carry material financial risks. To help manage these risks, the asset structure of the EFA is guided by a number of strategic portfolio parameters. These parameters ensure that the assets held in the EFA support the strategic priorities of liquidity and safety of principal while also striving to minimize the cost of holding reserves. These parameters define the eligible currencies, issuers and asset classes, minimum credit and liquidity standards, and quantitative limits for overall portfolio risk.

The diversification and asset quality standards specified in the portfolio parameters are less effective at controlling interest rate and foreign exchange exposures. To better manage these risks, Canada manages the EFA using an ALM framework. Under this approach, every foreign currency asset is funded by a liability of the

identical currency and term-to-maturity. This effectively hedges the EFA's foreign exchange and interest rate exposures, although significant basis risk can remain.

The asset and liability matching framework has served Canada extremely well, effectively eliminating foreign exchange and interest rate risk at relatively low cost. There are a number of factors that explain this. First, Canada has a floating exchange rate with very infrequent intervention. As a result, the reserve portfolio stays hedged. Second, Canada's high credit quality and well-developed capital markets mean that it can fund the foreign exchange reserves relatively cheaply, both directly and synthetically. This allows the EFA to meet its liquidity and capital preservation goals and, typically, earn a positive net return.

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Chapter 11
How Singapore Manages Its Reserves

Ravi Menon

Abstract Singapore's reserves serve three objectives—as a buffer against crisis, as an endowment to finance current needs, and to maintain confidence in Singapore's exchange rate-centered monetary policy. The reserves are managed in three pots—the Monetary Authority of Singapore (MAS), as the central bank, manages the official foreign reserves (OFR) and invests them mainly in safe and liquid assets; the GIC, a fund manager to the government, manages a diversified portfolio with a higher risk profile to achieve sustainable long-term returns; Temasek, an investment company wholly owned by the government, is an active equity investor which seeks to deliver long-term shareholder value. MAS' approach to managing the OFR encompasses robust risk management, balanced asset allocation, and an efficient investment process. Risk management involves the setting of liquidity and risk tolerance levels, and employing stress tests to assess the risks to the portfolio. To achieve a balanced asset allocation, the OFR is diversified across geographic regions, asset classes, and currencies. The investment process includes judicious benchmark selection and customization, and tapping into specialized external investment expertise.

11.1 Introduction

Singapore has official foreign reserves (OFR) of almost US$300 billion (Fig. 11.1). In absolute terms, this is the 11th highest stock of OFR in the world, and as a percentage of GDP, and on a per capita basis, it is the third highest in the world.

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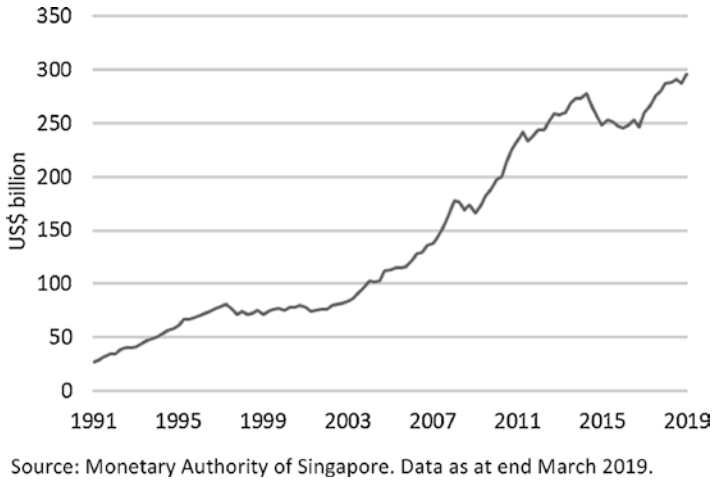

Fig. 11.1 Singapore's official foreign reserves. Source: Monetary Authority of Singapore. Data as at end March 2019

Singapore's OFR sit on the balance sheet of the Monetary Authority of Singapore (MAS), the central bank and integrated financial regulator.

Besides the OFR, there are two other pots of national reserves in Singapore. The Government of Singapore Investment Corporation (GIC) is a fund management company that manages on behalf of the Singapore government a diverse portfolio of foreign assets well in excess of US$100 billion. In addition, Temasek Holdings, an investment company wholly owned by the Singapore government, holds equity stakes in a variety of domestic and foreign corporates, amounting to more than US$200 billion.

This chapter seeks to answer three questions: what role do the reserves play, how are the reserves accumulated and managed, and how are the OFR managed?

11.2 Why Does Singapore Hold Reserves?

Singapore's reserves serve three objectives—to serve as a buffer against crisis; to provide a stream of investment income to help finance part of the annual government budget; and to maintain confidence in Singapore's exchange rate-centered monetary policy. The reserves are thus a "rainy-day" fund, an endowment fund and a stability fund.[1]

The imperative to hold a buffer against crises is rooted in Singapore's geography and history. Specifically, it is a city state smaller than Greater London and has no natural resources. It has to import most of its food, including water. When Singapore

[1] See also Chap. 7.

became independent in 1965, it had no hinterland and meagre financial reserves, and depended mostly on entrepot trade as it hardly had an industrial base. It was not expected to survive, let alone succeed.

An acute sense of vulnerability has been part of Singapore's DNA since its birth. This sense of vulnerability, in turn, underpinned two convictions: first, that the only way to survive and make a living is to make Singapore relevant to the world; and, second, it must build up strong buffers so that it can withstand the shocks that come with being so small and open to the world.

As Singapore grew and prospered as a business and financial center, its vulnerabilities to the vagaries of global trade and financial cycles also grew. The need to build up a sufficient "rainy-day" fund to tide it through shocks and crises has remained as relevant as ever. Total trade is three times the size of the Singapore economy and gross capital flows into and out of Singapore are 77% of GDP.

The role of the reserves as a "rainy-day" fund is not theoretical, as these reserves have indeed served Singapore well in past crises. For instance, they helped underpin confidence in Singapore in the throes of the Asian financial crisis, and during the global financial crisis, the reserves were drawn down to finance a package of measures aimed at preserving jobs by subsidizing employers' wage bills and helping viable companies to stay afloat by sharing the risk of bank lending.

A second purpose of the reserves is to serve as an endowment. This has grown in importance, and salience, in recent years. The income from investing the reserves provides an increasingly important source of revenue to fund government expenditure. The size of government in Singapore is small, with government spending—comprising both operating and development expenditure—at about 16% of GDP. However, tax and non-tax revenues are even lower, at 15% of GDP. In other words, Singapore runs a structural deficit on its primary fiscal balance.

This is where the investment income from the reserves comes in. The constitution of Singapore bars the government from borrowing to spend or to spend surpluses accumulated from previous terms of government. Instead, it allows the government to spend up to half of the expected long-term real returns from the net assets invested by MAS, GIC, and Temasek. This is known as the Net Investment Returns Contribution (NIRC). The NIRC is already the largest single contributor to revenues in the government budget, accounting for about one-fifth of revenues (Fig. 11.2).

The role of the reserves as an endowment from which to draw a steady stream of income to finance the government budget will become even more important in the years ahead. An aging population will mean higher expenditures, especially for healthcare, and slower economic growth will mean lower tax revenues.

The third purpose of the reserves is to serve as a stability fund. More specifically, the reserves help to maintain confidence in Singapore's exchange rate-centered monetary policy framework. As Singapore is a small and highly open economy, inflation and aggregate demand are more significantly influenced by the exchange rate than interest rates. Singapore's monetary policy is therefore centred on managing the exchange rate of the Singapore dollar against a basket of currencies within a

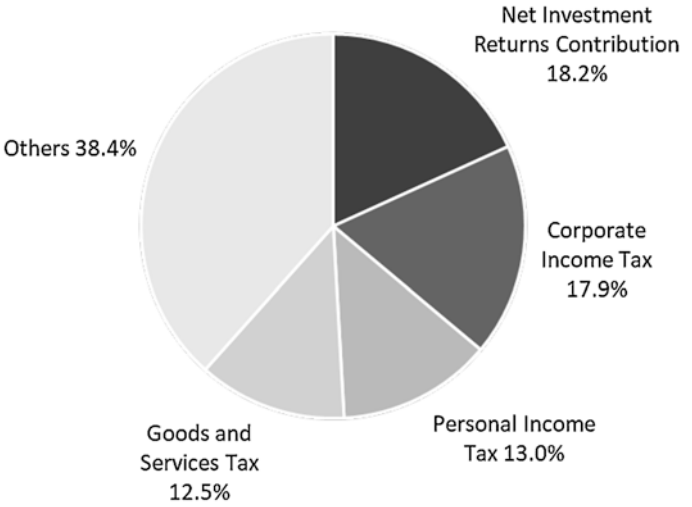

Fig. 11.2 Singapore government revenue contributors. Source: Singapore Ministry of Finance. Financial Year 2018 budget data

policy band. The reserves play an important role in enabling MAS to conduct monetary policy and secure macroeconomic stability.

11.3 How Are the Reserves Accumulated and Managed?

Singapore's reserves are held and managed in three distinct pots: MAS, GIC, and Temasek (Fig. 11.3). The government sets the overall investment objectives for the three entities, and monitors the risk and return profile of the total reserves. However, it plays no role in the investment decisions of the three entities, which are made on purely professional grounds.

11.3.1 Monetary Authority of Singapore

MAS, as Singapore's central bank, manages the OFR. The process of accumulating or using OFR is intricately tied to MAS' conduct of monetary policy. MAS may accumulate or sell foreign assets, principally through its intervention operations in the foreign exchange market, to manage the float of the Singapore dollar. Given Singapore's positive net savings and persistent capital inflows, the nominal exchange rate often tends to appreciate more than what is required to keep inflation low and

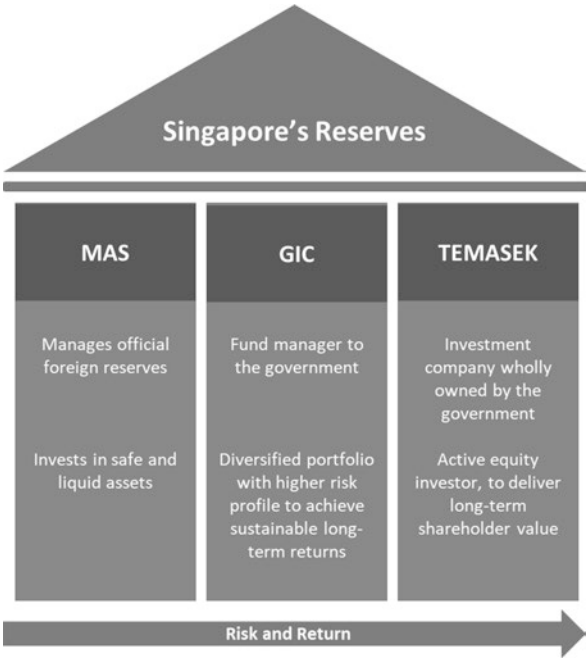

Fig. 11.3 Overview of MAS, GIC, and Temasek

stable. MAS accumulates foreign assets on average in the process of managing the Singapore dollar within its policy band even as it sells foreign assets during times of stress on the Singapore dollar.[2]

As the central bank, MAS is the most conservative of the three investment entities, with the OFR invested mainly in safe and liquid assets. The OFR is sized to take into account its role as a buffer against a large and sudden outflow of capital that would undermine confidence in the exchange rate and Singapore's macroeconomic stability. Traditional measures of reserve adequacy, such as the number of months of imports the OFR could finance if all other sources of foreign financing dried up, are less relevant for Singapore. A sizable and liquid OFR sends a clear signal that MAS has the wherewithal to resolutely defend the Singapore Dollar against speculative attacks.

11.3.2 The Government of Singapore Investment Corporation

The GIC is a professional fund management company that manages the government's foreign assets. These assets are separate from the OFR. The history of GIC begins with MAS. Through the 1970s, Singapore ran persistent fiscal surpluses,

[2] See also Part V.

received sizeable capital inflows, and had an elevated private savings rate. This led to a substantial accumulation of OFR, well in excess of what was required for MAS' central banking operations. Therefore, in 1981 the GIC was set up—in today's parlance, as a sovereign wealth fund—to manage part of the reserves for higher returns without the central bank constraints of liquidity. Part of the OFR was transferred from MAS to GIC, which was tasked with investing the reserves in a globally diversified portfolio of asset classes with a higher risk profile to deliver good long-term returns.

11.3.3 Temasek Holdings

The third pot of reserves is managed by Temasek, an investment company wholly owned by the government. Temasek's history also dates back to the early years of Singapore's development. There was little private capital in those days, but a rapidly industrializing economy needed key infrastructure—including in aviation, shipping, telecommunications, banking. The government therefore set up enterprises in these areas. Temasek was formed as a holding company for these enterprises in 1974 so that the government could focus on its roles of policymaking and regulation without conflict, while Temasek would own and manage these investments on a commercial basis.

Today, Temasek is an active equity investor that aims to deliver sustainable long-term shareholder value. More than a quarter of Temasek's portfolio is invested in Singapore, with the rest invested in Asia and global markets. The initial portfolio was provided by the government, but since then Temasek's funds have come mainly from the investment growth of its own portfolio. Compared to MAS and GIC, Temasek is further out on the risk/return spectrum.

11.4 How Are the OFR Managed?

The OFR is the portion of the reserves that MAS is responsible for. There are three prongs to MAS' approach to managing the OFR—robust risk management; balanced asset allocation; and efficient investment process.

11.4.1 Robust Risk Management

The starting point to MAS' approach to managing the OFR is its risk management framework, which sets out its liquidity and risk tolerance levels. These relate to the ability of the portfolio to meet liquidity needs under stress conditions, and the maximum loss of the portfolio under tail risk scenarios. These liquidity and risk tolerance

levels are determined on the basis of what is minimally required to meet the objectives of the OFR in supporting MAS' conduct of monetary policy. They are factored in the construction of the MAS portfolio and closely monitored on an ongoing basis.

MAS employs a comprehensive range of stress tests to assess the risks to the portfolio on a continual basis, and to establish whether the portfolio remains resilient to potential tail risk events over the medium term. The following types of stress tests are conducted:

- Historical: Shocks are applied to the portfolio using asset price movements seen in historical stressed episodes, such as the global financial crisis, the dot.com bust of 2000, the 1994 bond market sell-off, etc.
- Vulnerability-based: The portfolio is subject to hypothetical scenarios that stress in turn each of the portfolio's risk factors, such as equity, interest rate, credit, inflation, and foreign exchange.
- Thematic: These are forward-looking stress tests that are designed by considering prevailing market conditions and potential risk events on the horizon.

Depending on the stress-test results, MAS will consider appropriate responses and portfolio adjustments when needed. The risk management framework is reviewed on a regular basis to ensure it remains fit for purpose.

11.4.2 Balanced Asset Allocation

Subject to the liquidity and risk tolerance thresholds, MAS seeks to achieve good long-term returns on the OFR through a balanced asset allocation. It invests the OFR in a well-diversified portfolio, probably more diversified than is the case for most central banks.

The portfolio is geographically diversified across advanced and emerging market economies, with investment-grade bonds in advanced economies making up the largest share. The portfolio is also diversified across asset classes, in cash, bonds, and equities, and has a diversified currency mix, with about three-quarters of the OFR denominated in US dollars, euros, Japanese yen, and pound sterling, with the US dollar forming the bulk.

Each asset class in the portfolio serves a function. Cash and nominal government bonds facilitate regular operational needs and can be quickly deployed to fulfill urgent liquidity needs under stressed conditions. Advanced economy inflation-linked bonds are less liquid than nominal bonds but provide inflation protection. Equities provide exposure to long-term growth assets with higher return potential, but also with higher risk.

MAS' investment horizon is longer than that of many central banks. This has given it the flexibility to invest in more volatile and longer duration asset classes beyond fixed income, including equities. Both the risk management framework and strategic asset allocation are approved by the MAS board of directors and reviewed regularly.

11.4.3 Efficient Investment Process

MAS strives to achieve an efficient investment process, underpinned by two elements: judicious benchmark selection and customization, and tapping into specialized external investment expertise. First, MAS uses asset class benchmarks to represent the investment universe and risk profile of each asset class that can be easily replicated to evaluate its investment performance. These benchmarks could be market capitalization weighted or customized. For some asset classes, MAS has chosen to apply certain customizations to market capitalization weighted benchmarks, guided by considerations of liquidity, stability, and concentration risk.

One area where MAS has applied customization is in fixed income, where the gains from credit improvement are limited, relative to the large downside from the threat of default. MAS has therefore limited its exposure to some large government bond markets, taking into consideration the default risk of these bonds.

Another area where MAS has customized its benchmark is with respect to renminbi (RMB) assets, in particular Chinese government bonds. Here, the consideration was not to limit exposure but to gain exposure ahead of market benchmark inclusion as markets develop. MAS started investing in RMB assets in 2012, fully expecting market indices to catch up at some point. Indeed, recent announcements by major index providers to include or accelerate the schedule of inclusion for RMB assets in their indices reflect this trend.

Next, there is tapping into relevant investment expertise. Part of the MAS portfolio is managed by reputable external fund managers who are hired for their deep investment expertise and specialized knowledge in particular investment fields. For instance, factor-based investing is an area that MAS is watching closely. Institutional investors are starting to look beyond asset classes to view returns via a "factor lens." There are two applications of this approach: return enhancement and portfolio analysis. Looking through asset class labels to underlying risk factor exposures can enhance understanding of return sources. Equally, they also help to enhance an understanding of risk drivers.

In fact, the vulnerability-based stress tests that were described earlier are an application of this factor approach. This can help investors to create more efficient and diversified portfolios, compared to a traditional asset class-driven approach. However, MAS has also been mindful not to fall into the trap of data-mined quantitative strategies that rely on factors that may not be robust through time.

11.5 Conclusion

In Singapore, reserve management is a multi-objective, multi-agency, and, most importantly, a multi-generational effort. The reserves serve as a buffer against bad times, as an endowment to finance current needs and as a foundation for macroeconomic stability. As custodians of the national reserves, MAS, GIC, and Temasek

owe a duty of care and responsibility to the ultimate beneficiaries of the reserves: current and future generations of Singaporeans. It is a duty that motivates their investment and risk managers as they go about their work each day, trying to extract value while staying clear of pitfalls, amidst the turbulence, tides, and ebbs of the financial markets.

Chapter 12
European Central Bank: The Investment Decision-Making Process and Its Governance

Torsti Silvonen and Etienne Port

Abstract This chapter describes the foreign reserve management framework of the European Central Bank (ECB) and the related decision-making process. The ECB's decentralized foreign reserve management system is unique among central banks around the world, as it involves all of the national central banks which are part of the Eurosystem. This special characteristic influenced the design of the framework, as well as its functioning and governance. The distinctive features of and roles played by the three investment management layers (i.e., the strategic and tactical benchmarks, as well as the actual portfolios) are covered in detail, including the decision-making structure of each level. The chapter describes the evolution of the ECB's reserve management framework over time which has been shaped by the aims to create incentives to enhance performance and promote risk-taking at various levels, encourage open information and knowledge sharing, as well as support inclusiveness within the Eurosystem. The framework has been periodically adjusted as a result of the inclusion of new members in the Eurosystem and has also contributed to enhancing the absolute return on the ECB's foreign reserves.

12.1 Introduction

The European Central Bank (ECB) and the Eurosystem were established in June 1998 and have a unique foreign reserve management framework. The Eurosystem aims to perform its policy function efficiently by using the experience and expertise of the national central banks (NCBs), which act as "internal external" managers for the ECB. This chapter describes how the decentralized framework is set up and governed and how it has been functioning from a governance and decision-making

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perspective. It is structured in three sections. Section 12.2 explains why the ECB's foreign reserve management framework is distinctive in its setup. Section 12.3 goes more into the details of the ECB's governance and decision-making structure for its decentralized foreign reserve management framework. Section 12.4 examines how the framework has been adjusted and has worked over the years. Section 12.5 concludes.

12.2 The Unique Foreign Reserve Management Framework of the ECB

This section provides the background to the ECB's governance structure by explaining why the ECB's foreign reserve management framework is unique and what makes it different from that of other central banks.

12.2.1 The ECB's Decentralized Framework

The European System of Central Banks (ESCB) consists of the ECB and the NCBs of the European Union (EU) Member States. The Eurosystem is a subset of the ESCB and consists of the ECB and those EU central banks that have adopted the euro. The central banks of all EU Member States are the sole subscribers to and holders of the ECB's capital and the shares of each of them in this capital subscription are calculated using a so-called capital key which reflects the respective country's share in the total population and gross domestic product of the EU, with these two determinants having an equal weighting. These shares are adjusted every 5 years and whenever a country joins or leaves the EU. Table 12.1 shows the share of euro area and non-euro area NCBs in the capital of the ECB.

The activities of the ESCB are carried out in accordance with the Treaty on the Functioning of the European Union and the Statute of the European System of Central Banks and of the European Central Bank. Accordingly, the NCBs of the Eurosystem participate in the ECB's policy and investment operations to the extent deemed possible and appropriate and, with a view to ensuring operational efficiency, the ECB has recourse to the NCBs for carrying out the operations which form part of the tasks of the Eurosystem.

The Statute of the ESCB describes the ECB's main tasks, which include the conduct of foreign exchange operations and the management of the official foreign reserves of the euro area countries. The official reserve assets of the ECB have been provided by the NCBs of Member States[1] whose currency is euro (participating

[1] "*The European Central Bank (ECB) shall be provided by the national central banks (NCBs) of Member States which have adopted the single currency in accordance with the Treaty establishing*

Table 12.1 Euro area and non-euro area NCBs' current share of the ECB's capital[a] (capital key)

NCBs	Country	Capital key in %[b]	Euro area membership	Share in the capital paid up by euro area NCBs in %[c]
Nationale Bank van België/ Banque Nationale de Belgique	Belgium	2.4778	1999	3.5200
Deutsche Bundesbank	Germany	17.9973	1999	25.5674
Central Bank of Ireland	Ireland	1.1607	1999	1.6489
Banco de España	Spain	8.8409	1999	12.5596
Banque de France	France	14.1792	1999	20.1433
Banca d'Italia	Italy	12.3108	1999	17.4890
Banque centrale du Luxembourg	Luxembourg	0.203	1999	0.2884
De Nederlandsche Bank	The Netherlands	4.0035	1999	5.6875
Oesterreichische Nationalbank	Austria	1.9631	1999	2.7888
Banco de Portugal	Portugal	1.7434	1999	2.4767
Suomen Pankki—Finlands Bank	Finland	1.2564	1999	1.7849
Bank of Greece	Greece	2.0332	2001	2.8884
Banka Slovenije	Slovenia	0.3455	2007	0.4908
Central Bank of Cyprus	Cyprus	0.1513	2008	0.2149
Central Bank of Malta	Malta	0.0648	2008	0.0921
Národná banka Slovenska	Slovakia	0.7725	2009	1.0974
Eesti Pank	Estonia	0.1928	2011	0.2739
Latvijas Banka	Latvia	0.2821	2014	0.4008
Lietuvos bankas	Lithuania	0.4132	2015	0.5870
Euro area NCB sub-total[d]		70.3915		100.00
Българска народна банка (Bulgarian National Bank)	Bulgaria	0.859		
Česká národní banka	Czech Republic	1.6075		
Danmarks Nationalbank	Denmark	1.4873		
Hrvatska narodna banka	Croatia	0.6023		
Magyar Nemzeti Bank	Hungary	1.3798		
Narodowy Bank Polski	Poland	5.123		
Banca Naţională a României	Romania	2.6024		
Sveriges Riksbank	Sweden	2.2729		
Bank of England	United Kingdom	13.6743		
Non-Euro area NCB sub-total[d]		29.6085		
Total[d]		100.00		

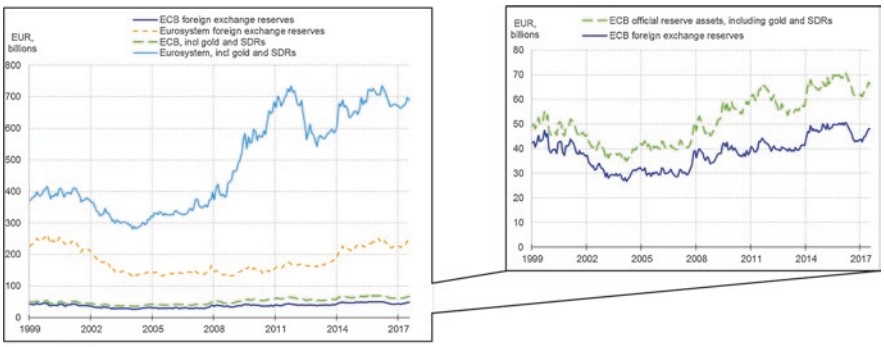
Source: ECB

[a]As at 31 July 2018

[b]Used for the calculation of NCBs' contributions to the ECB's foreign reserve assets

[c]Euro area NCBs' capital key rebased to 100 for the Eurosystem, used to calculate the size of the ECB's foreign reserve portfolio allocation to NCBs

[d]Owing to rounding, the total may not correspond to the sum of all numbers shown



Source: ECB.

Fig. 12.1 Eurosystem and ECB foreign exchange reserves and official reserve assets. Source: ECB

NCBs). Each participating NCB has transferred to the ECB foreign reserve assets in proportion to its share in the capital of the ECB. Table 12.1 shows that, as at 31 July 2018, 70.3915% of the foreseen EUR 58 billion equivalent of foreign reserve assets had already been provided. Figure 12.1 illustrates that the market value of official reserve assets expressed in euro terms changes over time due to investment returns and fluctuations in the market prices of investments and in exchange rates.

The market value of the ECB's official reserve assets[2] was at the end of 2017 equivalent to around EUR 62 billion, of which around EUR 43.8 billion were in foreign currencies (the US dollar, the Japanese yen, and the Chinese renminbi) and the remainder was mostly composed of gold (EUR 17.6 billion) and special drawing rights (SDRs).

In total, the Eurosystem held EUR 669.7 billion worth of official reserve assets, of which around EUR 227 billion were in foreign currencies and the remainder was mostly composed of gold (EUR 375 billion) and SDRs. The ECB's foreign reserves are one component of the combined foreign reserves of the Eurosystem and can be considered as the Eurosystem's liquidity tranche, whereas the NCBs hold the investment tranches with more management flexibility which may also allow them to focus more on return aspects. Indeed, in case of need, the foreign exchange (FX) interventions by the Eurosystem are financed using the ECB's foreign reserves, for

the European Community (participating NCBs) with foreign reserve assets…," according to the Guideline of the European Central Bank of 3 November 1998 as amended by the Guideline of 16 November 2000 on the composition, valuation, and modalities for the initial transfer of foreign-reserve assets, and the denomination and remuneration of equivalent claims (ECB/2000/15), OJ L 336, 30.12.2000, p. 114. As a result of EU enlargement, and in application of Article 48.3 of the Statute of the ESCB, the limit on the euro equivalent of the foreign reserves that may be transferred to the ECB was increased to currently EUR 58 billion. The euro equivalent of the foreign reserve assets transferred to the ECB is based on end-December 1998 exchange rates.

[2] Following the definition of official reserve assets on the ECB's website: http://www.ecb.europa.eu/stats/ecb_statistics/escb/html/table.en.html?id=JDF_RA6_RESERVE_ASSETS&period=2017-12.

which an overriding priority is assigned to liquidity and security ahead of return considerations.

The foreign reserve management framework of the ECB is based on a decentralized approach. When the ECB was initially set up, it was perceived that leveraging on the expertise of the euro area NCBs for the management of the ECB's foreign reserves would be particularly opportune in the early stages when the ECB might not quickly gain full operational capability to manage its FX reserves itself. However, while some functions, such as risk management and accounting, are nowadays carried out in a centralized manner at the ECB, most of the front and back-office functions are decentralized across the Eurosystem and the decentralization principle remains a cornerstone of the ECB's foreign reserve management framework. The ECB carries its foreign reserves in its balance sheet and gives an agency mandate to each participating NCB for the management of foreign reserve portfolios, similar to what some institutions do with external investment managers. This unique management structure was established with a view to ensuring an effective solution given the time constraints and to promoting broader considerations based on the inclusiveness of all Eurosystem members. Initially, each NCB managed both US dollar and Japanese yen portfolios[3] with a distribution of portfolio sizes to euro area NCBs equal to their share in the ECB capital paid up by euro area NCBs, as shown in the right column of Table 12.1. The NCBs' portfolios are periodically rebalanced to ensure that the relative size of the ECB's foreign reserve portfolios managed by NCBs reflects their share in the capital paid up by euro area NCBs.

12.2.2 The Purpose of the ECB's Foreign Reserves

The purpose of the ECB's foreign reserves is to ensure that, whenever needed, the Eurosystem has a sufficient amount of liquid resources available for its FX policy operations involving non-EU currencies. It should be noted, however, that the ECB's capacity to intervene in the foreign exchange markets is not restricted by its foreign reserve holdings on its own balance sheet, which in terms of their absolute size do not seem very large. This is because the NCBs are obliged to provide an additional amount of foreign reserves to the ECB should the need arise. The ECB could also fund FX interventions without having recourse to foreign reserve holdings, for example, by using foreign exchange swaps with market participants or with the relevant central banks.

The exchange rate of the euro vis-à-vis other currencies is determined by market forces. This is consistent with the long-standing commitment of the international community to market-determined exchange rates. The ECB has intervened in the foreign exchange market only on rare occasions since 1999, and then in close cooperation with the G7 members. The last intervention was in 2011 as part of a con-

[3] Gold is not actively managed.

certed international FX intervention to stabilize the yen at the request of the Japanese authorities following the tsunami catastrophe in Japan.

12.2.3 The Challenge Posed by EU Enlargement in 2004

Ten new countries joined the EU in 2004, with the presumption that they would eventually join the euro area after fulfilling the convergence criteria. As each Eurosystem NCB is entitled to participate in the operational management of the foreign reserve assets transferred to the ECB, the expected enlargement of the euro area naturally posed a challenge in terms of including an increasing number of Eurosystem NCBs in the ECB's foreign reserve management framework.

If done mechanistically, the enlargement of the euro area would have resulted in a significant increase in the number of the ECB's foreign reserve portfolios distributed to NCBs under an unchanged assumption that each NCB would manage two portfolios, one in USD and another in JPY. The ECB identified this challenge early on and, after around 4 years of experience with the decentralized framework, assessed in 2002 the potential impact of EU enlargement on the operational and risk management frameworks.

The outcome of the assessment led to the first change: the streamlining of the framework and the so-called *currency specialization* scheme that was implemented in 2006. The currency specialization scheme foresees that NCBs choose normally one currency of specialization for the management of the ECB reserve portfolios. The aim was to further increase overall specialization, limit the number of (small) portfolios, and maintain an efficient but diversified framework.

This new structure reduced the total number of ECB foreign reserve portfolios from 24 to 14 in 2006, even before any NCB of the new EU Member States that had adopted the euro joined the Eurosystem. As a result, the average size of the NCBs' portfolios increased. The second change after 2006 was the possibility given to any new Eurosystem NCB to pool its operational management activities with one or more other Eurosystem NCBs. Most of them would have had relatively small portfolios owing to their relatively small share in the ECB's capital key and could reach a larger portfolio size by pooling portfolios with another NCB. By 2018, six of the seven new Eurosystem NCBs since 2006 had chosen the pooling option.[4] Moreover, euro area NCBs have also had the option to abstain from taking part in the ECB's foreign reserve management mandates, but so far no NCB has chosen to use that option. Additionally, but only for contingency purposes, the ECB may also back up

[4] *"Each euro area NCB may: (a) participate in the operational management of the foreign reserve assets transferred to the ECB; or (b) either abstain from such management or pool such management with one or more other euro area NCBs,"* according to the Guideline of the European Central Bank of 28 November 2013 amending Guideline ECB/2008/5 on the management of the foreign reserve assets of the European Central Bank by the national central banks and the legal documentation for operations involving such assets.

an NCB(s) in the ECB foreign reserve portfolio management's front and back-office activities.

Finally, the overall foreign reserve framework is reviewed every three to 5 years which gives an opportunity to fine-tune the framework and for the NCBs to consider changing their currency of specialization, entering a pooling arrangement or abstaining from the management of foreign reserves.

12.3 Governance Structure[5]

This section answers the question *"how is the ECB's governance structure for its decentralized foreign reserve management framework set up?"* It covers in particular the three-layer approach of the ECB's foreign reserve management and the outsourcing of the day-to-day portfolio management activities within the Eurosystem to the portfolio managers of the NCBs.

Governance can be defined as the processes that exist within or between formal institutions expressing the way the rules, norms, and actions are structured, sustained, regulated, and held accountable. A sound governance structure relies on transparency and accountability and helps to ensure a clear investment decision-making process.

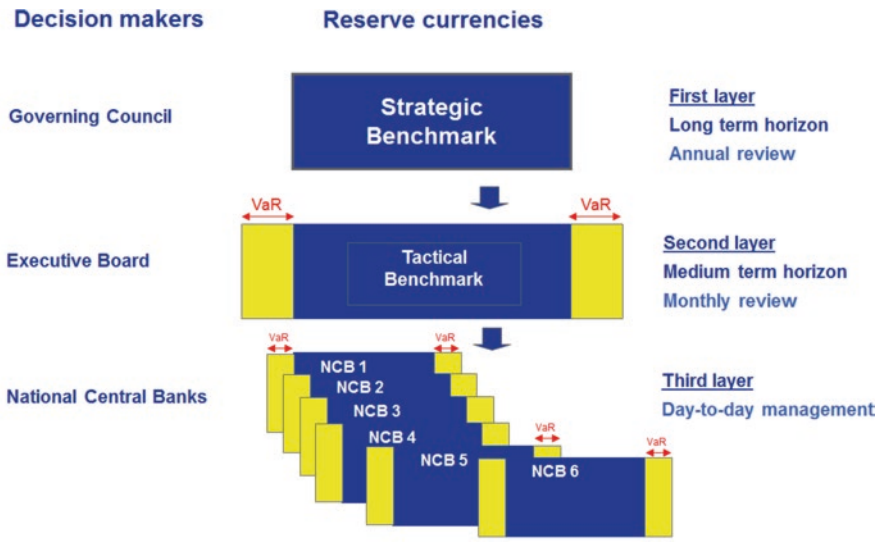
12.3.1 The Three-Layer Approach

The ECB's foreign reserve management framework consists of three layers, where two so-called benchmark layers and one NCB active portfolio layer reflect different investment horizons, as illustrated in Fig. 12.2.

The strategic benchmark (first) and tactical benchmark (second) layers are designed and maintained internally for each of the reserve currencies actively managed by the ECB.

The third layer consists of actual investment portfolios managed by NCB portfolio managers acting as agents of the ECB independently and autonomously (within given investment management contract rules). When NCBs carry out operations involving the ECB's foreign reserve assets with counterparties, they must disclose their agency status to them before entering into transactions, the ECB being the principal to all counterparties.

[5] See also Part V: "Governance and Risk Management."



Source: ECB.

Fig. 12.2 Governance structure of the ECB's foreign reserves. Source: ECB

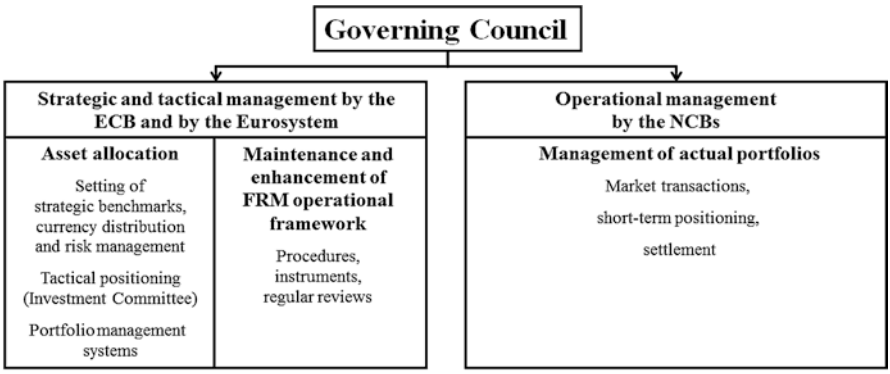
12.3.2 Governance through Two Benchmarks and One Actual Portfolio Layer

The ECB's foreign reserve management framework combines:

- the strategic benchmark's long-term risk/return preferences with the need at the ECB level to monitor and control the main risk parameters of the foreign reserve portfolios;
- the tactical benchmark's medium-term considerations with the possibility to adjust and optimize the market exposure over a 3–6 months horizon depending on market conditions; and
- the NCB active portfolio layer's considerations with the day-to-day operational involvement of the NCBs with the diversification benefits of various investment styles.

The absolute return of the ECB's foreign reserves is primarily driven by the composition of the strategic benchmark, while excess return above the strategic benchmark is incentivized and delivered by the two active layers: the "virtual" tactical benchmark and the actual portfolios managed by the NCBs. This setup allows the ECB to control its balance sheet risk while benefiting from short-to-medium-term market opportunities, knowledge sharing, and diversification.

Figure 12.3 illustrates the general governance structure. The currency distribution, as well as the strategic and tactical asset allocations, is done centrally at the ECB, while the day-to-day management of the foreign reserve portfolios is decen-



Source: ECB.

Fig. 12.3 Decentralized setup of the ECB's foreign reserve management framework. Source: ECB

tralized and performed by the NCBs. The operational maintenance and enhancement of the ECB's foreign reserve management framework is a joint task carried out by the Eurosystem.

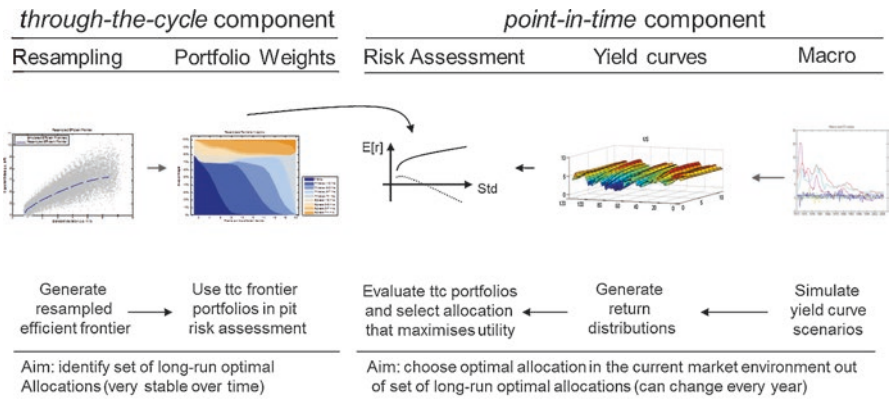
12.3.2.1 The Strategic Benchmark as the Driver of the Foreign Reserves' Absolute Return

The strategic benchmark is built to reflect the ECB's long-term risk and return preferences, subject to the principles of liquidity and security. It is reviewed every year and approved by the ECB's Governing Council, on the basis of a proposal prepared by the Eurosystem's Risk Management Committee with input from the Market Operations Committee. The strategic benchmark allocation is based on a modeling framework developed in-house which translates the ECB's risk and return preferences into a multi-objective function. This function incorporates the objectives for the foreign reserve portfolios, i.e., income, capital preservation, and stability.

The ECB's portfolio optimization process for the strategic benchmark consists of two components. A through-the-cycle component identifies efficient portfolio allocations based on long-term expectations of risks and returns through the economic cycle. The point-in-time component complements the long-term perspective by reassessing the utility of the through-the-cycle efficient portfolios taking into account the current and projected state[6] of the economy and financial variables.

Figure 12.4 depicts the optimization process which identifies the allocation that is best suited to reflect the long-term risk/return preferences of the ECB. This optimal allocation becomes the strategic benchmark and its return forms the basis of the

[6] External forecasts are used for macroeconomic variables and translated into yield curve scenarios (see Fig. 12.3).



Source: ECB.

Fig. 12.4 The two components of the strategic asset allocation optimization process. Source: ECB

foreign reserve portfolios' absolute return, on top of which the two active layers are expected to add value in terms of additional relative return.

12.3.2.2 The Tactical Benchmark as the First Active Decision-Making Layer

The tactical benchmark is the first active layer aiming to foster returns and outperform the strategic benchmark. The tactical benchmark is designed to reflect the ECB's medium-term (3–6 months) risk and return preferences against the background of prevailing market conditions in compliance with specific investment guidelines. The management responsibility for the tactical benchmark has been given to the ECB's internal Investment Committee (ICO), which has members from the ECB's investment and risk management units.

The ICO meets every month to discuss and assess the tactical benchmark proposals by the ECB's portfolio managers. The schedule for the ICO meetings is set in advance on a yearly basis for the following calendar year. The ECB portfolio managers' tactical positioning suggestions to outperform the strategic benchmark and the reasons behind them are explained in a written proposal that is presented to the ICO in a clear, documented, and transparent way. Once the proposals have been discussed and endorsed by the ICO, they are forwarded to the Executive Board for approval. Once approved, changes to the tactical benchmarks are communicated to the NCB portfolio managers some time in advance of their final implementation in order to allow the NCBs to prepare the rebalancing strategies for their portfolios in the respective currencies.

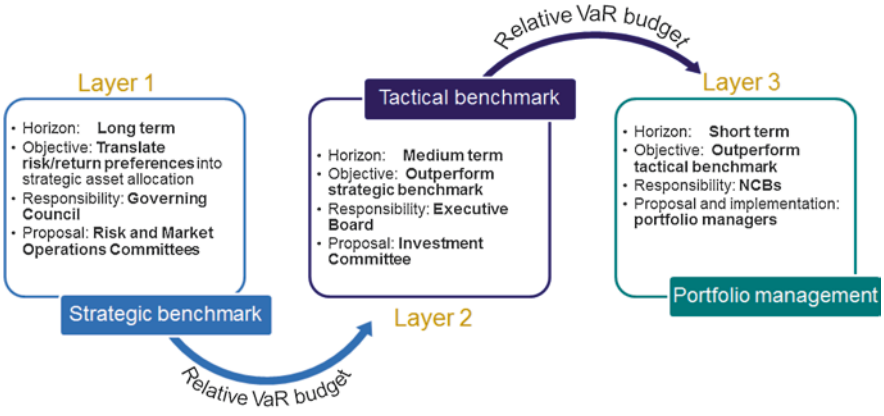
The nature of the active tactical benchmark management with previously scheduled monthly ICO meetings and the time gap between the decisions and their final

implementation mean that the ICO has to take medium-term market views as it cannot rely on short-term market moves or daily management of the portfolios.

12.3.2.3 Portfolio Management by NCBs as the Second Active Decision-Making Layer

NCBs' actively managed portfolios form the second active layer, with an aim to outperform the tactical benchmark. All NCBs have an identical mandate to manage the ECB's foreign reserves prudently in a way that maximizes their value, implying that NCBs undertake active management. The NCBs can make and implement investment decisions on a daily basis and have either a short-term or longer-term investment horizon depending on their preferred investment style. Figure 12.5 shows the three-layer approach, ranging from the benchmarks to the NCB active portfolio management level.

The Eurosystem has a specific working group, which meets three to four times a year and discusses and considers all types of issues related to the management of the ECB's foreign reserve assets. Its aim is to develop the framework and share knowledge on the latest structural and market developments, both from the front-office and back-office perspectives. For instance, an NCB may propose to the working group to consider adding an instrument that it has used for the management of its own foreign reserves, while other NCBs may not be as familiar with it and could therefore benefit from the knowledge. The task of this group is to provide support on various technical and procedural aspects by assessing and advising on potential improvements to the framework and on the list of eligible instruments and counterparties. It also assesses and develops the framework for FX interventions, in particular the procedural aspects.



Source: ECB.

Fig. 12.5 The three layers of the ECB's foreign reserve management. Source: ECB

12.3.3 Role of the Risk Budget Governing Active Management

Given the basic requirements of security and liquidity, the ECB's foreign reserves need to be managed prudently in a way that maximizes their value. The objective of the two active layers to outperform their respective benchmarks has created a competitive environment which is conducive to controlled risk-taking and active management. In this context, a passive management strategy carried out by the active layers which would aim to mainly replicate the benchmark and its return would not be warranted. A passive management approach in this type of decentralized framework would be inefficient, bring no portfolio diversification benefits, and lead to increased coordination costs.

As previously mentioned, the decentralized investment framework looks to capture additional performance through the two active layers. The type and horizon of the active positions taken by the NCB portfolio managers reflect their investment styles within given parameters, as active management needs to be controlled in terms of risk. Taking diverging positions relative to a benchmark implies return volatility compared with the benchmark return (tracking error), which creates financial risk. This risk is controlled by allocating maximum risk budgets to the active layers measured in terms of relative value-at-risk[7] (VaR).

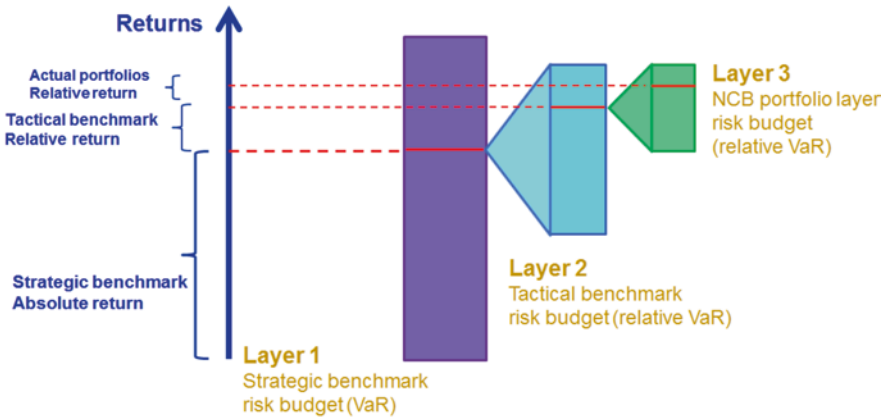
The risk budgets are set for both layers by the independent and centralized risk management function at the ECB, aiming to strike a balance between the need to control risk and giving leeway to the active layers for active management.[8] Figure 12.6 presents a stylized risk and return representation showing the composition of the return on the foreign reserve portfolios by the three layers according to their risk budgets.

12.4 Evolution of the Framework and its Performance over the Years

This section covers the evolution of the governance structure of the decentralized framework over the years to improve its efficiency, promote investment management best practices, and enhance the performance of the framework.

[7] Value-at-risk is the maximum loss not exceeded at a certain confidence level over a specific time horizon. For example, if a portfolio has a one-year 99% VaR of EUR one million, this means that there is a 1% probability that the portfolio will lose more than EUR one million over 1 year. Relative VaR is a measure of the risk of losses with respect to the benchmark result and is defined as the VaR of the difference portfolio (i.e., the actual minus the market-value-scaled benchmark portfolio).

[8] See also Chap. 17.



Source: ECB.

Fig. 12.6 Management structure of the ECB foreign reserve portfolios. Source: ECB

12.4.1 Areas of Evolution from a Governance Perspective

Since its inception in 1998 the ECB's foreign reserve management framework has been regularly adapted to ensure that the overall level of efficiency is maintained, including the aim to enhance the average return of the reserve portfolios. Four main areas of evolution can be mentioned:

- Expanded investment universe: with the aim of grasping new investment opportunities and increasing potential performance, various new instruments have been progressively introduced into the framework. These additions have partly reflected requests by the NCB portfolio managers and partly structural market changes, which have caused the scarcity of certain assets and led to the consideration of a broader investment universe within the risk management constraints. This has brought new active investment opportunities and flexibility to adjust positions with different liquid instruments. The introduction of new commonly used instruments has contributed positively to the portfolios' performance through a more dynamic active management and lower transaction costs.
- Enhanced strategic benchmark optimization approach: structural changes in the global fixed income markets led the ECB to reassess in 2015 its strategic asset allocation process. First, the modified durations of the fixed income market indices in the USA and Japan have been adjusted to reflect the longer maturity profile of the debt of various countries. Second, the scarcity of government bonds in the market amid a prolonged period of quantitative easing programs by the Federal Reserve and the Bank of Japan impacted the liquidity of these bonds. Both factors deserved close attention and needed to be taken into consideration in the optimization exercise.
- Move towards more specialization: after the implementation of a specialization scheme in 2006, a deeper division of labor among portfolio managers has enabled

them to become more focused and spend more time in their area of specialization. Against the background of streamlining activities, in 2014 one NCB delegated the back-office activities related to the management of the ECB reserve portfolio to the ECB.

- Move towards incentivizing risk-taking: two interlinked characteristics have been observed in the area of the NCB portfolio managers' investment management styles. First, there had been a certain persistence in the performance by some portfolio managers who demonstrated consistent outperformance skills over several others and, second, the allowed risk budget had been systematically underutilized by most portfolio managers. This laid the ground for efforts to better incentivize risk-taking to reap the full benefits of portfolio managers' skill (see Sect. 12.3.3).

12.4.2 Evaluation of the Framework from a Risk and Return Perspective

Overall, the decentralized framework has performed well against the following four general principles set in 2004 by the Governing Council: (1) credibility and effectiveness; (2) efficiency, risk, and return, (3) participation of the NCBs on a non-discriminating basis; and (4) accountability. In terms of the return on foreign reserve portfolios, the strategic benchmark and both active layers—the tactical benchmark and the NCBs' portfolio management layer—have made a significant contribution over the years. While the degree of outperformance of the active layers has fluctuated over time and among portfolio managers, it has overall remained more or less consistent over a long period.

12.4.2.1 Evaluation of the Performance of the Strategic and Tactical Benchmarks

Based on the evidence, one can make four main observations about the performance of the ECB's foreign reserve management framework.

First, the strategic asset allocation has served well the purpose of investing in safe and liquid assets in the foreign reserve portfolios held to fund FX interventions while ensuring capital preservation.

Second, the foreign reserve portfolios have consistently delivered adequate returns over the years. Active management of the tactical benchmark and the NCB active portfolios has provided additional return, which was particularly noticeable at the time when government bond yields were low.

Third, the tactical benchmark has also successfully seized medium-term opportunities. The enhanced return provided by the tactical benchmark has also made it more challenging for NCB portfolio managers to beat.

Fourth, market timing plays a key role in generating excess return, as the investment universe is limited mainly to liquid government bonds and a few highly rated agencies or supranational issuers. This means that there are relatively limited credit management opportunities for both active layers.

12.4.2.2 Evaluation of the Performance of the NCBs' Active Portfolio Layer

NCB portfolio managers seek to meet a double objective: outperforming the tactical benchmark and achieving the best ranking among peers. They monitor each other's performance and ranking at a monthly frequency when the performance and risk reports (including the performance of the strategic and tactical benchmarks) of all portfolios are distributed to all NCBs. The attitude towards risk-taking has been diverse, but one published study about the ECB's foreign reserve management and its internal risk-taking[9] found evidence of significant risk-shifting behavior in response to the year-to-date ranking. In general, those NCB portfolio managers whose portfolios were performing below the benchmark increased their risk-taking, while portfolio managers performing above the benchmark did not adjust their risk-taking on the basis of their interim ranking. The study also highlighted that currency specialization had led certain lower-ranking NCB portfolio managers to increase their risk-taking.

The experience from the beginning also shows that the NCB portfolio managers have utilized their risk budget to a varying extent. The use is quite dispersed, but so far a higher number of NCBs has been in the lowest quartile than in the highest quartile of the risk budget band.

The frequency analysis of top-ranking portfolios still reveals some persistence in performance year after year. There also appears to be a positive correlation between the frequency and the magnitude of outperformance, showing consistency in portfolio management skill even if there has been a change of portfolio manager at an NCB.

This suggests that the ECB's foreign reserve management framework has benefited over time from the diversification of management styles, investment strategies, and risk-taking attitudes. A small group of NCB portfolio managers stands out for using more risk budget, exhibiting more tracking error and following more dynamic investment strategies with higher risk and also higher return. A few portfolio managers succeeded in generating on average higher excess return than their peers for the same level of risk taken with a higher information ratio.[10] Interestingly, portfolio returns have not been correlated with the size of the NCBs' portfolios.

Nevertheless, there are limits to the diversification benefits when the investment universe is limited to one single asset class, as the number of independent bets is

[9] Scalia and Sahel (2011).

[10] The information ratio is a measure of portfolio returns above the returns of a benchmark, usually an index, over the volatility of those returns.

limited (limited alpha[11]), making it more difficult to generate excess return. Furthermore, diversification opportunities are constrained by the framework and are not adjustable as the number and size of portfolios are constrained by the capital key distribution. This ECB-specific constrained diversification feature does not allow an unconstrained optimal diversification to be reached in terms of pure risk/return considerations as there are other built-in factors to be considered within the Eurosystem setup.

There are some observations in relation to the ECB's decentralized framework that are not focused on performance, but should still be highlighted.

First, the nature of these portfolios for the purpose of funding FX interventions is more policy than investment-related. This is reflected in the governance and decision-making, which consider both good and bad times. For example, during the global financial crisis, the framework proved to be resilient and there was no need to carry out specific adjustments due to the volatile market environment. The main risk parameters of the strategic asset allocation remained unchanged and the risk budget of the active layers was not lowered. In fact, active management in the aftermath of the crisis brought about the best years of excess return across portfolio managers, owing to portfolio managers' ability to stay in the markets, identify new trends, and seize new investment opportunities.

Second, various "soft" benefits—in contrast to the "hard" financial and diversification benefits—have arisen over time. The framework has been conducive to fostering cooperation and inclusiveness within the Eurosystem, to building professionalism and a coherent portfolio management culture, to sharing knowledge and exchanging information, to leveraging on expertise, and in some cases to exchanging staff. In sum, the framework has acted as a powerful channel of cross-fertilization within the Eurosystem.

Third, in an environment of low or even negative yields, additional basis points of excess return drawn from the active management of the two layers make a difference and have contributed to mitigating the adverse effects of negative yields.

[11] According to the law of active management, the higher the number of independent bets, ceteris paribus, the better the information ratio and the chance to generate alpha, which is the risk-adjusted return in excess of a benchmark index and a common measure for assessing an active manager's performance. The bets of portfolio managers can differ in several ways, by addressing not only different sources of alpha (which in a traditional fixed income portfolio are duration, yield curve, credit, and to a lesser degree security lending), but also market timing, usage of the risk budget, etc. For this reason, combining different investment styles dynamically improves the risk/return profile of the aggregate portfolio, also reducing drawdown risk and improving the consistency of performance.

12.4.3 Incentive Structure to Promote Decision-Making and Risk-Taking at Various Levels

The ECB regularly reviews the framework in terms of efficiency and best market practices, also with a view to finding other than financial incentives to increase efficiency and promote active risk-taking. The best examples of such adjustments are the move to the currency specialization scheme and to the pooling scheme.

The currency specialization scheme (as explained in Sect. 12.2.3) was the first major initiative to improve the efficiency of the framework. It allowed NCB portfolio managers to focus on single bond markets and led to an enhancement of expertise and, in many cases, positive effects on portfolio returns. The reduction in the number of portfolios has lowered overall coordination costs at the ECB and eased the burden on IT and portfolio management systems. In particular, the pooling of NCB portfolios was instrumental in limiting the increase in the number of Eurosystem portfolios when new NCBs joined the Eurosystem. This made the risk limit system less complex, also offering space and flexibility for further potential enhancements.

The pooling arrangements have made the framework simpler and more efficient, and the experience of pooling partners has also been positive. Even though pooling agreements follow certain formal minimum requirements set by the ECB, there is significant leeway for pooling partners to negotiate the terms of their practical bilateral agreement. So far, all pooling arrangements combine two NCBs as it would be challenging to operate a pool with several pooling partners, unless a deep and explicit division of labor is agreed upon. The main benefits cited are the open exchange of market views and trading ideas by sharing experience and the strengthening of the working relationship between the two NCBs. Pooling arrangements do not seem to have had any particular impact on the usage of the risk budget. It also seems that cost savings played a role when deciding to pool relatively small ECB foreign reserve portfolios versus an alternative of maintaining a minimum infrastructure to comply with all the requirements set in the management guidelines for the ECB foreign reserve portfolios.

In addition, over the years, a wide range of incentive proposals to increase return have been discussed, for example, incentivizing the active layers to take more risk through a higher utilization of the risk budget or higher visibility and better official recognition of performance rather than a financial reward. In terms of increased efficiency, a deeper specialization of NCBs or a division of labor in various areas of responsibility, e.g., front office, back office, and market analysis, has also been considered. From among the various ideas, the following incentive-enhancing proposals have been implemented:

- An internal performance target for the tactical benchmark: within its Investment Committee, the ECB sets every year an internal performance target for the tactical benchmark in each currency, with the aim of guiding and incentivizing risk-taking relative to the strategic benchmark. Assigning a clear and measurable

numerical objective is felt to be a good asset management practice and allows portfolio managers to better analyze in terms of risk the required positioning parameters (size, potential, target, stop-loss) to reach the return objective.

- A minimum usage of the risk budget for the portfolios managed by NCBs: despite the consistent outperformance observed on average over the last decade, the available risk budget was on average clearly underutilized. Stakeholders in the ECB's foreign reserve management framework were confident that there was a potential to enhance the overall return on foreign reserves by finding more or better incentives for risk-taking, although there is naturally no certainty that higher risk-taking would lead to higher return. Internal Eurosystem surveys showed that some institutional factors had been hindering portfolio managers' attitude towards risk-taking.[12] After comprehensive discussions, it was agreed to set a minimum usage target for the relative VaR budget for all NCB portfolio managers which was perceived as a good measure to address portfolio managers' resistance to taking more risk. Portfolio managers have committed to use on average a minimum percentage of the daily relative VaR limit calculated at the end of each day but smoothed over the medium term. Each portfolio manager's risk usage is monitored and each portfolio manager regularly shares at the working group meeting his or her market views, positions taken, and how these views and positions worked out. This openness is meant to enhance knowledge sharing and encourage self-enforcement rather than setting a hard target or limit for risk-taking.
- More flexibility for closing some tactical benchmark positions: the management of the tactical benchmark was also made less rigid by introducing the possibility to close some positions outside the fixed monthly ICO calendar. The flexibility to take some profit or limit losses within a given predefined framework was seen as enhancing the potential return on foreign reserves and incentivizing tactical benchmark managers to take more risk.

The added transparency has worked as a means to foster competition. NCB rankings and peer pressure have motivated portfolio managers, with the regular circulation of portfolio managers' performance and risk usage information. Inclusiveness in the framework and peer pressure have continued to work smoothly hand in hand.

Greater attention and recognition have also been given to outperformance. The performance of portfolio managers is regularly discussed and analyzed by the dedicated Eurosystem working group. The best-performing portfolio managers per reserve currency are invited annually to present their investment strategy, positions, and performance to the Eurosystem's Market Operations Committee and receive recognition for their work. The ranking list is circulated every year also to the Governing Council. Policymakers' increased attention to the management of foreign reserves is a stimulating factor for all portfolio managers.

[12] Among them, in some cases the risk-averse attitude of the portfolio managers' hierarchy and in other cases constraints imposed by internal investment committees may have contributed to portfolio managers refraining from taking bold positions to utilize investment opportunities.

12.5 Concluding Remarks

The decentralized framework for the management of the ECB's foreign reserves originates from the EU Treaty and is unique among central banks around the world. It was initially designed to leverage on the existing Eurosystem resources to cope quickly and efficiently with the task of foreign reserve management when the ECB was being set up. The framework has evolved over time, with a view to encouraging efficiency, increasing the number of eligible instruments while maintaining high liquidity requirements, applying competitive benchmarks at two levels, promoting best practices, sharing information, and maintaining inclusiveness. As such, the decentralized framework has also been instrumental in enhancing the absolute return on the ECB's foreign reserves.

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Part IV
Asset Allocation in a New Context

Chapter 13
Reserve Management at Danmarks Nationalbank: Combining Liquidity Tiers with an Adaptive Risk Budget

Morten Kjærgaard, Rasmus Vahle, and Jacob Wellendorph Ejsing

Abstract Over the recent years, Danmarks Nationalbank has transformed its approach to reserve management. The new framework is organized around two main pillars—a tiered liquidity management framework and an overall risk budget. Together they provide a framework for handling large balance sheet fluctuations—a consequence of the fixed exchange-rate policy—while aligning long-term exposure to investment risk with the primary policy objectives. The anchoring of the risk budget to a "policy portfolio" clarifies the risk and return implications of the bank's multiple objectives and highlights the rationale for diversification.

13.1 Danmarks Nationalbank's Purpose and Policy Mandates

The Danish central bank, Danmarks Nationalbank, implements the country's monetary and exchange-rate policy. To achieve stable prices, Denmark conducts a fixed exchange-rate policy and has done so successfully since the early 1980s, first against the Deutschemark and, since 1999, against the euro. As the monetary-policy objective of the euro area is to maintain inflation rates below, but close to, 2% over the medium term, the fixed-exchange-rate policy provides a framework for attaining low and stable inflation in Denmark. The policy allows the krone to fluctuate within a narrow range against the euro.[1]

The main policy tools are the monetary-policy interest rates. However, as the first line of defense, Danmarks Nationalbank will influence the exchange rate of the

[1] For a description of Denmark's fixed-exchange-rate policy, see Spange and Toftdahl (2014).

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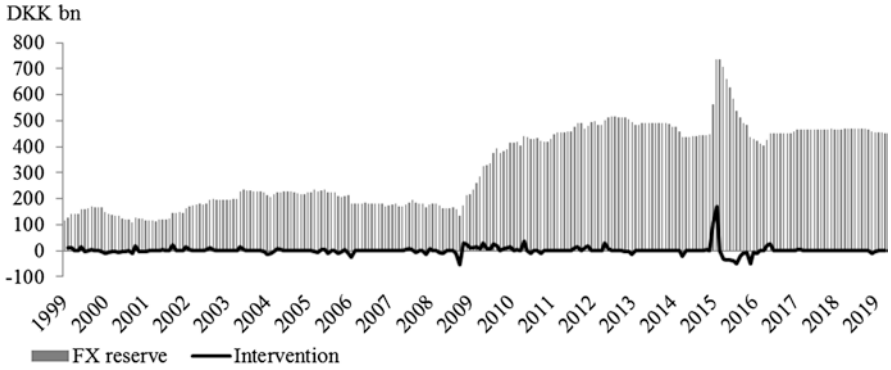
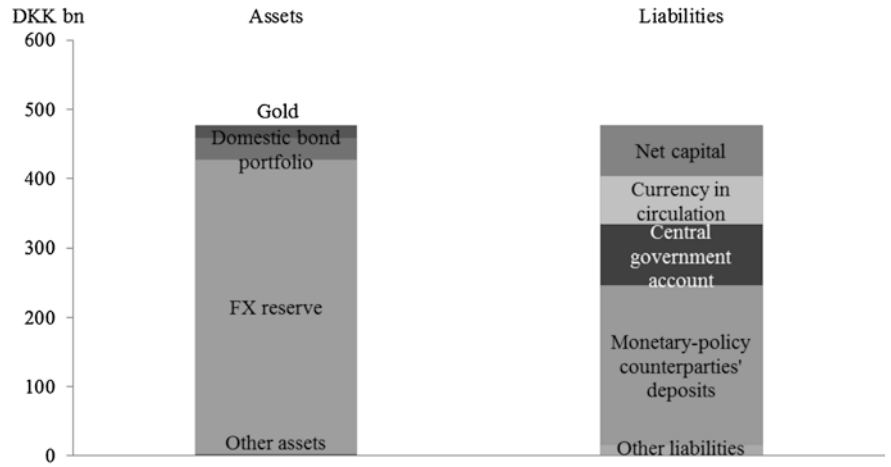


Note: Monthly observations. Last observation is 30 Apr. 2019.

Fig. 13.1 FX reserve and interventions. Note: Monthly observations. Last observation is 30 Apr. 2019



Note: As at 30 Apr. 2019.

Fig. 13.2 Assets and liabilities of Danmarks Nationalbank. Note: As at 30 Apr. 2019

krone by intervening, i.e. by buying and selling foreign exchange (FX) in the market. Danmarks Nationalbank has been subject to relatively frequent inflows and outflows of foreign currency and the size of the foreign-exchange reserve has fluctuated significantly over time (see Fig. 13.1 and Danmarks Nationalbank 2015). In addition to giving Danmarks Nationalbank the ability to intervene in FX markets, the foreign reserves support policy objectives of safeguarding financial stability and lending to the IMF.

The sizeable FX reserve constitutes the bulk of the bank's assets (Fig. 13.2). In addition to the FX reserve, other major asset categories include the bank's gold

holdings[2] and a portfolio of domestic bonds. The gold holdings are mandatory as the bank—pursuant to the 1936 Danmarks Nationalbank Act—must hold a certain amount of physical gold. Liabilities mainly consist of monetary-policy counterparties' deposits, central-government deposits, currency in circulation and the bank's net capital. The central bank uses fair-value accounting and all price movements—including gold returns—thus directly affect the profit and loss account.

13.2 Reserve Management at Danmarks Nationalbank

The primary concern of Danmarks Nationalbank's reserve management is to maintain a highly liquid FX reserve to preserve—at all times—the ability to intervene in support of the krone. As a subordinate objective, the bank strives to earn the best possible return given the numerous constraints following from the policy objectives. For this reason, the bank takes on limited, diversified investment exposures in equities, corporate bonds and other asset classes.

Reserve management is organized around two main pillars—a tiered liquidity management framework and an overall risk budget. Together they provide a framework for handling large and sudden balance sheet fluctuations while aligning long-term exposure to investment risk with the primary policy objectives. Further, the approach links all parts of the portfolio with the underlying objectives and provides a transparent separation of policy risks and investment risks.

13.2.1 Liquidity Management

13.2.1.1 A Two-Tiered Approach[3]

Reserve management at Danmarks Nationalbank first and foremost revolve around liquidity management. On the basis of an assessment of all financial objectives and commitments, the majority of the reserve is structured into a highly liquid tier ("tier 1"). Tier 1 only holds instruments that can be liquidated at very short notice.[4] It is based on a ranking of instruments according to suitability and further diversified into multiple subgroups addressing the risk of sudden illiquidity shocks in certain market segments. Reducing concentration across issuers and securities also lowers

[2] Gold is included as part of the FX reserve in Nationalbanken's official reserve figures, but for the purpose of this chapter the term "FX reserve" includes only financial claims.

[3] See also Chap. 21.

[4] Tier 1 assets include, for example, cash balances at accounts with official institutions, reverse repos and government bonds issued by countries with a high credit rating.

the cost of liquidation, as price impact tends to increase with the size of the exposure being liquidated.[5] The reserve further consists of a less-liquid tier ("tier 2").

The separation of the FX reserve into the two liquidity tiers is formalized in an investment mandate, reviewed and approved by the Board of Governors at least annually. The mandate stipulates a maximum amount that can be invested in the less-liquid, second tier. This cap makes it possible, on the one hand, to invest in less-liquid instruments with a view to earning an illiquidity premium (or to invest in risk factors not available in a liquid format). On the other hand, it also formalizes the understanding that this category of assets will take longer to liquidate and thus is intended to be shielded by the highly liquid tier in case of intervention needs.[6] It is thus expected that tier 2 exposures can be maintained through times of market stress. To guide the decision on the size of the cap, the size of the bank's long-term liabilities—net capital and currency in circulation—is used as starting point. The cap is then fixed at a level where the ability to intervene is uncompromised.

The cap on tier 2 assets ensures that the main part of the FX reserve is always placed in the most liquid assets available. The reserve management team will—in case of currency outflows—sell highly liquid tier 1 assets and—in case of currency inflows—place the cash in similarly liquid assets. Large FX inflows have previously been followed by large outflows—and vice versa. Temporary increases in reserves, therefore, could prove costly if inflows were tied up in illiquid assets. Relying on liquid instruments during episodes of interventions keeps round-trip transaction costs low.

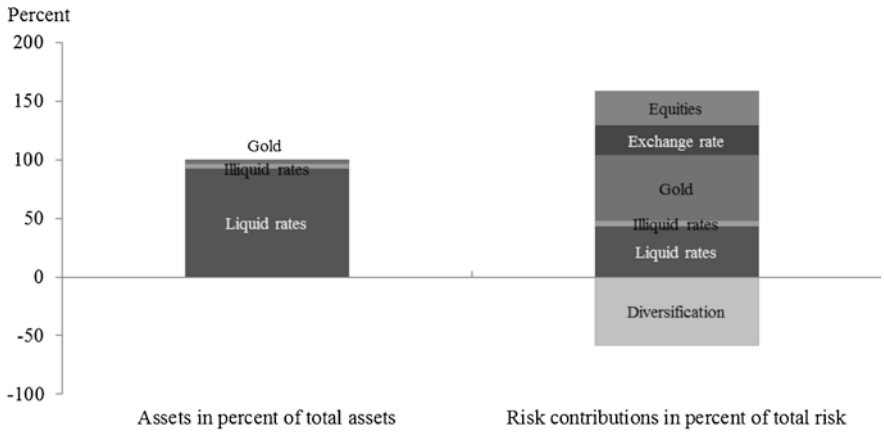
13.2.1.2 Separating Cash and Risk Allocations using Derivatives

On top of the two liquidity tiers, Danmarks Nationalbank uses derivative overlays (bond futures, FX forwards and equity index futures). This facilitates a separation between cash and risk allocations. Investment exposures can be obtained in the form of cash investments in either of the liquidity tiers or via derivatives. If investment exposures are taken in tier 1 and the cash instruments need to be sold, overall risk exposures will be maintained via derivatives in order to keep the preferred risk profile. For example, a long-dated German government bond could be used to obtain part of the desired exposure to interest-rate risk. At the same time, the bond would belong in tier 1 as it is a highly liquid asset. If the bond is sold to provide cash for intervention, the equivalent exposure to interest-rate risk can be obtained via a bond future (or an interest-rate swap).

Hence, to be eligible for tier 1, an asset must not only be highly liquid (and expected to remain so even under stressed market conditions), but also satisfy additional requirements. Specifically, tier 1 assets should either provide only negligible

[5] See, e.g. Dufour and Engle (2000).

[6] While less liquid than the assets in tier 1, the tier 2 assets are still relatively liquid in absolute terms. At the time of writing, tier 2 holdings include corporate bonds, emerging market bonds (in EUR or USD), sub-sovereign bonds, covered and agency bonds, etc.



Note: As at 30 Apr. 2019.

Fig. 13.3 Breakdown of assets and risk. Note: As at 30 Apr. 2019

credit and market risk exposures (e.g. short-term reverse repos) or appropriate, liquid derivatives should exist in which hedging can take place (e.g. highly liquid futures in the case of the long-term German government bond). If these criteria are not satisfied, even a highly liquid asset will belong in tier 2.

The breakdown of the portfolio in terms of cash assets (Fig. 13.3, left) is very different from the breakdown in terms of risk contributions (Fig. 13.3, right). This reflects both the distinct risk profiles of the different assets, e.g. gold, and the risk contributions of the derivative overlays, e.g. equity index futures. The assets consist mostly of money-market instruments whereas multiple sources contribute significantly to the overall portfolio risk. The large difference between gross risk contributions and total risk reflects the significant degree of diversification.

13.2.2 Risk Budgeting[7]

The Board of Governors expresses its tolerance towards risk by specifying a so-called risk budget—i.e. an acceptable range for risk—within which the reserve management team must steer investments. Risk is defined as tail risk in relation to the overall financial result of Danmarks Nationalbank. It is calculated by simulating a distribution for the profit and loss on all items on the balance sheet, aggregating the numbers into a distribution for the overall profit and loss and then looking at the worst 5% of cases. An overall risk budget imposes a holistic risk assessment in that

[7] See also Chaps. 17, 21 and 27.

individual allocations are based on their contribution to overall risk rather than on measures of stand-alone risk.

13.2.2.1 Using the Policy Portfolio as Risk Reference

To anchor the decision of what risk level to target, Danmarks Nationalbank uses the risk on a (hypothetical) portfolio reflecting the exposures the central bank would have, if it did not engage in any return-seeking activities. We refer to this portfolio as the "policy portfolio". Such a portfolio holds only the assets and liabilities needed to fulfil the bank's policy functions and obligations.[8] The actual assets of Danmarks Nationalbank consist of e.g. emerging market bonds and corporate bond ETFs. These assets have been bought to increase return and do not belong in the policy portfolio. Instead it is assumed that the (hypothetical) policy portfolio invests the FX reserve solely in highly liquid and low-risk euro assets that support the policy objective of intervention buffers. The policy portfolio represents the inherent risk level of the institution and in this sense provides a natural reference for decisions on risk targets.

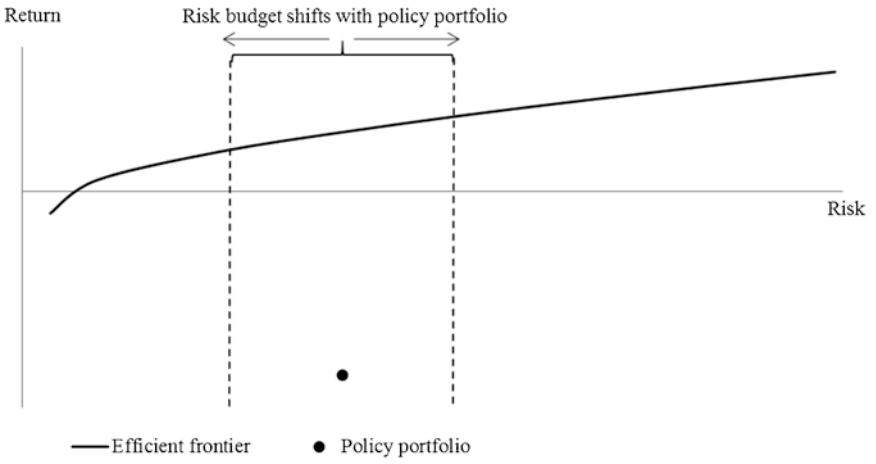
The Board of Governors mandates the reserve management team with a risk budget that is expressed relative to the risk of the policy portfolio. As the risk budget is linked to the policy portfolio, it becomes dynamic (or adaptive) in the sense that the acceptable risk level shifts through time with the risk of the policy portfolio. At the time of writing, the risk budget is defined as a symmetrical range centred on the risk level of the policy portfolio (Fig. 13.4). Depending on the preferences of the Board, the risk budget could in principle be shifted higher or lower than the risk level of the policy portfolio—while still being dynamically linked to the policy portfolio.

13.2.2.2 Defining the Policy Portfolio

The exact definition of a "policy portfolio" and its inherent financial risks will differ among central banks. In the case of Denmark there are three main elements. First, Nationalbanken needs a FX reserve in euros to support the fixed exchange-rate policy. This necessarily exposes Danmarks Nationalbank to fluctuations in the exchange rate of the krone vis-à-vis the euro.[9] When the krone strengthens, the value of the FX reserve—measured in kroner—decreases and an accounting loss is incurred. The fixed exchange-rate policy, however, ensures that these fluctuations are bounded and small. Further, because the FX reserve is partly funded by the monetary-policy

[8] The risk of the policy portfolio is defined as the simulated average financial result—on a rolling one-year horizon—in the worst 5% of cases, if the bank were to hold this portfolio.

[9] Due to the exchange-rate policy, the majority of the FX reserve is invested in euro. All holdings in currencies other than euro are hedged back into euro with FX swaps. Thus, Danmarks Nationalbank only has currency exposure against the euro.

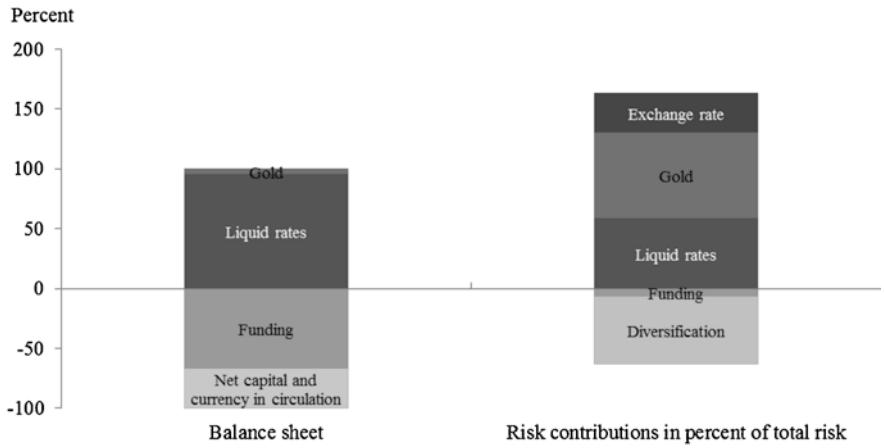


Note: The depicted efficient frontier is a constrained frontier, as portfolios on the frontier have to include unavoidable policy risk. The frontier therefore also shifts with the policy portfolio.

Fig. 13.4 Illustration of the dynamic risk budget. Note: The depicted efficient frontier is a constrained frontier, as portfolios on the frontier have to include unavoidable policy risk. The frontier therefore also shifts with the policy portfolio

counterparties' short-term deposits with Nationalbanken, the FX reserve necessarily exposes the central bank to the spread between the domestic policy rate applied to the deposits and the foreign short-term interest rates earned by the FX reserve. When domestic rates increase relative to foreign rates, it increases the funding cost of the FX reserve. Second, under the Danmarks Nationalbank Act, the central bank must hold a stock of gold. The size of these holdings and gold's considerable return volatility makes gold the main source of risk in the policy portfolio (see Fig. 13.5). Third, it is the task of the central bank to provide credit against collateral to monetary-policy counterparties. These are short-term loans collateralised by highly rated securities and therefore only give rise to comparatively small amounts of interest-rate risk.

To use the theoretical construct of a "policy portfolio" in day-to-day reserve management, it has to be expressed in the form of a concrete portfolio with clearly defined exposures to risk factors. Specifically, the policy portfolio has to be defined in terms of exposures to actual instruments in order to calculate daily risk figures and to break down profit and loss contributions from policy and investment exposures, respectively. The policy portfolio is "model-free" in the sense that no portfolio optimization is used to define it. The assets of the policy portfolio are defined as the FX reserve invested exclusively in liquid, low-risk instruments as well as the (actual) gold holdings. Specifically, the hypothetical FX reserve is made up of balances in cash accounts (mainly at other official institutions), reverse repos and short-term highly liquid governments bonds with interest-rate exposure swapped to an overnight rate. To make the policy portfolio a realistic reference, allocations to



Note: As at 30 Apr. 2019.

Fig. 13.5 Breakdown of policy portfolio balance sheet and risk. Note: As at 30 Apr. 2019

the different assets reflect what would be practically feasible if the central bank actually was to hold the policy portfolio. The policy portfolio's liabilities consist of net capital, currency in circulation, the central-government's account and monetary-policy counterparties' (net) deposits.

13.2.2.3 The Dynamic Risk Budget improves the Risk/Return Trade-off

Linking the risk budget to the policy portfolio—as opposed to operating with a static risk budget—allows reserve management to keep the portfolio at an attractive risk/return trade-off, avoiding situations where changes in policy-related financial risk force a change in risk allocation. To illustrate the benefit of a dynamic budget, changes in the value of gold holdings will serve as an example. The bank's gold holdings are considerable relative to net capital and contribute substantially to the total mark-to-market risk of the bank. They are mandatory and as such cannot be rebalanced: if the price of gold doubles, the isolated price risk on gold doubles as well.[10]

Over time, bond and equity returns have had low—or even negative—correlations with gold returns.[11] Taking the policy portfolio as the starting point, Danmarks

[10] Given that gold holdings are fixed, it may be tempting to ignore gold altogether when quantifying risk and making allocation decisions. However, from a fair-value perspective, gold represents a non-trivial part of the central bank's net assets. Hence, ignoring returns on gold and its correlation with returns on other exposures will generally lead to inefficient allocation decisions.

[11] For instance, using four decades of weekly data up until end-April 2019 (obtained from Bloomberg), the correlation between gold returns (measured in USD) and returns on the S&P 500 index is 0.01.

Nationalbank can therefore increase expected returns without increasing overall risk by adding moderate amounts of equity and duration exposure. The diversification benefits of equity and duration vis-à-vis gold—in the context of Danmarks Nationalbank's balance sheet—are thus substantial.

With a dynamic risk budget, if gold risk increases, both the budget and the efficient frontier shift to the right. In this way the portfolio can be kept at the targeted risk/return trade-off. Managing the reserves with the policy portfolio as a reference can thus be seen as a way to consistently choose a sequence of "optimal" portfolios given the level of financial risk stemming from the central bank's policy commitments or institutional obligations.

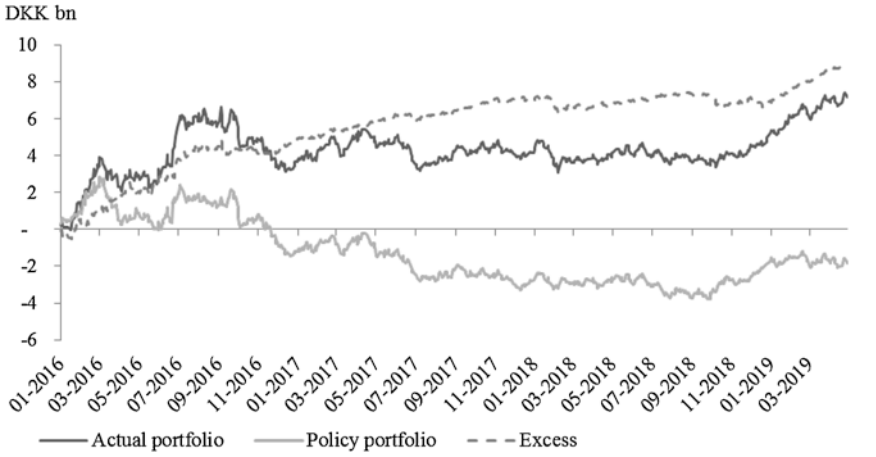
With a static risk budget, on the other hand, changes in policy-related exposures—to the extent that they increase total risk—could require reserve management to immediately reduce allocations to investment risk in order to comply with the budget and while doing so, give up an increasingly attractive risk/return trade-off. Such behaviour is not compatible with harvesting risk premia over the long run. In the specific case of gold exposures, pressure to sell equities at a time when gold value is soaring can lead to pro-cyclical behaviour. With the dynamic risk budget, the target for equity exposure will ceteris paribus increase with an increase in gold-related risk. This reflects the role of equities in diversifying gold exposure.

13.2.2.4 Decomposing Profit and Loss into Contributions from the Policy Portfolio and Investments

The distinction between the policy portfolio and the actual portfolio allows for a decomposition of the profit and loss account into contributions from the policy portfolio and from investment decisions, respectively. Figure 13.6 shows this decomposition since the beginning of 2016. The allocations to investment risk (which include exposures to equity and credit markets, as well as duration exposures) have more than offset the losses of the policy portfolio during this period.

13.3 Investment Decision-Making Process

The guiding principles of Danmark Nationalbank's reserve management are laid out in two short documents: the "principles for portfolio management" and the "investment mandate". The former outlines the overall objectives and governance of reserve management. The latter is reviewed and approved at least annually by the Board of Governors and stipulates the risk budget, "model-free" exposure limits for key risk factors, the cap on less-liquid investments and the set of eligible instruments. The governance setup delegates a range of decisions to the reserve management team and thus allows policy makers to focus on high-level decisions. The reserve management team reports monthly to the Board of Governors on portfolio decisions and developments.



Note: Last observation is 30 Apr. 2019. Preliminary numbers, including only profit and loss from financial portfolios. The starting point – beginning of 2016 – is due to data availability. During the period, the targeted risk level has been changed strategically.

Fig. 13.6 Accumulated return on policy portfolio and actual portfolio. Note: Last observation is 30 Apr. 2019. Preliminary numbers, including only profit and loss from financial portfolios. The starting point—beginning of 2016—is due to data availability. During the period, the targeted risk level has been changed strategically

The investment mandate defines the overall scope for investment risk, but does not specify the precise allocation to investment risk. The reserve management team aims to keep the portfolio well diversified, in line with the risk budget and at an attractive position in the expected-shortfall/expected-return space. Re-allocations—including rebalancing towards the centre of the risk budget—are revisited at a monthly frequency. As long as the allocation is within the overall risk budget and the exposure limits stated in the investment mandate, the portfolio adjustments are executed at the discretion of the reserve management team. To promote decision-making and execution, the reserve management front- and middle-office functions (the reserve management team) are organizationally close.

Extensive delegation to the staff involved in day-to-day management keeps the time from analysis to implementation short and makes efficient implementation of portfolio decisions possible. In this way, the reserve management team can rebalance portfolios and navigate market events without unnecessary delays. For example, the reserve management team is responsible for credit lines, duration, equity and corporate bond exposures within the limits stated in the investment mandate.

13.3.1 Quantitative Asset-Allocation Framework

13.3.1.1 In-House Risk Modelling

Managing the portfolio according to the risk budget requires a solid quantitative framework. With a view to ensuring agility and a thorough understanding the modelling trade-offs involved, Danmarks Nationalbank develops and maintains its own risk model. Developing the model in-house—as opposed to relying on off-the-shelf systems—also allows for detailed modelling of the elements of particular relevance to Danmarks Nationalbank. For example, the model is constructed to take into account the longer horizon[12] of a central bank and the dynamics of some key risk drivers are modelled in greater detail.[13]

The model simulates return scenarios for all the bank's existing assets and liabilities and on this basis calculates risk from the overall profit and loss distribution.[14] Also, the model supports allocation decisions by quantifying overall risk and return implications of contemplated changes to exposures. Breakdowns of risk and return are computed along multiple dimensions and are used, e.g. to decompose changes in total risk into contributions from different sub-portfolios, risk factors or asset classes. These results form part of the monthly risk report to the Board of Governors.

The model structure is similar to that outlined by Meucci (2009). Based on decades of market data, return scenarios for all relevant exposures are generated in order to simulate portfolio outcomes. To do this, all exposures are mapped onto a set of risk drivers. For yield curves, for example, the risk drivers are estimated level, slope and curvature factors. A joint (fat-tailed) distribution is then estimated and a large number of scenarios for all risk drivers are generated. The approach allows for flexible modelling of risk-driver dynamics.[15]

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[12] Currently, a projection horizon of 1 year is used in the model.

[13] The model also allows for different rebalancing frequencies for different investment strategies—ranging from relatively frequent rebalancing of duration exposures to no rebalancing at all for gold.

[14] The return scenarios for a given asset (e.g. a position in a 5-year German government bond) is a vector of simulated returns over the one-year horizon for this particular asset. Hence, the asset's expected return is computed as the mean over these scenarios, and the (stand-alone) risk is computed as the average tail return (e.g. over the 5% worst returns). When combining scenarios for multiple assets using the appropriate portfolio weights, simulated risk and return figures for the entire portfolio are obtained.

[15] At present, the modelling of yield curves poses particular challenges. In multiple countries, yield curves appear close to their effective lower bound and the risk and return profile for bonds is likely to be asymmetric in the years ahead. To accommodate this feature, so-called shadow-rate models are used. For an in-depth treatment of these challenges, see Krippner (2015). If these asymmetries are not properly addressed, the model may overstate the potential diversification benefits between

13.3.1.2 Setting Expected Returns

To quantify risk/return trade-offs, estimates of expected returns are needed and these are imposed on the return scenarios for all investment strategies. However, risk premia are difficult to pin down, both over the short and long term. As the model is used for daily risk calculations and compliance, a methodology that is both readily understandable and consistent over time and across investment strategies is preferred. As a starting point, expected returns are based on a "no-change" assumption for market variables. Despite its simplicity, this approach has been empirically superior to more elaborate methods in predicting future excess returns across assets, time periods and regions (see, e.g. Koijen et al. 2018). The approach allows for the calculation of expected returns on all assets using a generalization of the notion of "carry". For yield-curve strategies, for example, the expected returns are derived from observed yields by assuming that the yield curve does not change over the forecast horizon.[16] Similarly, expected equity returns are obtained—in the spirit of the Gordon (1959) growth model—by assuming unchanged dividend yield and constant market capitalization relative to nominal GDP. The method provides a set of expected returns across all investment strategies that does not rely on potentially over-parameterized models or (overly subjective) staff research. At the same time, the derived carry-based expected returns evolve through time according to factors that have proven (somewhat) predictive for returns historically, such as the slope of the yield curve or the dividend yield for equities.

In general, this methodology will tend to overstate risk premia. For example, a steeper yield curve will lead to higher expected returns for duration exposures. The steepness, however, may reflect prospects of increasing yields in addition to genuine term premia. This effect is controlled by scaling down the derived "no-change" risk premia.

13.3.2 Rebalancing the Portfolio

The starting point for rebalancing the risk allocation is a model-based proposal. To increase the robustness of the portfolio optimization results, transaction costs and diversification constraints are imposed and the model is only allowed to optimize over a rather narrow set of key exposures. The result is a robust, near-efficient reallocation of exposures based on market data and model assumptions.

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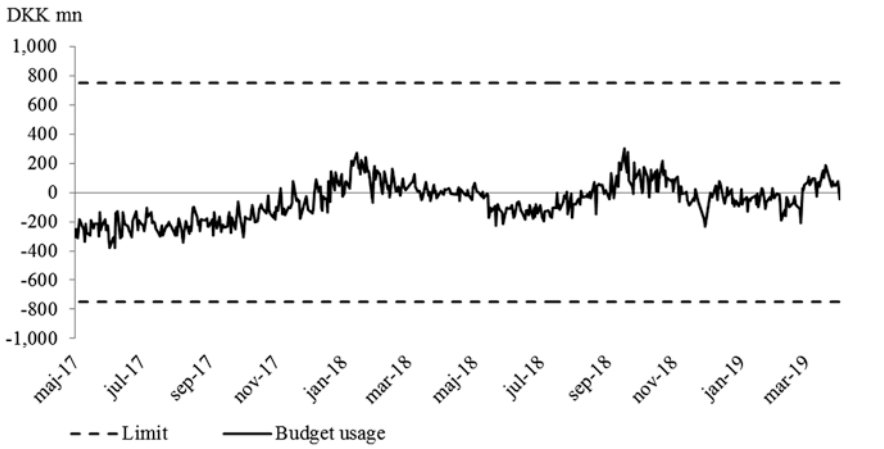
bonds and other assets.

[16] To illustrate, the carry return on a 5-year position over the next year is the 5-year yield plus the return from rolling down the yield curve, i.e. the spread between 5- and 4-year yield times 4 (duration of the position after 1 year). The risk premium is taken to be the difference between the carry return and the (riskless) one-year yield.



Note: Last observation is 30 Apr. 2019. Risk budget usage is computed as the risk (i.e. expected shortfall) on the actual portfolio minus the risk on the policy portfolio.

Fig. 13.7 Risk budget usage. Note: Last observation is 30 Apr. 2019. Risk budget usage is computed as the risk (i.e. expected shortfall) on the actual portfolio minus the risk on the policy portfolio

At a monthly frequency, the model-based proposal and its implications for risk and return are reviewed and other more qualitative considerations—outside the scope of the model—are taken into account. Also, practical issues regarding the feasibility of implementation need to be addressed.

Although an "efficient frontier" is one of the outputs from the portfolio optimization, the reallocation decision does not centre on keeping the portfolio exactly on this—somewhat hypothetical—frontier. Over time, the portfolios making up the frontier will differ markedly in composition and keeping the portfolio on the estimated frontier will require a large amount of trading. Keeping the portfolio only in the proximity of the frontier tends to require much less trading. The portfolio is adjusted to keep the risk/return trade-off at a satisfactory level, taking into account also real-world constraints. Over time, the risk on the actual portfolio is kept in the vicinity of the risk of the policy portfolio (Fig. 13.7).

As a central bank, it is particularly helpful to use the results from a quantitative portfolio model as the basis for portfolio decisions. Compensation of the central bank's staff is—for good reasons—not linked to financial performance. This can, however, lead to overly risk-averse behaviour. It is easy to get caught in a situation, where focus is solely on the risk of individual assets seen in isolation, which may, for example, lead to zero allocation to equity or duration. With the help of the dispassionate rigour of a quantitative model, more emphasis can be placed on how the assets interact and contribute to the risk/return characteristics of the portfolio as a whole.

13.4 Concluding Remarks

Over recent years, Danmarks Nationalbank has transformed its approach to reserve management. Although the new framework has only been in place for a limited period, the benefits are already showing. Danmarks Nationalbank has been able to align exposures to investment risk with the primary policy objectives and has introduced new asset classes. The anchoring of the risk budget to the policy portfolio helps communicate the risk and return implications of the various objectives, for instance, by allowing a decomposition of profit and loss into policy portfolio returns and excess return generated by investment risk. It also helps clarify the rationale for diversification.

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Chapter 14
The Swiss National Bank's Investment Decision-Making Process from a Safe-Haven Currency Perspective

Sandro Streit and Patrick A. Muhl

Abstract Defining an investment policy at the Swiss National Bank (SNB) has a long history and tradition. Strategy definition is a two-stage process. As a first step, the investment policy framework is drawn up, comprising all aspects of central banking, reputation, and risk policy, and a detailed, feasible long-term asset allocation strategy is formulated. In the second step, an investment strategy for the following 12–15 months is then prepared on the basis of this "neutral" allocation. Any deviations from the LAA are solely attributable to market valuation estimates. The SNB reports in a safe-haven currency, i.e. the Swiss franc. This has far-reaching implications for investment policy: the SNB can hold a higher proportion of risk assets relative to other central banks, while the diversification effect of risk assets is less pronounced and that of bonds stronger. The gradual expansion of the investment universe over the last 20 years has been accompanied by an ongoing improvement in the portfolio's risk and return profile, even against the backdrop of the significant expansion in the SNB's balance sheet. Ultimately, it has also alleviated the issue of excessive concentration in certain markets, which had become ever more problematic in light of this substantial balance sheet growth.

We have received helpful comments from colleagues at the Swiss National Bank. We would particular like to thank Benjamin Brunner for his help in preparing the figures. The views expressed are our own and do not necessarily reflect those of the Swiss National Bank.

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14.1 Introduction: The SNB's Investment Process

14.1.1 The Origins of the SNB's Investment Policy[1]

Investment policy has been one of the SNB's core functions ever since the revised National Bank Act (NBA) came into force in 2004. Even before then, the SNB had been a pioneer among central banks in terms of both defining an investment decision-making process for the management of its foreign exchange reserves and in expanding the number of asset classes it invests in. For example, the SNB was one of the first central banks to work with external asset management companies (from 1978). It was also in the vanguard in building up independent portfolio management operations (from 1984), establishing an independent risk management function (1997) and investing some of its foreign exchange reserves in equities and corporate bonds (2004).

These developments all began in the mid-1970s, when the management of foreign exchange reserves first came to the forefront of central bank activities. At that time, reserves mainly comprised US dollars and the strategic focus in managing them was on maximizing security and liquidity. Following the introduction of the floating Swiss franc exchange rate in the wake of the collapse of the Bretton Woods system, the SNB sustained considerable currency losses. In light of this, efforts were made to achieve greater returns at least on its US dollar investments. To this end, the SNB increased its portfolio of bank investments, since these commanded higher interest rates than US Treasury bills. Its investment activities initially remained largely passive. This was principally due to the fact that the residual maturity for its foreign currency investments was limited by law to not exceed 3 months.

As the investment needs increased steadily, it quickly became apparent that the investment maturity limits posed a problem. But not only that. The SNB was at times purchasing up to a quarter of some issues of short-dated US Treasury bills. On the one hand, SNB's purchases threatened to disrupt the US Federal Reserve's open market operations in setting the official interest rate, and, on the other hand, its dominant holdings reduced the market trading liquidity. In 1978, the statutory maturity limit was therefore extended from 3 to 12 months, thus paving the way for the SNB to draw up its first investment decision-making policy for its foreign exchange reserves.

Inter alia, the new policy stated that investments should be distributed over various US Treasury Bill maturities, with active management still remaining relatively limited. If, for example, the SNB expected US interest rates to fall, it extended the residual maturity of the foreign reserves portfolio, whereas if it anticipated a rise in rates, it reduced the portfolio duration. At the same time, the SNB sought to exploit temporary anomalies in the yield curve through arbitrage between different series of US Treasury bills. It also started to compare returns against reference portfolios (benchmarks) to evaluate the performance of its active asset management. And in

[1] Cf. also Moser and Stucki (2007).

1978, the SNB concluded an agreement with a specialist firm based in New York with respect to the management of part of its US dollar reserves.

The first extensive review of the SNB's foreign currency investment policy was carried out in 1983 and implemented in 1984. Based on the theoretical and empirical findings of the modern portfolio theory (MPT) and a reflection on the principles and practices of professional portfolio management techniques, the reappraisal gave rise to a plan of action. First, the portfolio management activities were separated from back-office activities at the organizational level. Second, a systematic investment decision-making and control process were established. Third, it was examined whether the statutory maturity limits could be extended even further and whether currency diversification could be improved using derivative financial instruments. However, the time was not yet ripe politically for all of the proposals. They were met with skepticism by the SNB's Governing Board, which was concerned about two separate issues. First, the reserve management practices should not interfere with the implementation of SNB's domestic monetary policy mandate. Any potential or real conflict between the two should be avoided. Second, a more active portfolio management style could raise resistance at the domestic political level as investment return, and not safety and liquidity, was given a more prominent role. As a consequence, these questions remained an unsettled issue and dominated internal investment policy debates in the years thereafter. In 1987, the Governing Board finally agreed to a gradual diversification into German mark and Japanese yen, although this was not implemented until 1989 owing to the exchange rate conditions and the central banks involved.

Meanwhile, a change in thinking was taking hold among financial market specialists on the suitability of residual maturity as an indicator for the liquidity of a particular fix or floating rate asset. An investment should instead be regarded as liquid if large volumes could be sold quickly at observable market prices without a loss in the principal value. Based on this view, statutory limits on maturities were no longer seen as an adequate tool for managing liquidity. In fact, SNB's investment activities in certain parts of the US money market could even influence the setting of market prices of such assets. As a consequence, the liquidity of SNB's large and concentrated holdings of US assets was lower than originally intended. Should the SNB need to raise USD by selling down the portfolio of US money market assets, it could find itself in an uncomfortable situation of bidding the price down on its holdings. This issue was even more pronounced as the markets for short-term German mark and Japanese yen investments were not sufficiently liquid at that time to serve as alternative investments.

However, it was not until 1 November 1997 that a partial revision of the NBA, primarily driven by investment policy considerations, opened up the possibility of adopting the sort of modern investment policy practiced by the SNB today. The residual maturity limit was abolished. Derivatives in the form of forwards, futures, swaps, and options were permitted. So, too, were a new type of transaction: repurchase agreements, or repos for short. Returns immediately became strategically important as an investment criterion.

1999 marked a further milestone. Drawing on the positive experience with the partial revision of the NBA and looking ahead to the reform of the monetary constitution,[2] it was decided to conduct a fundamental review of both the SNB's role as asset manager and the future structure of its assets. Extensive optimization calculations showed that the investment portfolio's risk and return profile could be further improved using additional diversification, for instance, through investments in other asset classes such as public equities and corporate bonds. The new NBA that came into effect in 2004 addressed these findings and recommendations by removing the relevant statutory investment restrictions. All in all, these actions considerably increased the room for maneuver. At the same time, the NBA stated the investment policy as a core part of the SNB's public policy mandate, underscoring the increase in the significance of the reserve management tasks over the preceding quarter of a century. The SNB's investment policy had thus arrived in the modern age.

14.1.2 The SNB's Investment Decision-Making Process[3]

The SNB takes a two-stage approach to defining its investment policy.

The first step involves drawing up the investment policy framework for the foreign exchange reserves investments. It covers all aspects pertaining to central banking, reputation, and risk policy which underlie the SNB's investment activities, such as the management of SNB's foreign exchange reserves is linked to monetary policy, to which it is always subordinate. This forms the basis for a long-term asset allocation (LAA). The LAA specifies the respective weights of the different currencies, the duration of all sub-portfolios, and the breakdown of the individual asset classes (equity exposure, country breakdown for government bonds, corporate bond component, supra/sovereigns, etc.). It addresses all the structural requirements[4] and optimizes the risk/return profile. It also takes the current size of the reserves portfolio into account to ensure that the optimized results are implementable. Furthermore, the long-term asset allocation is "neutral" in the sense that it does not reflect any market views, i.e. estimates of the cyclical valuation of investments. The LAA is drawn up in the form of specific, investable benchmarks and serves as a reference for the subsequent investment stages. It is reviewed annually and has a multi-year horizon. Adjustments are made for structural market changes, additional asset exchange reserves, liquidity requirements, or risk tolerance. The investment policy framework and the LAA are drawn up by the Risk Management unit and set by the SNB's Governing Board. The Risk Management unit is independent of the Asset

[2] The main issues were the unbundling of the Swiss franc from its Gold fixation and the stipulation of revised key principles of monetary policy, Cf. Klauser (2007).

[3] Also refer to: Maechler (2017).

[4] For instance, the approach of real capital preservation of the foreign exchange reserves: Which equity quota is required to preserve the capital in real terms?

Management unit and organizationally integrated into a different SNB department and therefore reporting to a different Member of the Governing Board.

In the second step, the Asset Management division prepares a strategic asset allocation (SAA) that reflects an investment horizon of 12–15 months. The SAA primarily considers cyclical valuations of assets and focuses on developing a deviation band around the longer-term LAA currencies, asset classes, and duration targets. The deviation range not only increases the flexibility for managing the foreign exchange reserve portfolio, it also provides a yardstick for measuring the contribution from active portfolio management. Decisions related to the SAA, again, ultimately lie with the Governing Board.

Based on these decisions, Risk Management prepares the specific strategic benchmarks and investment guidelines for implementation in the reserves portfolio by the front offices—one in Zurich and the other in Singapore.

The advantages of this two-tier approach are obvious: the discussions are clearly focused and the decision-making process is highly transparent. For example, if a change to the equity exposure is proposed in a one-stage investment process, it may be unclear whether this adjustment stems from long-term considerations (LAA) or is purely reflecting current financial market asset valuations. Having two discrete stages means that decisions are initially made on the "valuation neutral" LAA, and thereafter on current market valuations. And since this approach involves both Risk Management and Asset Management, it harnesses the strategy development expertise available in different areas of the SNB.

The SNB's investment process is structured along practices observed in large private sector institutional asset managers. The Investment Committee (IC) plays a key role in the implementation of the SAA. It has three members and is chaired by the Head of Asset Management. The two other IC members are sourced internally and nominated by SNB's Governing Board. It is a requirement that chosen individuals have profound investment experience but also that they have no access to sensitive monetary policy information. Additional to the IC troika, a risk manager participates at the meeting in order to safeguard the risk management requirements and enhance the mutual exchange of information.

Within the framework of the strategic guidelines, the IC decides on any tactical deviations from the respective strategic benchmarks, on the portfolio structure, and on the investment guidelines for the internal portfolio managers. Most of these tactical deviations are made in the form of overlay positions. Wherever possible, such positions are taken with derivatives (e.g., equity futures, interest rate swaps and futures, FX forwards, and credit derivatives). This is not only cost-effective, it also means that the excess return generated by the Investment Committee relative to the SAA can be calculated simply and precisely. It corresponds to the sum of all profits and losses on all overlay positions (including transaction costs), plus the results of any tactical deviations from individual benchmarks.

The individual internal portfolio managers do not act as an extension to the Investment Committee. They are given the leeway to implement their own trading ideas within the framework of the investment guidelines given by the IC. This encompasses timing, direction, and magnitude of position taking.

This approach allows performance to be precisely assessed at each of the three investment stages. First, the performance of the SAA is measured against the "neutral" LAA. Second, the Investment Committee's tactical management is measured against the SAA. Third, the individual portfolios against their respective benchmarks.

At present, 98% of the SNB's foreign exchange reserves are managed in-house. External asset managers, of whom there are relatively few by international standards, serve mainly as a yardstick against which internal portfolio management is measured. In this context, it is essential that both internal and external portfolio managers operate on a level playing field with respect to the given benchmarks and investment management guidelines. External managers are also deployed where they offer specialization advantages. For instance, the expansion of the investment universe to include equities in 2005 was initially outsourced. Once the necessary trading systems and resources for passive equity management had been set up and tested within the SNB, internal asset managers took over management of the equity exposure in 2007. The externally managed assets were thus brought back in-house.

A special facet of the SNB is the recent organizational separation of portfolio management from portfolio trading with the introduction of a trading desk. The decision addresses the resource bottlenecks in the portfolio management function. It was caused by the significant growth in the foreign exchange reserves over recent years and, in particular, by the increasingly loss of trading liquidity experienced in the international bond markets.

In the day-to-day business this is particularly evident in the growing commitment of resources to trading with consequently higher transaction costs for bond portfolio management. This reorganization centered on the trading desk, which comprises two teams. The OTC trading team is responsible for executing bond trades (corporates, supra-sovereigns, repos) and OTC derivatives (interest rate swaps and CDS). The exchange trading team handles the internal passive equity portfolios and is responsible for trading in all listed derivatives (futures).

Active bond portfolio management is thus separated along the value chain into portfolio analysis and portfolio trading (see Fig. 14.1). The analysts set the risk positions in accordance with the strategic and tactical limits (in the case of corporate bonds, the sector allocations for example). It is then the role of the traders to decide on the actual implementation (selection of instruments and position on the yield curve) and to conduct the necessary transactions on the market within a specific period.

What sets this approach apart from an execution desk model is that the portfolio traders have clearly defined discretion, i.e. scope for decision-making. Overall, the separation of portfolio analysis and portfolio trading essentially offers two advantages. First, the bundling of portfolio trading resources leverages synergies and delivers efficiency gains. Second, the division of responsibilities leads to greater specialization, which bolsters productivity and ultimately helps to safeguard the SNB's reputation among its business partners as a professional and competitive market participant.

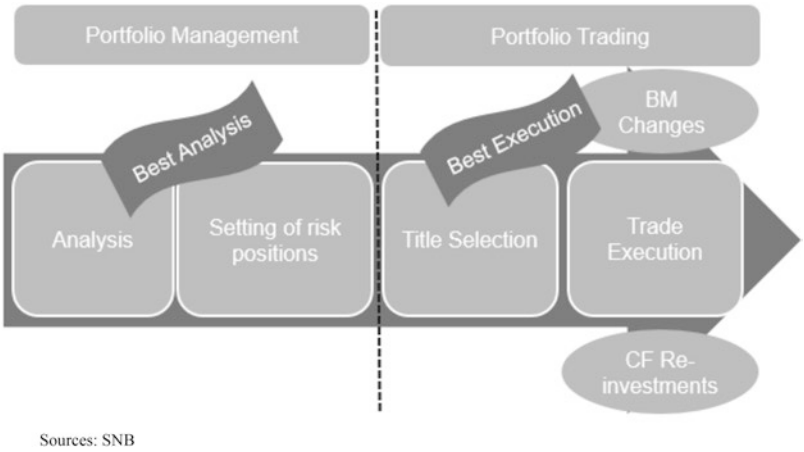


Fig. 14.1 Split of the value chain into portfolio management and portfolio trading. Sources: SNB

14.2 Distinctive Feature: Fundamentally Strong Currency as Unit of Account

Another special facet of the SNB's foreign reserve management practice, and one that sets it apart from some other central banks, is that it reports in a safe-haven currency, i.e. the Swiss franc. The safe-haven currency perspective is a key factor in determining an optimal asset allocation. The Swiss franc is a particularly sought-after investment currency during periods of international crisis. This historical observation is one of the reasons for its appreciation.[5]

Central bank's general ledgers are usually accounted for in their own, local currency while the foreign exchange reserves are accounted for in their respective foreign currencies. Generally, the exchange rate risk arising from this currency mismatch is not hedged. Hedging such risks not only defies the notion of holding international reserves in strong currencies. It might also lead to undesirable monetary policy implications. The SNB, too, uses its local currency as its unit of account, reporting its annual results, investment return, and risk in Swiss francs. What makes the Swiss franc special—at least as has been the case in the past—is that it is a fundamentally strong safe-haven currency. This particular characteristic has far-reaching consequences.

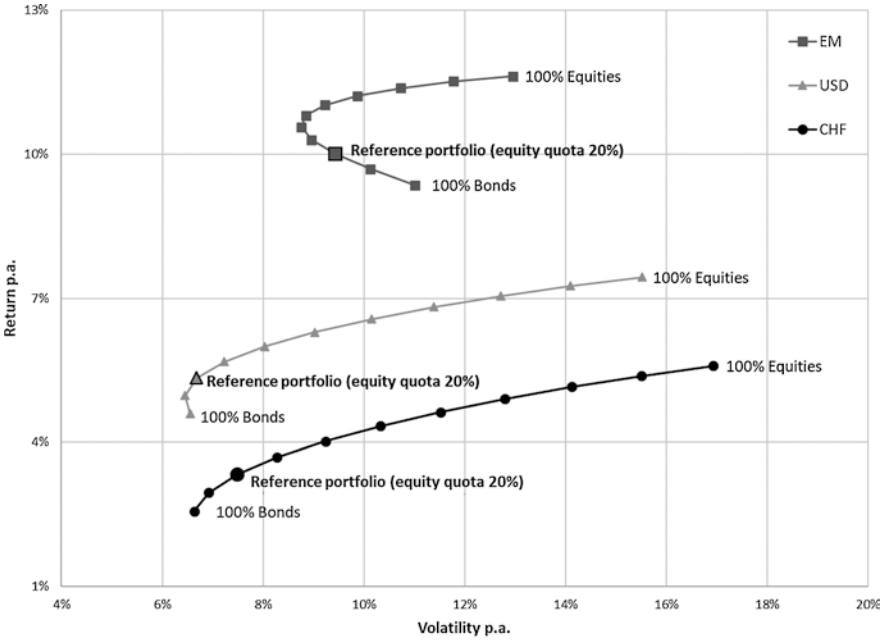
First, the SNB can hold a higher share of risk assets than other central banks that do not benefit from a strong home currency. This helps the SNB in achieving its goal of capital preservation in real terms. Thanks to the resilience of the Swiss franc in crisis situations, the SNB is not forced to sell its riskier investments—in the worst-case scenario at rock-bottom prices—to support its own home currency. This gives

[5] See also Chap. 5.

the SNB a somewhat longer investment horizon, allowing it to maintain a relatively high equity exposure (currently 20%) compared with other central banks.[6]

Second, the diversification benefits from holding the risk assets are less pronounced for the SNB. This is because the price of such investments typically falls during market turbulence while the Swiss franc appreciates. The SNB thus faces a double loss in the short term, on both risk assets and foreign currency. In short, there is a trade-off between the amount of and exposure to risky assets and the subsequent portfolio price and return volatility, i.e. higher expected return comes with higher P&L volatility.

This is clearly demonstrated by the SNB's foreign exchange portfolio. Figure 14.2 depicts the annualized average return and average volatility of the portfolio for various equity exposures based on monthly data since 1998—in Swiss francs (CHF), in US dollars (USD), and in an emerging market currency (EM). The latter two are shown here purely for illustration purposes in order to highlight the difference between reporting in a safe-haven currency compared with various non-safe-haven currencies. The dots for each bond/equity mix denote the equity exposures, starting at 0% on the left and rising in increments of 10–100% at the right-hand end of the



Sources: Datastream, SNB

Fig. 14.2 Distinctive feature of reporting in Swiss francs: weaker diversification effect of equities and low returns. Sources: Datastream, SNB

[6] See also Chap. 24.

curve. The larger dots indicate equity exposures of 20%, corresponding to the current bond/equity allocation in the SNB's portfolio.

The differences in the portfolio diversification effect depending on the choice of reporting currency—as shown here by the bend in the curves—are immediately recognizable. The more pronounced the bend, the greater the diversification effect. With the Swiss franc as the reporting currency, each increase in equity exposure—for example, from 0% to 10%—is accompanied by an immediate increase in volatility. From the SNB's perspective, enhanced returns, achieved through raising equity exposure, lead directly to increased volatility. If an emerging market currency is used instead, volatility is reduced for all equity exposures up to 40%, and the same applies for the US dollar, albeit up to 10%.

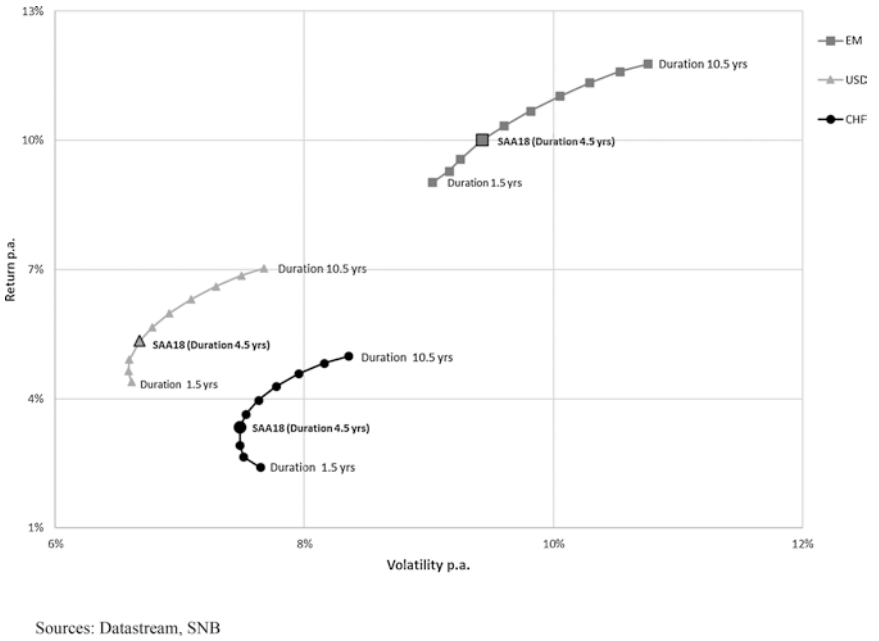
Yet volatility is just one of many risk assessment indicators. Using other risk measures (e.g., historical portfolio simulations during past stress periods) over longer time horizons such as 12 months shows that the current share of equities in SNB portfolio has a risk-mitigating effect (see Fig. 14.6). Furthermore, the likelihood of preserving the real value of investments over the long-term increases with an equity exposure around the current level. The SNB is in the fortunate position of not having to strive to minimize short-term volatility and can also take longer-term considerations into account.

Figure 14.1 reveals another interesting aspect, namely that the reporting currency evidently affects not just the diversification of equities, but also the level of returns. Hence, the average return in US dollars is over 2% points higher than in Swiss francs, and in an emerging market currency almost 7% points higher. This difference is primarily due to the appreciation of the Swiss franc in recent years.

The third consequence is that bonds, by contrast, have a stronger diversification effect in the case of the SNB. This is again attributable to the safe-haven status of the Swiss franc. Bond yields and the external value of the Swiss franc are usually negatively correlated. In other words, what the SNB gains from a fall in yields helps to offset the appreciation effect of the Swiss franc. Up to a certain level, increasing the duration does not result in a rise in volatility, and instead initially even causes it to fall (see Fig. 14.3).

On the basis of monthly data since 1998, Fig. 14.3 shows the annualized average return and average volatility of portfolios with various durations—once again, for illustration, in Swiss francs, US dollars, and an emerging market currency. Highlighted on each curve is a hypothetical reference portfolio with a duration of 4.5 years exclusively comprising US Treasuries and German Bunds. Left of this starting point on the curve, the duration reduces in steps of 1 year, initially to 0.5 years and from there—with the portfolio still consisting solely of Treasuries and Bunds—ultimately to 1.5 months. Moving to the right, duration increases in increments of 1 year to a maximum of 10.5 years.

The difference in the portfolio diversification effect depending on the reporting currency is again striking. When an emerging market currency is used, the curve is essentially linear, with an increase in duration directly entailing a rise in the p.a. portfolio volatility. The same applies, with a few exceptions, to the US dollar as reporting currency. In the case of the Swiss franc, however, an increase in duration



Sources: Datastream, SNB

Fig. 14.3 Distinctive feature of reporting in Swiss francs: relatively stronger diversification effect of bonds. Sources: Datastream, SNB

initially has a dampening and then a neutral effect, and only results in a rise in volatility above a certain level.

Although the SNB invests 80% of its foreign exchange reserves in bonds with an average duration of 4.5 years, the contribution of interest rate risk to the volatility of the foreign exchange reserves is minor (see Fig. 14.4). If the accounts were reported in US dollars or an emerging market currency, however, this risk contribution would be significantly higher. Meanwhile, with an emerging market currency, the equity exposure of 20% would help reduce volatility.

That said, the biggest risk factor with regard to the foreign exchange reserves is currency risk, which the SNB cannot neutralize for monetary policy reasons.

The reporting currency thus also determines total volatility (see Fig. 14.4). For example, if the reporting currency were the US dollar instead of the Swiss franc, the exchange rate risks would be much lower since a large share of the SNB's portfolio is invested in US dollars rather than Swiss francs.

As part of its monetary policy mandate, the SNB has, over the past 20 years, been using the investment policy latitude available to it to optimize the risk and return profile for its foreign exchange reserves. Unlike other central banks, the SNB benefits in this regard from an institutional framework that allows for a broad investment spectrum. Two key legislative changes are again important here: (1) the removal of the residual maturity limit of 1 year in 1997 and (2) the increase in the SNB's room for maneuver in investment matters following the revision of the NBA in 2004. Below we will examine what the SNB's diversification efforts have achieved.

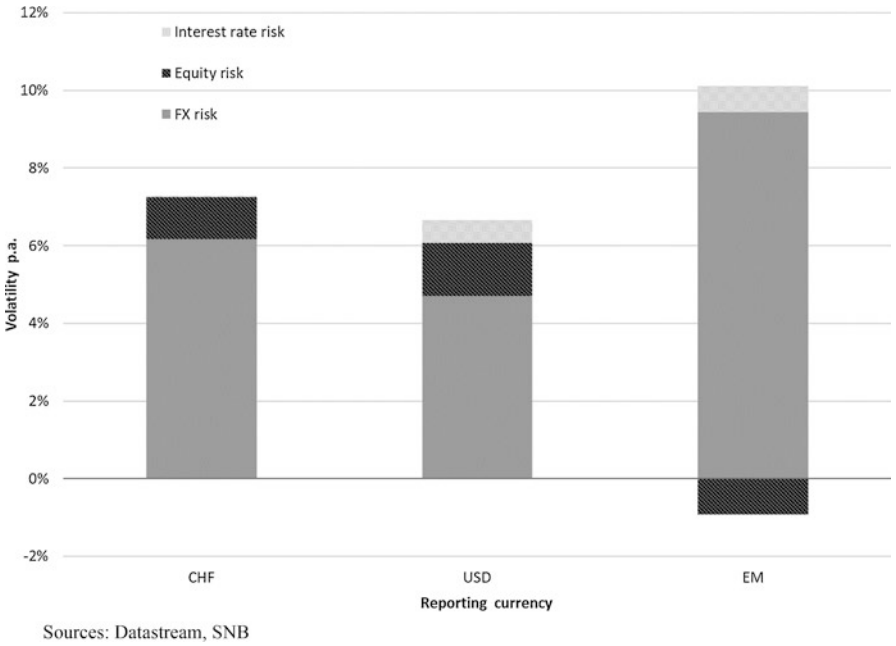


Fig. 14.4 Reporting currency effect on overall risk decomposition of SNB investments. Sources: Datastream, SNB

14.3 Experience from the Expansion of the SNB's Investment Universe to Include Additional Asset Classes and Investment Currencies

The analysis is based on the modifications made to the SNB's portfolio over the last 20 years and the impact these have had on the risk and return profile of its foreign exchange reserve portfolio. For the sake of comparability, the impact of the individual diversification measures assumes that the SNB's portfolio had the respective allocation over the entire period from January 1998 to May 2018 (see Fig. 14.5). The years marked in Fig. 14.5 refer to years in which a change to the portfolio allocation was made.

The first dot (I.) in the risk/return diagram shows the average return and volatility of the SNB portfolio with the allocation that applied until the end of 1997. If no changes had been made to the portfolio composition since then, the average return would have been around 1% and the average volatility almost 9%.

As mentioned earlier, a statutory maturity limit of 12 months was applied to foreign currency investments at that time. This requirement defined the composition of the portfolio. The SNB invested the foreign exchange reserves in the most liquid money markets: 80% in US Treasury bills and 15% and 5%, respectively, in German and Japanese money market instruments. The average duration was 0.5 years. The

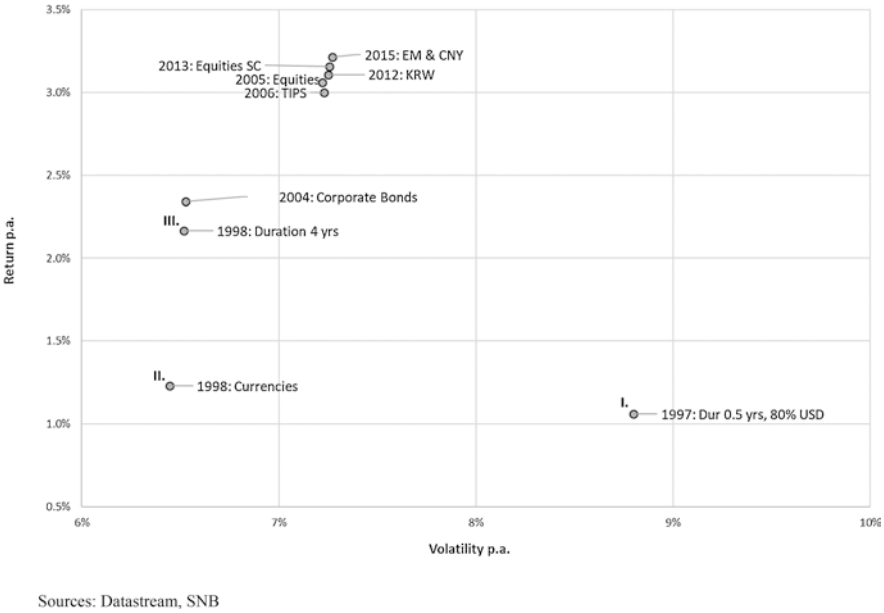


Fig. 14.5 Continuous optimization of risk/return profile over the last 20 years. Sources: Datastream, SNB

removal of this limit following the revision of the law in 1997 allowed the SNB to hold floating and fixed rate instruments across the full maturity spectrum. It also opened the door to investments in currencies other than the US dollar, German mark, and Japanese yen. The SNB included the pound sterling, Canadian dollar, and Danish krone as new reserve currencies and extended the average duration for all fixed income portfolios from 0.5 to 4 years. The overall effect of these investment policy changes is illustrated by looking separately at the two partial effects of adding new currencies and increasing the duration.

Focusing first exclusively on the currency effect, the next dot (II.) shows the average return and volatility of the SNB portfolio since 1998, where the foreign exchange reserves are no longer concentrated in investments in US dollars and are instead more broadly diversified. The duration is left unchanged, ceteris paribus, at 0.5 years. The diversification effect of adding new currencies is clearly visible. While the average return is essentially the same, the average volatility falls by 2.4% points. Although the addition of new currencies did not improve return appreciably, it did significantly reduce risk.

The next dot (III.) shows what happens if the duration is also increased, from 0.5 to 4 years. Average return rises substantially, by almost 100 basis points. The average risk, on the other hand, remains more or less unchanged.

Following the NBA revision in 2004, the investment universe was expanded to include new asset classes: corporate bonds in 2004 and equities in 2005. However, only equities and bonds issued by foreign companies were permitted by the

Governing Board in order to preserve room to maneuver for implementing the SNB's monetary policy. In addition, the Governing Board was concerned that its reputation would not be undermined by perceived, potential, and real conflicts of interest. By all means, the SNB did not intend to spread the perception of undertaking structural policies as well as hold paper of financial institutions which are part of SNB's lender-of-last-resort protection. To mitigate these concerns, the SNB decided to pursue a foreign equity investment strategy that aimed at market-neutral investments and a passive investment approach. This implies replicating individual equity markets in their entirety. The intention was to avoid selecting particular sectors or stocks, and thereby any semblance of structural policy, as well as to ensure that the SNB did not become a significant shareholder of individual companies. The Governing Board decided on indexed management of equity investments and a restriction to mid and large-cap companies.

With respect to international bonds, the credit rating requirements were reduced from AA– to BBB–, thus allowing investment in any investment grade bond. While the addition of corporate bonds produced only a slightly higher return (+20 basis points), building up the equity exposure had a greater impact, increasing the average return and volatility alike by 70 basis points.

In 2006, SNB began investing in US inflation-protected bonds (TIPS). Alongside equities, these real financial assets provide a counterweight to the high share of nominal investments and thus offer a hedge against the inflation risk factor. Nevertheless, in retrospect, the investment in TIPS has not yet proved its worth, at least in terms of returns. The portfolio risk and return profile deteriorated slightly, with a fall in the average return being accompanied by a slight increase in average volatility. This is principally due to the non-inflationary environment of recent years.

Driven by monetary policy considerations, the SNB's foreign exchange reserves grew significantly during the financial and sovereign debt crisis. Having stood at around CHF 50 billion in 2007, they had risen to more than CHF 750 billion by end-2017. From an investment policy perspective, the SNB reacted to this rise by gradually expanding its investment universe. Five new investment currencies were added: the Australian dollar (AUD), Singapore dollar (SGD), and Swedish krona (SEK) in 2010, the South Korean won (KRW) in 2012, and in 2015 the Chinese renminbi (CNY). The inclusion of the KRW, in particular, initially took many by surprise. Yet, the KRW is actually very attractive as a reserve currency for the SNB. This is because there is a low correlation between the KRW and the SNB's existing reserve currencies, and the South Korean government bond market is deep and liquid. Furthermore, South Korea has earned an acceptable credit rating by international credit rating agencies. As regards equities, the universe was expanded to include small caps in 2013, and investments in equity securities from emerging economies in 2015. The measures taken pushed the risk/return profile back up to higher average returns, albeit coupled with higher volatility (see Fig. 14.4).

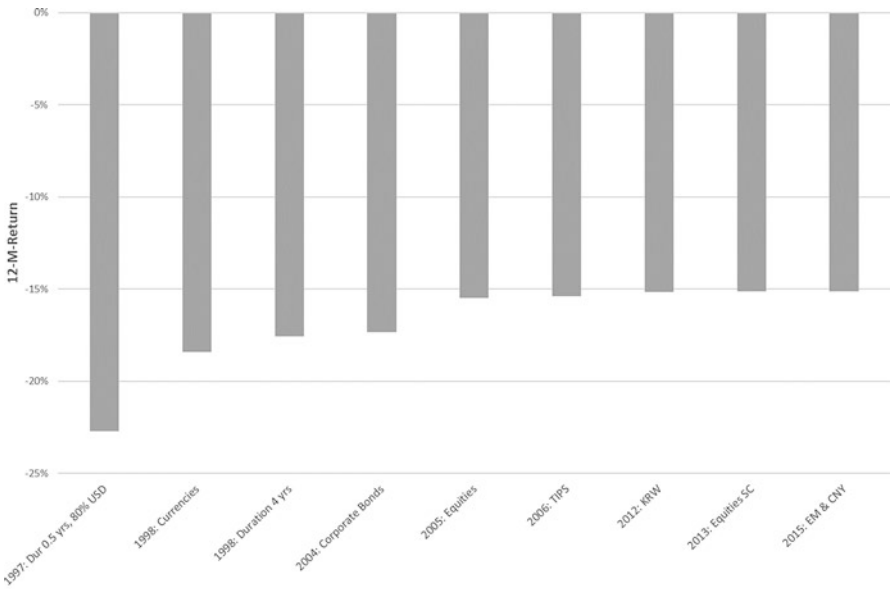
Overall, as Fig. 14.4 also illustrates, the diversification effects from currencies, asset classes, and duration extension are increasingly diluted. Every further change to the portfolio allocation in the form of a new reserve currency or asset class reduces the diversification effect. Other potential markets are too small, relative to

the size of the reserves portfolio and the capital for investment, to make a noticeable contribution to diversification or to contribute to a reduction in the market shares held by the SNB. Nevertheless, further alternatives with respect to expanding the investment set in order to optimize the risk/return profile are reviewed on an ongoing basis.

Figure 14.4 does not show the full picture, however. From a risk/return perspective, the current portfolio is certainly better than that of 1997—the average return is significantly higher and average volatility considerably lower. But how does today's portfolio compare with that of 2004, i.e. at the time of the last NBA revision? Is the current portfolio allocation also superior to that of 2004 in terms of diversification? There are no unequivocal answers to these questions. Today's portfolio does generate a higher return, but volatility has also increased.

Thus far our analysis has concentrated on volatility, but this is not the only measure of risk. The gradual changes implemented in the SNB foreign exchange portfolio can also be illustrated using the maximum 12-month loss (Fig. 14.6).

The steady decrease in the maximum 12-month loss is clear. From a comprehensive risk perspective—i.e. not solely on the basis of volatility—the SNB's portfolio has undoubtedly improved its risk and return profile over the last two decades. The current currency and asset allocation are far superior to that of 2004. Figure 14.6 shows how the inclusion of inflation-protected bonds has also made a positive contribution.



Sources: Datastream, SNB

Fig. 14.6 Diversification has proved its worth. Sources: Datastream, SNB

The SNB's experience with expanding the investment universe can be summarized as follows: First, the greatest diversification effect comes from adding a new investment currency. Second, increasing the duration of the portfolio has very little impact on risk—indeed it may even reduce it in some circumstances. In the SNB's case, this is attributable to an advantageous correlation with the Swiss franc exchange rate. Third, equities are a sensible addition to the traditional central bank portfolio.

14.4 Conclusion

Defining an investment policy at the SNB has a long history and tradition. The SNB follows a professional investment decision-making process for its foreign exchange reserves that is built on the same principles as those of large institutional asset managers. Strategy definition is a two-stage process. As a first step, the investment policy framework is drawn up, comprising all aspects of central banking, reputation, and risk policy, and a detailed, feasible long-term asset allocation strategy is formulated. In the second step, an investment strategy for the following 12–15 months is then prepared on the basis of this "neutral" allocation. Any deviations from the LAA are solely attributable to market valuation estimates.

The SNB reports in its local currency, the Swiss franc, the latter's distinguishing feature being that it is a fundamentally strong, safe-haven currency. This has far-reaching implications for investment policy: the SNB can hold a higher proportion of risk assets relative to other central banks, while the diversification effect of risk assets is less pronounced and that of bonds stronger.

The gradual expansion of the investment universe over the last 20 years has been accompanied by an ongoing improvement in the portfolio's risk and return profile, even against the backdrop of the significant expansion in the SNB's balance sheet. Ultimately, it has also alleviated the issue of excessive concentration in certain markets, which had become ever more problematic in light of this substantial balance sheet growth. Diversification has made this possible, and in so doing has proved its worth.

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Chapter 15
The Strategic Asset Allocation Framework of Banco de México

Gerardo Israel García López, Rafael Jiménez Padrón, and Andrea San Martín Kuri Breña

Abstract The strategic asset allocation framework (SSA) of Banco de México has evolved dramatically over the last few years. It has involved a long learning process that required a deeper technical training of its personnel and significant research. In this chapter, we will describe the evolution of the strategic asset allocation process used by the Central Bank of Mexico (CBM) to construct their benchmark for the investment of the international reserves portfolio.

15.1 Strategic Asset Allocation Framework of Banco de México

The strategic asset allocation framework (SAA) of Banco de México has evolved significantly over the last few years. It has involved a long learning process that required substantial research, and a deeper technical training of its staff. In this chapter, we will describe the evolution of the strategic asset allocation process used by Banco de México (BdM) to construct its benchmark for the investment of the international reserves portfolio.

Banco de México (BdM) has three main objectives for reserve management: liquidity, capital preservation, and return enhancement. Among them, liquidity stands out as the most important objective and is taken into consideration in any

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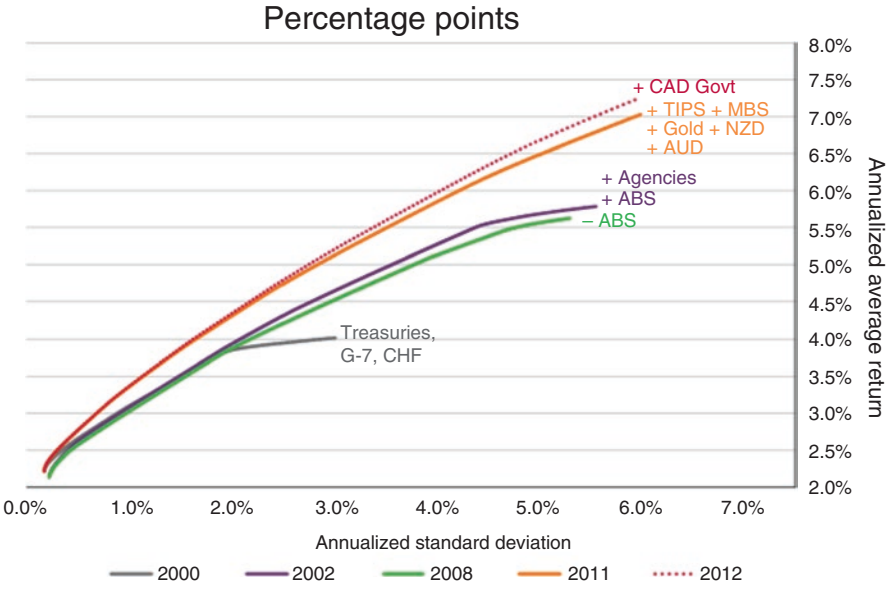
context for the ultimate composition of the reserve's portfolio. The focus on capital preservation or return enhancement—usually conflicting objectives—may change depending on the economic and financial context.

From 2000 to 2012, Mexico experienced a rapid growth of international reserves from USD 30 billion in 2000 to USD 160 billion in 2012. However, the yield differential between the average realized returns on assets and the interest rate paid on the passive side of the Central Bank's balance sheet (carry cost) was quite high. In that context, the BdM focused its SAA on enhancing the return of the portfolio to minimize the cost of carry. The aforementioned was achieved by pursuing diversification strategies into new asset classes that could enhance the expected return of the international reserve assets without significantly increasing the market risk. During this period, traditional optimization models (i.e., Markowitz) allowed the central bank to find the optimal portfolio. As a result, gold, new currencies (AUD and NZD), and some fixed income assets such as mortgage-backed securities, inflation-linked bonds, debt issued by international organizations and non-US government debt were included to the investment portfolio (Fig. 15.1).

Nonetheless, beginning in 2013 the CBM realized that the challenges for reserve management were changing and would become more challenging. The looming normalization process of the Federal Reserve monetary policy stance would likely result in an appreciation of the US dollar and an increase in interest rates that could

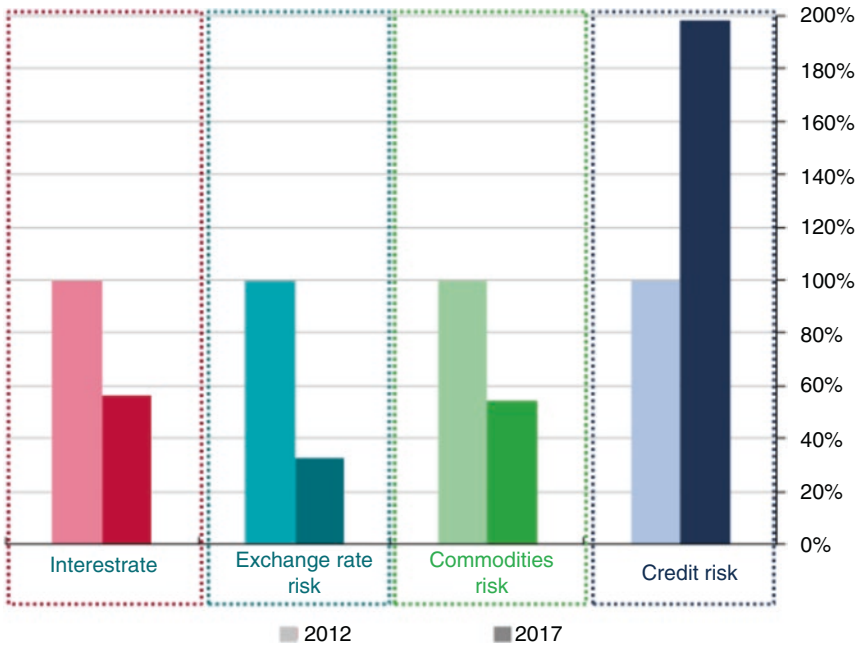


Source: Central Bank of Mexico with total return indices of Bank of America / Merrill Lynch. The data used in this chart comprises the period between 2000 and 2018.

Fig. 15.1 Evolution of Banco de México's efficient frontier derived from Strategic Asset Allocation (SAA) decisions. Source: Central Bank of Mexico with total return indices of Bank of America/Merrill Lynch. The data used in this chart comprises the period between 2000 and 2018

pose a significant risk to the returns of the international reserves portfolio. In addition, reserve accumulation had come to a halt given lower oil prices, and Banco de México had to use its reserves on several occasions to restore the adequate functioning of the FX market (FX intervention). As a result, BdM shifted the balance of its objectives towards capital preservation by identifying the main risk factors of its portfolio and adding forward-looking measures to its optimization models, moving from a purely historical approach to a Bayesian framework. As a result, BdM lowered the duration of the portfolio, decreased significantly the exposure to non-USD currencies, and hedged the exposure to gold prices through the use of financial derivatives (Fig. 15.2). In contrast, the exposure to credit risk increased, mainly through a larger exposure to bank deposits, though it came from a very low base and the central bank implemented other measures to mitigate counterparty risk (such as CLS that reduces settlement risk on FX transactions). Although on the duration side the BdM did lose some carry, the reduction in the exposure to gold and assets denominated in currencies other than the US dollar were successful in mitigating capital losses. At the same time, the volatility of the returns of the portfolio diminished considerably.

In the current economic context, the focus of the asset allocation process of BdM is still to preserve capital while having a more balanced portfolio that would be less



Source: Central Bank of Mexico.

Fig. 15.2 Banco de México's exposure to distinct risk factors. Percentage (2012's portfolio = 100%). Source: Central Bank of Mexico

affected by potential scenarios of economic growth. BdM acknowledges that there has been a structural change in financial markets where non-conventional monetary policies have changed asset correlations and suppressed volatility. Looking forward, it seems quite improbable that asset classes will behave as in recent history. In such a context, BdM made a significant adjustment to the strategic asset allocation methodology during 2018. The objective was to adjust its framework to be more robust, forward-looking, and more aligned to the objective of capital preservation.

In the next sections, we will dive further into the main changes of the asset allocation process which included not only the improvement of the model's inputs, but also a redefinition of the optimization model itself.

15.2 Improving the Inputs

Models are abstractions of reality and, as such, can only be informative and useful in a decision-making process if they are based on reasonable assumptions and use the best possible inputs. In this regard, BdM started the reformulation of its SAA process by revisiting its understanding of financial asset returns.

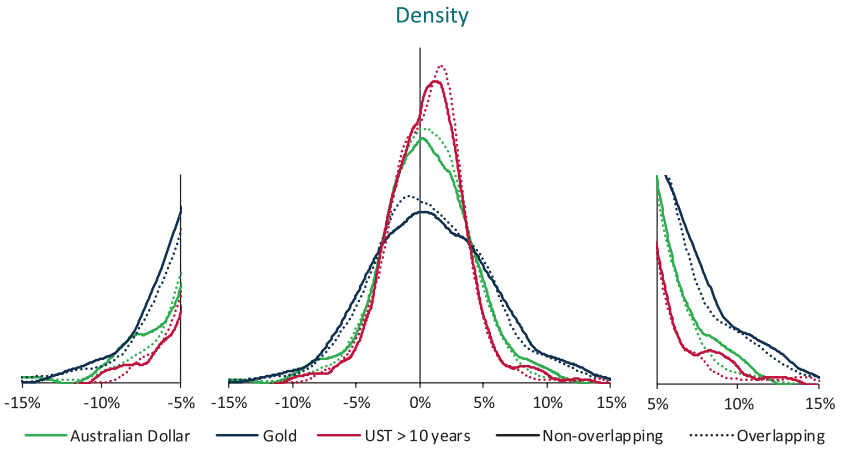
Asset returns are the most fundamental input in any strategic asset allocation exercise, regardless of the sophistication of the methodology, since they will end up determining the most fundamental elements of the data generating process that will be used to estimate the composition of the portfolio (moments of the distributions, metrics of interaction between assets, tail dynamics, among others). Given its importance, BdM devoted plenty of time and resources to determine the best way to model the inputs. The main findings are described below.

15.2.1 Frequency of Asset Returns, Overlapping vis-a-vis Non-overlapping Data

Asset returns usually come from time series of prices, but gauging the appropriate frequency to measure returns is important (daily, weekly, monthly, yearly). The first step is to understand the effect of an overlapping with respect to a non-overlapping measurement. To be more precise, let us assume that we have daily prices data and that we want to calculate monthly overlapping returns. That means that the first return (logarithmic or percentage change) will be the one gauged between the first day of month A and the first day of month B, the second would be the return between the second day of month A and the second day of month B, and so on. This would mean that if we have a time series with a length of n days, we would have approximately n-21-1 monthly returns. The alternative, would be to calculate the monthly returns by using non-overlapping measurements, that is: the first return would be the one calculated from the closing price of the asset at the end of month A (one price) and its equivalent monthly closing price of month B; the second would be the return

between the end of month B and the last day of month C, and so on. This would result in a much smaller time series of around $n/21$ observations. Even though it may seem at first glance that the more data the merrier, overlapping returns have a fundamental flaw that will produce unwanted properties in the distributions of returns. The information embedded in the prices is essentially the same for both options, however, in the overlapping case, one is only artificially manufacturing more observations. Let us illustrate this with an example. Assume the price of a stock starts month A at a level of 100 and that it trades at a level 120 on the first day of month B, the first observation would be a 20% return; then, it is very likely (under reasonable assumptions) that the previous and next observations are somewhere around the 20%. This effect will translate in a repetition of observations and, by construction, observations that lie around the center of the associated distribution will be repeated more. Thus, with respect to the non-overlapping case, we will end up with densities with a different mean, an overestimated mode and, as a result, underestimated tails. Figure 15.3, illustrates the impact of this seemingly naïve discussion in the marginal distributions of three assets.

Once we know that non-overlapping data seems to be a better way to reflect the distribution of returns on financial assets, the next question is what the appropriate frequency of data is. In that regard, BdM believes that using weekly returns is the best option since it constitutes a frequency that is small enough to simulate short-term trading strategies, but at the same time mitigates the microstructure problems associated with very low-frequency data such as daily returns: thin trading, lack of liquidity, among others.



Source: Central Bank of Mexico with total return indices of Bank of America / Merrill Lynch. The data used in this chart comprises the period between Jan-2000 and May-2018.

Fig. 15.3 Returns distributions and tails. Source: Central Bank of Mexico with total return indices of Bank of America/Merrill Lynch. The data used in this chart comprises the period between Jan-2000 and May-2018

15.2.2 Distribution Properties of Asset Returns

The traditional mean-variance optimization approach (MVO) that seeks to maximize the expected return of the portfolio subject to a predefined level of volatility (or vice versa) is implicitly assuming normality in the distributions of financial assets' returns. However, empirical evidence shows that distributions tend to have fatter tails. BdM believes that there is a way to overcome such assumption and better reflect the historical and prospective distributions of asset returns:

15.2.2.1 Marginal Distribution of Returns

The MVO assumes that the distributional properties of asset returns (marginal distributions) can be characterized by using the first two moments of the distribution (mean and variance) and thus it is possible to model returns using a normal distribution. However, it is well known that distributions of returns tend to have fatter tails and are skewed with respect to a normal distribution. Consequently, BdM decided to enhance the estimation of asset returns by modeling them through non-parametric distributions (kernel). As an example, Fig. 15.4 clearly shows that kernels represent the empirical distribution of the returns of a US Treasury index with maturities between 5 and 10 years much better than a normal distribution. Regardless of the type of kernel used, it is possible to capture the kurtosis and the skew of the data much more precisely than when using normal distributional assumptions. More formally, applying a Jarque–Bera normality test to the errors associated to the estimation of an autoregressive model of order one (AR (1)) to the returns of an index of US Treasuries

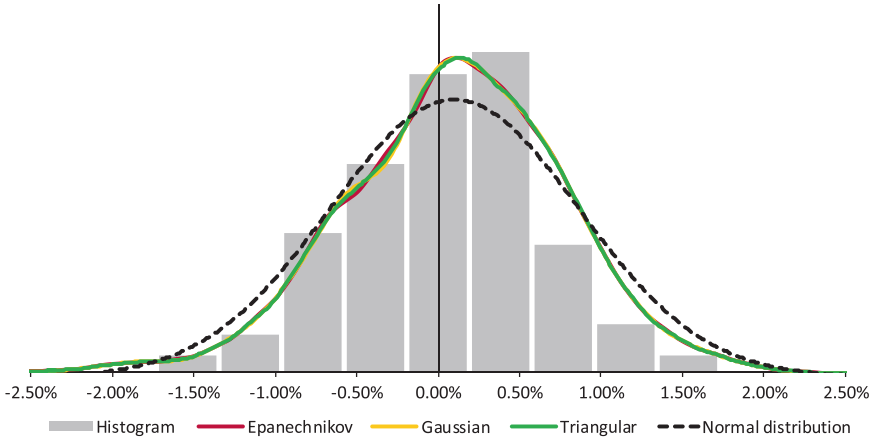


Fig. 15.4 UST 5-10y weekly non-overlapping returns. Source: Central Bank of Mexico with total return indices of Bank of America/Merrill Lynch. The data used in this chart comprises the period between Jan-2000 and May-2018

from 5 to 10 years gives a statistic for the chi-squared of 112.72 (p-value = 0); thus, there is enough statistical evidence to reject the null hypothesis of normality. This result is true for most of the assets classes that constitute the portfolio of international reserves of BdM. In summary, non-parametric distributions (derived through kernels) enable to capture the exact shape of the distribution of returns with a high level of accuracy, given the fact that they do not have a predetermined shape as in the case of the parametric family, and that they are essentially sophisticated histograms that can produce a continuous and well-defined distribution.

15.2.2.2 Joint Distribution of Asset Returns

The MVO procedure implicitly assumes that the joint behavior of assets' returns can be described as well with a multivariate normal distribution. This happens, as a by-product of the classical way of representing the objective function that the investor optimizes to construct its portfolio: maximize expected returns subject to a level of volatility (measure of risk). By construction, the solution of this optimization problem only requires a vector of expected returns ($\pi_{n\times 1}$) and its covariance matrix ($\sum_{n\times n}$), which are the the two moments that fully characterize a multivariate normal distribution. However, for the particular basket of the eligible assets, BdM finds that the multivariate Jarque–Bera normality test applied to the errors associated to the estimation of a vector autoregressive model of order one (VAR (1)) yield a p-value of 0, for both the skewness and kurtosis component; allowing the rejection of the null hypothesis of joint normality. Even though this is an empirical fact known from a long time ago, it is not obvious how to find a multivariate distribution that gives the correct joint behavior of assets and that captures the marginal properties obtained in the kernels. It is in this context, that Meucci (2010) proposed the usage of the Sklar theorem (see Box 15.1 for a formal definition) which essentially states that there is a way to use the data to find a multivariate distribution function (named "copula") that gives the correct joint behavior of assets, regardless of the characteristics of each marginal density.

Box 15.1 Sklar Theorem

Let $\mathcal{F} \in \mathcal{F}\left(F_1,\ldots,F_n\right)$ be an n dimensional distribution function with marginals $F_1,\ldots,F_n$.

Then there exists a copula $C \in \mathcal{F}\left(\mathcal{U},\ldots,\mathcal{U}\right)$ with uniform marginals such that

$$F\left(x_1,\ldots,x_n\right) = C\left(F_1\left(x_1\right),\ldots,F_n\left(x_n\right)\right).$$

In addition, copulas provide a nice data generating process that enables to generate simulations. The aforementioned has several benefits. On one hand, it is sometimes necessary to optimize the portfolio for a specific investment horizon (say 1 year) that differs from the data generating process (say weekly). In such a case, the risk-reward characteristics of the portfolio are going to be directly linked to the data frequency. In other words, a hypothetical investor that feeds the weekly data into his optimizer will only find the optimal portfolio for a one-week investment horizon, which may not be the same for a yearly horizon. In addition, the investor cannot really know what the yearly expected return is and where the annual expected loss lies for such portfolio (CVaR). Annualizing CVaR numbers would be incorrect since the investor would be implicitly assuming that the CVaR, which by construction is a rare event, would be materializing every week of the year and this would be severely overestimating risk. The ability to simulate returns through the copulas allows the investor to overcome such problem, assuming the data generating process (copula with the right marginal distributions) is independent and identically distributed (i.i.d). If so, the investor can generate data (a new joint distribution with new marginals) of the appropriate investment horizon, and then optimize the portfolio. On the other hand, having a well-defined data generating process means that one will be able to increase the size of the sample, thereby populating places with few observations such as the tails.

Notwithstanding all the benefits previously mentioned, it is not trivial to find the right copula that reflects the joint distribution of assets´ returns. Therefore, Banco de México decided to find the parameters of a T of student joint distribution that fits the data as best as possible, through a maximum likelihood procedure. The process will generate an estimation for the rank correlation matrix and for the degrees of freedom. BdM found that the degrees of freedom depend on the period of data used to estimate the distribution ranging from 8 to 90; which suggests that sometimes the tails of the joint distribution are important (degrees of freedom below 30) and that sometimes, especially during periods without financial crisis, a normal distribution would be just fine (degrees of freedom above 30). Deciding which periods of data should be used to estimate returns is a subjective decision that requires great care, as with all statistics related to financial data. Data from the very distant past might not be relevant if there had been structural changes. However, data from recent history may also not be representative if one is living in unusual times with low volatility that is unlikely to continue in the future.

15.2.2.3 Forward-Looking Distributions of Asset Returns

As in previous years, BdM does not want to optimize the international reserves portfolio looking only at historical returns. Neither do we want to assign purely subjective forecasts of returns to asset classes. To achieve such goal, it is necessary to produce a forecast of the density of each asset in the eligible basket, the

interaction between assets (say a rank correlation matrix) and tail dynamics. In addition, it is important to highlight the fact that the investor needs to forecast the total return associated with having an exposure to a particular asset. To illustrate with an example, assume the numeraire of an investor's portfolio is the US dollar and that the investor is trying to forecast the distribution of returns of the 10-year German bond for a one-year horizon. Then, the investor will need the distribution associated with the fixed income returns—that will at least be decomposed into a carry and a capital gain component due to the movement of interest rates—and the FX exposure linked to the euro-dollar exchange rate. Thus, in this simple example, the hypothetical investor already needs a distribution of returns related to changes in interest rates, a distribution of FX returns, and a joint distribution that links them together. As it can already be perceived, the exercise is complicated. Once the latter is considered, the problem simply becomes monumental. How good is your forecasting model (goodness of fit, mean squared error, and others)? Should the investor base its forecasts on economic models or should the investor be using machine learning methods? How much data should be used to calibrate the model and from which period?

It is in this context that BdM decided to pin down their forecasting methods to one of the most powerful ideas in modern finance: the efficient market hypothesis (EMH) that states that a capital market is efficient if it fully and correctly reflects all relevant information in determining security prices. In that sense, the market is possibly one of the best aggregators of information and thus it is possible to extract information from market prices to model the expected return of the asset classes for the investment horizon. With that said, the question becomes how can one obtain forecasts using prices of financial assets? BDM's answer is to use the Breeden–Litzenberger model for FX returns and the Ho–Lee model for fixed income returns (See Boxes 15.2 and 15.3).

Box 15.2 Modeling Foreign Exchange Returns

Estimating prospective returns of currencies (assuming the USD is the numeraire) requires a well-behaved and representative distribution estimation, and the FX options market looks like a natural starting point. In the first place, from the volatility smile of European options, it is possible to obtain a risk-neutral probability distribution for almost any relatively short-term horizon (from 1 month to 3 years, at least). Moreover, the liquidity of this market and the powerful result of Breeden–Litzenberger model (see below for more details), will allow the investor to estimate statistical densities that do not depend on specific distributional assumptions (such as the log-normality assumption used to derive the Black–Scholes–Merton equation), and that tend to yield intuitive and well-behaved distributions.

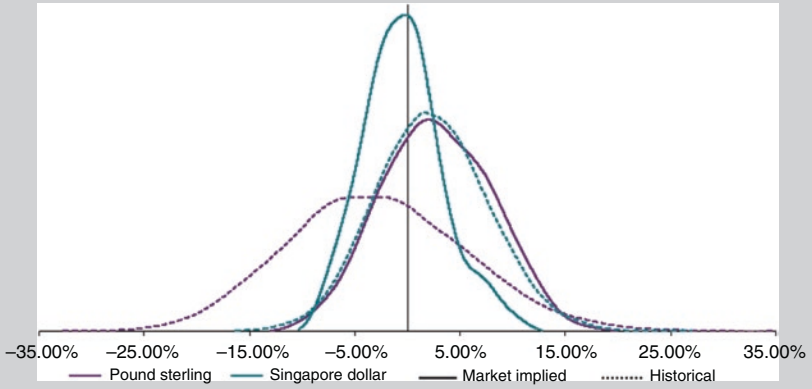
The pricing formula of an European call option is given by

$$c_0 = e^{-r*dt}\mathbb{E}\left[\max\left(S_T - K,0\right)\right] = e^{-r*dt}\int_0^{\infty}\max\left(S_T - \mathrm{K},0\right)\bullet f\left(S_T\right)dS_T$$

where S_t is the price of the underlying asset, d_t is the time to maturity, K is the strike price ofthe option, r is the risk free rate with maturity d_t, and $f(S_T)$ is the risk − neutral density function of the underlying asset.To calculate the density function $f(S_T)$ Breeden − Litzenberger proposed the following formula:

$$\frac{\partial^2 c_0\left(K\right)}{\partial K^2} = e^{-r*dt} f\left(S_T\right)$$

To illustrate with an example, assume a hypothetical investor is standing at the end of 2017 and that his investment horizon is one-year. Figure 15.5 in Box 15.2 shows a comparison of two types of forecasts you would have gotten at this particular date, for a group of selected currencies: (1) a statistical density of 1 year returns based on the last 5 years of historical data (2013–2017) and (2) a statistical density of 1 year returns based on the implicit distribution in the options market.



Source: Central Bank of Mexico with total return indices of Bank of America / Merrill Lynch. The market implied information uses 1 year calls/puts of the cross between the shown currency and the USD. Historical information is annualized through a process that simulates under the traditional i.i.d. assumption (independent and identically distributed random variables).

Fig. 15.5 Distribution of annual returns based on historical and market information (Densities). Source: Central Bank of Mexico with total return indices of Bank of America/ Merrill Lynch. The market implied information uses 1 year calls/puts of the cross between the shown currency and the USD. Historical information is annualized through a process that simulates under the traditional i.i.d. assumption (independent and identically distributed random variables)

As can be seen, the distributions obtained from historical information and from market prices could not be more different. For the case of the pound sterling, the historical data would suggest that the expected return of having a one-year exposure to such currency would be negative (around −5%) and would also imply a wider dispersion of its associated density with respect to the rest of the distributions of the chart. In contrast, market implied information forecast a distribution that draws a completely different picture; expected returns are positive and the dispersion of its density is smaller than that of the one drawn from historical data. If we dive deeper into such distributions, the conclusions seem obvious. The historical data (using the last 5 years) include a very important event: the Brexit referendum. Thus, it is very possible that the forecast using historical data will be affected by a massive and, presumably, one-off event, implying a high possibility of currency depreciation and higher volatility of returns. On the other hand, market prices were revealing the expectation of inflationary pressures building up in the UK economy and the implied pace of monetary policy normalization. Such economic backdrop would most likely point to an appreciation of the sterling, just as the market implied distribution suggests.

Box 15.3 Modeling Fixed Income Returns

There is a vast amount of literature that tries to model the term structure of interest rates by assuming that long-term rates are the result of the expectations of the evolution of short-term rates. The Ho–Lee model focuses on providing a specification for the evolution of short-term interest rates, while capturing the exact shape of the yield curve. The model assumes that short-term interest rates are determined by a very simple stochastic process (see below).

Ho–Lee Model:

The Ho–Lee model assumes that the evolution of the short-term interest rate, with continuous composition, evolves according with the following stochastic process:

$$(i) \quad r_{t+1,j} = r_{t,j} + \theta_t dt + \sigma \bullet \sqrt{dt} \qquad \text{with } q = \frac{1}{2}$$

$$(ii) \quad r_{t+1,j+1} = r_{t,j} + \theta_t dt - \sigma \bullet \sqrt{dt} \qquad \text{with} \qquad 1 - q = \frac{1}{2}$$

where $\boldsymbol{r}$ is the short − term interest rate that goes from t *to* $t + 1$, $\boldsymbol{d_t}$ is the fraction of a year between each point of the tree, $\boldsymbol{j}$ is a constant that indicates an upside movement, while $\boldsymbol{j + 1}$ indicates a downside movement, $\boldsymbol{q}$ is the risk − neutral probability, σ is the historical volatilityof the short − term interest rate, and $\boldsymbol{\Theta_t}$ is an adjustment parameter that is calibrated for each t.

In that regard, the Ho–Lee model estimates short-term interest rates with a binomial process, thus allowing the generation of a risk-neutral binomial tree. The objective of such tree is to obtain a distribution of short-term interest rates—and consequently a distribution of prices for each bond in the economy at different periods of time—such that the discounted expected value of the payoffs of each bond is exactly the price observed in the market (using a risk-neutral probability of 0.5% for up and down moves). That distribution of prices enables the estimation of return distributions consistent with forward rates. In other words, and perhaps more intuitively, the expected value of rates at each period of time determined by the tree is going to be something very similar to the short-term forward rate observed in the market. Therefore, what we are achieving is to "open" the forward rate to move from a single number (as is possible to obtain directly from the yield curve) to a full range of possibilities (a distribution) centered on the forward rate with a dispersion determined by the historical volatility of the underlying (short-term rate).

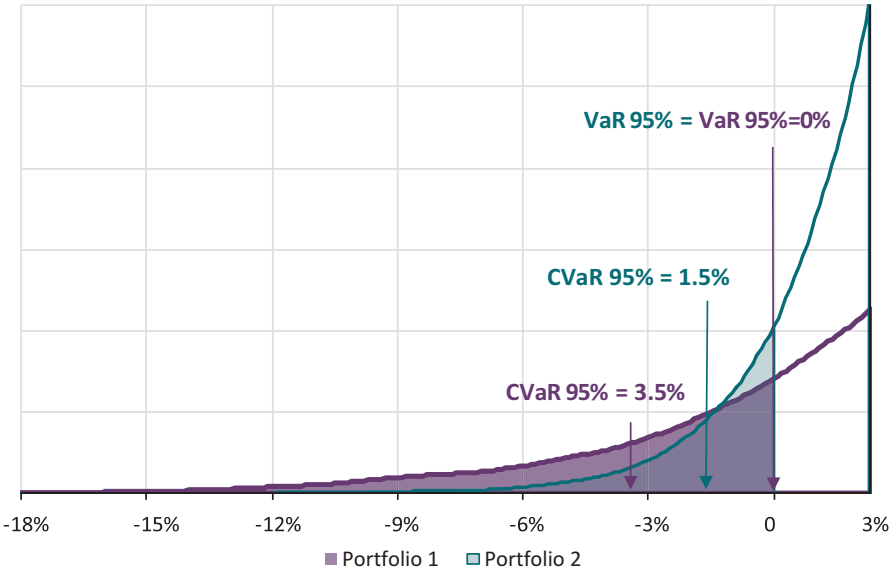
To obtain a multivariate data generating process that will constitute the forecast of the joint distribution of returns for the investment horizon, the investor needs to use historical data to calibrate the joint behavior of assets and of tail dynamics (parameters of the copula), and prospective marginal densities to obtain the dimension of returns. It is worth mentioning that, as far as BdM's knowledge, there is not yet a reliable way to calibrate the parameters of joint behavior of assets from forward-looking information; thus, the procedure is implicitly assuming that the relation between assets (say correlations) and tail dynamics (say degrees of freedom) can be correctly estimated with historical information. Therefore, BdM devotes considerable time in determining the correct period for calibrating their models.

Lastly, BdM is well aware that obtaining densities from prices will yield risk-neutral distributions and in that sense, the central bank has developed a statistical methodology to incorporate risk premium into the model estimation.

15.3 Adjusting the Optimization Model

During 2018, BdM adjusted its optimization model as well. As previously mentioned, Markowitz methodology (MOV) assumes that volatility is the right metric to gauge the risks associated with an investment. However, for a long-only investor like a Central Bank, the above may not be true as lower volatility does not necessarily mean capital protection, which is one of the main goals for reserve managers.

In this sense, the central bank decided to redefine the risk metric so that it could be more consistent with the capital preservation objective. More concretely, BdM needed a risk measure that focused on the left-hand side of the distribution of returns of the portfolio. The two main candidates that were analyzed were valued at risk (VaR) and conditional value at risk (CVaR, or expected shortfall). VaR at a 5% level of confidence represents the fifth percentile of the distribution of returns of the portfolio, thereby focusing in the worst-case scenarios. However, VaR lacks the ability to capture the dynamics of the tail of the distribution below such threshold and, thereby, it does not capture the expected realization of losses in the worse possible cases once the VaR hurdle is crossed (which is captured by CVaR). To illustrate the above, Fig. 15.6 shows two hypothetical portfolios with the same VaR but with very different tail dynamics. As can be seen, it is clear that even though portfolio 1 represents a riskier investment, reflected in the fatter left tail, VaR would have considered both portfolios to be equally risky. On the other hand, as one would expect, portfolio 1 has a higher CVaR than portfolio 2, which allows us to conclude that the CVaR is a better measure of the potential risk of adverse scenarios and capital losses.



Source: Central Bank of Mexico.

Fig. 15.6 Left tail of the distribution of returns of two hypothetical portfolios (Densities). Source: Central Bank of Mexico

As a result, BdM modified its optimization model to maximize expected return and minimize risk defined as CVaR, instead of volatility. Such optimization procedure allows the investor to obtain a curve similar to the efficient frontier from Markowitz, but where the X axis is represented by the conditional value at risk. In this way, it is possible for the investor to choose between different efficient portfolios depending on its risk profile. In the case of BdM, the portfolio that would be chosen would be the one that maximizes the ratio of expected return to CVaR, which is something analogous to finding the maximum Sharpe ratio portfolio in the Markowitz problem.

It is worth mentioning that using copulas to estimate the joint behavior of the asset's returns is what really puts everything together and what will allow the investor to use more sophisticated methods to estimate the optimal portfolio and adjust the risk metric to CVaR. For instance, say the investor was using the correct non-parametric distribution of the returns of every asset but fitting a normal distribution to explain the joint behavior between them. Then, redefining the risk metric to CVaR would have been irrelevant since a normal distribution can be fully described by two parameters; return and volatility.

15.4 Conclusions

In the last few years, Mexico has experienced significant changes in economic and financial conditions at home and abroad. Such changes have had an impact in our reserve management activities, including our SAA process. We have transitioned from having a focus on the enhancement of the return portfolio during a period of large accumulation of foreign reserves, to a focus on capital preservation given our lesser accumulation of foreign exchange assets, and a more uncertain external environment. At the same time, we have worked comprehensively to build a more solid, but also more flexible platform that facilitates portfolio construction and the day-to-day management of the international reserves portfolio.

In doing so, BdM has further diversified the reserve portfolio adding new assets classes and new eligible currencies. In addition, the BdM has sought for a well-balanced portfolio under different economic scenarios, and continuously identified and evaluated the main risk factors of the reserves portfolio.

During 2018 and 2019, BdM modernized its portfolio construction process by redefining the objective function of the optimization model, so that it is more consistent with the capital preservation objective. We also worked on enhancing the inputs of such model, incorporating features as the non-normality of returns, and prospective information embedded in market prices. As a result, BdM now has a more robust, transparent, and forward-looking methodology to take the most important decision of any reserve manager: its Strategic Asset Allocation.

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Chapter 16
Dynamic Strategic Asset Allocation at the National Bank of Belgium: Why and How to Implement It in a Central Bank

Etienne Lavigne

Abstract The management of central bank foreign exchange reserves is a topic in which best practices do not remain constant but evolve. For a number of countries, the international reserves have become a significant national asset. For other countries, the reserves are still seen in the context of monetary policy implementation. In most cases, however, the reserves are higher today than they were 10 years ago. Furthermore, new capital markets have opened up and a broader range of financial instruments have been added to the universe of acceptable reserves assets. In all cases, the task of managing these reserves has changed and become more complex. At the same time, public interest has increased and reserves management activities—and their resulting returns—have become more visible. The asset management units within central banks, therefore, do not only have responsibilities towards their own senior management. They are also market participants and public servants. This attention is both legitimate and important. But in all this, their day-to-day portfolio management activities are primarily guided by the traditional trilogy of objectives, i.e. "safety first", then "liquidity" and finally "return". These objectives have guided reserves managers over the years and are still valid. But they need an update and an extension in order to meet new multi-faceted challenges. This chapter seeks to show one possible way forward.

The views expressed in this article are those of the author and do not necessarily reflect the views of the National Bank of Belgium (NBB).

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16.1 Foundation Supporting Dynamic Strategic Asset Allocation

16.1.1 Theoretical Foundation

The efficient market hypothesis (EMH) is an investment theory developed by Fama, whereby asset prices are said to reflect all publicly available information.[1] Theoretically, therefore, there is no method, such as technical or fundamental analysis, that would enable an investor to construct a portfolio that consistently would generate an additional return over and above that of the market portfolio, i.e. portfolio "alpha". As a consequence, passively holding the market portfolio must be the preferred option.

Numerous empirical studies question the EMH theory. Market prices often deviate from their "equilibrium" values and episodes of market dislocation, or bubbles, are frequent. The phenomenon of volatility clustering, characterized by a system with two regimes, i.e. "risk-off" (steady and low volatility) and "risk-on" (panic-driven and high volatility), is also evidence frequently presented against the EMH theory. Similarly, risk premiums are not always at their long-term equilibrium levels and their predictability even seems related to the macroeconomic cycle.

Several studies have analysed the factors behind market price behaviour that seemingly contradict Fama's EMH.[2] The main factors usually mentioned are: "home-biases", market regulation, liquidity imbalances and forced hedging. Behavioural finance is providing a deeper understanding of the inadequacy of the EMH theory, explaining the markets' under/overreaction by the slowness of the adjustment process to news (pricing discovery errors) and by herding (trend followers jumping on the momentum bandwagon). A dynamic asset allocation that seeks to exploit such "factors" and "anomalies" is therefore called for. This chapter will explore such a dynamic strategy and locate it in the context of managing central bank foreign exchange reserves. Before we get there, however, the next section looks into the limits of dynamic asset management.

16.1.2 Boundaries of Dynamic Management

Even with strong arguments supporting the dynamic asset management case, some important factors may reduce the potential advantages or even increase the implementation risks when the strategy requires frequent portfolio rebalancing. Frequent rebalancing is operationally challenging and implies high transaction costs that reduce the earning potential in the reserves portfolio. Certain financial markets and

[1] Fama (1970).

[2] Ang et al. (2009).

their asset classes are susceptible to frequent rebalancing. In general, such markets are characterized by the following phenomena:

- Some market behaviour is chaotic[3] (non-random) due to dependence and non-normality, implying that forecasting future return is possible but difficult;
- Markets could inherently be risky with regular price bubbles and crashes. This mostly happens when supply and demand for specific asset classes are deeply unbalanced;
- Markets and their participants might send price signals that seem "obvious" but nevertheless are misleading;
- Large moves in the markets usually occur within a limited period of time (timing concentration), implying that the time of entry or exit may have a major impact on the final return of a dynamic strategy;
- In situations of market stress, prices may jump rapidly (discrete prices), implying that there is no certainty of being able to reduce market exposure at a predefined level.

16.2 Motivation for a Dynamic Asset Allocation for Central Bank Reserve Management

16.2.1 Dual Identity of Central Banks

Central banks usually have a dual identity. First, as a public policymaker, they are responsible for monetary policy implementation. Second, central banks may also be considered as independent institutions belonging to the financial sector and, as such, requiring financial strength.

The primacy of the policy objective over profit considerations is a cornerstone of central bank governance. Nevertheless, a "trade-off" between the central bank's two identities is needed, as a strong financial position allows for smooth implementation of policies. Adequate financial strength is needed (1) to ensure the central bank's credibility and its capacity to continue carrying out its main mandates, (2) to avoid any doubt about its present or future capacity and its independence from short-term political pressure and (3) to avoid the fiscal implications of losses to its capital base. It should be added that the relevance of this objective depends on some specific factors such as the actual size of the central bank's reserves in excess of policy needs, the market risk it bears on its balance sheet and the share of funding it realizes from non-interest-bearing liabilities, i.e. banknotes.

[3] Chaos is a behaviour of dynamical systems that are highly sensitive to initial conditions.

16.2.2 Inadequacy of Real Outcome when Compared to the Objectives

The strategic asset allocation process is usually based on the central bank's objectives in terms of risk tolerance and/or a return target—either absolute or in excess of a given benchmark, i.e. portfolio alpha. In many cases, the decision process relies on assumptions about expected future returns, volatilities and correlations—over time and under different scenarios. Changing market conditions may however create a mismatch between the defined objectives (*ex ante*) and the outcome (*ex post*). A major shift in market conditions, for example, may have a significant impact on the portfolio risks and, as a consequence, the risk tolerance level may be exceeded.

Market changes may also prompt reaction from central banks in the event of unacceptable return volatility, large exposure to statistical tail events, lower market liquidity and higher asset return correlations that reduce the expected gains from a broadly diversified reserves portfolio. In some circumstances, the "do nothing" option could result in a significant active deviation from the targeted asset and currency allocation. Therefore, actions such as altering the interest rate risk exposure or reducing inappropriate concentration risks could be considered in order to gradually return to the targeted risk tolerance level. Market changes may also dramatically reduce the expected risk-adjusted return, as well as increasing the probability of tail losses.

These markets induced movements that catapult the reserves portfolio away from the targeted risk tolerance level and/or the return objective reduce the attractiveness of the "do nothing" option and increase the case for a (more) dynamic strategic allocation.

16.3 Taxonomy of Dynamic Strategic Asset Allocation

16.3.1 Central Banks and Different SAA Styles

Let us define the Strategic Asset Allocation (SAA) as the long-term reserves portfolio that numerically defines the weigh to various eligible investable asset classes and currencies—taking the risk aversion of the institution into account (with or without liabilities).

Taking a long-term view is a key element in the making of a robust SAA. The investment time horizon is dependent upon the specific situation of each central bank in terms of their monetary policy mandate, the size of their foreign currency reserves and, possible, financial market instabilities. Central banks also differ according to the degree they would deviate from the SAA by making active investment decisions. Table 16.1 summarizes the main investment management options for a central bank with a long-term SAA in place.

Table 16.1 Taxonomy of active investment styles for central banks with a long-term SAA in place

SAA style	Central bank context
Fixed with rebalancing	• Inherent to passive style investment • Usual for MTM portfolios • Reinvestment rules for HTM
Fixed with overlays	• More "active" central banks • Strategic portfolio tilting
Flexible SAA	• Explicit dynamic management objective oriented • Much less frequent for central banks

MTM marked to market, *HTM* hold to maturity
With time passing, some operations are needed to maintain unchanged the main characteristics of a portfolio even under a full passive management

16.3.2 Fixed SAA with Rebalancing

The fixed SAA with rebalancing investment style is the least active of the three generic investment management processes. It implies a regular rebalancing of the investment portfolio back to the initial SAA. It is based on the belief that (1) asset prices have stable known points of reference and/or (2) there is no significant ability to predict investment returns or even risks.

The value of this rebalancing method stems from (1) the alignment with the strategic weights based on stable characteristics (risk, return and correlation), (2) a dynamic rebalancing using an expected mean-reversion behaviour of markets or (3) a disciplined approach avoiding biases and short-termism.

The main drawbacks of this method are (1) the misalignment with market changes (risks, returns, mean reversion, risk aversion, etc.), (2) the bias of "anchoring" investment behaviour with a fixed allocation in all market circumstances and (3) the delivery of highly variable risk outcomes.

16.3.3 Fixed SAA with Overlays

The fixed SAA with overlays approach keeps a fixed SAA as the reference point (reflecting risk/return choice), but applies on top of it a stand-alone overlay portfolio that over/underweighs specific asset classes already in the SAA. The over- and underweights reflect views on the asset class's relative risk/return attractiveness. This method is based on the belief that markets are not always and everywhere efficient, thus implying some ability to predict returns and/or risks while keeping the SAA as a stable anchor over the long-term.

The value is generated by exploiting extreme market behaviour (mean reversion, etc.), using relations between economic cycles and risk/returns patterns to reduce risk or enhance return. The "anchoring" bias is still present, albeit to a lesser extent, and the main drawback is the sensitivity to regime shifts.

16.3.4 Flexible SAA

The flexible SAA investment style constitutes a fundamental change relative to the discussed options. There is no longer any framework with fixed SAA weights for any portfolio assets as a reference. It is based on the belief that investors (1) look for fixed risk/return factors, not fixed assets (impacted by market changes) and (2) may change their objectives due to changes to the internal or external economic or financial market environment.

These types of investment strategies are mainly based on the assumption of mean reversion of markets (trends are more frequent or longer than reversals) and persistence of volatility changes (clustering). Their drawbacks are however difficult to manage: complex governance frameworks, potential transaction cost in volatile markets, behavioural biases, tendency to short-termism.

Rebalancing of investment portfolios is usually the first step towards the implementation of some form of a dynamic strategic asset allocation. Further steps in such a process involve, first, confidence in own forecasting abilities, and, two, ability to design and manage the governance issues involved. Below, we describe these steps in some more detail.

16.4 Steps Towards an Effective Dynamic SAA

16.4.1 Defining the Priority: Risk or Return

The cornerstone of risk management within any SAA process is asset and currency diversification. But diversification is not a panacea as it can include some major drawbacks:

- Not necessarily optimal as expected returns are not constant and only partly predictable;
- Vulnerable to increases in volatility and correlations;
- Overall portfolio risk level may increase beyond the risk tolerance of the central bank.

Implementation of a dynamic SAA framework may help alleviate these drawbacks by (1) smoothing out volatility, thus reducing the risk of any disconnect from the desired risk and return profile, (2) avoiding extreme outcomes (tails) and (3) enhancing risk-adjusted returns (Table 16.2).

Central banks normally focus on controlling risks rather than maximizing return on their reserves portfolio. A dynamic SAA rebalancing approach could prove to be an efficient approach to support the arguments for controlling the level of risk: (1)

Table 16.2 Taxonomy of dynamic strategic asset allocation and implementation steps

SAA style	Use for central banks
Fixed with rebalancing	• First step • Dynamic rebalancing • With rules to manage risk
Fixed with overlays	• Second step • Need confidence in ability to predict
Flexible SAA	• Final step • Need strong forecasting capabilities • Need strong governance

market risks are easier to forecast (volatility trends) than market returns and (2) return forecasts could be used to assess market vulnerability levels.[4]

We have found support that risks are easier to forecast and manage than returns. However, this does not imply that the observation of some specific risk measure is enough. A stable and low-volatility environment may hide latent risk with underestimated liquidity risks or excessive risk-taking. On the other hand, higher volatility could send the wrong signal of a fundamental deterioration whereas price-spikes can be provoked by beta strategies, high-frequency traders or new regulation.

16.4.2 Ability to Anticipate Market Trends at an Early Stage

When focusing on risk rather than return when dynamically managing the SAA, we do not have the ambition to predict shocks or trend reversal but in a more modest way, to detect early stage changes to market structures as signalled by risk and return expectations. Below we formulate our ambitions.

16.4.2.1 Quantitative Approach or Expert Judgement?

The methods developed to forecast/detect structural changes in capital and financial markets are either based on quantitative tools such as statistical methods or trading strategies, or on expert judgement. Both approaches present advantages and disadvantage such as those summarized in Table 16.3.

Central banks work within a specific context with a strong emphasis on governance (see Sect. 16.3), avoiding any (sign of) conflict of interest and giving priority to the monetary policy mandate. The use of quantitative (trading) methods, implying a quite disciplined and mechanical approach, could be precarious for central banks as the various buy, sell and hold signals provided by such models could be inadequate to follow in all market circumstances. This is so because such actions

[4] Overly optimistic expected returns could be a sign of future disappointment.

Table 16.3 Quantitative and qualitative method: advantages and disadvantage

	Advantages	Disadvantages
Quantitative methods	• Disciplined approach—anchor • Reduce availability bias • Manage risk aversion bias • Take account of regression to the mean (basis forecast) • Realistic (if kept simple)	• Ignore new environment • Sensitive to regime shifts • Mechanistic approach
Expert judgement	• Adds analysis on specificities to average view • Reduces anchor with past • Easily allows forward view	• (Risk of) lack of discipline • Bias of overestimating rare event probability • Bias of overconfidence in own judgement

could conflict with other public policy objectives, such as implementation of monetary policy or international cooperation between central banks.

But there are also more fundamental drawbacks to the use of statistical or econometric methods. It seems like a forlorn hope to seek empirical relationships that are transferable over time (time consistency) and that remain same and stable in a different market context (state consistency).

Economies and financial markets are highly complex, undergo evolutionary changes and are impacted by beliefs. It is therefore extremely challenging to adequately capture such structures and processes by a predefined set of consistent quantitative measures and models. The fact that markets tend to follow chaotic moves also reduces the usefulness we may expect from quantitative models.

On the other hand, the use of expert judgement to provide helpful insights that can guide the dynamic investment decisions may also be challenging due to biases of overconfidence in own forecasts and overestimation of rare event probability and to the lack of discipline. Empiricism without a strong logical structure contains a real danger—in particular when internal governance structures and processes that overlay the investment decision-making process are weak. Table 16.4 shows selected biases inherent in the dynamic SAA, quantitative methods and expert judgements.

We can distinguish cognitive shortcuts, such as hindsight, e.g. avoiding risky actions, confirmation, anchoring, availability (based on "easy" information), overconfidence and emotional shortcuts such as loss aversion and conservatism.

The implementation of a dynamic SAA combining quantitative methods and expert judgement helps reduce several known behavioural biases.

16.4.2.2 Advantages of a Combined Approach

One way to take advantage of both approaches, i.e. quantitative methods and expert judgement, while reducing their respective drawbacks is to build a framework combining several methods at different stages of the investment decision process that supports a dynamic SAA approach. A stylized framework is shown in Table 16.5. Following this table, we will discuss each of the five steps in some more detail.

Table 16.4 Summary of answers to quantitative and qualitative challenges

Dynamic SAA is an answer to	Quantitative method is an answer to	Expert judgement is an answer to
• Conservatism bias • Anchoring bias • Status quo bias	• Confirmation bias • Hindsight bias • Mental accounting bias • Overconfidence bias • Loss aversion bias	• Availability bias • Illusion of control bias

Table 16.5 A stylized framework for implementing a taxonomy of dynamic asset allocation

Step	Description	Motivation
1.	Macroeconomic dashboard	• Introduce discipline without mechanical approach • Provide "unbiased" information • Identify "richness/cheapness"
2.	Identify shift in volatility/correlations	• Persistence of volatility • Detect changes at an early stage
3.	Trading signals tools and expected returns	• Use of expected returns and trading signals to identify potential risk changes
4.	Expert judgement	• Introduce qualitative factors and experience
5.	Decision based on integration of risk forecast and return forecast	

Trading signals are usually using back-testing to find the "best" rule within all possible rules. We are facing here the well-known risk of "survivor" bias

16.4.2.3 Step 1: Macroeconomic Dashboard: Construction and Use

The first step involves building a dashboard that contains the outcome of simple statistical time series analyses with a variety of factors such as relative values for various asset classes and macro variables. The eclectic dashboard is parsimonious. It is designed to avoid rigidities and a mechanical derivation of trading strategies.[5]

First, we must choose macro factors which may have a significant impact on our portfolio returns, such as level of yields (real and nominal) and yield-spreads, price levels (gold, commodities, currency pairs, etc.), risk level (volatility, correlations, etc.), economic conditions (unemployment, inflation, growth, etc.). Then, we assess generic investment strategies, such as long/short positions versus a given benchmark along standard dimensions such as market, foreign exchange, credit and liquidity risks. Typical investment strategies would be an overweight of corporate bonds versus Treasuries, long High Yield versus High Grade, long TIPS versus Treasuries, etc.

[5] The dashboard, inspired by an article by Clewell et al. (2018), has been developed with T. Provoost from the National Bank of Belgium (NBB).

The following information is computed and reported:

- Ranges are chosen for each factor to define low, medium and high regimes; the current value of the factor and its percentile are provided;
- A matrix is providing for each strategy and each factor:
- the average expected return under the strategy[6] (e.g. long IG corporates versus US Treasuries) for the specific regime, as well as the percentile and the range of returns (10%, 90%);
- the same information for the strategy during the specific regime compared to the strategy applied through all regimes;
- signals are provided when specific thresholds are met.[7]

For a given strategy, some factors may provide signals (buy/sell) and others not. The matrix is giving added-value information which needs then to be confirmed by additional analysis.[8]

If a specific factor such as US unemployment or Real 10 year yield provides significant signals for a specific investment strategy, it could be useful to analyse in detail the evolution and the content of this factor in the present cycle, compared with historical cycles. This could help to confirm the validity of the signals or, on the contrary, to reduce their value. If conflicting signals are provided for a given strategy, the origin could be found in the present cycle specificities.

16.4.2.4 Step 2: Identifying Shifts in Volatility/Correlations

The goal of the second step is to detect at an early stage any structural changes in the financial markets. It is based on the fact that volatilities are persistent and stick to the current level before slowly trending back to their long-term average. We combine short-term, medium-term and long-term measures of volatility (historical and implied) as well as correlation evolutions. Annex 17.2 gives a simple example of volatility analysis based on signals provided by moving averages crossing. The use of moving averages, as well as a longer time horizon, reduces the statistical noise. A matrix similar to the one used for (excess) return analysis can be applied to volatility of assets and provides historical patterns that can be used to detect early changes in volatility.

16.4.2.5 Step 3: Identifying Expected Returns Signalling Changes in Risk Perception

The third step enriches the assessment of volatilities and correlations with analyses of expected returns that could indicate escalating risks, such as substantially higher expected interest rates or rich valuations of specific markets (equities, corporates,

[6] Depending on the factor regime (low, medium, high), the strategy return is calculated for a period of 24 months (forward).

[7] As we are looking to signals triggering further analysis, we have a preference to use the probability rate (with a high level of confidence) instead of the return expectation (average) of the strategy.

[8] An example of simplified dashboard and its interpretation are provided in Annex 17.1.

etc.). Expected returns may be extracted from implied market quotes or explicit market forecasts, as well as estimated with the use of macroeconomic and financial indicators. Those expected returns could then be compared to historical patterns of risk/return relationships. The main factors having an impact on expected returns are short-term interest rates, credit spreads, the slope of the yield curve and inflation for real assets. For equities, we analyse various types of equity valuations and the return on equity.

16.4.2.6 Steps 4 and 5: Adequate Integration of Tools

As a starting point, the dashboard may provide useful additional information:

- A specific macro factor (VIX, Investment Grade credit yield spread, real yield, curve steepness, inflation, industrial production, etc.) provides multiple signals to different strategies due to its present level or regime;
- A specific strategy (long duration, long IG corporates, long TIPS, etc.) may receive several signals;
- Conflicting signals may arise; a more in-depth analysis is needed to identify the reasons (specific characteristics of the economic cycle; special context such as QE; etc.).

Then, the analysis of volatilities (implied/actual) and correlations help to detect shifts at an early stage. In such circumstances, the signals provided by the dashboard may be better interpreted. Other indicators may also be used to detect regime shifts, such as risk aversion indicators, slope of implied volatility curve (SKEW), etc.

Additional information such as high/low expected returns (compared with the historical mean) or signals provided by carefully selected trading rule models may then feed into the expert's final judgement.

16.4.3 Adequate Governance Framework[9]

When a central bank decides to apply a more active strategic asset allocation management, implying significant allocation changes, it also needs a solid and well-understood governance framework. Good governance reaches downwards throughout the organization but also adequately resolves and mitigates conflicts of interest linked to the institutions' dual identity (primacy of monetary policy within a financially solid institution) and steers internal and external communication.

The implementation of a dynamic SAA should avoid that the central bank becomes a price setter in the markets in which it invests its international reserves. For central banks with large reserves portfolios, a more prudent approach such as reducing the pace of purchases or ceasing them instead of initiating direct sales could be appropriate. This prudent approach must be taken into account at an early

[9] See also individual chapters in Part V.

stage of the implementation of a dynamic SAA, so that a potential "illiquidity" impact is included in the parameters of the asset allocation decision.

16.4.3.1 How to Deal with Conflicts of Interest

The monetary policy mandate has primacy over other central bank operations and must be clearly segregated from the reserve management activities. It is obvious that any conflict of interest or even appearance thereof must be avoided.

A framework to implement such governance should focus on the following elements:

- clearly establish and document the central bank's objectives and ranking priority, e.g. primacy of policy over financial strength;
- clear organizational structures with dedicated senior management and separate reporting lines, an appropriate Chinese Wall between policy and operational units;
- compilation and regular reviews of high-level documents defining a list of non-conflicting decisions with the central bank's mandate;
- separated Management Committee from the Investment Committee and independent Risk/Reporting/Compliance functions.

16.4.3.2 How to Handle Internal and External Communication

The major challenge of communication in the context of dynamic strategic allocation is to provide clear information to all levels of the organization and to avoid any doubt about potential conflict of interest.

External communication should put the emphasis on the framework and structure in place to avoid obtaining and exploiting "inside information" on monetary policy matters or real/potential conflicts of interest, as well as a document stating clearly the hierarchy of objectives of the central bank.

The level of detail of external communication should be carefully defined to strike a balance between external transparency, on the one hand, and summary reporting, on the other, to avoid signalling effects or misinterpretations on portfolio changes.

16.5 Examples of Dynamic Strategies within a Framework for Central Banks

After our consideration related to the framework for a dynamic SAA, it is now appropriate to consider some examples of various dynamic strategies. From our experience and analysis, it appears that some strategies could be useful for central banks because they have proven successful in reducing tail risk.

Several investment strategies may be suitable for reserve management/risks units at central banks as some central bank portfolio managers often subscribe to strategies that are income, momentum and contrarian related. Table 16.6 summarizes their targets and their risks.

Table 16.7 outlines the priorities of a typical central bank according to the financial market context (normal or crisis).

It can be argued that an investment strategy avoiding tail losses fits better with the mission of a central bank. A comparison between momentum and contrarian strategies is shown in Table 16.8.

Momentum strategies take advantage of changes in or the existence of various asset return trends and their autocorrelation. The main risks are (1) the tail risk (and negative skewness) during market turning points, (2) stationary market trends implying transaction costs without strategy gains and (3) weak capacity to detect changes in volatility regime.

We tested momentum strategies in two areas, one to manage portfolio duration and one to manage bond/equity allocation. Table 16.9 provides the main results of these analyses.

It appears that momentum strategies are particularly well suited to reduce tail risk. But those strategies incur small losses in a trendless market and potential large losses at market turning points. Some predictive capacity must then be available to reduce these risks. The framework proposed to create some ability to anticipate trend reversals at an early stage could be considered as a prerequisite for applying momentum strategies.

Table 16.6 Different investment strategies have different return targets and risk properties

Strategies	Target	Risks/properties
Income	Get steady flow (coupon, dividend)	• Potential large losses if crisis • Negative skewness, high kurtosis
Momentum	Perform when significant move	• Incorrect identification of trend • Stationary markets, no clear trend • Tail risk during turning points and Δ^+ volatility • Normal skewness, high kurtosis
Contrarian (relative value)	Benefit from discrepancies	• Positive skewness, low kurtosis

Table 16.7 Normal market context versus a crisis context

	Normal context	Crisis context
Target	Get income = income strategy	Avoid bad returns = hedging strategy
Cost	Potential large losses	Negative trading impact
Priority CB	Low/medium	High

Table 16.8 Comparing momentum and contrarian-based investment strategies

	Trend	Contrarian
Type Strategy Context	• Momentum • Buy when Δ^+ prices • Ability to forecast trend	• Mean reversion; averaging down • Buy when Δ^- prices • Ability to identify intrinsic value and convergence with forecasts
Option profile	• Convex	• Concave
Trading impact	• Negative	• Positive
Result	• Frequent small losses • Less frequent large gains • Actions to improve success ratio	• Frequent small gains • Less frequent large losses

Table 16.9 Summary of two types of investment strategies

	Port duration	Bond/equity share
Objective	Active duration management around 2 years duration based on momentum in rates	Active allocation of equities based on recent risky assets' volatility level
Indices	US Treasuries various ranges	Russell 3000/USTR 1–10 years
Performance	No excess return	Weak excess return
Volatility and drawdown	Significant risk reduction	High risk reduction

16.6 Conclusion

From an academic research standpoint as well as from our own foreign reserve management experience, it appears that market forecasting is possible but very difficult due to the chaotic characteristics of financial markets.

Even if the primacy of their monetary policy mandate is fully recognized, central banks must manage and protect their financial credibility and avoid any major overshoot of the risk tolerance ceiling for the management of reserve assets. It follows that a dynamic SAA investment approach presents real advantages for central banks.

Faced with the need to forecast regime changes as early as possible, we propose a framework seeking to combine the advantages of quantitative methods and expert judgement while reducing usual behavioural biases. The cornerstones of this framework are (1) a macroeconomic dashboard to identify signals to be analysed further and (2) identification of regime shifts in volatility.

Annex 16.1: Macro Dashboard: Simplified Example and Interpretation

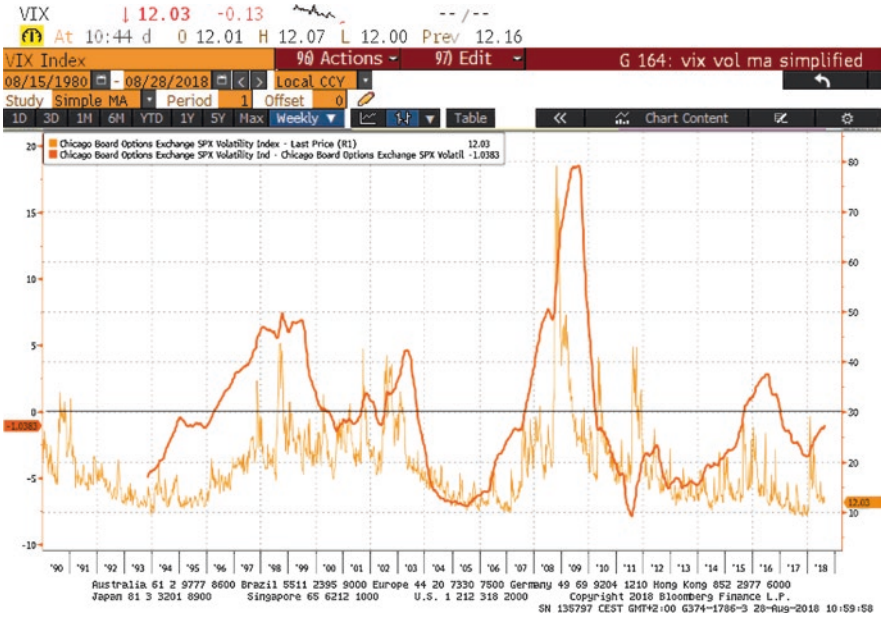
RELATIVE Horizon: 24m forward		10Y-2Y Nom. Yield Diff.	IG Credit Spread	US Unempl. Rate	VIX
Current value		0.23	0.39	3.90	12.12
Regime (percentile)	↓Consistency	Low (pctile. 18)	Low (pctile. 20)	Low (pctile. 1)	Low (pctile. 12)
Duration: 1-5y vs. 3m	12.13%	0.53% [-2.15%, 2.98%] (58.02%)	-0.60% [-2.37%, 1.01%] (69.14%)	0.64% [-2.46%, 3.05%] (64.63%)	-0.84% [-2.60%, 0.87%] (77.78%)
Equities vs. Treasuries	9.72%	-9.19% [-29.60%, 8.95%] (65.43%)	4.74% [-3.36%, 10.63%] (85.19%)	-12.13% [-29.58%, 10.94%] (74.39%)	1.76% [-5.52%, 10.06%] (74.07%)
HY vs. IG Corporate	29.10% (▼)	-6.44% [-14.53%, 2.70%] (80.25%)	-1.13% [-5.63%, 2.48%] (44.44%)	-7.26% [-14.49%, 1.73%] (85.37%)	-1.17% [-5.17%, 2.26%] (48.15%)
IG Corporate vs. Treasuries	67.45% (▼)	-1.76% [-4.76%, -0.27%] (98.77%)	-0.78% [-1.22%, -0.12%] (95.06%)	-1.37% [-4.66%, 0.60%] (73.17%)	-0.92% [-2.44%, 0.15%] (67.90%)
TIPS vs. Treasuries	26.88% (▼)	-0.60% [-2.35%, 1.07%] (60.61%)	-0.64% [-2.50%, 1.09%] (67.74%)	-0.25% [-1.89%, 1.40%] (46.34%)	-1.11% [-2.69%, 0.53%] (79.07%)

Current value	*IG Credit spread* (1)	
Regime (percentile)	0.41	
	Low (25)	
IG corporates versus US Treasuries (2)		
General		
+ average return	+0.30%	(A)
+ range	−0.14%/+0.96%	(B)
+ percentile	82.7%	(C)
Relative		
+ average return	−0.78%	(D)
+ range	−1.22%/−0.12%	(E)
+ percentile	4.9%	(F)

(1) Factor (here: IG Credit Spread)
(2) Strategy (here: IG corporates versus US Treasuries)
(A) Average return (annualized) from the strategy 24 months forward (long IG corporates versus US Treasuries) when the factor regime is low
(B) Range of return (annualized) from the strategy when the factor regime is low (10%; 90%)
(C) Percentile of positive performance of the strategy when the factor regime is low
(D) (E) (F) Same information as (A) (B) (C) but with the return from the strategy when the factor regime is low compared to the return applied regardless of factor regime.
In this case,

+ a weak positive signal (general) indicating that the strategy is still positive when the factor (IG spread) has a low regime
+ a strong negative signal (relative) indicating that the strategy is much less attractive in a low regime compared with the strategy applied regardless of the regime

Annex 16.2: Volatility Analysis



Crossing of moving averages of different window length as signal.

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Chapter 17
Central Bank of Lithuania: Asset Allocation in a Risk Parity Framework

Jonas Kanapeckas

Abstract This chapter reviews the Strategic Asset Allocation (SAA) at the Bank of Lithuania (BoL) and presents its transformation from a capital preservation approach based on historical data to a new framework which rests on three pillars: a forward-looking regime aware asset return simulation procedure, a risk budget, and a risk parity concept. A comprehensive review of the theoretical and practical aspects of the new framework is presented, paying special attention to the analysis of advantages and disadvantages based on practical experience in a central bank context. The potential of the current SAA framework at the BoL to strike the balance between the diversification, search for yield and the risk-on and risk-off nature of the markets is demonstrated. The analysis explores potential directions for further development of risk parity-based asset allocation. The considerations are given to merits of moving from an asset-based risk parity toward one that is founded in risk factors or in a hierarchical clustering. The possibility of replacing the volatility diversification with a tail risk diversification approach is emphasized as a way of alignment of asset allocation with the fact that central bank's investment portfolio is, in its essence, a portfolio for "rainy days".

17.1 Introduction

A review of Strategic Asset Allocation at the Bank of Lithuania and its transformation from 2012 until 2017 is written by a practitioner for practitioners (Fig. 17.1). It neither pretends to give ultimate and theoretically sound recipes for all SAA related issues nor to present a suitable solution for all central banks. Nevertheless, I hope that my fellow colleagues, risk and asset managers at central banks, will benefit from our experience and lessons learned from these challenging but meaningful years.

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J. Bjorheim (ed.), *Asset Management at Central Banks and Monetary Authorities*, https://doi.org/10.1007/978-3-030-43457-1_17

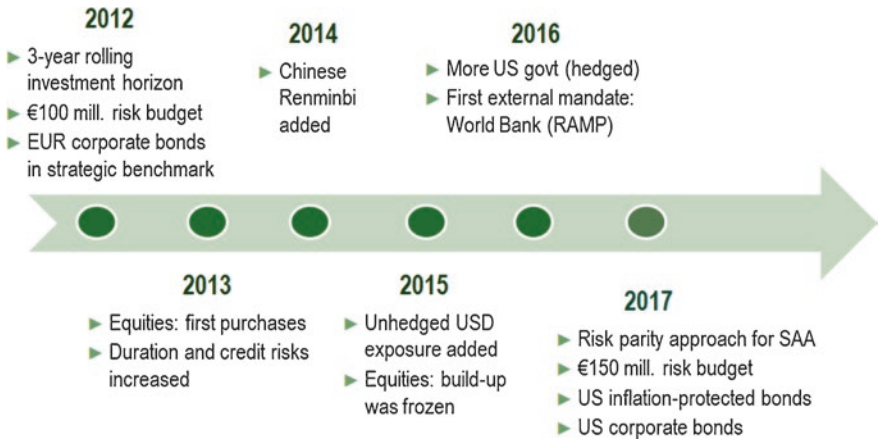

Fig. 17.1 Transition time line—main decisions at the Bank of Lithuania

Despite the pessimistic prospects for achieving positive and "normal" investment returns during the years of the Global Financial Crisis (GFC), and as a reaction to this, the BoL managed to transform its risk-averse capital preservation based and historical data-driven SAA approach into a new framework. This new SAA framework rests on three pillars; first, a forward-looking regime aware asset returns simulation procedure, second, a risk budget and, third, risk parity concept.

In 2012 the BoL decided that its traditional capital preservation policy should be replaced by a non-zero risk budget[1], i.e. acknowledging that, given financial markets realities, there was a non-negligible probability of realizing negative returns on its foreign reserves. The forward-looking regime switching (RS) asset return simulation framework was implemented by the end of the same year. It thus became the core of the risk budget calculations, where the risk budget itself was defined as the value-at-risk (VaR) at the 95% confidence level over a 1-year horizon.

The following years were devoted to adopting the risk budget approach and asset returns simulation methodology to a rapidly expanding set of investment strategies and asset classes. By the end of 2017, the diversification efforts and experience gained during those years resulted in the decision to integrate an ex-ante VaR-based risk budget with the risk parity concept in the upgraded version of the SAA framework.

Simulation of asset returns, risk budgets and the risk parity concept are now interlinked components of a comprehensive SAA framework. However, it was introduced gradually, taking into account the most urgent priorities of day-to-day asset and risk management activities, resources available, and other more practical considerations. While working on the different aspects of the SAA framework, our efforts were concentrated on proceeding as quickly as possible towards the comprehensive framework instead of polishing every element of the system. Given

[1] By non-zero risk budget we mean a zero tolerance for financial loss, i.e. negative return.

limited resources within a relatively small central bank, we preferred pragmatism over theoretical ideals whenever possible.

The rest of the chapter continues with the description of return simulation procedure. Next, we describe risk budgeting practices and a risk parity-based strategic asset allocation with a real-life example. Discussion of the risk parity strategic asset allocation is then followed by suggestions on how this framework could be augmented using ex-ante expected shortfall[2] estimates as a risk measure and diversification by hierarchical clustering. Finally, we conclude with some general observations related to our experience in upgrading the strategic asset allocation process.

17.2 Modeling Asset Returns

In the years leading up to 2012, the BoL had pursued a capital preservation policy in managing its portfolio of foreign reserves. Throughout those years the chosen strategic benchmark aimed at preventing a negative return over a 1-year time horizon. The fulfillment of this requirement was based on historical data and equivalent to believing that such a portfolio would be immune against negative returns, i.e. that history would repeat itself without extreme negative surprises.

The BoL, as other central banks at that time, relied on historical data for feeding the SAA optimization process. Acknowledging the limits to such optimization, the BoL complemented its SAA derivation with stress testing and scenario analysis as a way to, at least partially, overcome such limitations.

Following the global financial crisis of 2008 and the subsequent sovereign debt crisis in Europe, sovereign bond yields dropped to unprecedentedly low levels or even became negative. It became painfully clear that an SAA relying on the unconditional distribution of asset returns was grossly overestimating expected future returns and underestimating risk (see, for instance, Bernadell et al. 2004, p. 23). As Sheikh and Sun (2012) formulated "No single strategic allocation is resilient to all economic regimes—the concept of a static "all season" portfolio is a myth."

It has been argued that historical data-driven SAAs could be augmented by "using long-term historical data for estimating volatilities and correlations, while deriving expected returns from a combination of long-term historical data, economic theory and current market circumstances" (Blitz and van Vliet 2011). Nonetheless, it usually aimed at developing "all season" portfolios that were static and assumed to be optimal across a range of economic scenarios (Sheikh and Sun 2012).

The problems with the traditional SAA development approach, optimized with respect to an unconditional distribution of asset returns, were apparent not only for

[2] Value-at-risk is defined as the loss level that will not be exceeded with a certain confidence level during a certain period of time. Expected shortfall is an average of losses that exceeds the value-at-risk estimated with the corresponding confidence level and over the same period of time.

investment practitioners but also for academic researchers. For instance, Ang and Timmermann (2012) presented empirical evidence for a successful application of a regime switching model applied across fixed income, equities, and currency markets. Sheikh and Sun (2012) found that this approach improved the risk/return ratio in the management of most financial assets. Moreover, ignoring regime switching in asset returns in a traditional SAA context was seen as detrimental to achieving an optimal risk/return ratio. Tu (2010), for example, found that accounting for regime switching between upturns and downturns in the stock market was economically significant for an optimal portfolio even if uncertainty about model parameters were taken into account. Ang and Bekaert (2004) concluded that substantial value added could be expected from regime aware asset allocation among cash, bonds, and equity investments. Kritzman, Page, and Turkington (2012) analyzed risk premium dependency on economical regimes for a wide range of asset types and strategies. They found evidence that a regime switching aware asset allocation outperformed a static asset allocation in out-of-sample backtesting. This outcome was even more conclusive for investors which were especially sensitive to large losses.

Timmermann and Guidolin (2004) compared the suitability of a regime switching model for VaR and expected shortfall estimation for the joint distribution of stock and bond returns with a Gaussian IID and a multivariate GARCH. They found that the regime switching model suggested higher tail losses and expected shortfall (that was important for risk management) and showed better forecasting ability in out-of-sample setting at horizons between 6 months and 2 years (that was essential for the SAA optimization).

As can be seen from Guidolin (2011), Markov switching models had been used to model non-linear dynamics in asset returns since the end of the 1990s and its popularity was well grounded on both statistical (forecasting ability) and economic (consistency with the theory) reasons. Furthermore, it has been known (Sheikh and Sun 2012) that different asset classes exhibit different returns during different economic environments that could be characterized by macrovariables such as GDP and inflation as well as by the stance of monetary policy (easy/restrictive). Therefore, the model which would be able to connect macroeconomic variables with the regime shifts in asset returns could allow an investor to condition return projections on economic scenarios. This approach could have very valuable, forward-looking features—especially in a low interest rate environment.

In our view, such types of models can be found in Bernadell et al. (2005) or in Bindseil et al. (2011): "… modelling framework relies on a Nelson–Siegel parametric description of the shape and location of the nominal yield curve (Nelson and Sigel 1987) in combination with a three-state regime switching model (Hamilton 1994), extended with time-varying transition probabilities that depend on realizations of exogenous macroeconomic variables…Based on the evolution of such macro variables, projections can be constructed for the development of the yield curves within each currency area." Given these considerations, BoL decided to follow the aforementioned authors.

In 2013, shortly after the decision to implement this approach, the BoL started passively investing in an equity index composed of companies from developed

countries (see Fig. 17.1). Since the modeling approach only covered nominal and real yields, the asset return framework had to be modified and extended towards equities. This posed several challenges.

On the one hand, equity returns have high variability even at horizons as long as 10 years or more. After reviewing the research literature on forecastability of equity returns, we concluded that it is essentially impossible to forecast short-term equity index return.

Although empirically there is a moderate forecasting ability in the long term (at least 5–10 years), it still leaves a lot of variability unexplained (e.g. Davis et al. 2012). This conclusion together with the intention of passively tracking an equity index without being engaged in market timing, and our short, 1–3 year risk-return horizon, lead us to the focus our attention more on the potential risk (the whole return distribution) of equity instead of trying to come up with point estimation of their expected returns at a certain time and in specific markets.

On the other hand, there have been some empirical observations since the 1990s claiming that short- and long-term yields, yield curve steepness, and yields on corporate debt have some ability to predict subsequent aggregate stock returns (Campbell and Thompson 2008). Therefore, we decided that simulated Nelson–Siegel factors of government and corporate yield curves could be employed to simulate the distribution of equity index returns.[3]

In 2015 an un-hedged US dollar position was added to our investment portfolio and strategic benchmark as a way to rebuild foreign reserves after former euro-denominated foreign reserves became domestic assets due to the introduction of euro in Lithuania.[4] Therefore, there was a need to add exchange rates to our return simulating framework.

Chen and Tsang (2013), using monthly data for the UK, Canada, Japan, and the USA, showed that cross-country relative Nelson–Siegel yield curve factors have predicting power towards exchange rate movements and excess currency returns over a horizon of from 1 month to 1 years ahead. Our own analysis also indicated that cross-country differences of regime switching Nelson–Siegel yield factors had statistically significant forecasting ability for exchange rate returns and allowed us to compliment projected yield curves with simulated exchange rates.

Taking into account our plans to invest in US mortgage-backed securities (MBS) we extended our return simulation framework by implementing the methodology presented in Brennan and Kobor (2010). In their work, they modeled different sources of MBS index return, namely coupon, price, and pay down return as

[3] The forecasting regression where Nelson–Siegel factors of government and corporate yield curves are independent variables and stock market returns are dependent variable must be estimated. For the sake of robustness, we leave only the most statistically significant regression coefficients (as a rule 0.01 significance level is required).

[4] Accounting currency of the BoL balance sheet is euro. Until euro introduction in 2015 essentially all foreign reserves of the BoL were either euro-denominated or hedged back to euro assets. The reason of avoidance currency risk was the fact that Lithuania had been maintaining currency board with euro as a base currency.

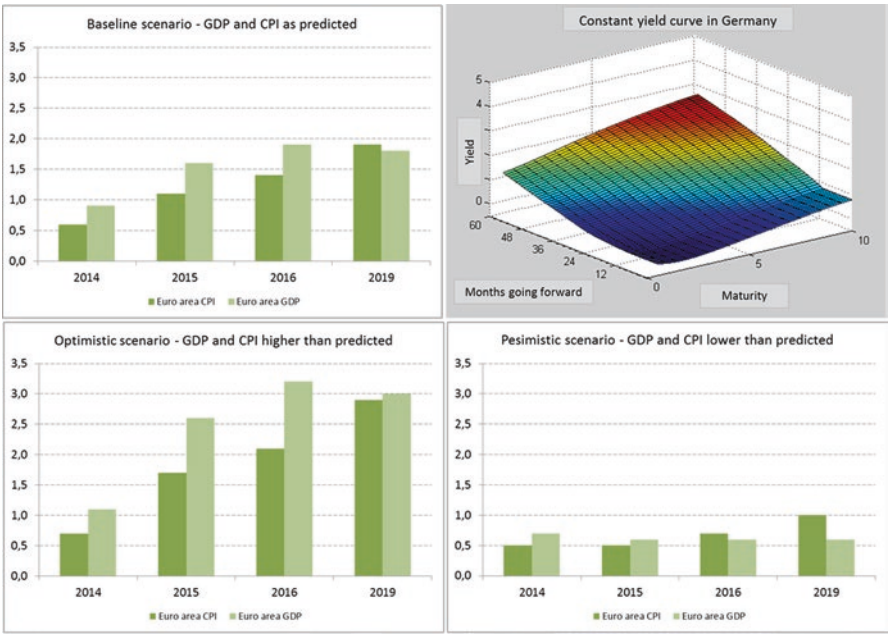

Fig. 17.2 Examples of hypothetical macroeconomic scenarios

dependent on interest rates (in our case yields simulated by Markov Switching models are used).

One of the most important advantage of the implemented return simulation framework is its ability, by construction, to condition projected return distributions on different views about GDP growth and inflation.[5] Additional scenarios[6] can be added using an entropy pooling approach introduced by Meucci (2010a, b), which allows imposing views on selected properties of simulated or historical distributions and, at the same time, to remain as close as possible to the original distribution.

Figure 17.2 shows examples of a few hypothetical scenarios.[7] Three scenarios are obtained by modifying assumptions on future GDP and CPI; the fourth scenario is obtained using entropy pooling and baseline assumptions on GDP and CPI but requiring the average yield curve in Germany to remain constant during the next

[5] Macroeconomic scenarios require relatively little technical knowledge of financial markets and potentially could be easy to communicate and discuss them at the Board or Investment Committee. Although in practice, this advantage is not absolute, as members of the decision bodies can have their own, different from the model, and not necessarily consistent views on return sensitivity to different economic situations.

[6] For example, we may want to assume that, due to unconventional monetary policy, an average level of the yield curve will remain lower than it used to be in the past at the same level of GDP and inflation.

[7] Scenarios presented here serve as an illustration only.

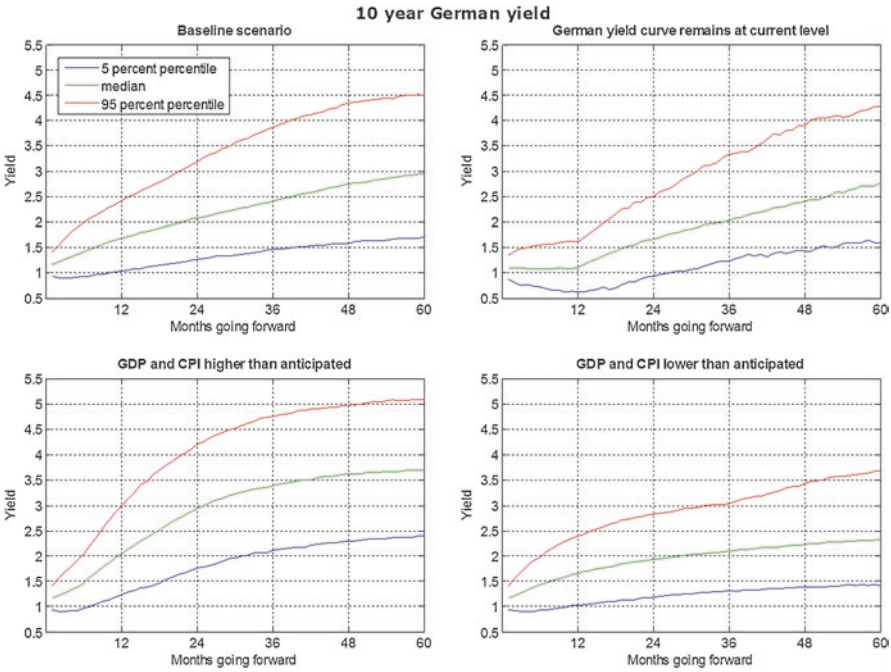

Fig. 17.3 Projected yield curves given the hypothetical macroeconomic scenarios

12 months. Figure 17.3 depicts the evolution of the selected yield distribution going forward for corresponding scenarios.

After using the return simulation procedure for more than 5 years we are able to conclude that we achieved our goal to establish a return simulation framework which is:

- Forward-looking (instead of historical) and dynamic (instead of through-the-cycle);
- Open to alternative views of the world (preferably based on a macrofoundation), i.e. takes historical relationships and apply to current or anticipated economic environment, allow flexible adjusting of model assumptions;
- Extendable to other asset classes such as asset backed, inflation-protected securities, equity indexes, currencies, etc.

Our current in-house implementation supports five currency areas, i.e. the Eurozone, USA, Canada, Great Britain, and China, covering more than 25 nominal and real yield curves as well as interest rate swaps curves. Certainly, there are quite a few ways how the simulation framework could be improved further. For example, various valuation ratios could be taken into account when equity returns are simulated or regime switching of covariances could be added. We are of the opinion that the former would improve the plausibility of our equity return simulations for longer horizons. We could also envisage that it would further increase the compliance

of our simulated returns with the well-known empirical stylized properties of historical return data such as volatility clustering, heavy tails, etc. As the simulation framework is based on monthly data, model parameters are re-estimated and new simulations are re-generated every month. At first, these simulations were used only for reporting and risk management purposes, but since 2017 they serve for SAA optimization as well.

17.3 Risk Budgets

Risk budgets, together with other limits, express the risk tolerance of an institution and encompasses a set of questions that has an immense importance for all layers of financial assets management. In the following section, I will describe the main decision points we had to resolve in the process of establishing a risk budget framework at the BoL.[8]

Relative or Absolute Risk Budget? One of the first questions to be answered when defining risk tolerance is the question of whether it should be defined as an absolute or as a relative number.

Risk budget expressed as a certain percentage of the portfolio size has certain advantages. For example, it automatically takes into account changes in the portfolio size and summarizes the riskiness of the portfolio in one number.

However, the risk budget should also consider the institution's financial resilience and its ability to absorb[9] financial losses, e.g. its statutory and reserve capital, provisions, and revaluation accounts. This speaks in favor of an absolute risk budget.[10]

From 1994 to 2015 the BoL operated under a currency board arrangement. This means that the domestic currency in circulation was backed by foreign currency and gold reserves. Over the years, excess foreign reserves were generated due to return on investments. The size of excess reserves (financial resource that allows absorbing possible losses without endangering credibility of the currency board), being an absolute number, constrained potential risk budget by an absolute limit as well.

Despite arguments in favor of an absolute risk budget number, we do not think that the relative risk budget as a share of a portfolio is an unimportant policy parameter. In fact, both dimensions are equally important not only for analysis purposes but also for the capacity to absorb losses from the reputational risk point of view. Both absolute and relative losses are equally capable of triggering real and perceived reputational risks. Moreover, whenever the risk-bearing capacity or the

[8] To a limited extent the following description is overlapping with the exposition of risk budgets at the BoL given in Arust (2017).

[9] From the financial and reputational point of view.

[10] RB could be defined as a certain percentage of financial buffers, but that does not change the essence of the argument.

portfolio size changes considerably, it is advisable to review the absolute and relative risk budget levels. Keeping both measures up to date, therefore, is of utmost importance.

Risk Budget Scope, Size, and Underlying Risk Measure When designing the risk budget set up, central banks should also decide which general or specific risks this concept is going to cover and whether all foreign exchange reserves or only specific tranches thereof will be subject to it.

Ideally, all risks and their codependency should be taken into account by the risk budget measure. However, this ideal is hardly possible both from a theoretical[11] and a practical point of view. Moreover, even joint modeling of only credit and market risks is technically challenging as it requires modeling expertise, a number of critical assumptions, and a reliable data set. The BoL decided, at least for the time being, to leave credit risk outside of the risk budget framework and concentrate our efforts on the most actively taken and managed risk, i.e. market risk.[12]

There are obvious merits in measuring and managing the risk of all financial assets or portfolios in an integrated manner. However, taking into account different policy constraints and goals relevant to different portfolios, applying the risk budget concept to all portfolios could be an unnecessary practical complication. For instance, when it was introduced at the BoL we had (1) a liquidity portfolio that was small and relatively market risk-free; (2) a gold portfolio that was managed passively with a significant revaluation account surplus; (3) an investment portfolio, in which, almost all our active interest rate risks were taken. Therefore, it was relatively straightforward to decide that only the active investment portfolio should be subject to the risk budget framework.[13]

The most significant policy decision was to replace the traditional capital preservation or zero risk budget policy with a non-zero risk budget target. The arguments for this change were:

- Given extremely low or even negative sovereign bond interest rates, it was unrealistic to assume that non-negative return could be delivered with sufficiently high probability without a costly and almost full restructuring of the investment portfolio;
- Even a drastic reduction of the market risk taken in the investment portfolio could result in a loss due to negative yield on the safest investments;
- Leaving the risk tolerance unchanged for prolonged period of time in an elevated market risk environment (i.e., when it was required to accept relatively higher risk for the same level of expected return) meant that the portfolio's relative

[11] Not every type of risk is equally well, if at all, quantifiable by currently existing tools and models.

[12] Credit risk is managed outside of risk budget framework by diversifying idiosyncratic credit risk to the extent possible, limiting total credit risk and concentration by additional limits.

[13] Nonetheless, we also analyze all risks and portfolios on an aggregate level and we take into consideration all risks and portfolios when the decision about the appropriate size of risk budget is made.

Table 17.1 Risk budget allocation

Responsibility		Portfolio	Objective	Risk budget over 1 year, EUR million, 95% confidence level	
Board[a]		Strategic	Maximize diversification given the risk budget	–[b]	150[c]
Investment management department	Asset allocation division	Tactical	Beat strategic benchmark	35	
	Trading division	Investment	Beat tactical benchmark		

[a]SAA is proposed by Risk Management and Reporting Division in consultation with Investment Management Department
[b]EUR 75 million until 2017
[c]EUR 100 million until 2017

market riskiness effectively would be lower. Potentially, an unchanged risk tolerance could result in lower average expected returns over the medium to long investment horizons.

The size of the risk budget was determined by the Board considering the size of the financial buffers, excess foreign exchange reserves, and the view of the public on the acceptability of financial losses incurred by the central bank. The BoL emphasized the communication aspects of this policy change, i.e. it announced and explained the risks budget concept, its size (EUR 100 million[14]), and the reason for its introduction. After 5 years, in 2017, this exercise was repeated and resulted in 50% increase of the risk budget to EUR 150 million as a reflection of higher financial buffers and the readiness of the bank to increase the size of the investment portfolio.

The BoL considered value-at-risk and expected shortfall as two alternative risk measures that could be used for calibrating risks according to the risk budget. The BoL was fully aware of the statistical superiority of expected shortfall concept, e.g. its focus to the tail of distribution and sub-additivity. However, the VaR was seen as having its own strengths being an industry-standard risk measure and by its relative easiness to backtest.[15] Hence, the Board decided to define the risk budget as a 1-year VaR[16] measured with 95% confidence.

Using a statistical ex-ante measure of risk shows an institution's belief in its ability to estimate VaR adequately and to take market variability into account. Measuring VaR over a calendar (accounting) year could, however, be seen as inconsistent because it would not take sudden or unexpected changes in the financial market

[14] EUR 100 million approximately amounted to 2% of the financial assets.

[15] Fewer data are necessary to backtest VaR than expected shortfall.

[16] Despite that VaR has been selected as the main measure of market risk, ES has always been used in analysis and taken into account in all risk-related decisions.

valuations into account. This argument combined with the fact that our investment portfolio, at least potentially, changes its positions daily, made a strong case for monitoring risk daily and that also the VaR measure should be recalculated daily using forward-looking ex-ante return simulations over rolling 1-year horizon.

Risk Budget Allocation A risk budget could be allocated to different portfolios, strategic or tactical benchmark, different asset classes, risk factors, etc. (see Table 17.1). The BoL started its risk budget allocation after the Board decided which part of it should be allocated to strategic benchmark and active management. Following the common approach of allocating the majority of risk to the strategic benchmark, EUR 75 million (see also the footnotes to Table 17.1) were allocated to the strategic benchmark and, assuming 0.6 correlation between strategic benchmark and active management,[17] EUR 35 million were allocated to active management.[18]

In 2017, a rigid risk budget for the strategic benchmark was abandoned. Instead, the decision on the appropriate riskiness of the strategic benchmark is now made by the Board at regular intervals.[19] Although there had been no deliberate risk allocations to different asset classes until the SAA based on risk budget approach was implemented, risk contributions from different asset classes that resulted from the mean-variance SAA were always carefully analyzed and taken into consideration.[20]

Evaluating Compliance with the Risk Budget and Dealing with Its Breaches The compliance of the investment portfolio, the strategic benchmark, and the positions taken by the active portfolio management with the risk budget limits is checked daily using once a month simulated returns. In other words, only portfolios positions are subject to daily changes. The risk budget, its allocations to strategic benchmark and active management, as well as the return simulation framework are all tools that provide important guidance and keep market risk aligned with the BoL's risk appetite. Importantly, this framework is not a substitute for a comprehensive set of limits devoted to the risks that are not captured by the VaR calculation or limits used to keep short-term opportunistic trading risk contained.[21]

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[17] Average realized correlation of yearly returns was much lower, e.g. since 2013, it was −0.07.

[18] At lower decision-making level these 35 million euros were divided between the tactical benchmark and active portfolio management.

[19] As a rule, strategic benchmark is reviewed at least yearly and it allows reconsidering the most appropriate risk level for any given situation in the market and achievable risk-return tradeoff. Making this decision the total risk budget must be satisfied and sufficient room for active management should be left.

[20] Selecting VaR instead of ES as a risk measure has certain disadvantages for decomposing the risk, e.g. it is difficult to decompose risk to its factors, and resulting decomposition is unstable. In order to elevate this issue, we apply the smoothing technique (kernel weighting across percentiles).

[21] Additional short term, e.g. 1-day or 1-month, VaR model could be seen as beneficial because it would allow taking into account less systematic factors that influence short-term changes in market value of portfolio or would be better suitable for projecting short-term dynamics in the market.

It is required that active portfolio management risk budget limit breaches must be resolved as soon as possible by adjusting portfolio positions. In the case of the strategic benchmark, a more flexible approached is adopted, i.e. it is required to approach the Board whenever the strategic benchmark VaR exceeds its risk budget and, only after analysis of the situation in the market, the decision is taken by the Board whether to retain or reduce benchmark positions or whether the heightened risk could be tolerated temporarily.[22] The decision of not acting automatically on VaR related breaches is rooted in the need to avoid procyclicality in adjusting portfolio as well as in the awareness that any VaR model has its limitations.

17.4 Risk Parity-Based SAA

Historically the BoL approach to SAA rested on two main principals: no loss over a 1-year time horizon and no view on expected returns. Beginning in 2012, more and more emphasis was given to the mean-variance optimization and to the active views on expected financial asset returns.[23] The reason for this shift in emphasis was that it became more and more apparent that historical realized returns or current observable yields were overestimating future total return expectations. However, as the mean-variance approach tends to result in unstable portfolio allocations, a high-risk concentration and questionable out-of-sample performance, a long list of remedies had to be applied to these shortcomings, although, unwelcome effects were not easy to avoid completely. Application of ex-ante VaR constrain to the SAA makes the situation even more cumbersome, because it forces to move the strategic benchmark along the mean variance frontier due to changes in ex-ante VaR. This creates an additional source of instability to the SAA.[24]

When in 2016 the Risk Management and Reporting Division (RMRD) was made responsible for developing the SAA (subject to the endorsement by the Board[25]), it was decided to reconsider the whole approach and make it more robust with respect

[22] In the course of 5 years we have two cases where the Board had to intervene and decide on the need to restore the compliance with the strategic benchmark risk budget limit. If strategic benchmark positions were causing investment portfolio's risk budget limit breach, the same flexible limit restoration procedure would be applied.

[23] Asset allocation division was established and made responsible for expressing views on expected returns and using them as an input for both strategic and tactical asset allocation.

[24] In a mean-variance framework optimal portfolios are situated on the efficient frontier. The efficient portfolios changes from one optimization exercise to another. If a portfolio is forced to move along this efficient frontier due to changes in VaR, the instability of SAA increases even further.

[25] RMRD represents the Middle Office according to the classical organizational structure of investment activities at a CB. Front Office at the Bank of Lithuania consists of two divisions: Trading Division and Asset Allocation Division. Until 2016 the latter division was responsible for both tactical and strategic benchmarks. The decision to reallocate SB preparation to the RMRD was at least partially motivated by the aim to avoid a potential conflict of interests between strategic and tactical benchmark proposals.

to avoiding the pitfalls specific to mean-variance optimization. The result was the decision to adopt the risk parity approach.[26] The following arguments were made in support of this innovation:

- After allocating the total risk budget to passive and active investment management, further diversification of active risk was insured by allocating additional risk budget limits and by an investment style diversification. As the biggest share of risk was allocated to the strategic benchmark, it was deemed as a necessity to have this part of the risk budget explicitly allocated to different sources of risk.
- It was a long-time conviction of investment practitioners that keeping a keen eye on the risk was seldom enough. It is equally important to avoid risk concentration even if they are found to be within the defined limits, because high concentration in adverse market circumstances could increase the chances that portfolio's risk will blow up in an out-of-sample setting.[27] Hence, diversification was put at the heart of our SAA under the risk budgeting framework.[28]
- Because the decision to increase the risk tolerance by abandoning the capital preservation principle was organizationally challenging, it had to be accompanied by an effective risk management framework that would ensure economical use of the risk budget. As Maillard et al. (2010) showed, risk parity portfolio volatility is located in the space between that of the minimum variance and equally weighted portfolios, hence, the risk parity could be considered an attractive method to minimize risk without suffering from a few concentrated positions that are the standard property of minimum variance portfolio.[29]
- The value of the risk parity approach for the rather risk-averse BoL is exemplified by the result found in Qian (2006). Qian show that ex-ante risk contributions are significant predictors towards the contribution of different positions to the ex-post losses—and even more so for large losses.
- The biggest positions of the investment portfolio are driven by the SAA decisions; therefore, frequent changes in the strategic benchmark could cause costly position trading, and make active portfolio management even more challenging. Mechanical fixation of portfolio weights could resolve this problem but would

[26] There are several different risk parity definitions and approaches to achieve it. When we speak of risk parity we have in mind the approach which results in equal contributions to portfolio risk from different risk sources or asset classes.

[27] Interested reader can find analytical and more technical argumentation about dangers of risk concentration in a risk-on/risk-off environment in López de Prado (2012) or Bailey and de Prado (2012).

[28] Making diversification the main goal of SAA requires a thoughtful understanding of complex interactions between mark-to-market and accounting data, especially if accounting applies an asymmetrical treatment of gains and losses. Failing to acknowledge that marking to market reflects the economic substance of investment transactions to be realized in accounting over longer-term precludes making full use of diversification potential and, generally, could lead to sub-optimal investment decisions.

[29] Recent financial crises have shown that investing in a few, even safest assets, could be dangerous, because the assumption about the existence of risk-free assets could turn to be a great exaggeration.

leave a total level of ex-ante risk somewhat out of control. There is a wide body of empirical research showing relative stability of the risk parity allocations over time in comparison to other asset allocation methods (e.g., Brignone and Forte 2016). Roncalli (2013) refers to at least two theoretical reasons behind relative stability of the risk budget solutions: (1) it takes into account both marginal volatility and position's weight, whereas a mean-variance portfolio considers only marginal volatility; (2) it has an implicit restrictive mechanism because it is, in essence, a minimum risk portfolio subject to a constraint on weight diversification. Acknowledging the above-mentioned arguments, the BoL found that a risk parity approach coupled with an ex-ante VaR limit is a promising tradeoff. It would enable management to adjust the SAA in the response to changing covariances and asset volatilities without unacceptably sacrificing portfolio stability.

- Estimation of expected returns has been one of the most daunting challenges for investment professionals and researchers for many years. Even more so because, as Chopra and Ziemba (1993) indicated, errors in expected returns estimation are more costly than utility function misspecification or variance and covariance estimation errors. Recognizing these difficulties, we decided that the risk parity framework would immunize our SAA to the extent possible from errors in expected returns estimation. The result shown by Medvedev (2014) using the theory of rational choice under ambiguity is very relevant here: A *risk parity* allocation *is*, with some approximation, the *minimum variance portfolio where the covariance matrix is adjusted for ambiguity in asset expected returns*.
- It immediately follows from the central bank mandate that while generating forward-looking returns for SAA purposes, due attention must also be paid towards the fulfillment of a market neutrality principle. As the risk parity SAA is neutral with respect to different risk sources and do not rely (at least explicitly) upon expected return projections, it is also making a substantial contribution to the market neutrality of central bank's SAA.
- Despite the fact that the risk parity concept by construction is not aimed at producing exceptional high returns and, accordingly, should not be judged by its performance alone, there is no shortage of empirical evidence that even in this respect and especially on risk-adjusted basis in an out-of-sample testing, the risk parity framework provides a promising asset allocation approach.[30] In our view, that should strengthen the conviction that effective diversification by applying a risk parity approach could help not only in managing risk but also in increasing return in the long run.

Other advantages of the risk parity approach can be found in Homescu (2014), but those referred to above were crucial input supporting our decision to adopt this method of asset allocation.

[30] See, e.g. Chaves et al. (2011) and Lohre et al. (2012).

Table 17.2 Strategic benchmark and its asset classes

Strategic benchmark asset classes	
Euro Corp	*Euro-denominated investment grade corporate bonds with maturity from 1 to 10 years*
UST	*US Treasuries with maturity from 1 to 5 years*
UST H	*US Treasuries with maturity from 1 to 5 years and currency risk hedged*[a]
Q862 H	*Equally weighted basket of US Treasuries, Canadian and British government bonds with maturity from 1 to 10 years maturity and currency risk hedged*
China Govt H	*China government bonds with maturity from 1 to 3 years currency risk hedged*
UST tips H	*US inflation-protected Treasury bonds from 1 to 10 years and currency risk hedged*
Equity	*MSCI WORLD INDEX (USD)*
US Corp H	*Dollar-denominated investment grade corporate bonds with maturity from 1 to 5 years and currency risk hedged*

[a]Base currency of investment portfolio is EUR

From all available risk parity alternatives known to us, we selected the one based on the so-called Minimum-Torsion Bets[31] (Meucci et al. 2015). The approach begins by finding the set of uncorrelated factors (theoretical assets) that are as close as possible (in some sense) to the set of original investable assets. This allows translation of any portfolio of original assets into equivalent portfolio of uncorrelated "assets" (so-called by the Minimum-Torsion Bets[32]). By analyzing how evenly the risk of the portfolio is distributed to uncorrelated factors, we are able to quantify how well diversified the risk of our portfolio is. The diversification measure called by Effective Number of Minimum-Torsion Bets is maximized when all risk contributions from uncorrelated factors are equal.

One of the strengths of risk parity based on the Minimum-Torsion Bets is the absence of several typical problems of risk parity portfolios obtained using traditional method of principal components such as instability, not-invariance under scale transformations, not-uniqueness, the difficulty of interpretation. For instance, in our experience so far, we experience no instability of the Minimum-Torsion Bets, and one of the most attractive attributes of this approach is its relatively intuitive interpretation.[33]

In the following few paragraphs we illustrate an application of the risk parity approach based on Minimum-Torsion Bets (MTBs) with a real-life example, omitting some non-essential details.

[31] In this risk parity method portfolio diversification is measured by Effective Number of Minimum-Torsion Bets (ENMTBs). The most diversified, i.e. risk parity portfolio has the highest achievable ENMTBs and corresponds to the portfolio that has evenly distributed risk contributions from uncorrelated factors, i.e. MTBs.

[32] The MTBs can be obtained not only from assets but from risk factors as well.

[33] Due to closeness of MTB to original assets (factors), the resulting risk parity asset allocation, with some approximation, could be communicated to the decision-making bodies in terms of the original assets of the portfolio.

Strategic Benchmark Asset Classes Asset classes suitable for the SAA should comply with all investment policy considerations and reflect the general risk attitude of an organization (see Table 17.2). It should also incorporate the available technical and human resources, staff knowledge and experience, intended investment style, etc. For the SAA to be meaningful it is commonly required that asset classes are relatively homogeneous, mutually exclusive, representative of the market segments, and broad enough to allow sufficiently big allocations.[34] Risk parity, in its own right, also requires being attentive to potential assets:

- If asset classes are too closely correlated, a numerical procedure for obtaining MTBs could produce unstable results.[35]
- Risk parity is reported as not invariant neither to a duplication of an asset nor the addition of a positive linear combination of assets already belonging to the eligible universe (Roncalli 2013).
- Risk parity is blind to underlying risk factors of the asset universe and can lead to naïve diversification, i.e. overweighting of the risk factor that has more numerous representations in the set of assets (Roncalli 2013).

It is likely that a risk factor based risk parity approach would be a preferable solution to the problems mentioned above (Bhansali et al. 2012), but currently, we limit ourselves to a careful analysis of asset classes, their embedded risk factors and, as a rule, require that the eligible strategic benchmark asset classes have return correlations lower than 0.9. The latter restriction could also be seen as a specification of mutual exclusiveness mentioned above.

Optimization Constraints Apart from the requirement of non-negativity of SAA asset weights, there is little need to have additional constraints, because risk parity itself minimizes concentration. Nevertheless, in practice, there still are policy driven and other limits on asset weights or other portfolio characteristics.[36]

Before the BoL became the member of Eurosystem, our investment portfolio was relatively stable although gradually increasing. The portfolio size was therefore treated as an exogenous parameter of the SAA. At present, the portfolio size is defined at every strategic benchmark revision point and can range from policy acceptable minimum of 1.5 to a maximum of EUR 5 billion that takes into account

[34] In addition, asset classes of SAA should be compatible with the risk budget size, i.e. if a specific asset class is exhibiting very high volatility, it could be that risk budget size precludes meaningful position in this asset.

[35] This is one of the reasons why we apply risk parity only to the investment portfolio, i.e. if, due to policy reasons, there is a similar or the same asset in another portfolio, diversification maximization via risk parity could fail. Another reason why we would not recommend blending portfolios for risk parity optimization is a quite common situation where non-investment portfolio has a relatively fixed structure serving specific policy goals. In this case, joint optimization would indirectly force investment portfolio also take into account goals set for other portfolios.

[36] For instance, we could not easily increase or reduce our China position and usually try to avoid reducing the long-term position in equities.

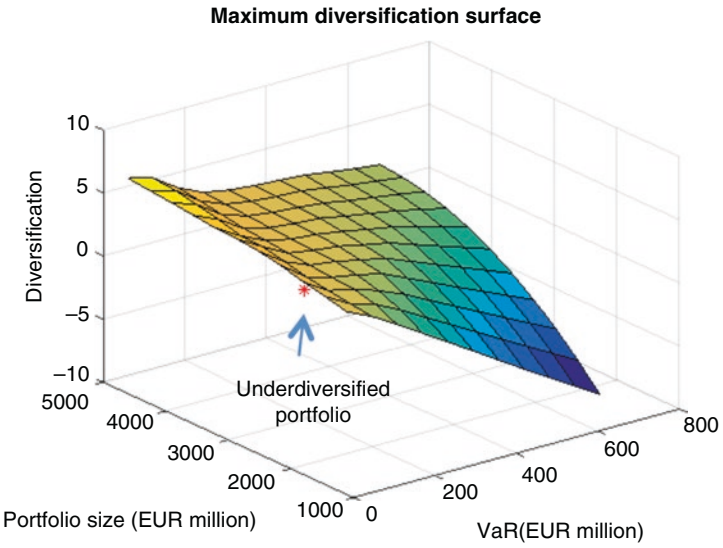

Fig. 17.4 The maximum diversification surface

the Agreement on Net Financial Assets.[37] Finally, the resulting SAA must comply with the risk budget as well.

SAA Optimization The SAA optimization consists of maximizing diversification measured by Effective Number of Minimum-Torsion bets for every potential portfolio size and VaR. The result of this procedure is a three-dimensional maximum diversification surface as shown in Fig. 17.4.

As most of our limits are absolute, their impact for the relative portfolio weights diminishes when the portfolio size gets bigger. This explains the tendency that portfolio diversification increases together with the portfolio size, i.e. relatively smaller and smaller limits allow diversification to approach its global maximum.

It is also interesting to note that if we wanted to take more risk, e.g. to increase expected return, we would have to increase concentration because the best-diversified portfolios are obtained when VaR is relatively low. Moreover, it would require a conscious decision on the tradeoff between benefits of diversification and the expected return. If we took the curve of the most diversified portfolios for any portfolio size, we could present optimization result in a two-dimensional graph. All portfolios on this curve differ in their VaR and not necessarily all of them (if any[38]) comply with the risk budget (Fig. 17.5).

If we look at Fig. 17.6 showing contribution to portfolio volatility from uncorrelated factors, i.e. Minimum-Torsion Bets, we can easily ascertain that optimal

[37] See https://www.ecb.europa.eu/explainers/tell-me-more/html/anfa_qa.en.html.

[38] If VaR of all portfolios exceed the risk budget, a curve (a set of portfolios) corresponding to lower risk should be selected potentially sacrificing some diversification.

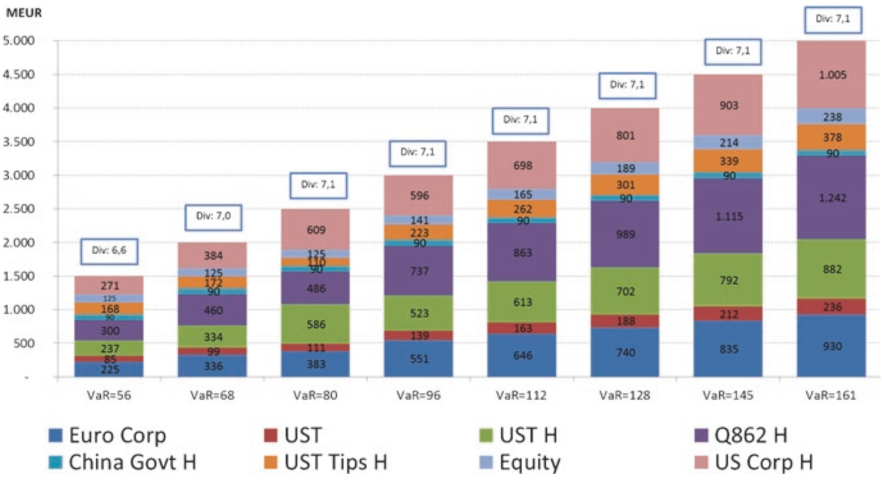

Fig. 17.5 Maximum diversification at different VaR levels

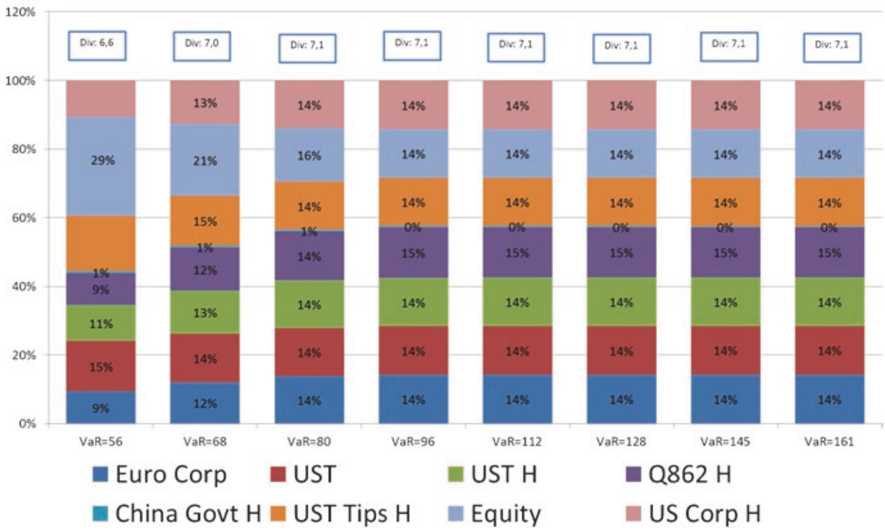

Fig. 17.6 Contribution to volatility from uncorrelated factors (Minimum-Torsion Bets)

portfolios are as close to risk parity as limits allow them to be. This because MTBs are considered to be close to original assets, the colors in Fig. 17.6 correspond to those on the previous picture emphasizing this relationship.

It is important to keep in mind that the implemented risk parity framework diversifies volatility, not VaR, i.e. a risk measure that is used to define risk budgets, as we can see from Fig. 17.7. If we make use of the fact that the VaR could be expressed (at least approximately) as an expectation minus volatility multiplied by a multiplier

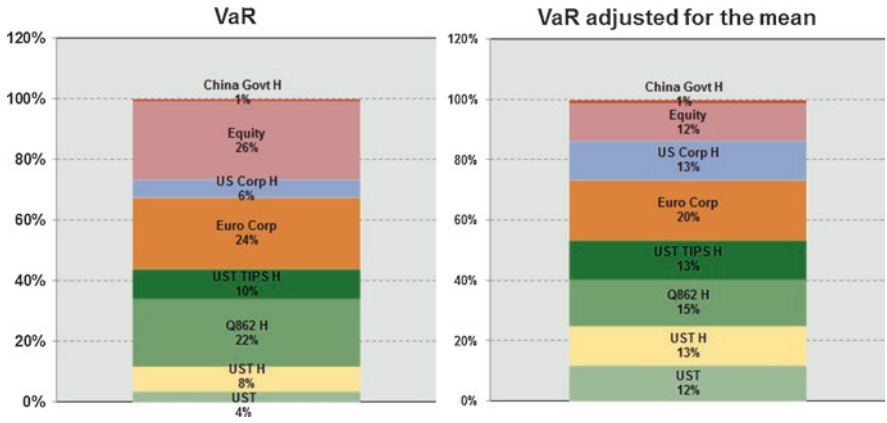

Fig. 17.7 Contribution to VaR from different assets

that is specific to the confidence level, and adjust the VaR for the mean, then the resulting contributions resemble the risk parity. That risk parity only partially diversifies our risk budget is a clear drawback. It deserves a thorough investigation in which a future solution should be obtained.

A Decision on the Optimal Strategic Benchmark The SAA is reviewed once a year unless the situation in the market or changes within the BoL calls for ad hoc actions. It is carried out with a holistic view in mind, drawing on numerous heuristics. The set of portfolios obtained using the procedure described above serves as a starting point for discussion at the Board level on defining the optimal SAA. Facilitating informed decision, the Board is provided with an additional analysis of diversified portfolios which includes but is not limited to:

- Credit risk level that is embedded in proposed strategic benchmarks;
- Expected returns for these portfolios over 1 and 3 years[39];
- Macrostress testing using forward-looking return simulation methodology;
- Historical worst-case analysis;
- Ad hock scenarios analysis;
- Transactions cost analysis.

When deciding on the optimal SAA for the BoL foreign exchange reserves, the Board also considers risk and return tradeoff offered by different diversified portfolios, their Sharpe ratio as well as a ratio of absolute return and absolute VaR. It is worth mentioning that the optimal portfolio from the standpoint of relative returns is not necessarily equivalent to the portfolio which is optimal from the absolute return perspective. Quite commonly, a ratio between marginal contribution to risk and return is not equal for different assets. Therefore, the portfolio with the highest

[39] Return expectations for different assets are provided by Asset Allocation Division, i.e. they are independent of risk parity optimization.

relative return and riskiness tends to be small in size (because it is limited by absolute risk budget). As a result, a portfolio with the highest relative return could have relatively low absolute return and be sub-optimal from point of view of absolute performance.

17.5 Risk Parity Based on Hierarchical Clustering, Non-linear Dependency and Expected Shortfall

Although we believe that our implementation of the risk parity approach does a good job achieving desirable features of the SAA, yet, as any asset allocation methodology, it has its own limitations. An extensive review of most often cited criticism of risk parity can be found in Homescu (2014), but based on our experience, we will focus on the possibilities to resolve two specific criticisms of the risk parity approach:

- A Minimum-Torsion Bets based risk parity approach pays no attention to the fact that not all correlations in the portfolio are equally important and ignores different potential of assets in increasing portfolio diversification. Sometimes it could even lead to a false sense of diversification (see discussion of asset classes in the section on risk parity SAA)
- An implemented risk parity SAA aims at diversifying volatility which is not the risk measure we use for the risk budget (see discussion at the end of the section on risk parity SAA). Moreover, volatility also has a drawback of not paying attention to lower percentiles of the return distribution.

Our attempt to make improvement to our SAA framework in aforementioned directions is based on the Hierarchical Risk Parity (HRP) framework proposed in Lopez de Prado (2016). HRP relies on graph theory and machine learning techniques. It is flexible with respect to measures being used for risk allocation as well as measuring the association between different assets. It does not require positive-definiteness of the covariance matrix and is able to reveal hierarchical dependencies between assets from empirical or simulated return data automatically.

High stability of asset weights and promising risk-adjusted performance of the HRP portfolios have been recently demonstrated by researchers. Lopez de Prado (2016) presented simulation results that showed the robustness of the HRP approach when assets are faced with both common and idiosyncratic shocks. Lau et al. (2017) applied the HRP approach to a wide universe of assets and found that this approach achieved the best risk-adjusted performance among tested risk-based asset allocation methods.

Differently from the original paper of Lopez de Prado (2016) and our current risk parity approach, we tried to diversify the expected shortfall risk but not the volatility of the strategic benchmark.[40] Extending risk parity to higher moments of return

[40] To make a comparison of different diversification methods less cumbersome, the following analysis is based on 3 billion EUR portfolio optimized using Minimum-Torsion Bets risk parity and Hierarchical Risk Parity algorithms. In both cases, the same set of constraints were applied.

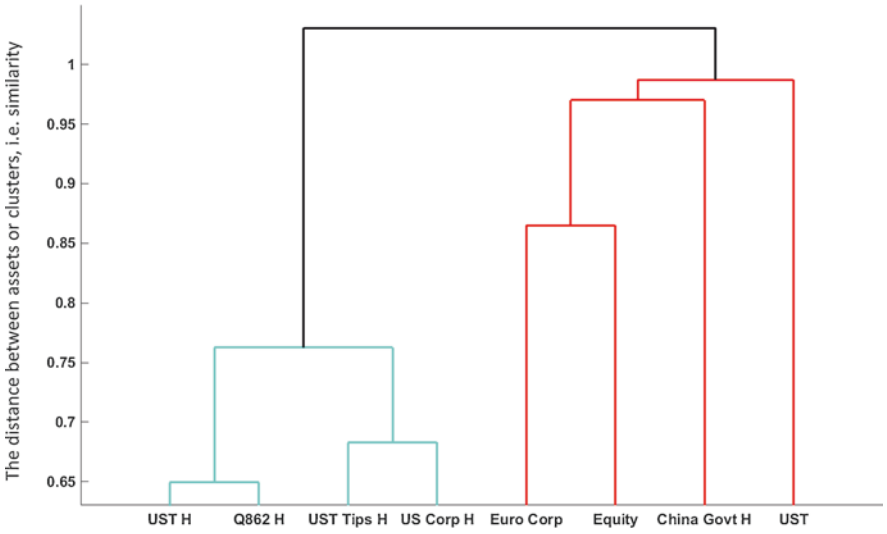

Fig. 17.8 Clusters of asset classes

distribution has, for some time already, attracted the attention of researches. For example, Bruder et al. (2016), after applying skewness-based risk parity to equity, bond and volatility assets indicated that it was more robust than volatility risk party. Baitinger et al. (2017) empirically and by simulation demonstrated that higher-moment risk parity portfolios outperform the plain risk parity ones, at least when asset returns show non-normality or strong codependency.

Hierarchical Clustering of Assets Technical details of applied clustering technique can be found in Lopez de Prado (2016).[41] Here we will present a high-level intuition of the approach.

Historical clustering starts with the correlation matrix and defines distance and closeness measures for different columns of the matrix. It recursively classifies columns of the correlation matrix (representing assets) into hierarchical clusters according to their closeness (representing codependency of assets). The result of this exercise is seen in Fig. 17.8 and offers an insightful view of our assets set (higher cluster signifiers less closely co-dependent assets belonging to the cluster).

For the most part, US-based assets returns are hedged back to our base currency, i.e. the EUR, and grouped into the blue cluster showing high correlation within this group with little possibility to have this part of the portfolio highly diversified. On the other hand, this cluster collectively represents "an asset" which is, on its own, is a good diversifier of the assets belonging to the second cluster. The red cluster

[41] One difference in our approach is that we used average linkage instead of single linkage used in Lopez de Prado (2016). We rely on the results of Raffinot (2017) showing that average linkage produced more robust portfolios.

groups relatively less correlated and diverse assets with good opportunities for diversification not only between two the most aggregate clusters but within the red cluster assets as well.

There is a quite long history of research identifying and modeling non-linear dependency between assets returns. In response to these findings, we tested the historical clustering concept based on a non-linear measure of dependency instead of correlation. We used mutual information index based on Shannon's entropy as a measure of dependency as in Baitinger and Papenbrock (2017). The resulting clusters were identical to those presented in Fig. 17.8, i.e. obtained using linear correlation as a measure of dependency between assets. This result was in line with Baitinger and Papenbrock (2017), where one of the conclusions was that dependencies between assets quite often could be sufficiently well approximated by a linear correlation.[42]

Risk Parity and Risk Budget Based on Expected Shortfall[43] Seeking to overcome the drawbacks of our current volatility-based risk parity (see above) in the Hierarchical Risk Parity approach we tried to achieve equal expected shortfall (instead of volatility) contributions from different assets and their clusters.[44] However, if we "naively" allocated the expected shortfall to different assets or clusters, our asset weights would be influenced by our views on expected returns, i.e. precisely what we tried to avoid by implementing RP.[45] Hence, we allocated not classical expected shortfall, but an expected shortfall (ES) defined with respect to mean (ES^{-mean}) by analogy to volatility definition.[46] The result of unconstrained optimization yields unconstrained Hierarchical Risk Parity based on ES^{-mean} and is presented in Fig. 17.9.

It is interesting to note that the unconstrained Hierarchical Risk Parity portfolio even without maximization of diversification coefficient not only distributes expected shortfalls equally among clusters but also as a byproduct achieves volatility diversification equal to 7, i.e. not far from a theoretically possible maximum of 8 (see Table 17.3). This result clearly emphasizes the diversification potential and robustness of this risk allocation method.

[42] As we, differently from Baitinger and Papenbrock (2017), used simulated returns, absence of sufficiently strong nonlinear dependency could be the result defined by the properties of our model.

[43] By analogy to our risk budget definition, we used 95% expected shortfall over 1 year.

[44] It is known that achieving expected shortfall parity is a tedious task for the realistic distributions of financial assets; however, for empirical or simulated distributions this task is relatively straightforward and could be accomplished using standard optimization tools.

[45] Although expected shortfall is a risk measure, however, it is influenced by return expectations as well (especially for longer horizons and lower confidence levels).

[46] That does not mean that we ignore return expectations completely, because when return expectations are low (high), the VaR limit for maximum diversification portfolios is more (less) binding. In short, that means a smaller portfolio of risky investments when expected returns are low and vice versa.

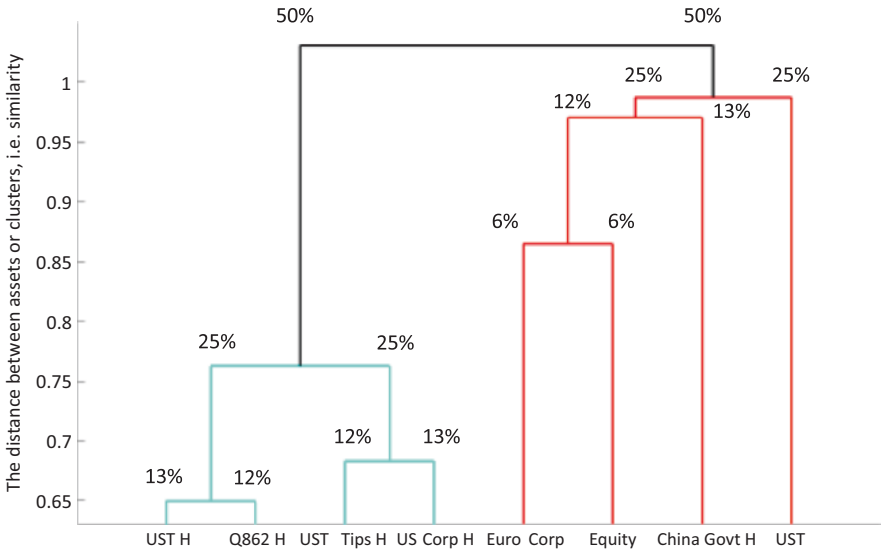

Fig. 17.9 ES allocations of unconstrained Hierarchical Risk Parity portfolio

More insights with respect to differences between the diversification achieved in a Minimum-Torsion Bets (MTBs) risk parity approach and the one from Hierarchical Risk Parity (HRP) can be gained if we compare these alternatives in a constrained optimization exercise. As we see from the last two lines in Table 17.3 the results of the two approaches are strikingly similar both in terms of total risk and volatility diversification. At the same time, there is one important difference: the volatility-based Minimum-Torsion Bets risk parity seems unable to take care of tail risk concentration stemming from EUR corporates and world equities, while Hierarchical Risk Parity based on expected shortfall recommends reducing these positions and proportionally outweighing them by position in US treasuries (Fig. 17.10).

From the comparison of the two alternative risk parity methods, we could draw the following preliminary conclusions:

- Both methods used to derive the risk parity are able to achieve a comparable level of diversification;
- At least for the chosen asset space and our implemented return simulation methodology, a possibility of non-linear codependences between asset classes could be neglected;
- The Hierarchical Risk Parity intuitively reveals the structure of assets universe;
- By construction, the Hierarchical Risk Parity is robust with respect to highly correlated assets, a case where standard risk parity struggles;
- An Hierarchical Risk Parity based on expected shortfall demonstrates better ability to diversify tail risk than volatility-based risk parity.

Table 17.3 Risk, diversification, and expected shortfall contributions

RP	Constrained	Expected shortfall contributions								ES (%)	VaR (%)	STD (%)	ENMTBs (%)
		Euro Corp (%)	UST (%)	UST H (%)	Q862 H (%)	China Govt H (%)	UST Tips H (%)	Equity (%)	US Corp H (%)				
HRP	No	6	25	13	12	13	12	6	13	−1.9	−1.5	0.9	7.1
HRP	Yes	**9**	**28**	13	13	0	13	**10**	13	−2.7	−2.1	1.3	6.3
MTBs	Yes	**20**	**12**	13	16	0	12	**13**	13	−2.5	−1.9	1.1	7.1

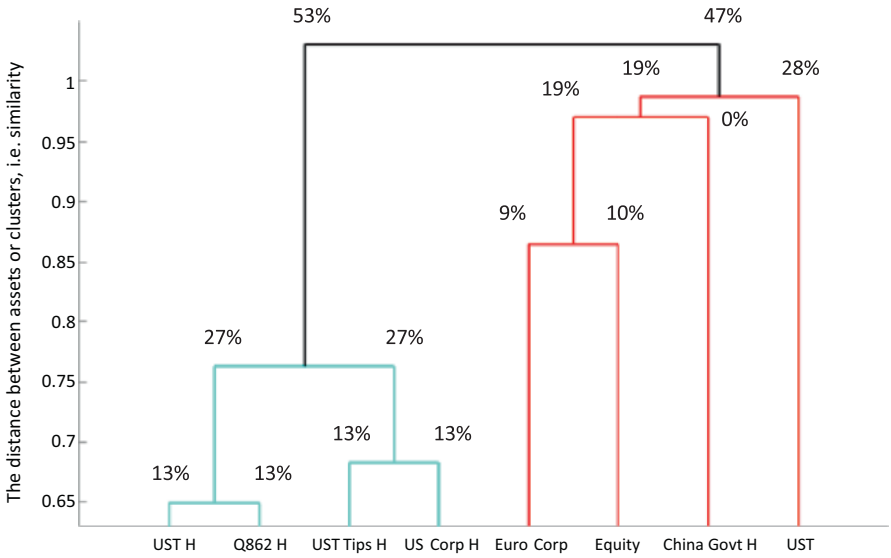

Fig. 17.10 Constrained Hierarchical Risk Parity portfolio expected shortfall allocations

17.6 Conclusion

In this review, we presented the results and lessons learned from implementing an explicitly forward-looking model of macroregime dependent assets returns, risk budgeting, and risk parity. Our main high-level conclusion is that all the components of the BoL's Strategic Asset Allocation framework constitute a robust, comprehensive, and consistent set of tools able to deal with current issues for asset management at a central bank. Moreover, we believe that the results of our analysis and experience provide some assurance that in the long run, this framework will allow for an appropriate level of returns on the central bank's investment portfolio, despite, or maybe because of, the extensive reliance on prudent risk management elements applied towards the Strategic Asset Allocation decision-making process.

We consider that risk parity applied to non-zero risk budget could be thought of as a generalization of a policy towards capital preservation, only a more realistic one, given current market circumstances and, more rational, given its important theoretical properties.

As with any methodology, the risk parity approach is not without its own limitations and could be enhanced by further research. Our analysis indicates some potential directions for further development of our Strategic Asset Allocation framework. For example, we could envisage moving from an asset-based risk parity approach toward one that is founded in risk factors (see Chap. 27) in a hierarchical clustering analysis. Furthermore, we see potential replacing the volatility diversification with,

for example, a tail risk diversification. In our view that would further align our Strategic Asset Allocation with the fact that central bank's investment portfolio is, in its essence, a portfolio for "rainy days."

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Part V
Governance and Risk Management

Chapter 18
Good Governance: Principles, Pitfalls, and Best Practice

Jennifer Johnson-Calari and Isabelle Strauss-Kahn

Abstract Good governance is a holistic concept that extends beyond legislators and supervisors to encompass all central bank functions—from the setting of investment policy to database management. The three main channels of governance comprise the legal authorizing environment, the top-down delegation of authority, and bottom-up transparency and accountability for outcomes. In this chapter, the authors review the principles underlying good governance, recognizing that the actual structure and organization may differ amongst institutions. The authors then describe the major challenges typically facing public sector asset managers, drawing on their experience working globally with public sector asset managers over decades. Some of these issues include the role of the Investment Committee within the decision-making hierarchy, accountability through meaningful reporting, and enhancing returns while mitigating reputational risk. The chapter ends with four initiatives that in many cases have led to more effective asset management operations: (1) implementing holistic change management practices; (2) regular strategic review of investment policy and guidelines; (3) clearly distinguishing between economic (investment) and accounting results when assessing investment outcomes; and, (4) developing a communication strategy for external stakeholders on the investment framework and performance indicators

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18.1 Introduction

Good governance is a holistic concept. It extends beyond legislators and appointed supervisors to encompass all central bank functions. Good governance manifests itself in the way institutions react to the ever-changing external and internal environment. It forms a decisive, but in many cases unspoken, part of the institution's culture. When governance is effective, the right decisions are taken in a timely fashion and wrong-footed decisions are prevented.

This is particularly important when central banks carry out their public sector mandate to invest the institutions' assets in private sector capital market instruments. Such investment decisions are associated with market, credit, liquidity, and operational risks that could impact the institutions' financial health and also their reputation. Moreover, central banks often delegate portfolio decisions to much lower functional levels than is typically the case for other important activities. Hence good governance is in demand. It must therefore come with clearly articulated policies and procedures, senior oversight, as well as with an assurance of full institutional backing for the decisions made, provided staff carry out their duties within the defined operational framework. The three main channels of governance comprise the external and internal authorizing functions, the top-down delegation of authority, and the bottom-up transparency and accountability with respect to reporting on activities and outcomes. While easily spelled out on paper, governance of investment management operations is fraught with difficulties, some of which are quite specific to official sector asset managers.

This chapter provides an overview of the key elements of what can be considered a strong governance framework, some common pitfalls and a few suggested actions that in many cases have been effective in strengthening governance. While official sector investors differ across class, size, geography, and level of development, we found similar governance challenges throughout the world and sought to identify best practices and solutions in working with governing boards and senior management to achieve better outcomes. While the focus of this chapter is on central banks, we believe the messages to be relevant also for other official sector asset allocators and managers.

18.2 The Governance Framework and Its Elements

18.2.1 The Legal Framework and Authorizing Environment

The central bank law sets the primary objectives for the central bank with respect to fulfilling its monetary policy, financial stability, payment systems, and foreign exchange reserve management mandates. While central bank laws may differ in detail for the various central bank functions, the law should install and protect the three pillars of good corporate governance: independence, accountability, and transparency.

At a high level, the principle of independence protects central banks against political pressures and, provides reserves managers the ability to fulfill policy objectives relating to financial stability and portfolio objectives relating to capital preservation, liquidity, and return. The degree of independence and autonomy can be characterized by four elements:

1. The mandate should be precise, clear, and not contradictory to avoid conflicts or disputes with the government;
2. The relationship vis-à-vis the government, and in particular the overriding principle of not financing government activities, should be clearly stated;
3. The power given to the central bank to make decisions should not be subject to contestation by the government; and,
4. The process of designating the decision-makers and limiting the length of their mandates should be clearly specified.

With respect to central bank reserves, central bank laws differ as far as specification of the ownership of the reserves and responsibility for their investment are concerned. In Europe, for example, the laws of the ECB and most European National Central Banks refer to "the foreign exchange reserves of the Member State." Nevertheless, the reserves appear on the balance sheet of the central bank and not the government.

The situation is different for the Bank of England, the Federal Reserve, and the Bank of Japan. In these cases, the central bank law specifies that the reserves are owned by the Government. The Government is also given the responsibility for its management. And, while the central bank may act as its agent for the investment of the reserves, the assets are not part of the central bank's balance sheet. As an example, such a legal framework can be illustrated by the decision of the Chancellor of the Exchequer to dispose of half the UK gold reserves in 1999 and to delegate authority to the Bank of England to sell the gold on the Government's behalf. As a purely practical manner, when investing foreign currency reserves in private markets, representations in legal agreements with counterparties as to the ownership, legal, and beneficial, are often required; so, clarity on the roles of principal and agent is also desirable from a business perspective.[1]

While there may be statutory differences in ownership, central banks are widely empowered to invest and manage the reserves, either as principal or agent. The International Monetary Fund (IMF) does not consider ownership when reporting a country's foreign currency reserve assets in its official statistics.[2] The government, however, is typically responsible for foreign exchange rate policy, which inevitably impacts the investment and management of the reserves by the central bank and requires close coordination.

Central bank laws nearly universally specify the roles and responsibilities of individuals and committees pertaining to the monetary policy mandate. In contrast, central bank laws are generally more silent on the specific responsibilities and

[1] See also Chap. 10.

[2] See Data Template on International Reserves and Foreign Currency Liquidity (March 23, 1999 revised March 31, 2000) and the Sixth Edition of the IMF's Balance of Payments and International Investment Position Manual (BPM6)—Jan. 11, 2010.

delegations with respect to the reserve management function. There are, of course, some exceptions but such mandates tend to be quite broad and generally, the governing board, and senior management are given discretion to develop a governance framework that meets the reserve management objectives as set out in the law.

With respect to defining the eligible universe of investable assets, the law typically follows the IMF reporting standard stating that foreign currency reserves need to be held in convertible currencies and invested in liquid or readily available investment instruments. Beyond this, some central banking laws either specify eligible asset classes and transactions or proscribe others, such as equities or derivatives. And, finally, a few central bank laws have set out a minimum credit rating for eligible investments.

Based on our experience, we believe that the definition of eligible asset classes, investment instruments, and transactions is better placed in the investment policy rather than in the central bank law. This allows flexibility as internal policies and guidelines can be adjusted by authorized central bank officials as deemed appropriate. Market instruments and portfolio management practices evolve, and reserve management needs to be able to keep pace. When investment criteria are legislated, the reserve management function can be hampered for decades, given the complexity and risks in amending the central bank law. While legislators may seek to limit various types of risks, proscribing specific investment instruments can have the perverse effect of accentuating them. For example, a proscription on the use of derivatives can deprive portfolio managers from using futures to efficiently manage market and liquidity risk.

All central bank laws stipulate the accounting framework to be applied to their operations and thus to investments and the treatment of foreign currency valuations. Since the 1997–1998 Asian emerging market crisis, there has been clear pressure to adopt International Financial Reporting Standards (IFRS) rather than national accounting rules for the purpose of transparency and international comparability. This, however, has had an important ancillary effect on volatility in central bank profit and loss accounts as instruments held in the reserves portfolio should be repriced daily by the prevailing price at the close of business. As a result, many central banks have responded by formulating separate policies for the accounting and government remittance of profits. This is not unlike public corporations, where the dividend policy is based on medium term earnings rather than annual profits. Some central banks have agreed with the government a remittance policy based on a historical moving average to dampen short-term earnings volatility and generate more stable government remittances.

Finally, as noted earlier, the delegation of decision-making with respect to the management of the central bank's reserves goes hand in hand with transparency and accountability. It is therefore most useful to have a clearly defined framework in which central bank reserve managers can operate without triggering personal liabilities for market losses that may be suffered as a result of their decisions. Creating such a "safe harbor" environment for investment decision-makers is found in the laws of certain countries governing the investment of private sector institutional assets such as pension trusts.

The regulatory approach governing investment management can be either quantitative (legislating limits such as to what portion of the portfolio can be invested in

certain instruments or asset classes) or qualitative (the criteria guiding the decision-making process) or, to a limited extent, a combination of both. The quantitative approach may have some shortcomings, however, as it does not allow for flexibility in addressing imminent needs of the portfolio.

A good example of the qualitative approach is found in the so-called prudent investment rule in the USA, which sprung from case law, and provides protection to a decision maker when he or she complies with relevant elements or principles of the rule. Generally, the investment decision needs to be prudent at the time it was made (i.e., it should not be judged retrospectively) and the inquiry is into the basis for fiduciary actions and whether similarly situated fiduciaries would act alike (i.e., the behavioral standard).

Codification of the prudent investor rule in the Employee Retirement Security Income Act (ERISA) of 1974 is based on modern portfolio theory and broadly comprises the following elements:

1. The standard of prudence is applied, and decision-maker's choices with respect to individual investments are evaluated as part of the whole portfolio rather than in isolation;
2. The central fiduciary consideration is the tradeoff between risk and return or, more specifically, the balance between the risk appropriate to the investor's investment objectives and the expected return;
3. There are no "prohibited" investments per se; each investment is judged by the role it plays in the portfolio and how appropriate it is for achieving the risk/return objectives;
4. Diversification, including its use in reducing idiosyncratic risk;
5. Requirement to use requisite skill and expertise, including monitoring and making adjustments in changed circumstances;
6. Delegation of investment management and other functions, subject to safeguards such as responsibility for oversight; and,
7. Compliance with the trustee's fiduciary duty of loyalty, no self-dealing, and proper resolution of conflict of interest situations.

While similar investment standards may not be codified, a central bank can self-adopt the prudent person rule as a basis for evaluating the appropriateness of an investment when in question. As a more general point, many central banks in exercising their investment management function could benefit from having such investment-related standards codified at the level of the central bank law.

18.2.2 The Policy and Economic Framework

While the exogenous legal framework provides the authorizing environment for the investment of the central bank's reserves, the policy and economic framework determines how these assets are deployed. Every country differs in terms of its economic situation, development stage, degree of financial stability, balance of payments vulnerabilities, and exchange rate regime. Differences also arise when external stake-

holders such as the Ministry of Finance or the European Central Bank own part of the national reserves. As a result, there is no "one size fits all" investment strategy for central bank reserves and a unique set of factors will determine the strategic asset allocation for the reserves and the foreign currency numeraire or base for the calculation of investment results.

Having said that, there are fundamental differences in the role of foreign currency reserves on the national balance sheet amongst three fairly distinct groups of countries: developed economies, emerging economies, and developing economies. Each of these groups is subject to different macro-economic risks with respect to balance of payments dynamics and their degrees of freedom in responding to imbalances. As foreign currency reserves are an important risk mitigation tool, the policy and investment framework differ substantially between these three groups based on their external risk profile. Let us now briefly review these differences and how they affect the policy framework and strategic asset allocation.

For developed economies, central bank reserves play an insignificant role in the functioning of foreign currency markets and represent a tiny fraction of daily turnover. Under normal circumstances, markets provide foreign currency to the economy and the foreign currency rate is determined by the intersect of supply and demand. The policy and investment framework are thus determined to great extent by institutional arrangements or country-specific economic exposures. For example, several Anglo-Saxon countries where the government explicitly owns the reserves have adopted an asset-liability approach at the central government level. In such instances, reserves are invested based on the market risk profile of government borrowings. In the case of Europe, the ECB has taken on the leading role for interventions, if needed, which abates the liquidity objective in the management of the National Central Banks' (NCB) reserves.[3] In this case, some NCBs have adopted an asset/liability approach at the balance sheet level to hedge the market value of central bank capital. Finally, a few central banks with large financial sectors relative to GDP invest explicitly in counter-cyclical assets given the exposure of the economy and the banking sector to a global systemic financial crisis.

Emerging market economies differ fundamentally from their developed economy counterparts in the policy objective for holding reserves. Whereas developed economies rely on markets to provide the private sector with foreign currencies, emerging market economies are more frequently shut out of international capital markets. Emerging market central bank thus holds reserves to back foreign currency liabilities at the country level both to support their borrowing capacity and rating as well as their exchange rate policy. As emerging markets tend to be riskier and the economies more volatile than their developed counterparts, the reserves may be required to stabilize the exchange rate under balance of payments pressure whether from the current or capital account. The level of the reserves relative to GDP is thus much higher for emerging market economies than for developed or developing countries and, consequently, investment return is a more important factor.

[3] See also Chap. 12.

While central banks in emerging market economies have similar objectives for holding reserves, policy differences emerge amongst countries. These differences are attributable partly to differences in country's risk profile and reserves adequacy, and partly to internal investment management capacity and culture. Reserves adequacy, and in particular the IMF Reserves Adequacy Metric, measures the level of reserves relative to potential draw-downs from balance of payments dynamics. Central banks with ample reserves adequacy may adopt a policy whereby reserves are invested over longer investment horizons to generate higher returns over time, while respecting potential short-term liquidity needs. Central banks with relatively low level of reserves adequacy invest over shorter investment horizons and sacrifice return in exchange for conservatism.

Finally, least developed economies tend to have no or very limited access to international capital markets and the central bank may be the primary provider of foreign currency to the markets. In such instances, the asset allocation would emphasize liquidity to provide sufficient foreign currency to domestic markets on a day-to-day required basis.

18.2.3 The Governing Board/Executive: Responsibilities and Delegation of Authority

The central bank law typically provides discretion to the governing board and central bank senior management to formulate and implement a governance framework to meet the objectives set out in the law. Such a framework typically encompasses the following principles and practices:

- Approval of the investment policy and strategic asset allocation at the highest decision-making levels;
- Clear delegation of authority and accountability for investment decisions within effective risk limits;
- Separation of functions in the investment management process and independent validation of processes, compliance, and reporting;
- Establishing key performance indicators on a qualitative and quantitative basis;
- Making sure adequate resources are allocated to reserve management including staffing, training, and systems;
- Conveying a culture of accountability, responsibility, learning, and continuous improvement; and,
- Setting out clear standards of care for investment management decisions.

The governing board is vested with responsibility and accountability for all policy decisions.[4] The board may delegate to senior management approval of the investment policy and strategic asset allocation and the authority to operationalize

[4] See also Chap. 19.

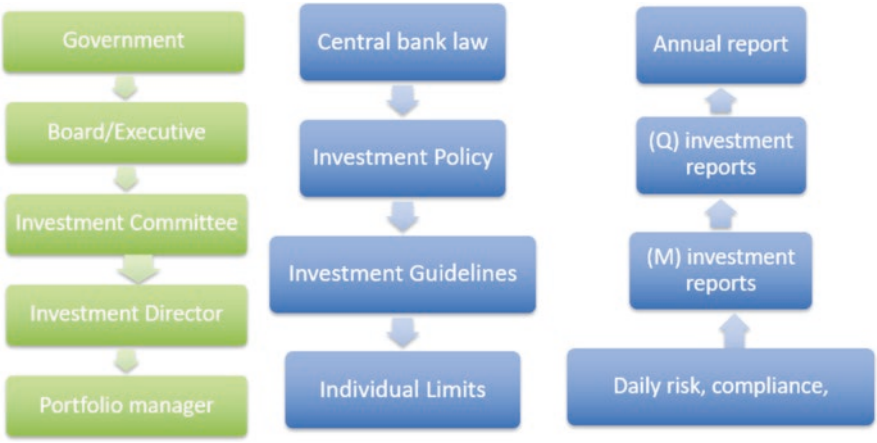

Fig. 18.1 A stylized authorizing environment

reserve management goals such as safety, liquidity, and return. Nonetheless, the governing board retains the ultimate responsibility for the oversight of results and for addressing weaknesses. The authorizing environment (Fig. 18.1) typically includes the investment policy, which is approved at the highest levels and the investment management guidelines, which is a more operational authorizing document encompassing, for example, specific market, credit, and liquidity risk limits.

The investment policy is the cornerstone of the investment management process and typically includes:

- The investment objectives and investment horizon;
- Eligible asset classes and transactions;
- The strategic asset allocation with respect to currency, asset class composition, and risk parameters;
- The "risk budget" and limits for active management or deviation from the strategic asset allocation and its investment benchmarks;
- The structure of reserves with respect to any tranches or sub-portfolios;
- Delegation of decision-making authority and terms of reference for the investment committee;
- Reporting content and frequency; and,
- Escalation procedures related to operational and or compliance risk incidents.

While the investment policy sets the broad objectives and parameters for the reserve management activities, the investment management guidelines are more specific as they inform the reserves managers how much they can invest, in what, with whom, and for how long. The investment management guidelines also set allowable deviations from the strategic asset allocation in terms of portfolio parameters and any non-parametric objectives such as ex-ante tracking error or value at risk measures—relative to the SAA benchmarks.

The composition of the investment committee will vary depending on its terms of reference. The seniority of the chair varies depending on the economic or financial importance of reserves within the country and central bank. Care should be taken, however, to limit the number of committee members to those with sufficient seniority and domain expertise to be able to oversee what is a fairly specialized activity. Executive training and technical briefings on key portfolio management concepts may assist investment committee members from other disciplines.

The investment committee may have responsibility also for the coordination and oversight of major projects and new investments. New business initiatives can cut across central bank hierarchical silos and the chair should have sufficient seniority to lead the project and resolve conflicts or bottlenecks where necessary. Finally, the investment committee should promote a culture of accountability, responsibility, knowledge sharing, and continuous improvement across all reserve management.

18.2.4 Accountability for Results and Safe Haven for Investment Decisions

Delegating and empowering from the top is necessary. Moreover, investment decision-making is typically delegated to lower level and more junior staff than in other central bank functions. Good governance thus requires strong oversight through explicit delegation of powers, agreement on key performance indicators and clear lines of oversight for accountability. Of high importance is also the explicit protection for staff when making investment decisions, provided they are operating within their authority. This again requires an open culture with mutually assured support along hierarchical lines. As senior management oversight over the investment functions depends on accurate, timely, and complete reports, we start with the necessary elements for robust reporting.

The central bank's various databases/data warehouses form the bedrock of reporting and evaluation. In fact, accountability starts here as these data containers store and process the raw material from which management reports are generated. Reserve management is a data-intensive operation and portfolio management databases require granular data on transactions, their size, market prices, coupons, maturities, credit rating, and other risk characteristics for every single instrument—currently in holdings and with a historic record for internal audit and controls. Such data management operations go far beyond the capacity of dated office solutions such as Excel. If the database is unstable, management reports can be flawed, and accountability compromised. While databases or data-warehouse may be the foundation of central bank governance, they can often be neglected for a variety of reasons, including cost, lack of expertise, reliance on internal IT departments rather than a vendored solution, reliance on Excel based solutions, and lack of vendored systems' coverage

and support to small and distant countries. Without strong database management and portfolio management systems, however, delegation of authority, accountability for decisions, and the safeguarding of reserves is compromised. The Board is therefore ultimately responsible for ensuring that the managerial and financial resources are made available for a robust data management solution.

Independent market valuation of financial positions is a second critical component of accountability. Market prices drive risk and performance reports and their integrity is critical for effective oversight. Private sector custodians can be a source of independent valuation for both external and internal asset managers and daily performance reports can allow portfolio managers to detect pricing errors. Segregation of duties between the persons valuing the portfolio and those responsible for investment decisions is another important control.[5]

Delegation of authority comes with accountability for compliance with limits and management of operational risk. Portfolio limits must be monitored, and exceptions reported daily to senior management and at least monthly to the investment committee. Generally, it is the role of the "risk management" function (often performed in a middle office but also in an independent risk management department) to generate compliance reports, which typically cover authorized investments, counterparts, position, and portfolio limits as well as non-parametric measures of potential future risk (see, for example, Chap. 19 for a discussion of the risk management function).

Key performance indicators (KPIs) covering financial performance, operational risk, and efficiency are critical management tools. One standard KPI is the total return vs a benchmark (alpha), which allows management to assess whether active portfolio management decisions have added or subtracted investment return over time. In evaluating performance, longer time horizons are more meaningful than, say, monthly data. Investment committee members are advised to focus more on one to three-year total investment returns in their assessment, while still well keeping a keen eye on the monthly numbers.

Operational risk reports rely to a great extent on self-reporting of operational "incidents" and openness should be encouraged so that errors are reported, and processes improved when errors exceed threshold levels. Efficiency reports focus on the cost of functions such as trade settlement. Efficiency reports are typically less a focus for public reserve managers than for private sector asset managers. Nonetheless, such reports should be encouraged as a way of improving cost-efficiency and as a foundation for decisions related to the outsourcing of specific functions where external providers may be more cost effective.

Daily management reports at the operational level allow mistakes to be addressed and escalated promptly. Periodic reports with historical trend analysis related to key performance indicators are now common agenda items at the investment committee, but still less frequently, at the board level. Such reports allow for a more comprehensive oversight of the investment management operations and inform strategic decisions.

[5] See also Chap. 20.

18.3 Governance Challenges and Potential Pitfalls

18.3.1 Board/Executive Roles and Responsibilities

Central bank boards and senior management often face similar challenges in fulfilling their policy and oversight responsibilities for investment operations. In our experience, three common challenges are:

- Lack of investment domain experience or financial market expertise as board members are often drawn from public service or academia with a background in economics or law rather than portfolio management and finance;
- A conflict of interest between the short-term interest of the government in higher annual profit remittances and the long-termer interests of the beneficiaries (i.e., time-inconsistency); and,
- Risk aversion or fear of "reputational risk" from short-term volatility in accounting figures, which limits investment returns and can lead to loss of capital both in real terms and, in a world of negative rates, in nominal terms as well.

In addressing the first, technical briefings can help empower Board members to address the policy and practical issues relating to key investment decisions, delegation, and oversight. In addition, board members can benefit from participation at high-level conferences on reserve management policy issues. Finally, critical but more technical decisions such as defining the risk tolerance, investment horizon, and approval of the strategic asset allocation may be delegated to a specialist subcommittee of Board members with financial expertise.

The second challenge relates to a government's desire for stable profit remittances and short-term volatility in accounting income. Some central banks have addressed this issue by separating the formula for remittances from annual accounting income, not dissimilar to public companies that adopt a stable dividend policy to protect shareholders from earnings volatility.

The third challenge implies mitigating reputational risk, which will be best addressed through communication policy discussed in more detail below.

18.3.2 Between Policy and Operations: The Investment Committee

The investment committee (IC) is a critical interface between the investment policy and investment management operations. If dysfunctional, bottlenecks, and "paralysis by analysis" can occur, resulting in lost opportunities and sub-optimal risk-adjusted returns. A common pitfall can be either an overly large or dysfunctional composition where members are chosen for seniority but lack domain expertise or relevant functional responsibilities. In some instances, problems can arise when the chief accountant is on the investment committee as the accounting perspective,

which focuses on annual accounting figures, is substantively different than the investment perspective, which focuses on total return over the investment horizon.

In our experience, another pitfall can be the delegation of responsibility to the IC for implementing market views through a tactical asset allocation. While the IC may be responsible for approving currency and investment benchmarks, delegating authority to committees for market position is fraught with difficulties. Empirical studies in behavioral finance suggest that investment committees are poorly equipped to outperform markets for reasons embedded in human biases, which include "chasing performance," loss aversion and group think. An exception could be when the IC is chaired by a Chief Investment Officer (CIO), such as in private asset management companies or some sovereign wealth funds, with line responsibility, accountability, and appropriate incentives for investment performance. In most central banks, however, IC members are not market experts, have other line responsibilities and cannot follow closely positions and market developments.

In our experience, market decisions are best taken by portfolio managers accountable to the director for individual performance and, in turn, to the IC for oversight of the portfolio as a whole. The IC can add substantial value to the investment process by articulating its investment beliefs regarding the potential for the central bank to outperform market benchmarks. Such beliefs can then be translated into market limits and guidelines on the recommended level of tracking error or active risk to allocate to each asset class or portfolio manager for active management. And, monitoring performance over time can inform decisions whether to increase or cut back such risk budgets for active management.

18.3.3 Management Reports and Key Performance Indicators

For effective reporting, less can be more. Effective management reports are concise and focus on critical portfolio parameters. Key performance indicators (KPIs) can be both quantitative and qualitative measures and generally cover at a minimum financial performance on a risk-adjusted basis, compliance, and operational risk.

In our experience, effective oversight can be marred by any one of the following:

- Excessive narrative when graphs and tables can quickly and more effectively convey portfolio information necessary for oversight;
- Excessive focus on short-term market developments, or "noise," which can lead decision-makers to make short-term and, at times, costly decisions to the detriment of the long-term strategic objectives of managing the reserves;
- Excessive focus on individual investments or sectors rather than the portfolio parameters as a whole, or only on the accounting information rather than the total investment return; and,
- A focus on portfolio results from past market movements and not on simulations of potential future outcomes from current risk positions.

A second pitfall lies in confusion over whether to focus on the portfolio total return or the accounting income in management reports. While the two eventually reconcile over time, the accounting income can actually give an incomplete story as profits and losses can be allocated across different time periods. Total return is a more comprehensive measure of performance and should be the focus of the Board and management in overseeing results both in absolute terms and relative to any policy benchmarks.

18.3.4 Reputational vs. Market Risk

Central bankers seek to avoid reputational risk arising from negative headlines. A common pitfall is for central bankers to invest overly conservatively and over short horizons to avoid negative income in either the quarterly or annual accounts. Such a strategy may or may not avoid reputational risk but will tend to generate lower investment returns on average over time.

In emerging market countries, central bank reserves can represent substantial portfolios both in absolute terms and relative to the size of the economy. Market risk cannot be avoided. An attempt to avoid reputational risk by investing only in "cash equivalents" is futile and can lead to negative returns in both nominal and real term, thereby violating capital preservation objectives. When viewed over longer investment horizons, the less risky portfolio is typically a more diversified portfolio with positive returns, which boost foreign currency investment income. Such a portfolio, however, is subject to short-term market variations in the quarterly or annual reports, which can give rise to a perception of "reputational risk." Communication strategy with respect to the investment management objectives, investment horizon, and risk parameters is the most effective form of mitigating reputation risk as it defuses potential criticism arising from normal short-term income volatility.

18.3.5 Organizational Challenges

A fundamental principal underpinning any asset management operation is segregation of duties for the processing of transactions or investments between those that: (1) authorize; (2) initiate; (3) settle; (4) account for; and (5) monitor compliance with rules. Most ill-fated stories of rogue traders (e.g., Barings, Société Générale, Kidder Peabody) illustrate how lack of internal controls and strong fire-walls between operational units constitute an open door to major operational risks and financial losses.

Over the years, central banks have duly implemented separation of the front, risk management, and operations/settlements functions within a broader reserve management or markets department. Segregation of duties has been further facilitated by integrated IT systems and straight through processing (STP) whereby authorized

users have protected access to only a limited part of the trade process flow. Recently, however, such segregation has extended even further, with the emergence of corporate "Enterprise Risk Management" (ERM) Departments, charged with managing bank-wide risks and, in some instances, the middle/risk management office has been folded into such departments.

In our experience, excessive organizational separation of reserve management operational functions can be dysfunctional from numerous perspectives. Reserve management and trade processing require managing to tight deadlines set by external parties and resolving settlement issues in a quick fashion. In reserve management, the portfolio managers represent the first line of risk management and the middle office/risk management unit needs to respond to their requirements for daily risk and performance reports. And, finally, an engaged risk management function needs to follow closely market developments.

This does not imply that operations/settlements and the risk management offices would report to the front office. On the contrary, they should have their own reporting line to a superior responsible for the oversight and coordination of these functions, including resource allocation and resolution of conflicts. Each unit would report also to the ERM Department as do all other corporate functions in the organization. In our experience, excessive separation between reserve management units can impede collaboration and creates inefficiencies, misunderstanding, conflicts, and misalignment of incentives and accountability. Moreover, it often leads to duplication of tasks, with a risk management unit re-emerging within the foreign currency reserves management department/division.

Another organizational challenge relates to corporate functions such as legal, compliance, and internal audit where professionals may not have the specialized experience or training required for highly technical investment management operations. It is therefore essential to create, and train specialist units dedicated to supporting reserve management operations.

In the case of legal counsel, it is typically beyond the capacity of internal counsel to solely support reserves management and the central bank may need to hire external counsel given the legal complexity and number of jurisdictions governing agreements with external asset managers, custodians, counterparties, and service providers. Notwithstanding this, the legal and investment teams can work together closely to facilitate mutual understanding of financial transactions, market conventions and standards, and risks in order to protect the central bank and its foreign currency reserves, in its relationships with private sector counterparties.

18.4 Four Initiatives That Can Lead to Stronger Reserve Management

18.4.1 Change Management

In our experience, there is no static "best practice" in reserve management. Markets change, the level of reserves and objectives change, as do the technical investment-related skills and abilities of central bankers. This dynamic environment can at times be at loggerheads with the conservative and staid corporate culture of central banks and other official sector asset managers. Too frequently, markets and external conditions change while policies and guidelines are inherited from earlier times and accepted as "cast in stone." Change is difficult in the best of times but particularly challenging in central bank reserve management given the corporate culture, primary focus on monetary policy and financial stability and, last but not least, the number of corporate functions involved in effecting change. It is important to acknowledge this complexity but not be daunted by it given the important stakes. Central bank reserves are frequently the largest investment portfolios in emerging and developing economies and an important source of foreign currency income to the country. Investment income can contribute to building the level of reserves in good times, thus reducing the risk of financial crisis in bad times. Given this, our first recommendation would be to embrace "change management" as a discipline with clarity and management focus on objectives, stakeholders, consultative processes, decision-making and implementation.

18.4.2 Regular Strategic Reviews

The blueprint for the investment of the reserves is embodied in the strategic asset allocation (SAA), which is a policy portfolio approved at the highest levels. The SAA should reflect a central bank's broad objectives and, for emerging economies, level of reserves adequacy. Its formulation should be devoid of explicit market views. Reserves adequacy, in turn, compares the level of reserves to an array of potential foreign currency requirements at the country level. As reserves adequacy levels evolve, driven by balance of payments dynamics, and financial stability developments, the appropriate level of risk embedded in the SAA needs to be adjusted accordingly (see Chap. 6). The objectives for reserve management change less frequently in developed economies but there are nevertheless regime breaks, such as joining the Eurozone common currency—or pegging the local currency to the euro, which can profoundly impact the strategy for the investment of the reserves.

When policymakers approve the SAA, being careful not "to set and forget" is good advice. Regular strategic reviews allow policy makers and reserve managers to evaluate the appropriateness of the strategic asset allocation with respect to the

external financial position of the country and opportunities to invest more efficiently. In addition, bottlenecks and resource constraints can also be identified and plans agreed to address these.

18.4.3 Achieve Clarity and Common Understanding on Differences Between the Financial Perspective and the Accounting Perspective

We recommend that management focus on the financial perspective rather than the accounting perspective in the investment management process. This requires agreeing on the appropriate investment horizon for defining the acceptable level of risk and assessment of results. It also requires focusing on the total investment return. In setting policy objectives and oversight, it is not uncommon for the governing board and executives to "default" to a one-year investment horizon as this corresponds to the accounting cycle regardless of the period over which the funds are likely to be available for investment. A longer investment horizon, when appropriate, can open many degrees of freedom and raise investment returns on average over time.

18.4.4 Stronger External Communications with Respect to Reserve Management Operations

While central banks have recently dedicated considerable efforts to strengthening external communications, this initiative has often excluded reserve management operations. In some instance, the public's only understanding of the reserve management strategy and results comes from the accounting information in the annual reports and any accompanying narrative or explanatory notes.

In order to mitigate reputational risk, it is important to convey ex ante the objectives for the investment of the reserve and the strategy and report the results over the appropriate investment horizon. This allows the central bank policy makers to frame the investment information and avoid misunderstanding. Furthermore, to avoid undue focus on short-term results, central banks can supplement the annual profit and loss statement by reporting results over multi-year horizons in the annual reports. Such reports may be on a total investment return basis with differences (vis-à-vis accounting results) explained and reconciled in the notes.

18.5 Conclusion

In conclusion, "best practice" in reserve management will never be static and governance needs to be both robust and agile in understanding and accommodating the drivers of change. There is no single recipe for every central bank but there are common principles. Understanding and adapting these principles to the unique reality of each central bank, its economy and its legislative structure is at the heart of good governance.

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Chapter 19
Central Bank of Brazil: Investment Decision-Making in an Integrated Risk Management Framework

Isabela Ribeiro Damaso Maia

Abstract Risk management is an evolving discipline. Its contribution to protect the integrity of an organization is well-known. The primary objective of the risk function is to establish a structural and process-driven environment that facilitates the achievement of the organization's objectives, mitigate risks whenever possible, and control residual risks. Combined, they improve the organization's resilience in case of risk incidents. Nevertheless, the risk function today goes beyond its traditional role of reporting and controls. It plays a fundamental role in the organization's operational and strategic decision-making processes. A pro-active approach therefore creates, collects, and disseminates information about all organizational risks. Risk information properly intertwined in the decision-making process, combined with a robust governance can minimize decisions biases and, consequently, foster a better alignment between strategic objectives, risk appetite and decisions. This chapter discusses how risk information can substantially impact the investment decision-making, improving decision quality and increasing transparency.

19.1 Introduction

Risk management is a fundamental activity for any public or private sector entity. It focuses on fulfilling its mandates and conducting its activities in an efficient, transparent, and accountable way. Risks are inherent in all activities. A proper understanding of the risks and the availability of risk information in the decision-making process enables the organization to make better informed choices and, consequently, improves the quality of the decisions. The question is: Have the decision-making

The views expressed in this chapter are those of the author and do not necessarily reflect those of the Banco Central do Brasil or its members.

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process and its governance at central banks been modified to benefit from the insights that risk management can provide?

This chapter discusses how risk information can substantially impact decisions, including those related to foreign reserves assets allocation. The following three Sects. 19.2, 19.3, and 19.4 describe how the risk management function has evolved over time, introduce some basic risk related concepts and point towards the duality of the risk management function. Next, in Sects. 19.5 and 19.6, the risk function is reviewed in an investment decision-making context and how it can help improving both decision-making quality and the transparency as well as accountability. Section 19.7 concludes.

19.2 Risk Management Developments

Risk assessment and management has always accompanied our existence. Early tribesmen have experienced nature as imposing its hidden and unknowable will upon them. Lacking today's calculating power and statistical tools, they constantly had to make existential choices in the view of uncertainty. Fast forward, as mankind started to create its own reality in parallel to what was imposed upon them by nature, a better understanding of probabilities and outcomes paved the way towards a more mature understanding of life's uncertainties. An early example on risk management may be found in the fourteenth century venetian city-states at the time of Marco Polo. By then, it was recognized that the ships sailing to and from Far-East harbors with their precious goods were at risk. Not only did the clever merchants split their cargo between ships, i.e. diversification, they also took out insurance in the case that hostile pirates or bad weather would hinder their safe arrival. In some commercial instances, primitive option contracts of protection were even negotiated between sellers and buyers of goods. Over time, however, theoretical developments in the area of mathematics and statistics lay the foundation for the development of sophisticated financial models. These models, again, laid paved the way for new financial and capital market instruments such as futures, options, and swaps. The 1980s and 1990s experienced a veritable explosion in the area of financial innovation and a rapid growth and distribution of financial risk models. One type of such models took advantage of the so-called Value-at-Risk (VaR)[1] concept. The VaR measure was certainly a milestone for financial risk management. Since its inception, VaR has become the industry standard by which market risk is both measured and managed by financial institutions. It is fair to claim that VaR was revolutionary at that time. It fundamentally changed the way private and public institutions assessed their financial risk and enabled them to make risk visible and manageable.

[1] Value-at-risk (VaR) is a statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time horizon, at a pre-defined confidence level. The focus in VaR is clearly on downside risk and potential losses.

The way risk assessment and management has evolved over time, coupled with an improved access to data and data processing through high-powered computers, show us how interlinked risk events are, be it from a natural, social, economic, or financial source. The "global village" term[2] introduced in the 1960s by Marshall McLuhan reflects today's world in an uncompromising manner: Interconnected commercial and financial institutions, borderless capital flows through open Balance of Payments, and financial markets open, and their instruments traded 24/7. But for all these observable developments, financial market participants have experienced increasing price volatility across and within global financial markets. The world definitely feels riskier today in the post Global Financial Crisis (GFC) era than before. Maybe also because of our increased level of knowledge and sophistication.

To better handle this "new normal" financial market related context, it is essential to take a holistic view of the institution's risks and of the environment in which it is operating. There is an urgent need to identify the existing net risk exposures, understand the institutions true risk appetite, and evaluate cost and benefits for effective risk mitigation strategies. Initially seen as a tool for value protection, i.e. the second line of defense, nowadays risk management is also recognized as an essential tool for value creation, i.e. a first order tool. As a consequence, the traditional approach to risk management which "only" combines and aggregates single types of risk in a silos-based style is more and more being replaced by a holistic approach. The holistic approach is set within an integrated risk framework that, for example, also accounts for the way different types of risks interact during financial market and economic stress situations.

19.3 Basic Concepts

As indicated above, risk assessment and management has experienced both evolutionary and revolutionary stages. During such time and state dependent processes, it is commonplace that new ideas are discussed, terms are formed, and novel practices introduced. More often than not, new concepts are easily misunderstood. Agreeing on the definition of basic risk concepts must, therefore, be considered a high priority.

Following Frank Knight's early discussions on the matter, we can make the following general statements (Knight 1921):

- True uncertainty: "not susceptible to measurement"
- Risk: "Uncertainty measured through a statistical probability distribution"
- Impact: "Consequences of a risk related incident"
- Causes: "Factors that may contribute to the occurrence of a future event"

[2] Global village concept was introduced by Marshall McLuhan, a Canadian philosopher and a public intellectual, in the beginning of the 1960s. He had a vision of technology reducing the size of the globe to that of a village, with information floating freely and simultaneously from one end to the other (McLuhan 1962).

Knight draws a clear distinction between uncertainty and risk. An ever-changing world brings new opportunities for businesses to engage in new markets and new products. But it also means that the managers of such activities have imperfect knowledge of future events. Therefore, according to Knight, risk applies to situations where we do not know the outcome of a given situation, but can accurately measure the odds. Uncertainty, on the other hand, applies to situations where we cannot know all the information needed in order to set accurate odds in the first place. "There is a fundamental distinction between the reward for taking a known risk and that for assuming a risk whose value itself is not known." Knight wrote. Risk is therefore often seen as a quantifiable uncertainty.

Intuitively, risk is usually perceived as something negative. The reason for such a view might be traced back to Kahneman and Tversky's prospect theory. Therein, it is argued that the impact of bad outcomes usually is more relevant than the utility arising from equivalent good outcomes: "people underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty. This tendency, called the certainty effect, contributes to risk aversion in choices involving sure gains and to risk seeking in choices involving sure losses." (Kahneman and Tversky 1979, p. 263).

Prima facie, a risk cannot be characterized as inherently good or bad. However, its realization might have either a positive or a negative impact depending upon the particular angle of analysis. For example: the risk of a currency devaluation may have a negative impact for importers, who will end up paying more for foreign products, and a positive impact for exporters, whose products will become more competitive in the international markets. Kahneman and Tversky also refer to this important "shift of reference" point: "Although this is probably true for most choice problems, there are situations in which gains and losses are coded relative to an expectation or aspiration level that differs from the status quo. For example, an unexpected tax withdrawal from a monthly pay check is experienced as a loss, not as a reduced gain. Similarly, an entrepreneur who is weathering a slump with greater success than his competitors may interpret a small loss as a gain, relative to the larger loss he had reason to expect." (Kahneman and Tversky 1979, p. 287).

As we have indicated above, however, risk is per se value neutral and should be seen as an additional information that supports any institution in navigating its operations during normal and not so normal times.

19.4 The Duality of the Risk Management Function

The contribution of the risk management function to protect the integrity of an organization is well-known. The primary objective of the risk function is to establish a structural and process-driven environment that facilitates the achievement of the organization's objectives, mitigate risks whenever possible, and control residual risks. Combined, they improve the organization's resilience in case of risk incidents. Nevertheless, the risk function today goes beyond its traditional role of reporting

and controls. It plays a fundamental role in the organization's operational and strategic decision-making processes. A pro-active approach therefore looks ahead and creates, collects, and disseminates information about all organizational risks. Risk information properly intertwined in the decision-making process, combined with a robust governance can minimize decisions biases and, consequently, foster a better alignment between strategic objectives, risk appetite, and decisions.

The risk function's contribution to organizational value creation is directly related to the usage of risk information during the decision-making process. Risk is an additional information to be considered that aims at enhancing the decision quality, improves resources allocation, and increases transparency. Figure 19.1 shows the two functions of risk: "protect value" and "add value."

This combination of value protection and value creation represents what we have denominated *risk duality*,[3] i.e. two complementary functions of risk—one that controls processes and one that supports decision-making. They combine to reach the primary objective of establishing an environment that facilitates the achievement of the organizations' objectives in a transparent manner and with an efficient allocation of resources.

In fact, the risk duality concept was developed as a response to the hierarchical structure of the organizations. The risk function's contribution clearly changes in importance as we move up or down the hierarchy. Figure 19.2 illustrates that its impact on the decision-making process increases in importance as it moves up the hierarchy, from the operational to the strategic level. On the other hand, risk as a tool of control increases in importance as we move down the hierarchy of the organization.

At the board level, where strategic decisions are taken, it is crucial that risk information and its supporting data are provided in a timely, accurate, and complete manner in order to support the senior decision makers. Once decisions are taken, an effective risk governance framework would have guaranteed that all risks had been properly identified, measured, and treated for a smooth implementation.

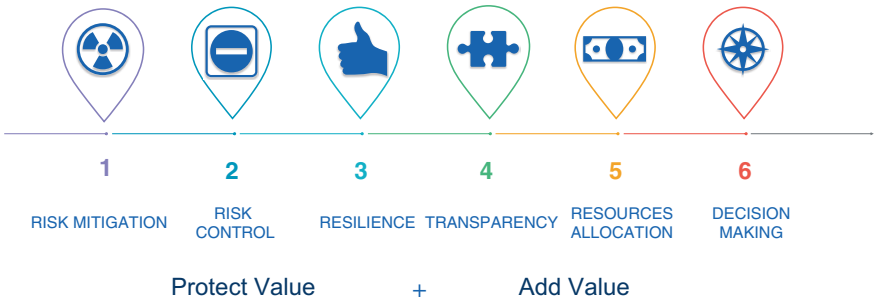

Fig. 19.1 Risk management value chain

[3] Risk duality is a concept created by Banco Central do Brazil's risk team to reflect the two complementary approaches to risk management.

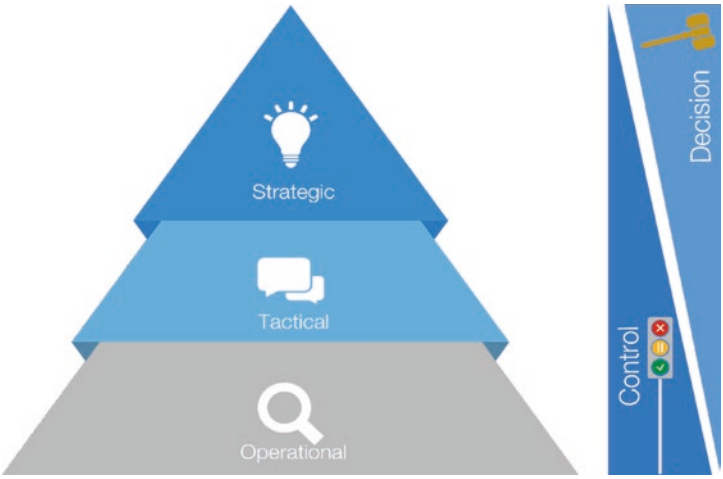

Fig. 19.2 Risk duality

As indicated above, the risk function and its conceptual duality must have an institution-wide reach beyond the traditional accounting-based risk assessment and management. In this sense, the risk function also encompasses the evaluation of reputational risks, operational risks, strategic risks, etc. In a holistic approach, risk integration is paramount to comprehend not only the different risk types, but also how they interact in normal and not so normal circumstances (Maia, Cacella and Fernandes 2012).

In the context of foreign reserves investments, the so-called first-line of defense is established in the front office in which the assets are managed as an on-going activity. The front office is thus responsible for ensuring that their portfolios remain within the given market, credit, and liquidity risk limits. The risk control function establishes the "second line of defense." It controls the implementation of the strategic decisions taken by senior management with respect to higher level investment management framework, policies, and procedures. Such information is compiled in regular reports that feed upwards from the operational to the tactical and strategic levels.

In this broader, all-encompassing context, developing an effective risk management concept is neither an easy nor a fast track activity. In particular, risk assessment and management evolve along with the institutions' risk culture. A new holistic approach cannot be imposed in a hierarchically top-down fashion, but must be developed step by step in a cautious way to achieve the necessary buy-in and commitment.

Experience shows that the foundation for an effective cross-functional risk function is composed of four elements: Governance, technology, people and risk integration.

- Governance stands for a strong organizational structure in which risk owners are clearly identified and in which risk information flows smoothly across and within the different hierarchical levels—being available either for control or for support of the decision-making process.
- Technology stands for data, robust models, and flexible IT tools. Robust does not mean finding the "final answer," but adequate for the circumstance at hand. In this sense, IT flexibility is essential to accommodate changes or enhancements of risk models whenever needed.
- People expertise means that mathematical model outcomes are considered as just another information made available for decision-making. Decisions are not taken by models. They are taken by people. So beyond quantitative information, decisions should also take into consideration qualitative aspects reflecting senior guidance.
- As analytic capabilities improved, risk models became more complex and understanding them became more difficult. Then, of no lesser importance is risk managers role in understanding models' limitations and in compiling and transforming operational analytical results into more comprehensive information for board members. People, their skills, knowledge, and intuitive understanding, therefore, will improve risk management transparency and contribute to management effectiveness.
- Risk integration does not mean to come up with one single risk number that covers all the risk types or that represents all risk exposures of the full organization. It stands for a holistic view that aims at understanding how the different risk types act alone and interact with other risk sources within and across and organization.

19.5 Describing the Investment Decision-Making Process

At the earliest operational stages of making investment decisions, instinct, intuition, and even superstition were the dominant drivers. This did not mean that decisions necessarily turned out to be bad or wrong-footed. However, as modern decision-making theories and models were developed, more disciplined and transparent processes came to practice. Today, most private and public sector asset and sovereign reserve managers have an articulated investment decision-making process in place.

Despite all progress, however, decisions on the allocation of significant resources towards any project often involve uncertainties about possible future outcomes. In the financial world, investment decision-making would not be different. Year after year, financial market participants have developed complex models and mining ever granular data aimed at turning uncertainties into risk—all in order to improve decision quality. Nonetheless, we still have to live with Knight's true uncertainties, and hope for improving our understanding of risks. For most of the everyday choices that individuals make, the risks are small. But when we consider the corporate world and the foreign reserve management activities of central banks, the risks impact

scale up and the outcomes can be significant—both along the positive and negative axis.

Given true uncertainties and the challenges in understanding risks, benchmarks become an important variable when managing investments. A strategic benchmark is a point of reference that reflects the long-term risk-return preference of senior management, usually the Board of the central bank. It is also a ruler for measuring performance in an active reserve management mandate.

Defined in advance, a sound and valid strategic benchmark should have the following characteristics—thereby providing credibility, transparency, and accountability to the investment decision process:

1. Investable: The manager must be able to buy all the assets of the benchmark;
2. Unambiguous: The identities and weights of each asset of the benchmark can be clearly ascertained;
3. Stable: There should not be high turnover of the assets in the index. A medium to long-term predetermined time horizon should be set in advance for reviewing the benchmark; and
4. Measurable: The benchmark's return can be easily calculated.

Short- to medium-term views of where the market and the resulting asset class returns might evolve are not accounted for in the strategic benchmark. However, it is usual to see central banks allowing for deviation bands around such benchmarks. The bands are meant to give the portfolio managers leeway to deviate from the strategic benchmark when they believe such deviations can lead to a performance in excess of the strategic benchmark's return. These deviation decisions are often referred to as "active portfolio management." The outcome of such active decisions is measured against the performance of the benchmark. At this operational level, central bank reserve management is in many ways similar to those found in a private sector asset management organization. In general, however, central banks tend to be very conservative with respect to the investment of its foreign reserves and the strategic benchmark is usually defined by the Board to reflect the institution's long term strategic objectives and risk appetite.

19.6 Decision-Making, Biases, and Risk Management Integration

Among many others, behavior finance studies have identified a decision-making bias called ambiguity aversion. This bias posits that people tend to avoid ambiguous alternatives in favor of more certain ones. Baron and Frisch (1994) attribute this behavior to a general desire to avoid alternatives where information may be incomplete. In the context of risk function, the ambiguity bias has a particular role in defining the effectiveness of risk management. Since forward-looking estimates for the firm risks are probabilistic by nature, this introduces uncertainty into manage-

ment decision-making about the performance benchmarks used to evaluate the investment process. In more general terms, behavior finance posits that individuals are rationally bounded and prone to cognitive biases.

Another relevant behavior bias is confirmation, which attributes greater weight to information supporting a particular view. This bias may be associated with the "house money effect," described by Thaler and Johnson (1990), where prior financial performance influences an individual's risk appetite. In this context, a prior period of sustained favorable financial performance would be a confirming event of future strong performance, thus reducing management's level of loss aversion. In some way, risk models based on historical data tend to contribute to this behavior on the idea that todays' numbers are the best indicators for tomorrow.

Anchoring, another explored bias, claims that people tend to sustain their first decisions, even if data indicates that they are wrong. It is an attempt to avoid the discomfort of a cognitive dissonance. In this sense, quantitative risk managers are still struggling with their models adding even more complexity in an already known game with a negative outcome.

Tversky and Kahneman (1974) also refer to an "illusion of validity" where overconfidence in a particular view or outcome is established merely by the coherence of a story and its conformance with a point of view. Confirmation bias and the illusion of validity may be reinforcing biases for managers.[4]

Risk information properly interfaced with the strategic investment decision-making is paramount and together with adequate governance thereof can help to eliminate or minimize decisions biases. Naturally, the governance structure and processes are not the same in all central banks as they typically reflect the particularities of such entities. Nevertheless, in the foreign reserves management context, there are key aspects to be observed in order to avoid traps in the investment decision-making process. For example, if optimization models limitations are ignored, the portfolio might not properly reflect the strategic objectives of the organization. In this sense, the following aspects should prevail:

- Strategic objectives and risk information lead the discussion, not a market view;
- Multiple alternatives and trade-offs are presented to the Board for decision;
- Scenario analysis is used to define a portfolio that will behave well under a multitude of distinct circumstances, including extreme events; and
- Optimization model outputs are just another information in the decision process.

The strategic benchmark reflects the risk/return preferences of the Board and takes a long-term, through the cycle, perspective. Figure 19.3 shows how an integrated risk framework supports the investment decision-making function at different stages of the process of foreign reserves strategic asset allocation.

Starting with long-term strategic objectives aligned to the organization's risk appetite, strategic risks are identified and taken into consideration when setting the

[4] See also Chap. 17.

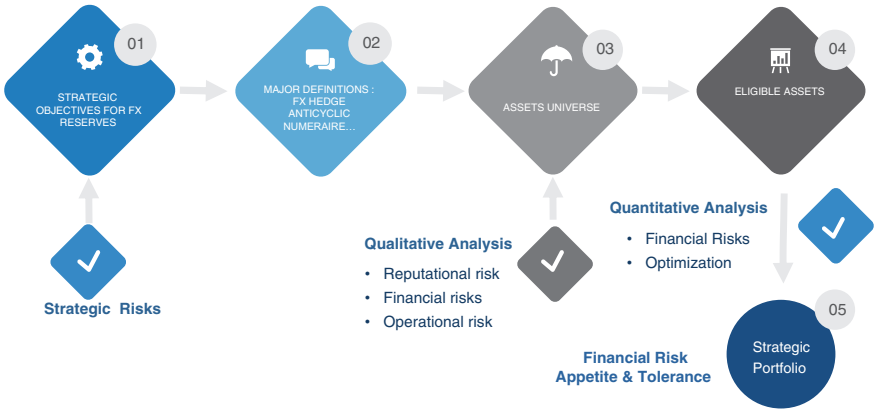

Fig. 19.3 A stylized risk and investment decision-making flow-chart

primary definitions that will drive the investment decision. At this stage, issues like numeraire, currency allocation objectives, and general characteristics of the portfolio are decided, like procyclical or countercyclical behaviors.

In the next phase, reputational risk, liquidity risk, and operational risk are introduced in order to back-stop the asset class selection. Once eligible assets are defined, financial risk preferences like maximum exposure to specific markets or asset classes and minimum credit quality are set as restrictions before turning the results over to an optimization model.

Among several optimization models available in the literature, the stochastic models should prevail as return is expressed by a probability distribution function. At the efficient frontier, the risk level will indicate the optimal strategic portfolio. Following the identification of the optimal portfolio, the risk tolerance establishes specific risk limits that set the leeway for the implementation of active investment management strategies, i.e. the deviation ranges around the strategic benchmark's asset weights.

Although strategic objectives usually reflect long-term investment horizons, annual reviews of the strategic benchmark are recommended to check if the portfolio is still aligned to the objectives. A review can also be done at any time, whenever necessary, as for example in case of significant changes in market risk conditions. Active management reviews are much more often and tend to follow market standard, which is quarterly. From the flow presented in Fig. 19.3, it can be observed that risk function is deeply involved in the investment decision process, both in terms of value protection and creation. Even though unquantified uncertainties may still change the expected outcome, the risk involvement certainly improves the decision quality and fosters a cross-functional alignment of interests and resources towards achieving high-level institution goals.

Although important in the short- to medium-term, market conditions and associated market views should have no immediate impact on the asset allocation defined

under the described holistic and integrated strategic benchmark definition[5] (Cacella 2017). Short-term market views, as discussed, are employed to support active investment strategies seeking to exploit market inefficiencies.

19.7 Final Remarks

Risk assessment and management takes both a backward and a forward-looking view. It draws on available tools and past data in order to paint a possible picture about the future. At its core, the risk function aims at identifying risk factors that may impact significantly the integrity and the operation of the institution in question. It is concerned with assessing and managing a wide spectrum of risks—marked, credit, liquidity, financial, strategic, and reputational.

Good governance shall avoid conflict of interest, include commitment to engage stakeholders' interests, and foster alignment around critical decisions and risk management. A risk framework embedded in the governance can substantially impact the decision-making quality, increase transparency, and harness accountability.

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[5] SAA stands for "Strategic Asset Allocation."

Chapter 20
Governance, Risk Management, Reporting, and Control at the Central Bank of Colombia

Marco Ruiz

Abstract There are several factors that can lead to successful outcomes in asset management at central banks and monetary authorities. For instance, having a robust asset allocation model, highly experienced portfolio managers, and sophisticated quantitative tools for implementing investment strategies. Nonetheless, in this chapter I will argue that governance, risk management, reporting, and control can be even more important than any of the factors mentioned above. That is true for any asset management operation but it is even more so for central banks, given the amount of reserves that they manage and the importance of their functions.

This chapter discusses some general principles related to governance, risk management, reporting, and control. As an illustration, I will explain how those principles are implemented in the reserve management function at the Central Bank of Colombia. However, I will also attempt to show that the principles discussed here can be implemented differently in other organizations.

The first section of this chapter explains very broadly how the Central Bank of Colombia manages foreign exchange reserves. The second section deals with governance, the third with risk management, and the fourth with reporting and control. The fourth section discusses the process-based management framework as a way to put the whole process together. The final section concludes.

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20.1 Managing International Reserves Portfolios at the Central Bank of Colombia

As of June 2018, the Central Bank of Colombia managed 47 billion US dollars in foreign exchange reserves. The portfolio of the central bank is conventional in terms of asset classes because it is only invested in highly credit rated fixed income instruments. Government debt makes up the majority of the portfolio, followed by government-related debt (e.g. supranationals and agencies). There are small allocations to corporate bonds and mortgage-backed securities.

About two thirds of the portfolio are managed passively and one third actively. What is very particular about the active portfolio, compared to other central banks, is that the portfolio managed by the internal desk represents only around 5% of the total portfolio. Seven external managers manage the remaining 25%. The investment process of Colombia's foreign reserves is dynamic, not only because of active management but also because the benchmark is adjusted periodically based on changing investment environment and conditions. There are two benchmarks, one for the short-term or liquidity tranche and another one for the medium-term or investment tranche. The investment horizon for the short-term tranche is 1 year whereas for the medium-term tranche is 3 years. The benchmarks are the result of optimization exercises that are updated monthly but that only result in changes in the portfolio—typically once a year—when the cost of rebalancing is lower than the cost of not having the optimal portfolio. The level of control and oversight of the portfolio is high, given the nature of the reserves and the importance of active internal management of the portfolio.

In addition to managing the foreign reserves, the Central Bank of Colombia was appointed by the National Congress to be the manager for the country's sovereign wealth funds in foreign currencies. As of end 2017, those funds were close to 4 billion US dollars.

20.2 Governance[1]

The Reserve Management Guidelines, produced as a joint effort between the staff of the International Monetary Fund and other institutions, explain the best practices in reserve management governance. According to the Guidelines, the "internal governance structure of the reserve management entity should be guided by and reflect the principles of clear allocation and separation of responsibilities. Sound management of internal operations and risks requires appropriately qualified and well-trained staff, following sound business practices".[2]

[1] See also Chap. 18.

[2] Revised Guidelines for Foreign Exchange Reserve Management, International Monetary Fund, 2014. https://www.imf.org/~/media/Websites/IMF/imported-full-text-pdf/external/np/mae/ferm/2014/_revgudferm14.ashx.

There are three key levels of governance in the management of foreign exchange reserves

- Strategic: the central bank defines the objectives for foreign reserve management and its restrictions. Decisions such as tolerance to market and credit risk are made at this level, although, in some cases, they also include asset allocation and investment guidelines. These decisions are usually made by the board of the central bank.
- Operational: Senior management of the central bank decides on the operational policies required for a proper implementation of the decisions made at the strategic level.
- Tactical: day-to-day decisions made by the front, middle, and back offices, in order to comply with the strategic and operational decisions made by the board and senior management.

All of these key levels of governance are interrelated and influence each other, as the operational and tactical levels are sources of ideas for the strategic level. For example, proposals to modify the investment guidelines that are decided at the strategic level often come from the lower-level front and middle offices.

In the specific case of the Central Bank of Colombia, the strategic decisions are made by the Foreign Reserves Committee which is attached to the Board of Directors. This Committee is responsible for establishing investment guidelines that define the criteria for the composition of the investment portfolio, the universe of eligible assets, authorized operations, and the acceptable level of exposure to different risks. The Foreign Reserves Committee also approves the strategic asset allocation (SAA), which includes the methodology and the resulting benchmarks.

The Operational Committee of the Foreign Reserves is another key part of the governance framework in Colombia. The objective of this committee is to oversee the operational performance of the reserve management function and aims to improve operational efficiency over time. Notably, this is the instance where all operational issues, such as guideline breaches and settlement failures, are reported. The Operational Committee does not make any investment decisions since its goal is to facilitate and oversee the implementation of the decisions made by the board. This committee is made up by the Assistant Governors who oversee the operational areas (front, middle, and back offices), and the board's general counsel.

As mentioned above, the tactical decisions are made at the front, middle, and back offices. The International Investment Department, which is part of the Division of Monetary and International Investments, is responsible for implementing and monitoring the investment policies established by the Foreign Reserves Committee. Within the International Investment Department, the Portfolio Management Unit (front office) is responsible for investing the portion of the foreign reserves portfolio that is managed internally, while the Risk Management Unit (middle office) is in charge of risk management, compliance, and performance attribution. It is worth noting that the investment process does not include tactical asset allocation because there is sufficient room for active management, whose results are measured against the benchmark approved by the Foreign Reserves Committee.

The functions of the back office for reserve management are performed by an independent department that is responsible for accounting, confirmation, conciliation, and settlement of the operations undertaken during the investment process, including the operational aspects related to custodians, counterparts, correspondent banks, and external managers.

This multi-layered governance structure with clear roles and accountabilities has served the Central Bank of Colombia well because the responsibilities of each person in the reserve management process are clearly defined and, when something unusual comes up, it is easy to identify how to manage it and who is responsible. As it will be explained letter, there are performance metrics for each functional area that attempt to measure the efficiency of the process and go beyond risk and return metrics. The benchmark is not static, and both the staff and the Board have the chance to monitor and make sure that it is achieving its short and long-term objectives. Additionally, during complex periods, such as the financial crisis and the European sovereign debt crisis, investment decisions were made rapidly.

No governance structure is appropriate for all institutions. For example, in certain institutions, the benchmark and the investment guidelines are defined not at the board level but at an investment committee level. This may happen because the board does not meet often or because its members do not have the required knowledge of financial markets and asset management. In other central banks, the functions of the Operational Committee are performed by individuals and not in a committee setting, which facilitates decision-making.

One general principle that should be applied to any good governance, however, is that the higher the level of involvement of the board in the strategic decisions of the asset management function the better. This principle is important since better oversight and informed decision-making are critical, particularly when making investment decisions during periods of financial market turmoil and stress. Although the board of any central bank tends to focus more on other critical functions, such as monetary policy, the reserve management function plays an important role in the balance sheet and the income statement of the central bank. As a result, the strategic decisions in this domain must be fully owned at the board level.

Another fundamental principle for good governance is that the role of every person who participates in the process must be clearly defined. Asset management is a function where multiple decisions must be made continuously and it can be inefficient to escalate most or all issues to the board or senior management, which is why it is reasonable for several institutions to have an investment committee that is in charge of more technical decisions, such as the investment guidelines. Documenting properly the responsibilities of each operational area and each person reduces uncertainty and speeds up the decision-making process. Nonetheless, the organization also needs to be flexible because the roles will change as time passes, either because there are more efficient ways of getting things done or because there are changes in the environment or the technology. A central bank needs a proper balance between a well-documented process and the willingness to change whenever needed.

20.3 Risk Management[3]

Risk management is one of the most important functions in any asset management operation. Using a sports analogy, any successful team should have a strong defense. Likewise, risk management is critical in order to reduce the probability of materialization of serious events. In the case of central bank assets, risk management is extremely relevant, considering that the board and the public are more mindful of losses than of gains.

Risk management should not only be thought of as the responsibilities of a functional unit but rather it should be embedded in the culture of the central bank. All of those involved in managing foreign reserves must see themselves as risk managers, not only of financial risk but also of legal, operational, and reputational risk.

Managing risk is different from minimizing risk since the latter is usually an obvious temptation within the general risk-averse culture of central banks. Managing risk should go hand in hand with enhancing risk-adjusted returns. In the case of Colombia, given the size of foreign reserves and sovereign wealth funds, any increase in returns is significant for both the central bank and the country as a whole. The risk management area should see itself as a facilitator of risk taking, such that every decision to increase returns has a proper analysis of risk. Avoiding risk is the easiest way to reduce the probability of unfavorable events but it could also prevent the organization from achieving its organizational objectives. Nonetheless, risk managers should have the opportunity to speak up when investment ideas are not consistent with the risk tolerance of the central bank or when investment proposals do not have a proper risk evaluation.

Strong risk management in a central bank requires the following conditions:

1. Awareness of the importance of risk management at the board and senior management level. The organization should be willing to develop and compensate risk managers adequately if it wants the risk management function to succeed. Additionally, the board and senior management should understand that they are the ultimate risk managers in the organization, as they are responsible for making the most strategic decisions on asset management. They also exercise control over portfolio managers and risk managers and should get involved in the most relevant aspects of the investment process.
2. Highly qualified risk managers who understand both the quantitative and qualitative aspects of risk analysis. A good risk management team not only develops and understands risk metrics but also plays an active role in the definition of long-term strategies such as the strategic asset allocation and the design of the investment guidelines.
3. Portfolio managers should also become risk managers. As risk takers, they are the first line of defense in the organization. When portfolio managers understand risk, they are able to position the portfolio in a sensible manner. Going back to

[3] See also Chap. 21.

the sports analogy, a successful team needs attackers that are willing to defend when the opponent has control of the ball and anticipate the consequences of making wrong decisions.

4. Proper coordination between all stakeholders. There needs to be both formal and informal communication channels between all the levels of the organization. It is important to have formal settings, such as board meetings, where senior management, risk management, and portfolio management can monitor risk metrics and discuss the need to adjust the investment policy.

In the Central Bank of Colombia, the middle office sits in the same organizational area as the front office in order to generate proper coordination between the two areas, particularly in the most relevant long-term initiative, such as changing the SAA methodology or including new asset classes. Additionally, the career opportunities and compensation are the same in the front and the middle office. In order to create independence to the risk management function, the middle office reports independently to the Foreign Reserves Committee on return and risk metrics and to the Operational Committee on investment guideline compliance and operational risk. This dual reporting line achieves a proper balance between coordination and reduction of potential conflicts of interest.

The Risk Management Unit is responsible for monitoring all the portfolios on a daily basis to ensure that the managers comply with the investment policies established by the Foreign Reserve Committee. Risk managers also analyze the investment strategies of each portfolio and of the portfolio as a whole. The Risk Management Unit has working groups to control the most relevant risks. This includes market, credit, liquidity, operational and legal risks. To control some of them, the Risk Management Unit works as a team with other units from the Bank, for example, the Operational Risk Unit and the Legal Department.

The middle office has developed a fixed number of reports each with its specific content that is presented at set intervals to the board and senior management. Nonetheless, as the investment function develops, so does the reporting function. More importantly, since the middle office is actively involved in the investment process, because of their frequent contact and meetings with internal and external portfolio managers, they are able to identify possible improvements to the investment guidelines in order to optimize the risk/return profile of the reserves portfolios. Such possible changes to the guidelines are reviewed by the risk management team, which determines their suitability before they are proposed to the board.

The way that the most important risks are analyzed are as follows[4]:

- *Market risk*: The teams follow several standard measures such as duration, portfolio risk, and tracking error. Market risk is estimated with a multifactor risk model. The analysis of market risk has been enhanced in recent years with the inclusion of scenario analysis and stress testing. There has also been a significant

[4] See also publication: Banco de la Republica, Central Bank of Colombia, March 2011: "Foreign Reseve Management": https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/frmr_2011.pdf.

effort to produce non-standard metrics in order to assess the efficiency of active management, for example, looking at different measures of correlations between external managers.

- *Credit risk*: This is the risk of loss of principal due to credit events such as: (1) deterioration in the credit quality of issuers or issues and/or (2) default. To control credit risk, central banks set exposure limits on each type of financial asset. To limit credit risk, the Central Bank of Colombia uses the credit ratings published by S&P, Moody's and Fitch Ratings as a reference. In order to avoid relying only on rating agencies, the risk management team also analyzes market and fundamental indicators of the issuers. Given that analyzing credit risk is a resource intensive process, it is necessary to find a balance between independence and information completeness, which is why the information from the credit ratings is combined with internal analysis.
- *Liquidity risk*: It is the risk that the central bank may not be able to convert a reserve asset into cash quickly and where the transaction costs are unknown. Central banks minimize liquidity risk by investing in financial assets that are easy to liquidate on the secondary market, such as securities issued by the governments of industrialized countries (e.g. US government bonds). This risk is managed dynamically, since the liquidity conditions in the market change over time. The risk management unit of the Central Bank of Colombia built a liquidity risk metric in order to monitor the liquidity of the portfolio over time, considering possible liquidity needs and the size of foreign reserves.

Like other central banks, the Central Bank of Colombia defines investment tranches, as a means to manage liquidity risk. Investments with shorter maturity and higher liquidity are used for foreign exchange market intervention, while instruments with longer maturity and higher expected return are part of the portion of reserves that is expected to be used only in exceptional circumstances. Colombia's Foreign Reserves are divided into a short-term (liquidity) tranche and a medium-term (investment) tranche.

- The short-term tranche has an investment horizon of 12 months. The short-term tranche is intended to cover short-term liquidity needs and its sized is determined by customized reserve adequacy measures. Although returns are important for this tranche, more attention is given to capital preservation and liquidity. The short-term tranche includes the working capital which is the portfolio intended to satisfy immediate liquidity needs—such as intervention in the foreign exchange market.
- The medium-term tranche has an investment horizon of 3 years. The medium-term tranche is intended to be used only in exceptional periods of high liquidity needs, which allows this tranche to focus more on return enhancement, while remaining conservative.

To keep a low liquidity risk for its portfolio, Banco de la República maintains most of its investments in tradable securities with a broad secondary market and

with issue sizes in excess of US$250 million. Besides, the maximum permitted exposure to an issue is 10% of the outstanding value.

- *Operational risk*: It is the risk of loss due to deficient internal processes, mistakes made by personnel, fraud, or system or equipment failures. One example of operational risk is the failure to prevent investments in ineligible assets or trades with unauthorized counterparties. Since any operational event in the asset management function can have serious consequences because of the size of the portfolios, it is critical to monitor operational risk continuously. To manage operational risk, the International Investment Department has documented all critical operational processes. It has a database listing the errors that have occurred in the past and the follow-up on each of them. In addition, it has a methodology to measure the perception of operational risk for each of the Department's critical processes. This methodology allows the organization to focus the resources on the processes where the probability of errors is higher.

Besides risk metrics, the risk management team also monitors strategy and portfolio performance. Although overall performance is very important, so is the attribution by portfolios and risk factors. Performance metrics are then reported to the Foreign Reserves Committee.

Among the different risks faced by a central bank, reputational risk deserves a separate discussion. Since reserve managers are responsible for managing one of the most important pools of financial assets in the country, maintaining high reputation among the external stakeholders (e.g. politicians and the general population) is critical for a central bank. This requires proper care and thorough analysis when making investment decisions. Given the importance of reputational risk, it is easy for central banks to become overly conservative to avoid negative headlines and, in some countries, personal consequences for the individuals responsible for making decisions. Although being conservative is consistent with the nature of foreign reserves, going too far in that direction may result in significant opportunity costs, which may be considerable in dollar terms given the relative size of foreign reserves compared to the country's gross domestic product. Managing reputational risk must be a priority at the strategic, operational, and tactical level of the organization, and it must entail a permanent education process, both internally and externally, in order to minimize opportunity costs in a prudent manner. In the case of Central Bank of Colombia, transparency is the most important mechanism to manage reputational risk. The Central Bank publishes information about the investment of foreign reserves, most notably, having a chapter on the topic in every formal report to Congress and producing a periodic publication that only covers reserve management.

Finally, as mentioned above, risk management is also part of the portfolio management function. The front office team uses the same models and outputs to monitor the risk of the portfolios as the risk functions. In the case of the passive portfolios, the tracking error is monitored constantly in order to make sure that the indexation process is performed correctly. For the portfolios that are managed actively, the team uses a risk budgeting approach that intends to allocate risk to the investment

ideas in an efficient manner. Each portfolio manager proposes investment ideas in terms of conviction but without making return forecasts or determining the size of positions. The head of the portfolio management team takes all the investment ideas and decides on the overall level of active risk that he wants to allocate to the portfolio. Then he runs an optimization process in order to allocate risk across investment ideas in the most efficient manner. By taking correlation between the different strategies into account, it is possible to allocate more risk to the ideas that improve portfolio diversification.

20.4 Reporting and Control[5,6]

Reporting and control are essential mechanisms in the investment process. Reporting allows decision makers to know if the investment strategy is working as expected. A proper control of the investment management process allows early identification of structures and processes that are not working as well as expected or that could be improved. Reporting and control should not be mechanical activities and should contribute to constantly challenge the status quo. Consequently, they are two critical functions in order to generate continuous improvement in the investment activity.

In the case of the Central Bank of Colombia, performance and risk metrics reports are presented to the Board, at least every 2 months. On the other hand, reports on compliance and operational risk are presented to the Operational Committee every month. Additionally, the Central Bank has a broad infrastructure to control investments, including staff members from other organizations and different areas within the Bank to ensure impartial and independent control.

According to the Colombian Constitution, control over the central bank is exercised by the President of Colombia. The Law authorizes the President to delegate that function to the Office of the Auditor General. The Auditor General, as a delegate of the President of Colombia, is responsible for "certifying the Bank's financial statements, complying with the other functions specified for this role in the Commercial Code, and exercising control over the institution's management and results," including the management of foreign reserves. The Auditor is in charge of ensuring that the accounting of reserve assets is consistent with the accounting principles established by the Colombian Financial Superintendency. The Auditor is also required to present quarterly evaluations of the different aspects of reserve management to the President of Colombia, the Financial Superintendency, and the Board of Directors.

[5] See also Chap. 19.

[6] See also publication: Banco de la Republica, Central Bank of Colombia, March 2011: "Foreign Reseve Management": https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/frmr_2011.pdf.

In addition, the power to inspect and monitor the central bank is exercised by the Financial Superintendent. The Office of the Comptroller General has jurisdiction to the extent that the central bank is involved in fiscal management.

The Central Bank of Colombia is also required to appoint an external auditing firm, which is responsible for the audit opinion report stating that the financial statements are in accordance with international auditing standards.

Finally, the central bank has a Department of Internal Control. This department is in charge of verifying independently the existence of procedures to invest foreign reserves and the compliance with those procedures.

In addition to the control bodies mentioned above, the Bank presents two annual reports to the Congress of the Republic of Colombia. This is done for the sake of transparency and pursuant to the provisions set forth in the Law. The reports include information on foreign reserve management policies, composition, and performance during the financial period immediately prior to their publication.

Information on foreign reserves also can be found in the Bank's financial statements, in the statements delivered monthly to the Financial Superintendency, and in the information sent quarterly to the General Accounting Office. At the beginning of each year, the Bank's financial statements for the previous fiscal year are published on the Central Banks' website. The notes to the financial statements contain detailed information on items, such as foreign reserves, with comments about the portfolios and risk management policies. Finally, information on the stock of foreign reserves is posted weekly on the Bank's website.

20.5 Process-Based Management: Putting It All Together[7]

Process-Based Management (PBM) is an approach that views a business as a collection of processes, managed to achieve a desired result.[8] The Central Bank of Colombia has implemented a process-based management framework. One of its key processes is the management of foreign exchange reserves. Since the reserve management process is performed by different organizational units, it is important to have in place proper role descriptions, coordination, communication, transparency,

Fig. 20.1 Reserve management process

[7] See also Chap. 18.

[8] See: Shim et al. (2014).

and accountability. PBM implies that all participants in the process understand their roles and are accountable for the results. Consequently, PBM is an excellent way to put together all the different concepts discussed in this chapter.

Figure 20.1 shows the graphical depiction of the macro process diagram for the management of foreign reserves in Colombia. This broad framework is similar in all central banks. A very interesting aspect of this process is that the reserve management process involves not only the front, back, and middle offices but also the Board of Directors, senior management, and the legal department. The fact that multiple organizational units participate in the process means that coordination failures might get in the way of achieving the objectives or solving complex problems.

The way that PMB works in practice is that each sub-process is documented as well as all the interconnections between them. Some of the most important interactions between processes are:

- Monitoring the portfolios adequately helps the board modify or refine the benchmark or the investment guidelines.
- Investing portfolios requires financial market analysis, which can also impact the way the portfolios are monitored because risk managers need to be mindful of market conditions.
- Portfolio managers should understand how portfolios are monitored and know the different risk metrics of the portfolio in order to make adjustments proactively.
- The back-office functions such as settlement and valuation are critical inputs for creating risk reports and checking guideline compliance.

Besides documenting processes, PBM requires the calculation of performance indicators in order to measure the compliance, the efficacy, and the efficiency of the macro process. Reserve managers are used to working with multiple financial indicators (for example, total portfolio return, tracking error, etc.), but they are seldom used to measuring the efficiency of the process (for example, the number of deviations from the investment guidelines or the maximum number of days that it takes to check compliance). In the example above, each sub-process has defined one or multiple indicators.

One of the most important elements of BPM is to appoint a process leader. At the Central Bank of Colombia, the process leader is the head of the International Investment Department. The role of the process leader is to make sure that all the process is properly documented and that the performance indicators are reviewed and acted upon. An unofficial but critical role of the process leader is to make sure that the whole process works as expected by senior management. That does not mean that the process leader can influence decision-making in independent areas, such as the back office, but rather he should facilitate proper interaction and coordination between the organizational units.

PBM requires a cultural change in the organization because every person needs to feel accountable for the results of the overall process and not only those in a particular functional area.

Finally, a very important part of PBM is continuous improvement. The performance indicators are reviewed quarterly by the participants in the process in order to come up with an improvement plan that is coordinated with all the units. Part of this continuous improvement process is that each unit develops its working plan for each year, which is then shared with other areas, in order to understand what everybody is working on, assign resources, and define priorities if needed.

20.6 Concluding Remarks

Foreign reserve management is a continuously evolving area. Furthermore, the financial market and investment environment is always complex and, more often than not, volatile. It is difficult to extrapolate the past to predict future states. As a reaction to these circumstances, gradual asset class diversification and a conservative asset management style are therefore often encountered in central banks and official institutions.

Faced with these formidable challenges, good governance, risk management, reporting, and control are essential elements of the reserve management process. In fact, a very sophisticated investment strategy can fail if the board does not understand it, if the risks are underestimated, or if the different stakeholders cannot assess whether the objectives are being met based on poor oversight and reporting.

Given its importance, central banks should consequently think about the proper governance and monitoring framework for the organization, taking into account their regulatory environment and culture. Moreover, they should be willing to adapt the framework when it is not working as expected or when conditions change. This continuous change process should be, in and of itself, an objective of the reserve management function.

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Chapter 21
Foreign Exchange Reserves – Protection Connected with Financial Risks

Ewa Szafarczyk

Abstract Foreign exchange reserves are indispensable for fulfilling the central banks' statutory mandates. For some central banks their investment is in addition a major source of profit. However, holding the foreign exchange reserves exposes central banks to financial risks. Some of these risks are unavoidable and can be challenging to manage. Such risks may increase when central banks decide to invest part of their foreign reserves on the markets beyond the traditional scope of assets that hitherto have been perceived as safe and highly liquid. The increasing awareness of financial risks explains the popularity of dividing the reserves assets into subportfolios, i.e. tranching and a risk budgeting concept. Such frameworks are not a panacea for avoiding potential financial losses but could support well-structured financial risk management processes and assure more stable risk profile. But this framework works only with efficient decision-making process, adequate risk measures, and proper IT support—these are the classic challenges that central banks' risk managers have to address.

21.1 Introduction

Over the recent two decades the global foreign reserve assets have increased from the equivalent of US$ 1,8 trillion in 1999 to US$ 11,8 trillion[1] at the end of 2019, accounting for around 14% of the global GDP. Since 2008 international reserves have almost doubled. But are the foreign exchange reserves just a blessed protection

The views expressed herein are those of the author and do not necessarily reflect the views of the Narodowy Bank Polski.

[1] Currency Composition of Official Foreign Exchange Reserves, www.imf.org.

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against potential turmoil in financial markets, real economy challenges, and disorderly foreign exchange developments? Do they generate any risks or pose particular challenges for the central bank? Below, we will address these questions in some detail. We will start with a question that many central banks seem to grapple with. Do we have an adequate level of foreign reserves?

21.2 Reserve Adequacy

The question on reserves adequacy is probably one of the most challenging ones for a central bank to answer. Under normal conditions most central banks maintain what may seem to be ample reserves, but in the case of an economic or financial market shock these resources may immediately prove to be less than planned for.[2] Even strong macro conditions together with substantial foreign reserves may not shield a country from a sudden FX depreciation led by foreign and domestic investors' sentiment and shift in risk aversion. The magnitude of reserves that a central bank is ready to devote to fulfill statutory objectives is also crucial. Moreover, foreign reserves accumulation is usually driven by factors beyond the direct control of a central bank. Few central banks actively manage the reserves accumulation process by purchasing foreign exchange under regular, orderly programs, issuing foreign currency denominated securities, or using swaps or repos. Most central banks assess reserve adequacy with standard indicators. However, to account for country-specific vulnerabilities, central banks often complement these indicators with some forms of optimization techniques and tailored scenario analysis in order to fine-tune the level of international reserves.

Under a free-floating FX regime, the major objective of the foreign exchange reserves held by the Polish central bank—Narodowy Bank Polski (NBP)—is to strengthen country's financial credibility, reduce FX rate volatility, and avoid the balance of payment risks related to the so-called sudden stop.[3] Reserves can also be used to support the stability of local financial markets in times of market dysfunction. The scale of reserves accumulation by NBP, driven by euro inflows from the

[2] Despite development stimulated by the financial crisis, swap lines between central banks, IMF facilities or multilateral arrangements do not fully substitute for the foreign reserves.

[3] Sudden stop is an episode of a dramatic reversal in international capital flows. It can arise from financial distress in the global economy or originate from domestic imbalances. Sudden stops are more likely when global growth falters, risk aversion in financial markets rise and vulnerabilities

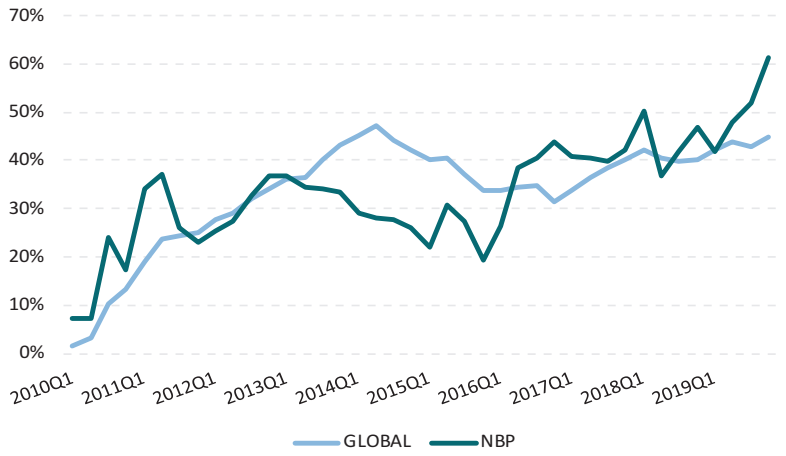


Fig. 21.1 Dynamics of official reserves asset accumulation (Source: IMF, NBP)

EU, has been broadly in line with global trends over the recent decade (Fig. 21.1). At the end of 2019 they reached the equivalent of US$ 128 billion.

Taking into account the role of foreign exchange reserves, an adequacy analysis run by NBP focuses on short-term financing needs. This analysis is based primarily on four components. Two of them account for the factors that can impact the sentiment and behavior of market participants. The third estimates short-term financing needs of the domestic financial sector taking into account the structure and dynamics of the Polish balance of payments. Finally, the fourth component relies on an optimization model that captures the central bank's cost of holding foreign currency reserves. Let us look at these components one at a time:

- The International Monetary Fund (IMF) has developed an "Assessing Reserve Adequacy" (ARA) metrics that relate the amount of international reserves to a weighted sum of short-term debt, other financial liabilities, broad money, and export. IMF recommends the adequacy ratio to be between 1.0 and 1.5. This numerical band was estimated based upon a cross-sectional regression analysis used to explain private sector consumption volatility and the probability of exchange market pressure events (IMF 2013) (see Fig. 21.2).
- Moody's Investors Service has introduced in their sovereign bond-rating methodology an external vulnerability indicator (EVI) that supports the assessment of a country's susceptibility to external vulnerability risk (Moody's 2013). This indicator measures a sovereign's capacity to use immediately available international reserves to make debt payments, even if there is a complete refusal of creditors to roll over debt that is due within a given year. Moody's compares the calculated level of this indicator to a predefined external risk scale;
- The NBP internal indicator is derived based on the comprehensive analysis of short-term public and private debt components, allowing the NBP to detect major

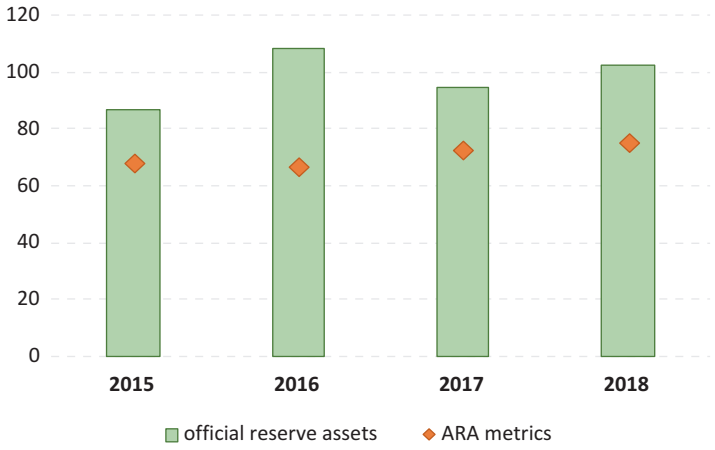


Fig. 21.2 Official reserve assets held by NBP versus level derived from ARA metrics (bln EUR) (Source: NBP)

risk factors that may lead to a disruption in refinancing or even to capital outflows. It accounts for the profile of debtors and the strength of their links with local entities – the probability of trade credit withdrawal, and aspects of liquidity that might be rendered to domestic entities from its non-local owners. Furthermore, it is assumed that a possible "flight to quality" can reduce non-residents' exposure not only towards short- as well as long-term debt but also towards the equity market. The desire to exit the local financial market might lead to significant portfolio outflows;

- The NBP also draws on an optimization model to derive the adequate level of foreign exchange reserves. It has been based on the Jeanne and Rancière (2011) model that seeks to estimate the magnitude of international reserves at which the marginal utility of foreign reserves in case of a sudden stop is equal to the marginal cost of reserves holding during normal times. The derived magnitude of foreign reserves is dependent upon short-term debt at remaining maturity, cost or reserves holding, probability of sudden stop, potential economic output gap, and currency depreciation in case of sudden stop. The model is calibrated for a base case as well as for stress test scenarios.

This four-component analysis is performed by the NBP both for official reserve assets as well as for its most liquid resources. The results are treated as an indication rather than a determinant for establishing the adequate level of foreign reserves. Complex determinants related to the balance of payments structure and its dynamics make it very challenging to define an adequate or an optimal level of foreign reserves. Model indications may be quite unstable and dependent on assumptions. Demand for foreign reserves can also be driven by external conditions, non-residents sentiment, fiscal and macro-prudential policy. All these factors are considered when deciding on how best to manage NBP's international reserves.

21.3 Risks of Reserves Holding

Although unconventional monetary policies, introduced by several central banks to mitigate the impact of the financial crisis, have reshaped the structure of their balance sheets, foreign exchange reserves still account for a significant position in most central banks' balance sheets. Foreign reserves are also one of the main drivers of the profit and loss account and a major source of financial risk to a central bank.

Foreign exchange reserves are primarily intended to support the central bank in the implementation of its statutory mandates. Such a role determines the foreign reserves management principles: safety of invested assets first and then their proper liquidity. But this role also generates financial risks for a central bank—to large extent unavoidable due to central bank's statutory responsibilities.

While central banks have some flexibility in managing the interest rate and credit risks of their reserves, there is less a possibility to reduce FX risk exposure—resulting from the very nature of foreign reserve assets. Hedging against the local currency could interfere with monetary policy goals, while hedging against selected foreign currencies as well as currency diversification has limited impact on overall FX risk exposure. And active management of the currency composition may be limited not only by the very objectives of holding foreign reserves but also by their magnitude.

Foreign exchange reserves accounted for around 98% of the NBP's balance sheet at the end of 2018, creating significant open FX position as generally over 80% of liabilities were in the local currency (PLN). Such open currency positions combined with significant FX volatility result in the dominance of FX risk on the NBP's financial risk map. Currency diversification—the major technique to manage central bank's exposure—has contributed to the reduction of FX risk taken by NBP by around 5%. Since 2007 NBP has gradually diversified the currency composition of its foreign reserves notably by taking positions in the Australian and New Zealand dollars and the Norwegian krone. Over the long-term horizon such a strategy contributed also to the return enhancement driven mainly by higher interest income on the invested assets.

When calculated relative to the market value of exposure, FX risk is outweighed by the gold risk.[4] But the gold risk is driven to a large extent by the PLN/USD volatility. In addition, the gold price correlation profile allows for a reduction of the overall market risk in the reserves portfolio.

Interest rate risk is limited by setting a modified duration at around two—a quite typical level for central banks foreign reserves investments. The active management of that interest rate risk exposure is supported by utilizing the standard bond futures contracts.

Sharpe ratio maximization highlights that further diversification benefits, i.e. volatility (market risk) reduction, could be achieved by investing part of the foreign reserves in equities. Such diversification effects seem to outweigh the significant price volatility of equities when calculated standalone. However, investing in equities introduces a high downside price risk and a less favorable credit risk profile than in the case of investment in traditional bonds which may challenge the foreign reserves management priorities.[5]

At the NBP, sovereign and credit risk exposure is controlled for by requiring a minimum security/counterparty credit rating of Baa/BBB. In addition, strict criteria are applied towards counterparties for uncollateralized money market operations. Also individual counterparties and issuer limits are imposed. Creditworthiness assessment incorporates analyses of financial data, ratings issued by major rating agencies,[6] market-implied indicators, and issuer/counterparty news. Credit limits primarily reflect counterparties' financial standing but also assure proper exposure diversification taking into account potential investment needs. When limits are utilized, the credit risk profile of particular transactions is also accounted for. Legal aspects in credit risk management are of highest importance—a lesson learned during the years of the Global Financial Crisis. The financial crisis also stimulated collateralization, development of comprehensive legal agreements covering overall relationship with a counterparty and facilitating close-out nettings of exposures. These developments are now becoming market standards.

Indeed, since the outbreak of the subprime crisis, the NBP's exposure towards uncollateralized deposits has been significantly reduced. This credit risk source has been replaced to some extent by allocation of international reserves in corporate bonds. This exposure is taken in the non-financial sector which supports credit risk diversification. Taking into account a possible further extension of the investment spectrum as well as the unique credit risk profile and related reputational risk, NBP constantly reviews and strengthen the creditworthiness assessment framework and credit risk measures. The central bank also develops IT tools that support advanced analyses as well as ongoing monitoring.[7] Principles of responsible investment are adressed by internal rules of negative-screening. In Figs. 21.3, 21.4, 21.5, and 21.6, we have highlighted major financial risks and their sources.

in the external and financial sectors increase. Shortage of financing may lead to economic crisis and deep contraction in output.

[4] Despite a decreasing role of gold in the global financial system, most central banks treat it as the strategic asset taking into account the physical properties of gold, its scarcity, and lack of credit risk or direct connections with economic policy of any country.

[5] See also Chap. 24.

[6] The US subprime crisis followed by regulatory changes stimulated trend towards reducing reliance on external ratings and promoted the development of internal assessment of counterparties' financial standing. Internal ratings assure much more transparency but to some extent duplicate external ones. Besides, most central banks cannot compete with rating agencies' access to information as well as dedicated resources.

[7] Generally, IT system should incorporate risk management standards but be tailored to the needs and objectives of a particular central bank. Development of internal IT tools assures that most objectives of risk management process are met but it is very demanding and requires dedicated team with adequate programming skills and risk management expertise. An alternative approach based on solutions provided by external vendors should ensure that the IT infrastructure is customized to meet the central bank's specific needs.

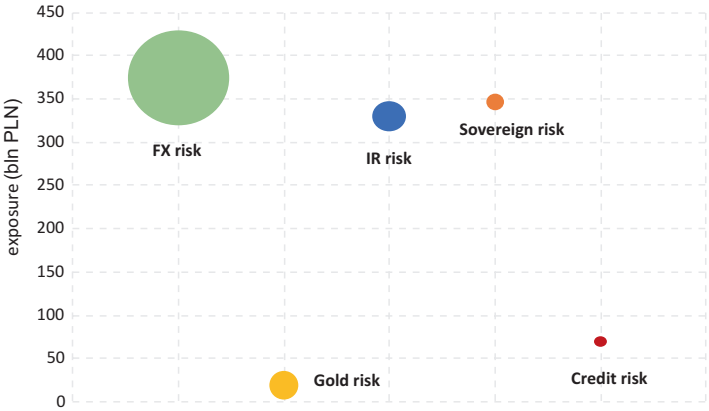


Fig. 21.3 Financial risk map at the end of 2018. The size of the bullets represents the risk estimate. Risks are estimated in PLN incorporating correlation between risk factors. Estimation is based on Value at Risk over one-year horizon with a 95% confidence level. Sovereign and credit risk is estimated with Credit Value at Risk simulation model (Source: NBP)

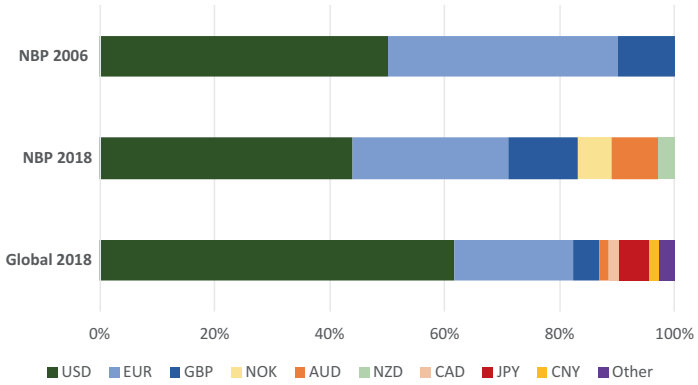
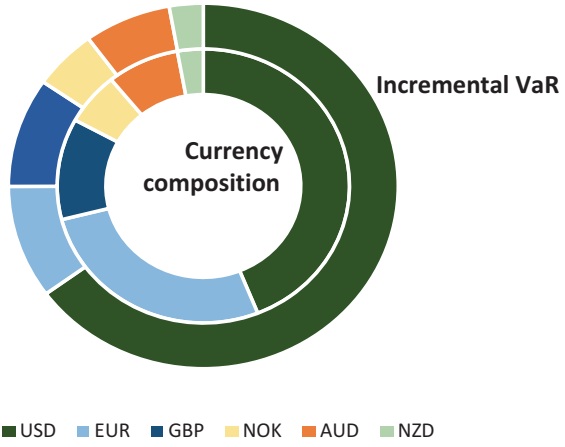


Fig. 21.4 Currency diversification (Source: NBP, COFER)

Fig. 21.5 FX risk decomposition (Source: NBP)



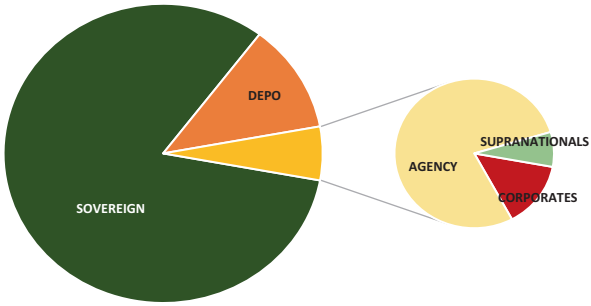


Fig. 21.6 Asset class structure (Source: NBP)

21.4 Risk Budgeting

Over the recent years several central banks have decided to invest in markets so far not considered suitable for foreign exchange reserves management as they were not meeting the traditional strict criteria of "safety" and "liquidity." Some new investments seem to go beyond the scope defined by the statutory central bank's responsibilities.[8] This trend is stimulated by foreign reserves accumulation outpacing potential financing requirements, a persistent low yield environment resulting in diminishing expected returns and high probability of losses, as well as by increasing fiscal needs. The increasing awareness of financial risks connected with such a tendency translates into the increasing popularity of tranching of reserves and the risk budgeting concept.[9]

No uniform definition of the risk budgeting approach can be referred to. It emerged with the "total return approach" that was adopted by private sector investment funds rather than central banks.[10] Recently, however, the risk budgeting

[8] Some central banks have decided to take advantage of the services offered by external asset managers. Outsourcing management of parts of their reserves, central banks hope to benefit from analytical and operational resources available for external asset managers, their market expertise and infrastructure, as well as the possibility to diversify portfolio management styles. However, contrary to expectations, the cooperation with external asset managers may result in a lower flexibility of portfolio management (adjustments of the investment guidelines), hinder control over the risk profile (especially for complex, non-transparent strategies). The administrative burden, need to assure coherence with internal accounting rules, reputational and confidence concerns should not be underestimated especially if the external management mandate is of limited scale.

The alternative way to invest in some complex, demanding assets is offered by futures contracts or exchange traded funds (ETF). However, in the case of the latter, investment transparency, legal issues as well as credit and liquidity risks should be considered.

[9] See also Chaps. 13.

[10] A total return strategy may offer a more flexible investment policy by relaxing the benchmarking framework. Although benchmark offers a very transparent investment framework together with objective performance evaluation, it may tempt passive management. However, these are not contrary approaches, but rather alternative ways to express investment objectives and constraints.

approach has been extended to support different investment styles/strategies—sometimes at the cost of a somewhat unclear role thereof in the risk management framework, its overlap with traditional limit systems or strategic benchmark determining expected risk/return profile. Sometimes, risk budgeting is tempting as a concept because it is seen as a panacea to avoid financial losses.

Nonetheless, risk budgeting may support the evolution of the financial risk management framework within the foreign exchange reserves investment process. First of all, it can provide a coherent limit system reducing the possibility of an unexpected risk concentration that sometimes may be enforced by nominal limits. Risk budgeting aims at risk redistribution rather than resource allocation. Central banks used to be perceived as stable, passive, long-term investors with an investment horizon over the business cycle, thereby avoiding behavioral biases and the tendency to lean towards "short-termism" in their investment decision-making. However, given the recent volatility in the financial markets, such an approach may result in not meeting ex ante risk and return objectives and lead to undesirable, ex post, investment outcomes and an unsatisfactory reserves portfolio performance. It should be considered that a constant currency and asset class composition also creates significant active positions and the SAA review typically linked to the accounting or reporting cycle may miss the timing of market developments. Under risk budgeting the search for stable risk characteristics could replace the desire to maintain a stable investment composition. An active investment approach within a defined risk budget accompanied with a tactical asset allocation[11] or, alternatively, a dynamic (adaptive) strategic asset allocation would allow a central bank more flexibility to adjust the reserve portfolio according to different market conditions. Such an approach may not only enhance returns but also support the capital preservation goal, reducing the downside risks.[12] Furthermore, it assumes that markets deviate from equilibrium due to behavioral finance, home biases, regulations, liquidity needs, and trends are more frequent than mean reverting.[13] These are tendencies that are worth exploiting—also in a reserves management context.

[11] Tactical asset allocation is usually decided upon by the Investment Committee (IC) within the investment framework determined by the Board of Governors. The IC should be staffed with experts with market intelligence and be given a mandate to make allocations away from the composition of strategic benchmark. The IC mandate could even be extended to encompass exposure to assets not included in strategic asset allocation. But in practice IC may be tempted not to take significant positions against the strategic benchmark during periods of increased market volatility when protection against downside risk is most desired. Dynamic SAA seeks to achieve similar goals with an absolute approach—asset allocation is determined over medium- to long-term horizon, varying over the business cycle, approved rather by the Board than the IC what by definition could result in lower flexibility.

[12] See also Chap. 17.

[13] Precondition and the major challenge for such an approach is the ability to anticipate market developments, define regimes, identify shifts in cycles at early stage with either qualitative (macroeconomic leading indicators, sovereign risk analysis, early warning signals) or quantitative signals (technical analysis, momentum, volatility patterns).

But the rational balance should be preserved. Reserves managers should not be tempted to behave like short-term investors, trading at noise, evaluating performance more frequently than justified by the investment horizon (myopic behavior), missing benefits of spread and term premium that can be realized only over longer period. Furthermore, it should be recognized that active management may contribute to procyclical behavior, thereby strengthening market turbulence. It also raises the concern whether central banks should act as any rational investor or focus on the primacy of financial stability in the global context not only the local one that is covered usually by statutory objectives.

The major steps in a risk budgeting process—each of them challenging and exposed to pitfalls—include the following:

- *Step 1. Determining/estimating the risk budget*. This first step is the cornerstone of the process, i.e. defining the role of the risk budget. Should the risk budget guide the strategic asset allocation or should it keep a tight hold on active management against predefined strategic benchmark? Does it focus on expected financial result framed by accounting rules or should it orientate itself towards return driven purely by market movements? Maybe it should be extended to capture more balance sheet positions—not only foreign exchange reserves but also financial assets related to monetary policy? These are some of the preliminary questions that this crucial first step seeks to answer.

  Then the "budget amount" reflecting the risk aversion must be determined. One of the basic principles of financial risk management is to reduce but not to eliminate risk. So the risk budget should ensure that the central bank's goals are achieved. A simplified but precautionary method could relate the risk budget to a central bank's capital. However, such an approach abstracts from the development of market conditions, central bank's tasks, and possible capital deterioration. Probably the most popular solution introduces the so-called neutral or policy portfolio reflecting asset allocation necessary to fulfill central bank's statutory tasks without any additional goals of portfolio yield enhancement (Fig. 21.7). Such a dynamic approach takes into account the changes of foreign reserves levels and the fluctuations of market variables. It also deals with the issue of unavoidable risks taken by a central bank. An extended approach towards risk budgeting could assume that income on policy portfolio should assure also the coverage of monetary policy costs and administrative expenses;

- *Step 2. Choice of risk measure*. Ideally, the selected risk measure should encompass the estimation of all financial risks-sources/categories into one single number. But challenges in determining correlation/cointegration or contagion between risk factors or choosing appropriate copula functions tempt to find its outlet in assumptions taken – for example, capturing interest rate and credit risk by volatility of spread curve or assuming independence of credit and market risk. Support for decision-making with respect to portfolio rebalancing in order to adjust the risk profile should be accounted for by the identification of the main risk factors, portfolio risk decomposition, estimating the impact of portfolio composition change on risk exposure (Fig. 21.8);
- *Step 3. Risk budget distribution*. Risk budgets that are redistributed towards the various investment portfolios, asset classes, or investment strategies can replace the traditional risk limit system. In theory it allows to distribute risk rather than capital (for example, risk parity concept) but in practice central banks only seldomly avoid risk concentration in their foreign exchange reserves;
- *Step 4. Risk budget monitoring*. An appropriate balance between the strategic character of the risk budget and its role as a real risk limitation should be taken into account. Additional risk budget buffers on top of the risk estimate or deviation band around such limits could facilitate this. But still, should investment

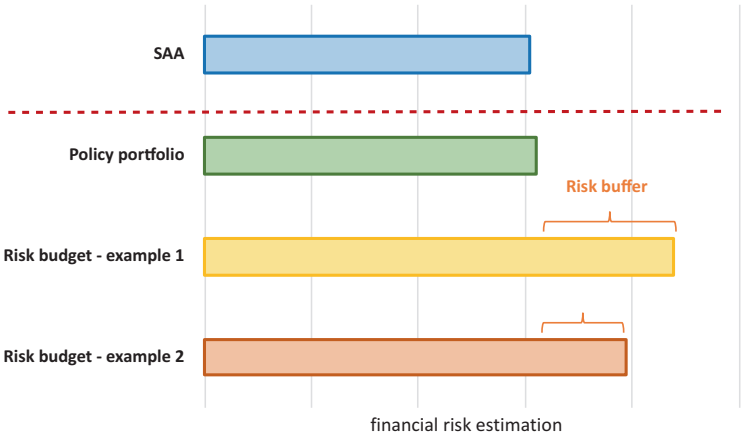


Fig. 21.7 Example of risk budget. This figure and Fig. 21.8 indicate examples based on NBP experience but do not illustrate any real policy portfolio or risk budget. SAA represents the overall financial risk estimation for a strategic benchmark. Policy portfolio stands for the portfolio that includes only gold and the most liquid and safe investment in USD and EUR. It can provide the base for risk budget estimation. Such a risk budget can be determined, for example, by assuming higher confidence level while estimating risk of policy portfolio (Risk budget—example 1) or estimating Expected Shortfall/Conditional VaR (Risk budget—example 2) (Source: author's calculations)

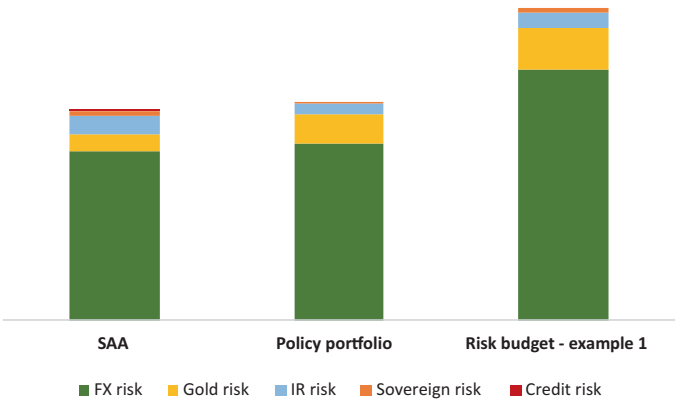


Fig. 21.8 Sources of risk budget. Figure 21.7 and this figure indicate examples based on NBP experience but do not illustrate any real policy portfolio or risk budget. This figure ilustrates sources of risk for strategic benchmark, policy portfolio and risk budget presented at Fig. 21.7 (Source: author's calculations)

portfolios be immediately adjusted in case when the estimated risk exceeds the delegated budget? Does the reasons for exceeding the budget matter?

The bulk of the foreign reserves held by the NBP has been managed actively under a three-step decision-making process: the strategic asset allocation reviewed by the Board of Governors at least annually, the tactical asset allocation determined by the Investment Committee, with the goal to adjust investment strategy to medium-term market developments and, finally, by the day to day active positions taken by portfolio managers. Of these three steps, the strategic asset allocation is, hierarchically, the most important from a reserves management perspective determining the desired risk/return profile.

The strategic asset allocation is supported by:

- Forecasting macroeconomic scenarios and associated financial markets movements. Once the SAA is determined, the major assumptions behind the base case scenario supporting it are reviewed quarterly in order not to miss the market conditions deviating towards the adverse/stress test scenario;
- Various optimization and simulation techniques conditioned on the NBP's objectives, as well as investment opportunities in eligible financial markets. The Bayesian approach allows to incorporate market forecasts into the expected return estimation under a Black–Litterman framework[14];
- Sovereign risk analysis based upon selected macroeconomic factors (specific for each economy, but also ensuring comparability). It allows the NBP to monitor dynamics of economic activity, fiscal conditions, international position, real estate and labor market conditions, and financial system soundness.
- Estimation of risks associated with the proposal of the strategic asset allocation as well as an impact on risk exposure of proposed or analyzed change of benchmark parameters (currency composition, modified duration, credit/spread risk profile). This is to some extend in line with the risk budgeting approach.

[14] The financial crisis has set off a wave of criticism with respect to utilizing quantitative approaches, as market developments questioned assumption related to time invariant correlations, normal distributions, etc., thereby undermining the dominant Markowitz paradigm. However, such quantitative methods offer structured, robust framework of strategic asset allocation analysis that may be enriched by incorporating qualitative elements taking into account central banks specific factors. Shortcomings may be overcome with regime switching models, non-normal distributed error terms, increased number of considered risk factors. Multi period approach with targets established over shorter horizon could provide an alternative solution. Historical returns could be replaced by forward-looking analysis of risk factors, incorporating alternative views. It is also important to consider model risks and limitations, understand assumptions and constraints imposed—too complex models or risk measures not tailored to the objective of analysis can result in ineffective solutions, difficult to interpret. And first of all, it is important to understand that the analytical tools are designed to support and not to determine strategic asset allocation.

21.5 Tranching of the Foreign Exchange Reserves

The desire to find the proper balance between statutory responsibilities of a central bank and the rationale for return enhancement (that may be contradictory) has supported the development of the concept of splitting foreign reserves into tranches. Tranching is justified primarily when different policy objectives, investment styles, liquidity requirements, and separate risk budgets are introduced for the various investment portfolios within foreign exchange reserves.[15] However, when the tranching approach is chosen, it is important to ensure consistency with the overall reserves management strategy allowing also for a flexible investment policy especially if the reserves are managed actively. Lack of a holistic perspective might introduce inefficiencies detrimental to the possibility of optimizing the whole portfolio.

Central banks usually distinguish between the so-called liquidity and an investment tranche of their foreign exchange reserves. These tranches are set up with separate investment objectives and horizons, management style, currency composition, eligible asset spectrum, etc. The liquidity tranche assures a smooth handling of daily cash flows needs. In some cases, central banks have also chosen to establish the so-called buffer tranche that is situated between the liquidity and the investment tranche. It is a portion of the reserves that can be utilized to meet extraordinary drawdowns in the liquidity tranche. The investment tranche consists of the foreign exchange reserves that are in excess of what is considered an adequate level. It is managed with the aim to enhance portfolio return over the long investment horizon within a specific risk budget (set up explicitly or defined by the strategic asset allocation and investment limits), allowing for the inclusion of less liquid asset classes.

NBP had tested the tranching approach but decided to reintroduce an integrated foreign exchange reserves management framework. In 2012, following a decision to further expand NBP's universe of investable assets for the reserves portfolio, a new investment tranche with a long-term investment horizon was introduced. It aimed at building exposure towards emerging markets local currency debt and US corporates in order to enhance yield over the long term horizon (Fig. 21.9).[16] However, as country-specific risks were perceived to increase, the decision was made to withdraw

[15] The future of the tranching concept could be driven by a slowdown in reserves accumulation due to a gradual reduction of global imbalances, reduced inflows into emerging economies, and an end to the commodity super-cycle. At the same time the liquidity needs are tamed with floating rate regimes that are becoming more common.

[16] Taking into account the objectives of foreign reserves management NBP has not opted for a segregated liquidity tranche. However, NBP maintains the so-called technical portfolio aimed at reducing potential impact of external flows on investment policy—resources have been maintained in such tranche only temporary and invested in short-term instruments.

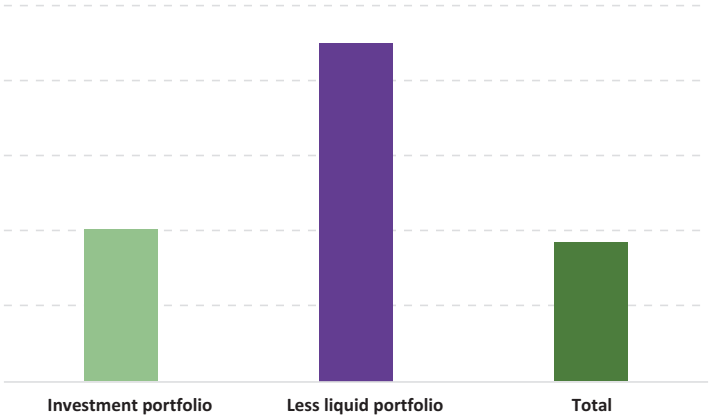


Fig. 21.9 FX risk estimation. Risk is estimated in local currency (PLN) with Value at Risk over one-year horizon with a 95% confidence level. Diversification effect allows to reduce overall FX risk despite higher volatility of EM currencies (Source: author's calculations)

from emerging markets, and in 2017 the NBP's holistic approach towards reserves management was reintroduced. It facilitates integrated investment strategy and risk management with more straightforward defined desired expected risk/return profile.

21.6 Profit and Loss Implications

The balance sheet structure and the specific market, credit, and liquidity risk exposures all find their way into a central bank's profit and loss statement. In order to reduce the potential impact of materializing financial risks in these accounts, central banks often use the leeway within the chosen accounting rules—usually by deciding to build up balance sheet provisions (general provision or separate ledger lines for foreign exchange, interest rate, and credit risk). However, it should be emphasized that the aim of such provisions is only to stabilize the profit and loss account over a long-term horizon, allowing for inter periodical transfer of financial surpluses. Such provisions do not impact the actual risk exposure in the portfolios of foreign reserves. Generally, the accounting approach deviates from the financial risk management perspective along several dimensions.

The provisions, accumulated at the cost of reduced profits, could then be used to cover unrealized costs stemming from adverse market movements or credit events over the subsequent years. In a sense such profit stabilization could sometimes act in a countercyclical manner. The financial profits are more probable in times of local currency depreciation that can be stimulated by

market conditions justifying higher payout to the state budget. Strong domestic macroeconomic fundamentals, on the other side, lead to an appreciation of the local currency against foreign currencies. The central bank's foreign reserves portfolio therefore suffers, at least temporarily, accounting losses. Furthermore, it is challenging to accumulate provisions that fully cover all FX risks in case of the significant open, unhedged foreign currency position as well as the reduced profit opportunities under the current low yield environment and the costs of monetary policy operations. The above-mentioned issues should be taken into account when defining the rules of provision accumulation (estimation method, distribution of financial surplus).

As a measure to reduce the impact of a possible PLN appreciation on the profit and loss statement of the central bank, the NBP builds up provision dedicated to cover unrealized FX losses. Its magnitude is determined taking FX risk exposure estimated with a Value at Risk method, as well as the additional buffer provided by estimated magnitude of revaluation positions, into account.[17] Furthermore, the probability of unrealized revaluation losses as well as a possible exhaustion of the provision is estimated based on simulations from empirical distribution of returns. The provision served well in its role to stabilize the NBP's profit and loss statement thereby securing a positive equity capital base (Fig. 21.10). As Polish law allows the NBP to cover losses from previous years only with reserve fund accumulated out of 5% of total annual profits, the building of provisions is important. As backward transfer of financial surplus is limited, the forward-looking provision is desirable.

Generally, interest rate risk can be managed more actively than FX risk, also with the use of derivatives such as bond futures contracts. Moreover, as central banks are basically long-term investors, they can benefit from accounting rules for the so-called held to maturity portfolios (HTM) that are not mark-to-market for accounting purposes in order to avoid unrealized revaluation losses. Such arrangement should be conditioned on:

- The central bank responsibilities—a need to assure proper liquidity of reserves, especially in case of financial market turmoil. It is important to point out that when a security from the HTM portfolio is sold, its realized profit/loss reflecting cumulated mark-to-market effect directly impacts the profit and loss statement;
- The expected market conditions—the slope of the yield curve and the expected path of yield developments. Total financial results over the whole investment horizon should be considered. Held to maturity portfolios are immune towards unrealized losses resulting from rising yields but may lock-in interest income at predefined levels. Rapid increase of yields in the initial phase of HTM strategy

[17] Since 2004 Narodowy Bank Polski has adopted Eurosystem accounting rules. They assume that unrealized revaluation costs impact profit and loss account while unrealized profits increase revaluation accounts at liabilities.

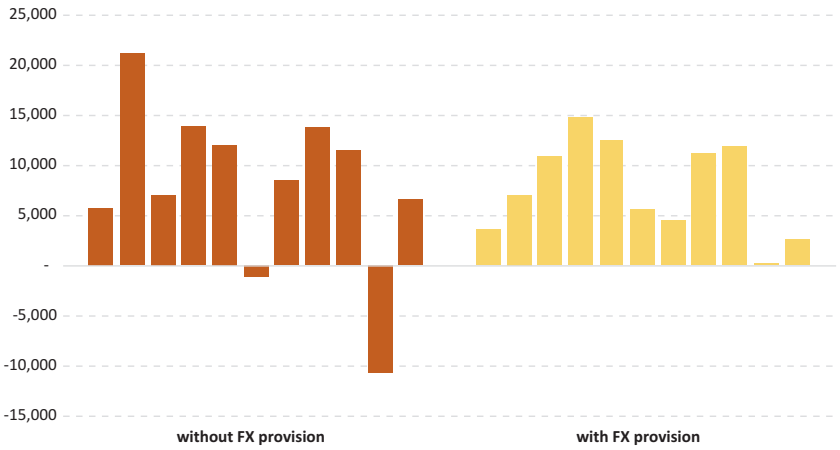


Fig. 21.10 Financial result on FX reserves management (Source: NBP)

can result in outperformance of actively managed short duration portfolio at the expense of lost income, i.e. a counterintuitive outcome. This can be overcome by gradual reinvestment of the maturing securities from the HTM portfolio at current yields, allowing the average yield of HTM portfolio to follow market developments;

- The impact on active management (currency composition, spectrum of asset classes) determining expected risk/return profile and realized profit/loss.

21.7 Conclusions

Foreign exchange reserves are indispensable for fulfilling the central banks' statutory mandates. Their investment is the major source of profit for many central banks. However, holding the foreign exchange reserves exposes central banks to financial risks that to some extent are unavoidable or challenging to manage.

The development of a risk management framework is an ongoing process in line with the changes to central bank responsibilities, instrument spectrum, operating environment, and market infrastructure. Recently it has faced an additional set of challenges by the introduction of new market regulations, comprehensive counterparty legal contracts, collateralization, central clearing hubs, etc. But the challenges also come from the high demand for adequate governance, control, and reporting driven by increased financial markets volatility and flood of information. This again requires, inter alia, development of IT infrastructure with integrated data warehouses, automated data import and reporting processes. Time will tell how these challenges will be addressed and impact future financial risk management standards at central banks.

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Chapter 22
Central Banks as Bankers to Each Other: Overview, Trends, and Future Directions in Global Official Sector Service Provision

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Abstract The choice of custodial and banking relationships is an underappreciated but important consideration for reserve managers in managing their overall risk profile. The major reserve currency central banks have long served as correspondent banks, transactional agents, and custodians for the safekeeping of foreign reserves for each other and the global central banking community. The ability of central banks to provide each other with safe, confidential, and reliable banking and custody services (BCS) has provided important public benefits, aiding in central banks' execution of foreign reserve management, monetary policy implementation, financial stability operations, and other mission-critical central bank activities. In the decade since the global financial crisis, and demonstrating the continued strong policy rationale for the inter-central bank provision of BCS, official BCS volumes have continued to grow, reflecting broader global reserve accumulation patterns, the impact of regulatory reforms, counterparty risk perceptions, correspondent bank de-risking, official cross-border financial stability initiatives, and other trends. More recently, the increasingly dangerous cyber threat to wholesale payments security has led central bank providers of BCS and their central bank clients to adapt in order to better protect foreign reserve assets from criminal actors.

The views expressed here are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System.

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22.1 Global Landscape of Inter-Central Bank Banking and Custody Services (BCS)

Modern central banks perform a number of critical functions in support of their public mandates, but generally less well-known among these are the functions that central banks perform for each other as correspondent banks, transactional agents, and custodians for the safekeeping of foreign assets. In fact, major central banks' provision of correspondent banking and custody services (BCS) to each other and to other central banks and official institutions ("official BCS") has been a cornerstone of global central bank cooperation dating in some cases to the early-twentieth century. The commitment to offering these services is grounded in the recognition among the major reserve currency central banks that they have a special responsibility to offer safe, confidential, and reliable BCS to global official sector institutions commensurate with their currency's international roles as widely used reserve and transactional currencies. These services support a number of core central bank responsibilities, domestic market function and development, and global financial stability. In particular, the official BCS provided by a group of official sector banking institutions[1] consisting primarily of the major reserve currency central banks provides the infrastructure, processes, account arrangements, relationships, and operational expertise that are important in the normal course of business and that have been successfully leveraged for policy purposes on numerous occasions during times of market disruption or other types of exigent situations.

The global official BCS landscape, however, has been continually evolving in important ways over the past decade, related to developments in FX reserve management practices, cross-border financial stability initiatives, monetary policy implementation, compliance programs, the de-risking of correspondent banking relationships, market functioning issues, and other developments. Moreover, the expanding universe of reserve currencies and needs of central banks to transact globally is resulting in a number of central banks expanding, or considering offering, BCS to other official institutions, including central banks in emerging market economies (EMEs). The rationale for these non-traditional official BCS providers is closely related with that of more established providers, though with some differences related to the size and involvement of foreign investors more generally in their local markets.

Major shifts in the risk environment for cross-border payment operations, in particular, as highlighted by well-publicized recent cyber fraud incidents, have impacted the conduct of business areas responsible for BCS provision. These incidents have highlighted the necessity of all actors in the global financial community to strengthen internal controls around cross-border payment processes and endpoint security. These new threats have prompted internal reviews of BCS operations and their associated risk controls across nearly all major official BCS providers. In confronting

[1] These official BCS providers include such institutions as the Federal Reserve Bank of New York and several others.

the challenges posed by the evolving external risk landscape, official BCS providers have found significant dividends from heightened cooperation and perspective-sharing on issues like "know your customer" (KYC) frameworks, SWIFT contingency procedures, real-time transaction monitoring, incident response, customer engagement strategies, re-articulation of business cases, and emerging technologies with potential implications for BCS.

22.1.1 Role in Early Modern Central Bank Cooperation

The provision of BCS among central banks has a long heritage. Early BCS consisted of the creation of nostro and gold custody accounts on behalf of other central banks in the early part of the twentieth century, with BCS agreements among the central banks of the USA, England, Germany, France, and Japan representing signal achievements in the early history of modern central bank-to-central bank cooperation.[2]

A catalyst for the establishment of many of the early inter-central bank BCS accounts was World War I.

In the case of the USA, the establishment of the Federal Reserve's first US dollar accounts for foreign central banks arose out of necessity after the USA entered World War I on April 6, 1917, with the signing of its first account agreement with the Bank of England on May 3, 1917. The leaders of the Federal Reserve foresaw a need to establish banking relationships with foreign central banks to facilitate wartime transactions. These included payments for war-related US exports, stabilization of exchange rates under the international gold standard, and financing of government debt. Following World War I, through newly established account relationships, the Federal Reserve provided stabilization loans to central banks in Europe in an effort to restore the pre-war international gold standard. In 1922, the Fed invested its first dollar balances on behalf of foreign official clients in US government securities, representing the beginning of the Fed's securities custody services. The Fed's agent and custodial services to foreign central bank clients provided a level of safety, confidentiality, and reliability that could not be matched by commercial banks. Today, while the scope of BCS has changed and broadened from these early days, the daily operational interaction between official BCS providers and their official sector clients around the world represents the most frequent and most tangible examples of central bank cooperation.

[2] The history of central bank cooperation goes back further to the mid-nineteenth century, with some European banks offering bill discounting services to each other, though this was relatively limited.

22.1.2 Profile of Current-Day Official BCS

Today's global official BCS landscape spans a range of major reserve currency central banks, representing both advanced and emerging market economies. Reflecting the safety, confidentiality, and reliability of holding with official BCS providers, securities and deposits held with official BCS providers have consistently been a large fraction of total global reserves. These natural service advantages, however, have made many official BCS providers sensitive to disintermediating commercial service provision, resulting in official BCS providers offering a relatively narrow range of services relative to the commercial sector.

22.1.2.1 Correlation with Reserve Currency Status

The number of official BCS providers has historically been relatively small as the case for offering these services traditionally has been strongly correlated with a currency's broad attractiveness as a global reserve asset, with the central banks of issue for the US dollar, euro, pound sterling, and yen among the long-established official BCS providers.[3] Of note, euro-denominated official BCS is offered by several national euro-system central banks, most prominently the Deutsche Bundesbank, Banque de France, and De Nederlandsche Bank, with the European Central Bank having responsibility for the overall framework.[4] Among other official BCS providers that issue reserve currencies, the Reserve Bank of Australia, Bank of Canada, People's Bank of China, and the Bank of Korea offer BCS and have experienced rising interest in their currencies among reserve managers. Consistent with the strong correlation of providing BCS with a currency's broad attractiveness as a reserve asset, official BCS providers generally maintain broad and global customer bases.

22.1.2.2 Size and Global Share of FX Reserve Holdings with Official BCS Providers

Major official BCS providers are estimated to have held in custody approximately $5 trillion in securities on behalf of global official institutions as of 2018. The Federal Reserve Bank of New York (New York Fed) accounted for approximately $3.4 trillion of this amount, or 75%, roughly mirroring the predominant role of the US dollar in global reserve holdings. Additionally, official BCS providers maintained approximately $1 trillion in deposit liabilities to global official institutions.

The footprint of securities in custody with official BCS providers as a percentage of total global official holdings of sovereign debt historically has been

[3] In addition, other official institutions such as the Bank for International Settlements have long provided official BCS to the global central bank community.

[4] See Eurosystem reserve management services: https://www.ecb.europa.eu/paym/erms/html/index.en.html.

approximately half of all global FX reserves, with a wide degree of individual variation across official BCS providers. For example, the New York Fed's custodial holdings footprint is approximately 75% of total foreign official holdings of US Treasuries, whereas other official BCS providers tend to have much smaller footprints. This suggests that central banks, with some notable exceptions, tend to use private service providers relatively more for the management of their non-dollar reserve assets. Official BCS providers hold a significant portion of all FX reserve deposits, with the balance held at commercial banks. The volume of deposits placed with official BCS providers has grown significantly in recent years (see Sect. 22.3 for discussion of post-global financial crisis trends).

22.1.2.3 Scope of Official BCS

While the precise range of official BCS differs across institutions, the "core suite" of official BCS can be said to consist of: (1) custody services for local sovereign fixed income securities; (2) funds transfer in local currency and through national payments systems; (3) overnight deposit services in local currency; (4) investment execution; and (5) FX purchase/sale services. These services are offered by all or nearly all major official BCS providers to global official sector institutions. Additionally, services offered by a subset of official BCS providers include term deposits, non-local currency deposits, gold custody, securities lending, and investment advisory services. A smaller subset offers banknote services, daylight credit, and overnight credit facilities for foreign official customers, reflecting the higher reputational, credit, and market risks associated with these service lines. Sensitivities around disintermediating commercial BCS providers and the benefits and costs of official BCS providers' provision of BCS have historically been a source of concern for some official BCS providers and generally resulted in official BCS providers limiting their services to a core suite of services.

22.1.2.4 Federal Reserve's Foreign and International Monetary Authority (FIMA) Services

The Federal Reserve's account infrastructure for foreign official institutions performs a utility-like function for foreign official institutions wishing to access US fixed income markets and correspondent banking services in order to execute core central banking and official functions. Through the Central Bank and International Account Services (CBIAS) area of the New York Fed, the Federal Reserve today offers banking and custody services in dollars to approximately 200 foreign central banks and monetary authorities, international financial institutions, national governments, and other foreign official account holders. The suite of services offered to these account holders is a bundled package of basic and interdependent dollar-based services in three general areas: fixed income securities transfer, custody and safekeeping services; payment services; and cash management and investment services.

Every day, New York Fed staff process on average approximately $600 billion in settlement volumes on behalf of foreign official account holders, with approximately $3.7 trillion of dollar securities and cash deposits held by foreign official account holders at the New York Fed, representing about half of the world's official US dollar reserves and one-third of the world's total official FX reserves.

The narrow scope of services partly reflects the fact that most customers actively manage their own portfolios, making their own investment decisions and using CBIAS to clear and settle the trades conducted directly with market counterparties. For some smaller or less sophisticated customers, a small volume of US Treasury buy and sell transactions are processed on a standing instructions basis. By and large, however, CBIAS is an "instruction-driven" business: customers provide instructions to pay and receive funds and securities.

22.2 Rationale for Continued Inter-Central Bank BCS

While central banks have a variety of commercial options for their FX reserve investment and payment needs, the rationale for using official BCS providers for a significant portion of their FX reserve management and official payments needs remains compelling. The major central banks provide BCS to facilitate international transactions in and official reserve holdings of their currency. If a given currency is important internationally, the major central banks of issue regard themselves as having a special responsibility to offer BCS commensurate with this role, including a broad range of cash, investment, and safekeeping services for reserve assets.[5] This is because safety, confidentiality, and reliability considerations have traditionally been strong motivations for the reciprocal provision of BCS among central banks, befitting central banks' characters as highly risk-averse stewards of national wealth, their imperative of maintaining unblemished credibility, and their role as guardians of domestic and global financial stability. From the standpoint of official BCS providers, the provision of BCS imparts benefits in terms of support for domestic market function and, in some cases, domestic debt market development.

22.2.1 Safety, Confidentiality, and Reliability Considerations for Core Central Bank Responsibilities

Safety, confidentiality, and reliability have been strong motivations for the reciprocal provision of banking and custody services among the world's central banks. In particular, central banks around the world have a mutual need for correspondent

[5] These motivations for central banks' demanding and supplying BCS to each other are confirmed by surveys of central bank BCS and reserve management departments. These surveys show that the reasons for official reserve managers to demand BCS from other central banks and for central banks to offer BCS are strongly correlated.

banking and custody services to execute on core central banking functions[6] in which the safety, confidentiality, and reliability of service provision are essential. This befits central banks' character and role as highly risk-averse stewards of national wealth, as well as central banks' imperative to maintain untarnished credibility for the formulation and implementation of monetary policy and domestic payment services. And this also befits central banks' responsibility to safeguard financial stability. This imperative results in central banks often preferring, and sometimes requiring, foreign reserve managers to use the account services of fellow central banks. This is especially true for liquidity tranches of reserve portfolios where safety and accessibility are critical for the execution of core central banking functions, including FX reserve management, intervention, time-sensitive official payments, macro-prudential policy, lender of last resort responsibilities, and other operations in foreign assets and currencies.

As stewards of national wealth in their role as managers of foreign official reserves, central banks seek to minimize custodial risk in the safekeeping of their foreign reserves. By using a central bank custodian, the risk of loss stemming from insolvency is removed. Central banks also do not pose significant counterparty risk relative to commercial service providers: when acting as a principal in a transaction with a client (e.g., in a repo trade), the risk of a central bank defaulting on its contractual obligations is virtually nil. In addition, reserve managers' use of central bank BCS avoids the front running risks they would potentially face in using commercial bank services where traders may seek to exploit knowledge of a central bank's positions and strategy for private gain. Relatedly, the confidentiality of holdings and activities at a central bank BCS provider supports the execution of sensitive operations that may require the utmost discretion (e.g., agent trades, FX interventions, etc.). Finally, central banks' use of other central bank BCS allows them to settle in central bank money, with attendant benefits from the standpoint of smooth settlement and service continuity.

22.2.2 Domestic Market Function and Development

The provision of BCS by the world's major reserve currency central banks can provide important support to domestic financial market stability, including through the maintenance of clearing and settlement balances, collection of unique market intelligence, and support for debt market functioning and deepening. For some official BCS providers, market development may be a strong motivation for their expansion of BCS.

[6] For example, FX reserve management, intervention, time-sensitive official payments, implementation of macro-prudential policy, lender of last resort backstopping, fiscal agency services.

22.2.2.1 Clearing and Settlement Balances, Market Practices

Through their provision of custody services, official BCS providers can reinforce the need for their official customers to confirm their transactions well in advance of the applicable cut-off times. This supports the timely delivery of securities with counterparties, promotes efficient market clearing, and minimizes the risk of late settlement and associated settlement fails.

22.2.2.2 Role of Market Intelligence

Through the provision of BCS, official BCS providers can also glean important intelligence and insights on market funding conditions, liquidity, portfolio management trends, and sentiment. This may be especially important during times of market stress. This intelligence supports the diagnosis of market functioning issues and thus facilitates more effective policymaking. This analysis can also be useful for monitoring broader financial stability developments.

22.2.2.3 Debt Market Functioning, Deepening and Development

Official BCS providers can also support the efficient functioning of domestic debt markets. They can encourage customers to lend out their securities and to adopt more active management strategies to the extent possible. Direct (bilateral, relying on a service offering of the official BCS provider) or indirect (via a third party agent) securities-lending services could potentially be attractive for many official customers that are not in a position to actively manage smaller portfolios themselves. This development may be especially relevant in an environment of reduced liquidity stemming from a declined supply of, and increased demand, for high-quality liquid assets ensuing from regulatory reform and quantitative easing policies by major central banks.

These potential benefits may face some restrictions. Some official customers may have mandates that restrict their operations (e.g., cannot legally engage in securities lending or repo transactions). Customers may also be committed to a buy and hold strategy, which prevents them from active trading. Finally, official BCS providers may face internal resource constraints. Implementing new or more sophisticated services can be a lengthy process that requires substantial resources and investment, especially as it entails assessing and addressing the potential exposure to different or greater financial or operational risks. The extra resources needed for heightened monitoring and intelligence gathering may also be prohibitive.

There is a perception among several official BCS providers, too, that commercial providers recognize the role that official BCS providers play in promoting liquidity in local securities markets by facilitating the participation of long-term foreign

investors. This may be most relevant in the case of EMEs where foreign investors, including foreign central banks, having the intention to participate in the domestic debt markets may be unfamiliar with local laws, regulations, and market practices and prefer official BCS to mitigate the potential risks. At the same time, the actions of central banks to support market liquidity during periods of the global financial crisis may have reinforced this view among participants in mature markets.

22.2.3 Global Financial Stability

The official BCS provided by the major reserve currency central banks to global official institutions provide the infrastructure for global financial stability operations through pre-established channels for liquidity assistance. The maintenance of BCS account platforms and personnel also support operational readiness more generally due to the experience and expertise that arise from the daily interactions between central bank operational staffs. In exigent circumstances, having the infrastructure and human resources pre-positioned and poised to respond can make a large difference in the effectiveness of crisis response measures.

22.2.3.1 Pre-Established Channels for Liquidity Assistance

For the world's major central banks, the maintenance of operational links through reciprocal account relationships is integral to their ability to engage in global financial stability operations. By having accounts, settlement instructions, tested and secure lines of communication, and business processes already in place at the time of or leading up to a crisis enhances major central banks' ability to respond to crises efficiently and flexibly. These account relationships have been used to support the stability of the global financial system, perhaps best exemplified historically by the Bretton Woods network of central bank swap lines.[7] More recently, in nearly every major international incident over the past twenty years that has prompted a coordinated response by the world's major central banks—be it coordinated FX interventions by the major central banks in the wake of the 2011 Fukushima disaster, swap lines in the wake of 9/11, or the swap lines instituted during the Great Financial Crisis—the reciprocal accounts among major central banks formed the backbone for the actual or potential execution of stabilization policies. Without these accounts, coordinated central bank action in pursuit of financial stability objectives would be either severely handicapped or entail unacceptably high risks in terms of the safety,

[7] The Federal Reserve's Bretton Woods-era swap lines with foreign central banks were first established in 1962 and used extensively until the collapse of the Bretton Woods system in 1973.

confidentiality, and reliability of these operations.[8] This partly reflects a practical reality that in exigent situations characterized by fast-moving events, incomplete information, and intense pressure, even the best of policies can fall short unless a level of trust, experience, and internal muscle memory exists for operations to be executed effectively. This level of operational readiness is developed and conditioned by having accounts, settlement instructions, tested and secure lines of communication, and business processes already in place at the time of or leading up to a crisis.

22.2.3.2 Staff Operational Readiness and Experience

Longstanding and daily interactions between central bank staffs in the course of managing each other's cash and custody accounts generate valuable in-house expertise in cross-border central banking operations. This network of inter-personal and institutional relationships in the global central banking community, at an operational level, may otherwise not exist. This knowledge and network of relationships may be leveraged by central banks to better understand the policy context behind global central bank actions, as well as of operating environments and constraints faced by central bank colleagues around the world. These operational insights and experiences with the policies, operating environments, and operating constraints of other central banks provide central banks with enhanced capabilities to formulate and execute policies in support of global financial stability objectives.

22.2.3.3 Unique Role of Federal Reserve FIMA Services in Support of Global Financial Stability

Concentration of Dollar Reserves and Centralized Account Platform

Reflecting the breadth of its customer base and dollar holdings, the Federal Reserve's account platform is a centralized banking infrastructure through which financial transactions in the dollar between virtually any official entity in the world can occur under a single roof using the same clearing and settlement staff. This provides an

[8] The mechanics of currency swap operations among central banks is a case in point. During the Great Financial Crisis, the Federal Reserve's dollar swap proceeds were originated in central bank accounts with the Federal Reserve and distributed to overseas private institutions according to the results of dollar auctions conducted by the central bank swap counterparty. By originating funds out of Fed accounts, rather than accounts at private agents, the risk of market participants being able to identify the distressed recipient institution is significantly reduced. Moreover, the overall size and ramping up of potential liquidity operations can be virtually unlimited. Use of a private agents for originating swap payments would likely present a number of other complications, including potential agent conflicts of interest (e.g., if the agent was also a recipient of swap proceeds) and perceptions that the agent is "too-big-to-fail" as a result of playing a critical utility-like function on behalf of the central bank.

important public benefit in terms of control of transactions, efficiency of execution, and confidentiality in two specific ways. First, this centralized and safe account platform for nearly all of the world's official institutions has played a critical role in the resolution of international debt crises throughout history such as the Latin American debt crises of the 1980s. Second, the centralized platform sustains a high level of operational readiness for cross-border dollar operations in support of global financial stability.[9] By allowing direct payments among account holders on a shared platform, or between the Federal Reserve and account holders, the speed and efficiency of often time-critical official payments is greatly shortened and simplified. Combined with the Federal Reserve's ownership and operation of Fedwire® Funds Service and Fedwire® Securities Service, this supports the Federal Reserve's crisis response capabilities in a highly dollar-based international financial system.

22.3 Post-Global Financial Crisis Trends in Global Official Sector Service Provision

In the decade since the Global Financial Crisis (GFC) of 2007/08, official BCS volumes have continued to grow, reflecting broader global reserve accumulation patterns, the impact of regulatory reforms, counterparty risk perceptions, correspondent bank de-risking, official cross-border financial stability initiatives, and other trends. This continued, and indeed growing, reliance on official BCS channels for the investment and payment needs of the world's central banks underscores the ongoing importance of these services despite the existence in many cases of commercial sector alternatives.

22.3.1 Custody and Official Deposit Trends

22.3.1.1 Aggregate Official BCS Holdings

Since the GFC, the trend of total FX reserves held with official BCS providers (securities in custody and deposits) has been in step with global FX reserve levels, with periods of global reserve accumulation resulting in greater reserves placed

[9] Additionally, the consolidation of back office systems for both FIMA services and the Federal Reserve's own System Open Market Account (SOMA) portfolio results in economies of scale and efficiency gains. The same personnel that perform back office operations for the Federal Reserve's own SOMA portfolio also perform back office operations for transactions for foreign official account holders. Cross-training of staff using the same systems for both FIMA and SOMA activities contributes to the accumulation of operational expertise and knowledge that allows staff resources to be flexibly mobilized across both domains according to sometimes rapidly changing needs. This benefits the execution of operations and mitigates operational risks, especially in exigent situations.

with official BCS providers, and vice versa. Holdings by the major official BCS providers have grown by approximately two-thirds over 2008–2018, with these holdings representing approximately half of global FX reserves at the end-2018, in line with the average holdings footprint over 2008–2018.

Since the GFC, there has also been a notable shift in the composition of official BCS holdings away from securities in custody and toward deposits. While most official BCS holdings consist of securities in custody on behalf of global official sector clients, official deposits have grown more rapidly since 2014, with deposits placed with official BCS providers nearly doubling over 2014–2018. This has partly reflected reserve managers' stronger desire for safety and liquidity of their reserve assets, potentially related to higher expected FX intervention or other hard currency backstopping obligations.

Federal Reserve's Foreign Repo Pool

Relatedly, the use of the Federal Reserve's overnight cash investment facility has grown sharply since the GFC. The Federal Reserve's foreign repo pool is an overnight investment facility that has been available to foreign and international monetary authorities (FIMA) that maintain accounts at the New York Fed since the mid-1970s.[10] The foreign repo pool provides central banks a ready source of US dollar liquidity, where the safety and accessibility of reserve currency funds is of paramount importance. Most of the approximately 200 FIMA account holders make use of the foreign repo pool, and aggregate investments in the facility have ranged between $225 billion and $265 billion over 2016–2018. Compared with pre-GFC balances averaging $20–$40 billion, the importance of the foreign repo pool service has grown for users in the post-GFC period as many FX reserve managers have simultaneously sought to increase the size of USD liquidity buffers for financial stability purposes and reduce their risk tolerance for commercial counterparty risk. Growing use of the foreign repo pool has been made possible by the post-GFC change in the US monetary framework and lifting of limits on the pool balances (see Sect. 22.3.2).

22.3.1.2 Official BCS Holdings Share

While the average official BCS holdings footprint has been historically relatively stable at approximately half of global FX reserves, it has tended to oscillate around this average due to cyclical factors. For example, during periods of strong reserve accumulation over recent decades reserve managers have sought to increase returns by diversifying their holdings into non-traditional assets and currencies. This has

[10] In this operation, at the end of each business day, account holders' cash balances are invested in an overnight reverse repo secured by the Federal Reserve's securities holdings.

tended to lead to reductions in the official BCS holdings footprint as these institutions generally offer a relatively narrow set of BCS (e.g., sovereign fixed income and no custody services for equities). During other periods when central bank reserve managers have prioritized the safety and liquidity of their holdings, the tendency has been for the official BCS holdings footprint to rise.

22.3.2 Changes in Monetary Policy Operating Frameworks

Significant changes in advanced economy monetary policy operating frameworks since the GFC have also had an impact on the management of official BCS by reserve currency central banks. The traditional approach for implementing monetary policy and managing domestic liquidity requires central banks to forecast the demand and supply of cash balances they hold as a liability. Foreign official deposits held at the local central bank are an autonomous factor outside the control of the central bank, generally representing drains on bank reserves unless actions are taken by the central bank to make the deposits "reserve neutral." Given that freely available reserves were generally quite small prior to the GFC, and that unpredictable changes in the autonomous factors could have a material impact on short-term interest rates even if they were relatively modest, official BCS providers traditionally have sought to closely manage the size and volatility of foreign official deposits, while mindful of the importance of its role as a service to other central banks.[11]

In the USA, in the pre-crisis operating framework, to ease the Federal Reserve's job in the daily forecasting of autonomous factors, tight limits were imposed on customers' ability to rapidly vary the size of their investment in the foreign repo pool. Since the crisis, the New York Fed has continued to provide the pool as a service and use of the pool has grown as the constraints imposed on customers' ability to vary the size of their investments have been removed, the supply of balance sheet offered by the private sector to foreign central banks appears to have declined, and some central banks desire to maintain robust dollar liquidity buffers.

[11] The size and volatility of foreign official deposits has been managed historically using a variety of methods. Some official BCS providers have applied caps on aggregate cash balances though many have preferred to manage cash balances at the customer level. The most common method of managing cash balances has been through the application of differential rates of remuneration through some tiering scheme. Some central banks have also used notification requirements and targets, and automatic sweeps of end-of-day balances to client accounts at commercial banks. In addition to these methods of managing the size of cash balances, many official BCS providers offset the draining impact of these balances by either conducting back-to-bank transactions with private market counterparties or using the projected size of these balances as an input into overall forecasting for open market operations.

22.3.3 Impact of Commercial Bank Regulatory Reforms

Another post-GFC trend that has impacted demand for official sector service provision has been the implementation of Basel III regulatory reforms that have sought, among other things, to reduce large commercial banks' reliance on potentially volatile short-term wholesale sources of funding and strengthen their liquidity buffers. In particular, with non-operational deposits incurring higher capital costs due to their required matching with high-quality (and relatively low yielding) liquid assets, commercial banks have sought to shed these deposits including those placed by central bank customers. This has contributed to a shift of FX reserve deposits toward official sector service providers, especially around regulatory reporting days.

22.3.4 Impact of Reserve Management Risk Governance Trends

Central banks' FX reserve management post-GFC has also been characterized by stronger controls on exposures in positions vis-à-vis risk assets and counterparties which has tended to increase dependencies on official sector service provision. At least in the initial post-GFC years, this represented a "back to basics" approach to reserve management focusing on fully guaranteed sovereign fixed income assets and limits on counterparty exposures including in some cases withdrawals of deposits from commercial banks. Both of these factors could be said to at least place limits on the shift away from official holdings even as a low or negative interest rate environment would seem to provide a countervailing motive for a diversification of reserves and holdings with commercial providers.

22.3.5 Impact of Correspondent Bank De-Risking

The trend of correspondent bank de-risking, driven partly by heightened costs of compliance with anti-money laundering (AML)/sanctions/countering the financing of terrorism (CFT) regulations and intensified due diligence activities, has resulted in banks in some higher risk jurisdictions, including some central banks, being debanked by commercial correspondent banks. In some cases this has resulted in additional complexities in official BCS relationships, with some official BCS providers facing increased pressures to support activities that may be outside the traditional boundaries of official account usage. Generally speaking, however, official BCS providers are not positioned to address or compensate for the broader challenges resulting from the de-risking trend.

22.3.6 Official BCS Risk Management Trends

Official BCS providers face a variety of risks (e.g., legal, reputational, operational, market, and credit risks) in their provision of BCS to the global official sector. Over the past decade, official BCS providers have made efforts to strengthen their risk management around official BCS activities. This has been in response to new and changing risks as well as greater scrutiny of these business lines against a backdrop of greater transparency in central bank operations and balance sheets in general. Moreover, large commercial bank fines for violations of AML/CFT/sanctions laws and cyber fraud incidents involving banks have highlighted the risks faced by all banks, including central banks, engaged in correspondent banking and other types of financial service provision.

22.3.6.1 Compliance Risk

Official BCS providers have been grappling with an increase in compliance obligations over the past decade with regard to complex AML/CFT/sanctions regulations and "know your customer" (KYC) due diligence. In recognition of these challenges and risks, most major official BCS providers have developed formal compliance programs with policies, procedural manuals, and dedicated compliance staff within the BCS business areas in addition to bank-wide compliance programs and staff.[12] These business area compliance staff comprise the "first line of defense" against compliance risks, with official BCS business areas also typically interacting on a regular basis with separate risk management, compliance, internal audit, and legal departments. In cases where suspicious transactions are detected and rejected, some official BCS providers escalate the cases to outside financial intelligence units, law enforcement, or prudential regulators. Enhanced KYC has been accomplished through a range of activities including increased in-person engagement and account reviews with customers, along with regularly updated account profiles based upon observed account activity.

22.3.6.2 Operational Risk

The provision of correspondent banking and securities custody services can involve the interaction of people with a complex set of processes and systems, failure of which can lead to significant financial and reputational losses for the central bank service provider in addition to potential disruptions to policy operations of client central banks. Official BCS providers have continued to make efforts over the past decade to mitigate the operational risks from these complex transactional

[12] Though not all central banks are subject to national anti-money laundering laws, many are subject to sanction laws and seek to comply with AML regulations and best practices.

operations, both by improving the efficiency and performance of routine daily operations, as well as strengthening operational resilience through robust business continuity and contingency planning in the face of new and growing threats to business operations.

Straight-Through Processing (STP)

Employing automation in back office clearing and settlement operations can lead to important reductions in risk. A number of official BCS providers, especially those with higher transactional volumes, have made efforts to increase the ratio of security transactions that are processed without any manual intervention (e.g., by adopting systems to automatically translate message formatting). Not only does increased STP help to reduce operational problems by reducing human intervention, it also permits business areas to be more scalable and to respond to surges of activity without surging personnel costs or dislocations.

Contingency and Operational Resilience

Official BCS business areas have devoted significant efforts to strengthening their operational resilience against a variety of threats to business continuity, most vividly demonstrated by high-profile incidents over the past two decades such as the 9/11 terrorist attacks, Hurricane Sandy, and cyber-attacks on both commercial and official institutions. Indeed, internal system disruptions, telecom network outages, office unavailability, terrorism, and cyber-attacks are just some of the types of threats that have animated efforts by central bank service providers to strengthen their business continuity planning (BCP). To mitigate against these threats, many official BCS providers have enacted some combination of the following measures: establishing split sites of varying warmth (e.g., active-active, active-passive/warm sites, cold sites/backups), permitting remote access arrangements, devising continuity plans with regular testing and ongoing analysis, allocating more resources to dedicated cyber security units, establishing alternative networks and redundant supply channels for utilities, cross-training of staff, organizational enhancements (e.g., creating Chief Information Security Officers), among other things.

22.3.6.3 Endpoint Security and Cyber Risk

Major shifts in the cyber risk environment for cross-border payment operations have had a significant impact on official BCS business areas responsible for provision of BCS. Cyber fraud incidents have highlighted the necessity of all actors in the global financial community, including official BCS providers and their clients, to strengthen internal controls around cross-border payment processes. This has triggered comprehensive internal reviews of BCS operations and their associated risk controls

across nearly all official BCS providers. In confronting the challenges posed by the evolving external risk landscape, official BCS providers have found significant dividends from heightened perspective-sharing with fellow official BCS providers given the challenges and complexities in strengthening prevention, detection, and incident response regimes around processing of fraudulent payment instructions. Several official BCS providers in recent years have started to incorporate information on the strength of clients' controls around critical endpoints (e.g., connections to the SWIFT network) in their evaluation of the riskiness of client relationships. Additionally, and more broadly, the global central bank community has strengthened collaboration in recent years on developing a holistic strategy to reduce the risk wholesale payment fraud related to endpoint security.[13]

22.4 Conclusion

The official BCS provided by the world's major reserve currency central banks have long played a critical role in helping central banks execute their public policy mandates. The continued relevance of these direct operational channels among the world's central banks is grounded in the safety, confidentiality, and reliability considerations that are foremost on the minds of central bank reserve managers when they select service providers. The ongoing, often daily interactions among central bank staff engaged in official BCS activities help central banks to sustain a level of technical and market expertise that is vital for their operational readiness, especially in crisis situations. The continued growth of official BCS volumes partly reflects the value that central banks place in offering and demanding official BCS.

While the fundamental rationale for official BCS may be a constant, the business of official BCS has continued to evolve and adapt in response to changes in the broader policy, regulatory, and threat environments. These changes in recent decades have included, among other things, new monetary policy operating frameworks, commercial bank regulatory reforms, the global de-risking of commercial correspondent banking relationships, and rising compliance and operational risks. More recently, the emergence of cyber threats targeting official cross-border payment operations has jolted the official BCS community into seeking a better understanding of the nature of cyber threats and existing vulnerabilities at both the institutional and systemic levels. In the face of these threats potentially striking at the core rationale for official BCS based on safety, confidentiality, and reliability, central banks have been intensifying their dialogue and cooperation in recent years to ensure these important operational links can be preserved.

[13] See "Reducing the risk of wholesale payments fraud related to endpoint security" (https://www.bis.org/cpmi/publ/d178.htm), May 8, 2018, BIS Committee on Payments and Market Infrastructures.

Part VI
New Trends in Asset Management

Chapter 23
Modern Central Bank Reserves Management: Introduction and Overview

John Nugée

Abstract The management of central bank reserves is a subject in which best practice does not remain constant but is continually evolving. As markets develop and overall levels of central bank reserves have grown, so the task of managing them has changed and becomes more complex. New instruments have been added to the universe of acceptable assets, and more markets have become open and investable for international investors. For a number of countries, the reserves have become a significant national asset and potential income generator that needs to be invested wisely and profitably, and public scrutiny of the activities of central bank reserves managers in these countries is both legitimate and important. Even for countries whose reserves are more policy-orientated and less a store of national wealth, the reserves management function has often grown in significance, and today's reserves managers have responsibilities to their own senior management, to their wider national public, and to markets and other market participants.

The traditional trilogy of objectives of "Security, Liquidity and Return" that has guided reserves managers over the years is still valid. But it needs updating and extending for today's more complex and multi-faceted challenges. This chapter seeks to do so.

23.1 Introduction

The management of national foreign exchange reserves is a task that almost all central banks undertake. In essence it is fairly simple: it is an asset management task, and at the day-to-day operational level, a central bank is not therefore that dissimilar from other investors in financial markets. Issues such as settlement, accounting policies, formal record-keeping, governance, and accountability need to be addressed, and later chapters in this book will do so.

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However, reserves management consists of much more than just managing assets. It is a multi-faceted and multi-dimensional operation, in most central banks fully integrated into the work of the rest of the bank, and it contains elements of both policy and market liaison alongside the asset management task.

On the policy side, the reserves management division may be charged with maintaining and defending an exchange rate, with maintaining the bank's (and by implication the state's) creditworthiness in foreign markets, and with managing and servicing the state's foreign debt obligations. It may also manage the bank's relationships with international financial institutions such as the IMF, the BIS, the World Bank, and so on.

Market liaison obligations may include overseeing and gathering information for the authorities on FX and bond markets, communicating the bank's intentions and in general, acting as the authorities' eyes and ears in the market, alert to market flows and stresses, and ready to warn those more senior of any impending challenges.

Even the asset management task may have additional layers of complexity beyond just the surface investment challenge. It contains elements of wealth management, income generation, and for many central banks also balance sheet management and balance sheet risk minimization. This part of the reserves management operation is best seen therefore as a financial management task, rather than just an investment operation.

These are three very different objectives, and they require different skills at both operational and managerial level. The respective weights of each of the three will differ for each central bank, and the impact on the bank, its operations, and its reputation will also differ. Finally, they will help determine the bank's investment objectives and style.

As a result, an important preliminary question for any central bank, before planning the details of the reserves management operation, is to determine the respective importance of the three elements of the reserves management task. In other words, central banks need to ask themselves "what is my Reserves Management operation really trying to do?"

23.2 The Reserves Management Policy Triangle

A useful tool for addressing this question is the Reserves Management Policy Triangle, shown in Fig. 23.1:

Different central banks will take different positions in this triangle:

1. A central bank for whom policy considerations dominate will find themselves at position 1—an example might be a central bank tasked with the defense of a currency level, currency peg, or formal currency board—such as, for example, the Swiss National Bank or Danmarks Nationalbank;

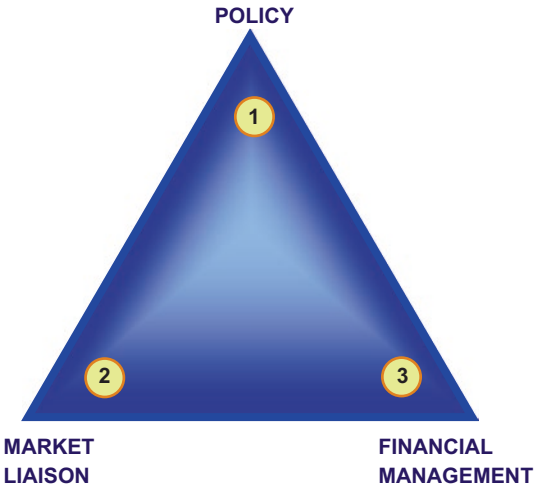

Fig. 23.1 The reserve management triangle

2. A central bank for whom market liaison issues are pre-eminent will find themselves at position 2—most of the major central banks in the world, such as the US Federal Reserve, the ECB, or the Bank of England will be in this position;
3. A central bank for whom investment and balance sheet management challenges are the most important will be at position 3—this will usually be the most suitable assessment for any central bank with sizeable or substantial reserves, such as the Hong Kong Monetary Authority or the Saudi Arabian Monetary Authority.

In practice, few central banks will concentrate on just one of the three policy objectives to the total exclusion of the other two, and the position within the Policy Triangle for any central bank will therefore be a more complex one, closer to one vertex than the other two perhaps, but probably containing elements of all three. Note in particular that the two central banks quoted as examples of Type (3)—i.e. banks whose main task is financial management—do also preside over formal currency pegs or boards. In both cases though the task of managing the currency link is secondary to the task of investment.

This in turn will guide the bank's reserves management style and allow a more nuanced assessment of the Classical Trilogy of reserves management objectives. This trilogy is always quoted as "Security, Liquidity and Return," with Return usually put forward as the least important of the three. However, using the Policy Triangle we can extend the classical approach and make allowance for the fact that for different central banks, the relative importance of the three classical objectives may be slightly altered.

In particular, a central bank whose reserves management operation is dominated by policy considerations will tend to emphasize the Liquidity of the reserves. This is because the reserves have to be ready for use whenever the policy objective requires them—for intervention, for example.

On the other hand, a central bank whose main use of the reserves management operation is for market liaison will tend to emphasize the Security of the reserves—this is because the reserves are unlikely to be used and are not significant in themselves as a financial asset, but for reputational reasons if no other, the central bank does not want to experience a loss.

Finally, those central banks with substantial reserves will definitely pay more attention to the Return part of the Trilogy, especially if the income derived from the reserves is an important contribution to the financing of the bank's overall operations.

By using the Policy Triangle, therefore, central banks can rationalize their own assessment of their priorities and needs against the traditional but at times somewhat rigid trilogy of "Security, Liquidity and only then Return."

23.3 Issues of Size

The next issue to impact the management of the reserves will be their size. In this section we do not address at all the question of reserves adequacy; in other words, what size the reserves should be, or what size is optimal. There is a large literature on this subject but few concrete conclusions and, with a few notable exceptions (see, for example, Chaps. 3 and 4), even fewer numerical formulae that prove enduringly useful. Instead we will approach the subject from the viewpoint of the senior management of the reserves management division and assume that the size of the reserves is given. The discussion is then how this impacts the choice of management style for the reserves.

For some central banks, the reserves are clearly inadequate for the tasks they have to undertake. Central banks in this position, with an outright shortage of reserves, will find that their reserves management operation is largely dominated by liquidity management and the husbanding of scarce resources. At a more senior level the dominant issues will be the rationing of access to foreign exchange (e.g., via exchange controls, direct control of foreign exchange expenditure by government departments), the prioritization of debt servicing, the establishment of credit lines, and the maintenance of a dialogue with providers of official sector finance such as the IMF.

Central banks with rather larger reserves, sufficient for their daily needs, will still face liquidity management issues, but in addition will be concerned with such issues as the hedging of any foreign currency debt, the maintenance of the bank's creditworthiness, and protection of the bank's access to market finance. Actively managing the assets in the reserves for return will still however be a relatively lower priority.

Once the reserves grow beyond this point, central bank reserves management starts to take on more the hue of an investment management activity. Liquidity management and the hedging of any foreign currency debt will remain important tasks, but for those banks whose reserves levels are comfortable, other issues such as interest rate management and risk management more generally will come increasingly to the fore.

In addition, central banks in this position will need to consider the level of transparency they provide to the various stakeholders (parliament, electorate)—as the reserves grow, so will the public interest in their management.

For those central banks whose reserves are even larger, to the point of being well in excess of what is needed for policy operations, the investment task grows even more in importance. Topics such as market selection, asset allocation, and diversification will need addressing, and governance and accountability issues will become more urgent.

Beyond this level, there are some central banks with significant wealth. Here the reserves management task is more akin to long-term wealth management: strategic asset allocation begins to dominate the investment challenge and questions not only of what the central bank should do from an investment perspective but also of whether various investments are appropriate for a public sector institution need to be addressed—an issue we explore at more length in a subsequent section below. There are also implications for the public profile of the central bank, and the relationship with any other state asset managers such as, for example, a SWF.

In all these cases, a central bank will determine its preferred reserves management style according to its own circumstances. It is important though that management is alert to the need to keep the style of their operations updated and appropriate to any change in those circumstances—the style of the reserves management operation is not a "once for all time" decision.

23.4 Issues of Market Presence

So far, our discussion has focused on the size of a central bank's reserves relative to its own needs and situation. There is however a second dimension to the question of size, the size of a central bank's reserves relative to the markets it wants to invest in. We will term this issue a central bank's Market Presence; this covers not only the absolute size of a central bank's position in the market but also the manner in which it manages that position.

For most central banks, and in most markets that reserves are commonly invested in, the question of market presence is a minor one. Where a central bank is a small player in a large market, it can usually act without needing to take into consideration the consequences of their actions for the market and for other investors. But this is not always the case, and in order to consider this further, we identify four broad categories of market presence.

In situations where a central bank's investments in a certain market are small relative to that market—either because the central bank's position is itself very small or because the market is a large and liquid one—the bank's resulting market presence is minimal. Its investment operations will not affect the market, and there are no overt reasons (beyond the need to obey market norms) for the central bank to consider how the market might react before it acts. Typically this will apply whenever

the central bank's preferred dealing size is smaller than the normal dealing size for the market in question.

For central banks whose positions and activities are of medium size relative to the market, for example, where the central bank's preferred dealing size is in line with what other market participants are comfortable with, there are some situations when the bank needs to exercise caution, but they are still limited. The bank will be a price taker in normal market conditions and able to trade at almost all times. Careful selection of counterparties will be advisable, to ensure that the central bank always has multiple options and that its activities are not transparent to any one market participant in their entirety, but this should suffice.

One a central bank reaches the point where it is large relative to a market, for example, where its preferred dealing size is larger than that common in the market, the situation it faces starts to change. The bank's activities are more likely to be noticed by other market participants and may move the market; in thin markets and times of low liquidity it may find that it becomes less of a price taker and more of a price maker. In such circumstances timing and sensitivity to the state of the market become more important, as does the choice of counterparty—these should be drawn from the premier houses active in that market.

When a central bank becomes very large relative to a market, perhaps a dominant player in the market, the position changes again. At this point timing and order management become crucial to avoid the central bank becoming blocked and unable to execute, and issues such as confidentiality pre-trade and transparency post-trade need to be discussed and managed. It is also important in such cases to maintain a close liaison with the regulators of the market; not all markets, and not all regulators, welcome the activities of foreign official sector investors, particularly where they are big enough to be potentially destabilizing.

It is important to note that the question of market presence is a dynamic one. Markets change both during the day as liquidity ebbs and flows, and over a longer time scale as market sentiment changes. Even the US Treasury market, usually considered the most liquid market in the world, can experience periods of poor liquidity, and any central bank with a large position in Treasuries will always prefer to trade in New York business hours (an issue that particularly affects Asian central banks, among the world's largest holders of Treasuries but whose business hours coincide exactly with New York being closed).

Equally, markets may be easier to trade one way than the other. It is well-known that it is often easier to buy into a small market that to sell out of it, and a position that is easy to establish may prove very much more challenging to exit from. And in a crisis, even normally highly liquid markets can freeze, and a trade that in normal times can be executed without difficulty or consequence may not be possible at all. Given the colloquial definition of an emerging market ("an emerging market is one that you cannot emerge from in an emergency"), then even some parts of the Treasury curve qualified as an emerging market in the Global Financial Crisis of 2008!

Central bank reserves managers will therefore need to keep a constant eye on their market presence and in particular note when the state of a market they are invested in is changing and they are in danger of moving from, say a small- or medium-sized player to a larger and more constrained one.

These two relative issues, of size and market presence or position, interact with each other and produce three very different states for the reserves management operation. In some markets the central bank will mainly act as a Liquidity Manager, in others it will mainly act as an Investment Manager, and in others still it will need the skills of a Market Manager. These three states are summarized in Fig. 23.2:

Note also that the issue of a central bank's market presence will also have an impact on its internal structure and controls. As market dominance increases, the pressure on internal risk and control units to operate appropriately also increases. Three areas where this is particularly relevant are:

1. The choice of counterparties. As a central bank becomes a more significant player in a market, so its business will be increasingly valuable to market makers and increasingly sought after. It is important that this choice—which may have significant consequences for those not chosen—is conducted in a rigorous and open way;
2. The separation of the portfolio management and trading functions. While for most central banks, the role of portfolio manager and trader can be combined, for the largest and most active central banks there may be merit in splitting the roles and creating a specialist execution or trading unit;
3. The role of an independent Risk Unit and its degree of separation from the main portfolio management operation. While for most central banks a Middle Office, at arm's length from the portfolio managers but still part of the Reserves Management Department, may be sufficient, some central banks may prefer to have a separate Risk Unit altogether with separate management and reporting structures.

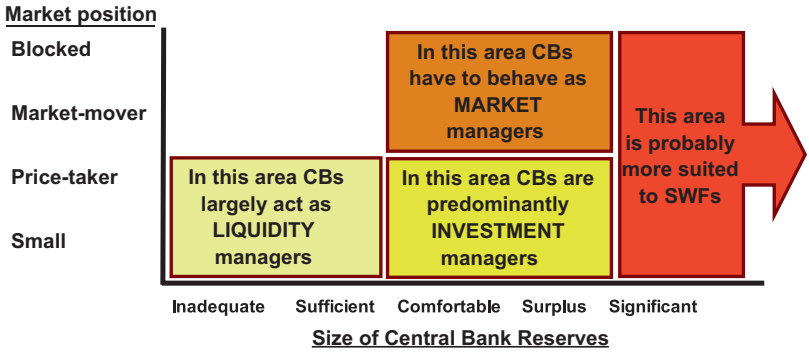

Fig. 23.2 The size of central banks reserves and the market position

23.5 Issues of Diversification and Suitability

A constant theme of central bank reserves management is the exploration of new markets to invest in. Since at least the 1960s, when the more advanced central banks first started moving beyond gold and time deposits and began to invest their reserves in government and other bonds, reserves managers have been well aware of the benefits of diversification of their reserves for both risk management and return enhancement, and the process shows no sign of stopping. Each generation of reserves managers takes the asset universe that it inherits from its predecessors as the baseline and explores whether or not to extend it yet again.

While this push towards diversification abated in the early phases of the Global Financial Crisis, it has increasingly gained traction again. In recent years this has led reserves managers to explore alternative asset classes and second-tier markets. These pose challenges to any investor looking to enter them for the first time, and central banks are no exception to this: factors such as size, liquidity, transparency, the investor's knowledge of the market's structure, and the availability of satisfactory counterparties all have to be taken into account alongside the risk and return profile of the market.

But in addition, central banks face some further questions before adding new markets, with all their complexity, to their investment universe. The first of these is to ask whether the proposed investment is worthwhile. There is no point in adding a new market with all its extra risk (including the reputational risk if the investment turns sour) if it is so small that the extra return that might be garnered is too limited.

A second important consideration is the degree to which both management and staff really understand the market. Governance issues are increasingly important as reserves sizes grow, and it is important that management can both explain and justify the investment to any critics, be they politicians, the press, or the public. Equally, the central bank needs to ensure that it has a large enough body of staff who understand the proposed investment. Central bank reserves management teams are vulnerable to key staff risk and should not build portfolios which are understood by just one or two people—such portfolios will be difficult to maintain if key staff leave.

Note that the employment of external managers to manage assets in a new market is only a partial solution to any internal lack of understanding of the market. An external manager will understand the mechanics of a market, and can teach these to the central bank's own staff, but the decision to enter the market in the first place can only be taken by the central bank itself and does require at the minimum an understanding of the characteristics, risks, and returns that the market offers.

Thirdly the question of market presence that was discussed in the previous section is of crucial importance when considering a market for the first time. In particular, a central bank intending to take a large position in a smaller market would be well advised to discuss their entry into the market with the relevant home central bank in advance of any trading. Not only is this courteous to a fellow central bank—reserves managers should always remember that what for them is a foreign market is for another central bank their domestic market—but the host central bank may be

able to offer information on the particular features of the market and even advice on how to approach it. It is after all in both central banks' interest that the investment in the market should go smoothly and add to rather than detract from the market's attractiveness to other participants.

Lastly, central banks need to consider how their potential entry into a new market interacts with the activities of any other official investor of the state. For countries with SWFs or national pension funds, what is optimal for the central bank in isolation may not be optimal for the authorities taken as a whole, and the central bank may have to step back from a diversification which on their own narrow assessment would be beneficial.

This covers the more operational issues that a potential diversification raises. And in every case, for every extension of the reserves management universe, the primary question has been "Does it add value to our operation at an acceptable cost?" But central banks also have to consider a secondary question, which is "Is it appropriate for us as a public body to engage in this market in this way?"

This, the suitability of a proposed investment, is no less important, and again distinguishes central banks from other large investors in markets. There have always been questions as to the appropriate style of reserves management—what activities are acceptable and legitimate, and what activities, even if financially beneficial, should be avoided. It is illustrative therefore to recap briefly the issues that previous generations of reserves managers have debated, to see how this challenge of suitability has played out in the past.

In the 1980s the big question for reserves managers was whether reserves should be managed actively for profit. Management of reserves had just moved from being an act of custodianship (safe-keeping and administration) to one of management (seeking efficiency and risk minimization), and the question was whether it was legitimate for central banks also to seek to manage the reserves for profit. It is clearly not appropriate for a central bank to consider the profitability of its operations in its own market—the asymmetry of information with other market participants is extreme—but in foreign markets, where the central bank is "just another player," the issue was less clear-cut.

The consensus that emerged was that profit maximization was a legitimate operation, provided the reserves managers were kept away from any policy discussions the central bank may be party to with other central banks (it is from this era that the physical isolation of reserves dealing rooms in most central banks stems); but even so it is interesting to observe how many central banks obscured their reserves management profits as "cost reductions" in their accounts from this era!

In the 1990s the main subject for debate was central banks' stance on gold. The gold market is the one exception to the rule mentioned above that every market is some central bank's domestic market—it was then a market of considerable importance to the central banking community, but with no single central bank directly responsible for its welfare. Did this make it a market that all central banks should collectively nurture and protect, or one without any oversight at all?

The question became one of whether central banks had the right to trade gold solely with their own objectives in mind, or whether they also had some responsibility

towards the overall functioning and health of the gold market. To the gold market's relief, the consensus was that central banks did have a collective interest in a well-functioning gold market, and it is from this era that the successive Central Bank Gold Agreements and central bank self-restraint in their gold trading come.

In the 2000s many central banks, faced with burgeoning reserves, began to explore the appropriateness of equities in reserves portfolios, and whether, if they were a legitimate diversification, they should be held passively or traded actively.

More recently, and with a significant number of central banks now happy to hold equities in their portfolios, the main issue has become whether, in the light of pressure on all investors to promote good management and good environmental and social governance, central banks should actively exercise their ownership and governance oversight responsibilities. [1]

At the time of writing, this question is still unresolved. It is by now widely accepted that one of the causes of the financial sector's excesses that led to the Global Financial Crisis 10 years ago was weak shareholder governance: the theory that the shareholder system of company ownership confers not only rights on shareholders, as the owners of their companies, but also obligations, and in particular the requirement to exercise control over executive management and to hold them to account, is not matched by much effective oversight in practice.

The conclusion that most commentators draw from this—that shareholders should in future exercise greater control over their companies—poses a particular challenge for central banks and their reserves management operations. As public bodies, most central banks have taken a positive decision not to play any part in the management of the (private sector) companies they have invested in. They have pointedly not taken up the directorships their shareholdings would entitle them to, and have in general abstained from exercising their rights to vote.[2]

This conscious decision by central banks to play an entirely passive role arose from the experiences of their SWF cousins in 2007, when a succession of high-profile SWF purchases of stakes in the developed world's financial companies engendered considerable comment in the western media, much of it hostile, on how control of the West's companies was being ceded to overseas holders. Most SWFs hastened to reassure their Western partners that this was not their intention and backed up these words by declaring that they would waive their shareholder rights. And central banks have almost all followed this line since.

However, while this was undoubtedly meant as a friendly gesture, it weakened shareholder governance, and it is now widely agreed that such complete passivity is not optimal, and that companies benefit from a greater involvement from their owners. But for central banks, there is a fine line separating Involvement in their companies and Interference. Too little involvement, and they stand accused of failing in their obligations. Too much, and they risk renewed criticism that they are seeking to exercise undue control.

[1] See also Chap. 24.

[2] See also Chap. 26.

This remains one of the central issues that central banks who hold equities in their reserves need to resolve. With their large stakes, their global viewpoint, and their very long investment horizons, they have the potential to make a major contribution towards the better governance of the companies they invest in. The leading central banks are well aware of this; the challenge remains however of finding a way for them to do so in a manner that is acceptable to all.

23.6 Issues of Management

Finally, we consider some of the special features of managing a reserves management division. Overall, the task of managing the reserves management division is not that different from the management task elsewhere in the central bank. But in the details, and especially in the management of the staff in the reserves management operation itself, it poses some unique and very interesting challenges.

At the overall level, reserves management shares three things with many other aspects of central banking.

1. It is not that difficult to understand the overall purpose of reserves management, or what one should be doing. But it is very difficult to get it consistently right;
2. It is not something the central bank will be praised for if all goes well. Indeed except for a few central banks with very substantial reserves, both efficient management and good performance will largely go unnoticed;
3. It is however something where if the central bank gets things wrong, it can cause unpleasant headlines and damage to the central bank's reputation probably out of proportion to any financial loss.

As elsewhere in the central bank, this puts a premium on clear written guidelines and agreed practices, good comprehensive reporting and two-way dialogue within the bank, and significant investment in transparency and explanation to stakeholders outside the bank. [3]

For the reserves management division, the most important of the three is probably the last, transparency with other stakeholders. This is partly because in practice it is very difficult to have excellent external communication without the other two already being in place, so that an emphasis on transparency to the general public will force a central bank to a high standard of internal governance and communications. But in addition, external communications have also risen in importance as central banks have moved their investments into newer and less well-known fields.

The introduction of equities, for example, into many central bank reserves portfolios significantly increases the risk of the central bank having to report a loss-making period; prior education that this is both inevitable and to be expected, and

[3] See also individual chapters in Part V "Governance and Risk management" for a discussion of reserve management governance at central banks.

no cause for concern or alarm, will repay many dividends and few central banks regret the resources they spend on educating their public, press, and political masters.

Where the task of managing the reserves management operation differs most from the management task elsewhere in the central bank is in the management of the staff of the division. Indeed, managing a reserves management team is one of the most interesting and—perhaps—challenging middle management tasks in a central bank.

Most reserves management staff, certainly at the portfolio manager level, are likely to be quite young. Despite this, they often have by necessity more authority, more independence of action (particularly when they meet their counterparties), and in general more ability to commit the bank than people several ranks higher than them in other divisions—they will be dealing with much larger sums of money than is common for people at their level and have the capacity to cause the bank significant losses, both financial and reputational. They also have a job with a more measurable output than many, with the result that they are under much greater measurement pressure (but equally know more clearly if they have done well). And finally, they have direct comparators outside the bank, often paid considerably higher salaries.

This, combined with the intensity of the job, often leads to an "esprit de corps" unlike that in many parts of the central bank. For many in the reserves management division, the rest of the bank is a strange and—if they are honest—not always very interesting place. As such, for many the natural career-move after their time in the reserves management team is not "somewhere else in the bank" but "somewhere else in asset management."

This constant pressure on staffing levels and threat of departures of key skilled staff—perhaps higher for those central banks in major market centers but there for all central banks wherever they are located—makes staff retention a key objective for those managing the reserves managers. The task is made more difficult by management's typical lack of flexibility over financial compensation, and it takes both skill and ingenuity to keep key staff from exercising their right to use their portfolio management skills elsewhere in the market.

Adding to the challenges facing management is the very different nature and interests of the various stakeholders they interact with. The easiest way to envision this is through a compass; the head of the reserves management operation has stakeholders above him or her (typically the Governor and Board), colleagues elsewhere in the bank at the same level, market contacts, and counterparties and below, the staff of the division. This is shown in Fig. 23.3:

Each of the four groups of stakeholders has differing expectations and requirements. Senior management will want the reserves management division to meet policy objectives and keep the bank out of the newspapers. Colleagues elsewhere in the bank (for example, the settlement teams who complete the deals the reserves managers have executed) want to complete their work with as few problems and errors and as little overtime as possible. The Markets want lots of trades, information, and reliability. And the portfolio managers want to enjoy their work and make

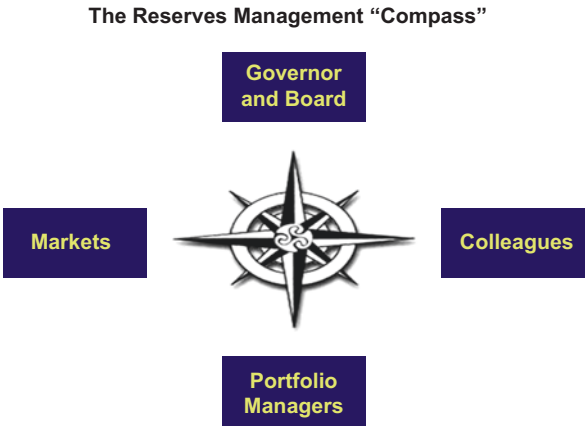

Fig. 23.3 The reserve management "compass"

profits for their portfolio (but secretly also probably want to learn enough to get a good job outside the bank).

It is a demanding set of requirements and responsibilities. But the sum total makes for one of the most rewarding positions open to middle management staff in central banking.

23.7 Conclusion

As overall levels of central bank reserves have grown—they are ten times as large in aggregate as they were 25 years ago—so the task of managing them has changed and become more complex. New instruments have been added to the universe of acceptable assets, and more markets have become open and investable for international investors.

For a number of countries, the reserves have become a significant national asset and potential income generator that needs to be invested wisely and profitably, and public scrutiny of the activities of central bank reserves managers in these countries is both legitimate and important. Even for countries whose reserves are more policy-orientated and less a store of national wealth, the reserves management function has often grown in significance, and today's reserves managers have responsibilities to their own senior management, to their wider national public, and to markets and other market participants.

The traditional trilogy of objectives of "Security, Liquidity and Return" that has guided reserves managers over the years is still valid. But it needs updating and extending for today's more complex and multi-faceted challenges. The remainder of this book seeks to do so.

Chapter 24
Bank of Israel: Integrating Equities into the Foreign Exchange Reserves

Andrew Abir and Golan Benita

Abstract Recently a number of central banks, including the Bank of Israel (BOI), have started to add risky assets such as equities to the traditional investment assets. This chapter elaborates on BOI's motivations to add equities to its portfolio, describes the process of its move into investing in equity, and reports on the contribution of equity investment to its portfolio performances. This chapter also describes the BOI investment philosophy, which has guided its investment decisions in the process of moving into equity.

24.1 Introduction

The move into investing in equities by central banks has raised quite a few eyebrows. Central bank investing has been synonymous with conservatism. Central banks have traditionally stressed the importance of liquidity and capital preservation for the investment of their foreign exchange reserves, while enhancing return has received far less emphasis. A typical reserve portfolio would have been composed of high-quality short duration government bonds with perhaps some allocation to government guaranteed bonds and short-term bank deposits. Yet recently a number of central banks, including the Bank of Israel (BOI), have started to add risky assets such as equities to the traditional investment assets of high-quality government bonds. In the most recent HSBC/Central Banking Survey (2018), 12 out of 71 respondent central banks were currently investing in equities, with a further 9 considering investing in equities now. BOI started investing in equities in 2012 and currently allocates around 13% of the reserves to this asset class. In this chapter we will outline the considerations that led us to start investing in equities and also discuss some of the deliberations that we have faced in incorporating equities into the foreign exchange reserves.

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The rest of the chapter is organized as follows: Sect. 24.2 elaborates on the motivations to add equity to BOI's reserves portfolio; Sect. 24.3 describes the process of BOI's investment in equity; Sect. 24.4 discusses BOI's investment philosophy and its implications for equity investment; Sect. 24.5 elaborates on equity's contribution to the BOI's reserves portfolio; conclusions and remarks are given in Sect. 24.6.

24.2 The Motivations for Adding Equity to BOI's Reserves Portfolio[1]

24.2.1 Objectives for Holding Reserves and the Principles for Managing Them

Generally, countries hold foreign exchange reserves for three main purposes:

- To provide the economy with sufficient foreign currency for an emergency situation.
- To enable the central bank to intervene in the foreign exchange market to carry out exchange rate policy or in the case when the market is not functioning properly (market failure).
- To enable the central bank to operate in the foreign exchange market in order to moderate capital flows that could de-stabilize the economy.

In order to achieve these goals, central banks normally invest their foreign currency reserves according to three basic principles:

- Maintaining the purchasing parity of the reserves.
- Managing the reserves at a sufficient level of liquidity.
- Achieving a suitable holding period of return, along as this does not endanger the first two objectives.

In the case of the Bank of Israel, the one of BOI's functions is to hold and manage the foreign exchange reserves (Bank of Israel Law 2010). The Monetary Committee, headed by the Governor, was granted the authority to establish the guidelines for the investment policy of the reserves. These guidelines specify the set of permissible assets and the risk profile for the investment of the reserves.

[1] See also Bank of Israel (2017).

24.2.2 *The Increase in the Size of the Reserves and Its Impact on the Risk Profile of the Reserves*[2]

A major factor behind BOI's decision to invest in equities was the increase in the size of the foreign exchange reserves (Fig. 24.1) and how this impacted the risk profile for the management of the reserves. The foreign exchange reserves of BOI grew from $29 billion (16% of GDP) at the end of 2007 to $113 billion at the end of 2017 (33% of GDP).

The increase in the size of the reserves was derived primarily from foreign exchange purchases by BOI as part of its monetary policy, in addition to revenue from interest and capital gains on the stock of already existing reserves. The level of reserves in 2007 was perceived as considerably below the minimum adequate level and the increase in reserves in the following years has brought them to a level that is slightly above the upper bound of the range of the BOI's estimation of the adequate level of reserves, $70–110 billion (the grey area in Fig. 24.1). The adequate level of reserves is estimated in accordance with the objectives of holding the reserves. These principles take into account the generally accepted international standards for assessing the adequacy of the reserves and the potential uses of the reserves, such as financing imports, repaying debt, and intervening in the foreign exchange market during emergencies. The appropriate level of foreign exchange reserves is designed to achieve the objectives of the public policy that were defined for it and is perceived as a positive indicator of the country's economic and financial robustness.

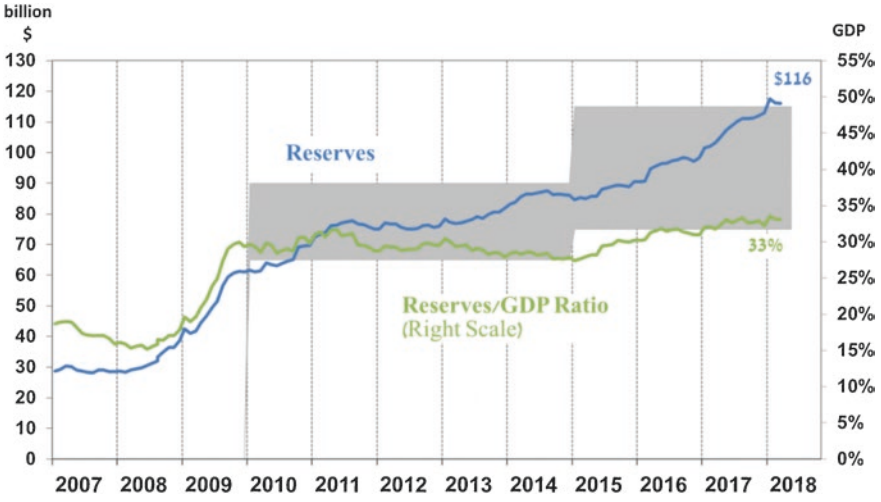

Fig. 24.1 Growth in the foreign exchange reserves of BOI 2007–2018

[2] See also Chap. 4.

The rise in the level of reserves in relation to the range which is regarded as adequate has implications for the risk profile of the investment of the reserves. One can think about how the size of the reserves influences the appropriate investment horizon for managing a central bank's reserves. As opposed to pension savings, it is unclear what is the appropriate investment horizon for managing a central bank's foreign exchange reserves. There is no defined maturity for the reserves and so they could be held for the long term and in that case should be invested over a long-term time horizon. However, the reserves must be available at any given time for use in a crisis and/or as a consequence of exchange rate policy. Even though the likelihood of a crisis may be low, the need for the reserves to be available is a major consideration in determining their risk profile and investment horizon.

Two factors can influence the choice of investment horizon; the exchange rate regime and the size of the reserves. In a fixed exchange rate, the central bank has to be prepared at all times to meet its obligation and supply foreign exchange, whereas in a fully floating exchange rate regime, there is no such obligation on the central bank. In terms of the size of the reserves, the lower the reserves relative to the estimate of the potential demands on the reserves, the higher the weight that will be given to the investment goals of liquidity and capital preservation relative to return. A higher need for liquidity, therefore, requires a short investment horizon. The higher the level of reserves relative to the required level, the greater the buffer for absorbing losses. This buffer makes it possible to invest in volatile assets such as equities, thereby benefiting in the long term from the risk premium inherent in these assets. In other words, the higher the level of reserves, the more weight can be placed on the objective of attaining return, compared to the other two objectives of liquidity and capital preservation.

In response to the increase in the size of the reserves, the BOI adopted a higher risk profile to give more weight than previously to the return objective. One way to think of this was that the increase in reserves meant that the utility from the return on riskier assets is now higher (Fig. 24.2). In a low reserve level environment, the

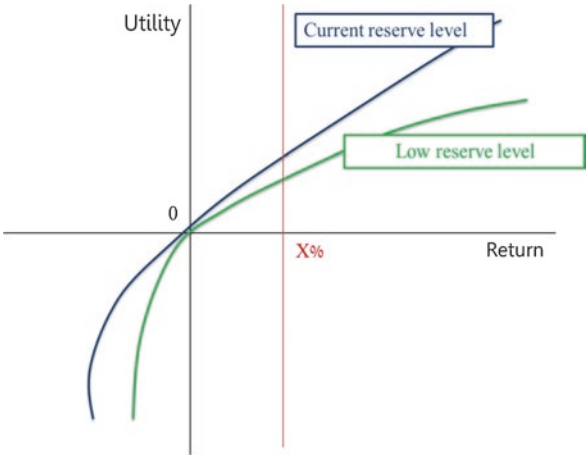

Fig. 24.2 Relationship between utility function of investment and size of reserves

investment manager is more sensitive to losses. As reserves increase, the utility derived from return is higher. As reserves represent a higher percentage of GDP, the reputational risk from foregoing return on these assets becomes more pressing.

24.2.3 The Change in Risk Profile and the Choice of Risky Asset Class

Prior to 2010, with a low level of foreign exchange reserves, the risk profile was defined in a very conservative manner—namely, with a 99% probability no negative returns over a 1-year horizon. This resulted in a portfolio consisting of mainly USA and European government bonds with a short duration (the overall duration of the portfolio was between 1 and 2 years).

The new risk profile adopted in light of the greater emphasis on return following the increase in the size of the reserves was defined as a 4% maximum expected loss on the return of the reserves over a 1-year horizon with a 95% confidence level—namely, the maximum loss that the Monetary Committee was willing to accept, without adversely affecting the attainment of the objectives for which the reserves are held. The risk measure CVARp (Conditional Value at Risk) is used to quantify the level of risk. The question then was what asset classes to add in order to facilitate the new risk profile.

We considered a number of asset classes that we could add to the existing reserve assets in order to fulfill the new risk profile, namely long duration government bonds, investment grade (IG) corporate bonds, and developed market equities. Initially we chose to add a pilot allocation of developed market equities and although we have later added longer duration bonds and corporate bonds, the majority of the risk budget is allocated to equities. A number of factors led us to prefer equities as the primary source of risk:

The Long-Term Equity Premium The starting point for equities is the historical outperformance of equities over government bonds, as demonstrated by Fig. 24.3.

Empirical findings indicate that over the long term, the investment in equities generates an excess return over the investment in government bonds. For example, an investment of one hundred dollars in the US equity index S&P 500 generated a cumulative return[3] of $6800 since 1980, compared to a cumulative return of merely $1200 on a one hundred dollar invested in US treasury bonds.[4]

This excess return obviously comes with higher volatility. In the short term, the return on an investment in equities is much more volatile than an investment in government bonds and therefore investment in equities is riskier (Fig. 24.4). For

[3] Including dividends.

[4] With maturities of 1–10 years.

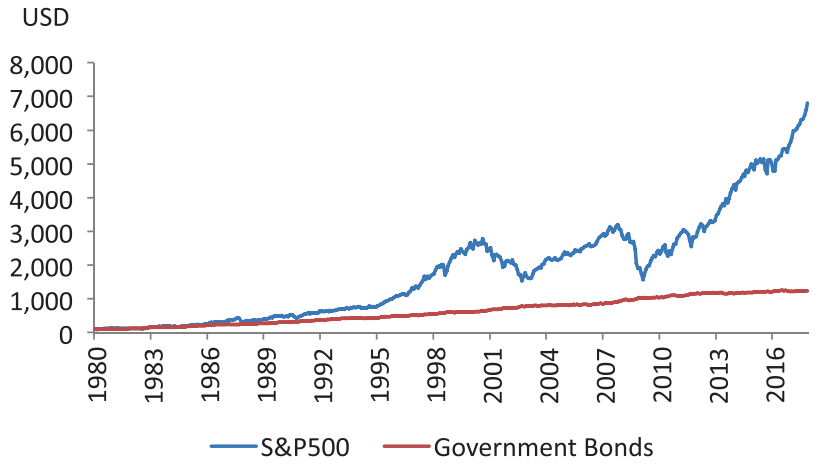

Fig. 24.3 Cumulative return of equities and government bonds in the USA 1980–2017

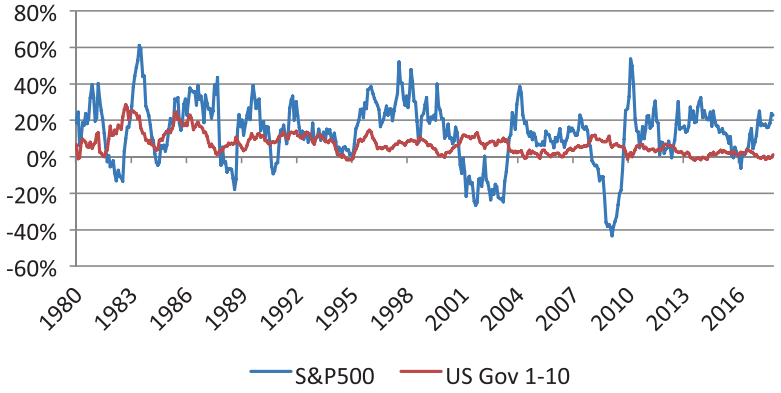

Fig. 24.4 12-month rolling returns

example, in the past 70 years, US equity market investments generated a negative return of at least 12% once every 5 years, on average. The longer the investment horizon, the greater the worth of investing in equities, as the proportion of cases in which a negative return is generated declines. In fact, in the past 70 years an investment in equities with an investment horizon of 10 years only twice generated a negative return.

24.2.4 Negative Correlation Between Equities and Bonds

When adding an asset class, it is preferable to be adding one that has negative or low correlation to the rest of the portfolio. In this case, one is looking for an asset class that has negative or zero correlation to government bonds. Using industry standard

Table 24.1 Correlation of monthly returns 2002–2017

	EM Local Debt	IG Corp	HY Corp	DM Equity	EM Equity	TSY 1-10	TBills
EM Local Debt	1.00	0.59	0.58	0.42	0.65	0.16	0.28
IG Corp		1.00	0.83	0.42	0.51	0.08	-0.23
HY Corp			1.00	0.74	0.75	-0.32	-0.22
DM Equity				1.00	0.83	-0.60	-0.06
EM Equity					1.00	-0.28	0.26
TSY 1-10						1.00	0.43
Tbills							1.00

benchmarks in USD, Table 24.1 shows the correlation of different classes 2002–2017[5]:

In this period only developed (DM) and emerging (EM) market equities and high yield corporate bonds (HY Corp) have had a negative correlation with US Treasuries (TSY 1–10 years), and while the correlation is not always stable over time, it does seem to hold up in crisis periods. This means that in periods where equities do badly, there is a reasonable probability that the rest of the portfolio that is invested in government bonds will provide protection to that underperformance, as there is a "flight to quality." A worrying exception is if the trigger to an equity sell-off would be rising yields in the bond market because of an inflation surprise.

24.2.5 Diversification Effect

Due to the significant negative correlation between equity and government bonds, adding some portion of equity to a government bond portfolio reduces its risk. This point is well illustrated in Fig. 24.5. It presents the probability of negative returns on a bond-equity portfolio as a function of its equity proportion. The probability of negative returns on a bond-equity portfolio is based on the historical annual rolling

[5] Based on rolling annual return.

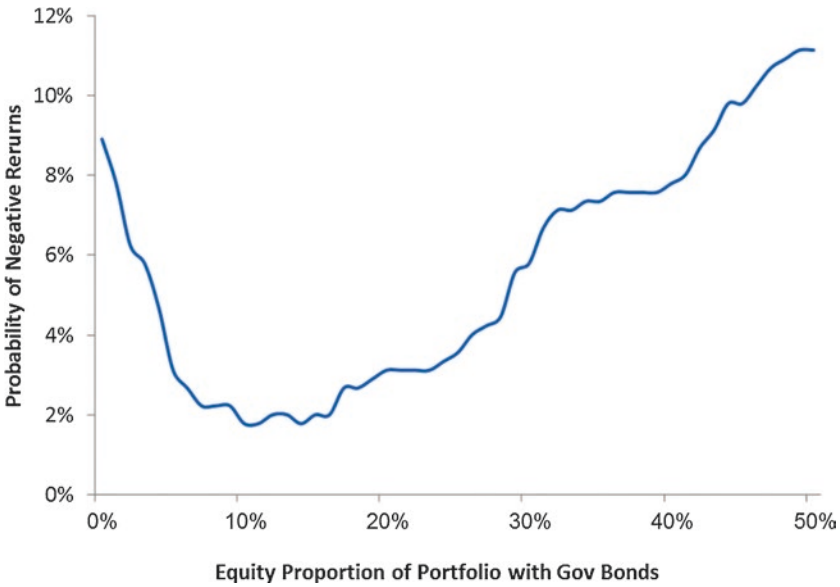

Fig. 24.5 The probability of negative returns over a 1-year horizon as a function of equity proportion

returns (1980–2018) on the S&P 500 and the US treasury 1–10 year index. As is evident from Fig. 24.5, the probability of negative returns decreases as the investment proportion in equity increases from zero to about 10%. This result implies that based on historical data, adding equity until a proportion of 10% is actually expected to reduce the portfolio's risk.

24.2.6 The Term Premium Is Expected to Be Low in the Foreseeable Future

In addition to diversification, there is also the fixed income yield environment to consider. Government bond yields in the USA and Europe have decreased over the past 30 years (Fig. 24.6). This continuing trend produced significant capital gains on investing in long-term government bonds resulting in a relatively high term-premium. As the yields in the USA and Europe have reached an extremely low level, it would be reasonable to assume they will increase in the future, which will result in a low or even negative term-premium. This implies that the nominal return on a bond-only portfolio is expected to be relatively low, which implies a high risk for a negative real return. Thus, investing only in government bonds risks the objective of preserving the purchasing power of the reserves, which in many central banks is one of the most important objectives. However, given the long-term equity premium, we

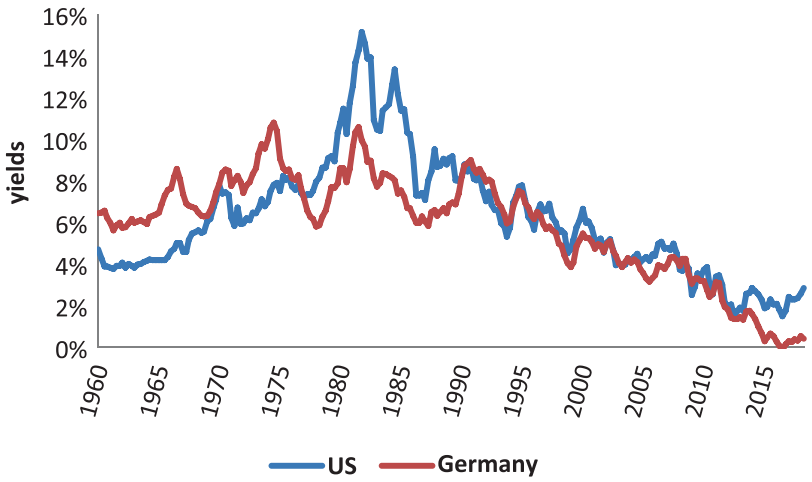

Fig. 24.6 10 years government bond yields in the USA and Germany

would expect that adding some portion of equity to the reserves portfolio mitigates that risk in addition to its diversification contribution, as mentioned above.

24.2.7 Liquidity in Equities

At least for US equities (especially large cap), liquidity is relatively good. The Bloomberg liquidity score measure[6] evaluates equities as being much closer to Government bonds than IG or high yield corporate bonds. While US Treasuries receive a liquidity assessment score by Bloomberg of 99–100, US equities (S&P 500 companies) are graded between 94 and 100, while IG corporate bonds are rated between 60 and 90 and high yield bonds between 25 and 40. An execution of a trade of $1 billion in a US equity portfolio could be done over several hours, without unduly affecting prices. In an IG corporate bond portfolio, it might take several weeks.

We looked at what percentage of equities could be added to a portfolio of government bonds without exceeding the CVAR limit of 4% losses over a 1-year horizon with a 95% confidence. The result we found was that it is possible to get to an allocation of around 15% equities in the portfolio without breaching the CVAR limit. Achieving the same effect of risk and return using IG or HY corporate bonds would require substantially greater investment proportion in this asset classes than equity, which will result in much less liquid portfolio.

[6] Bloomberg Liquidity Assessment quantitatively estimates a security's liquidity in terms of the security's liquidation cost and the number of days to liquidate an associated volume.

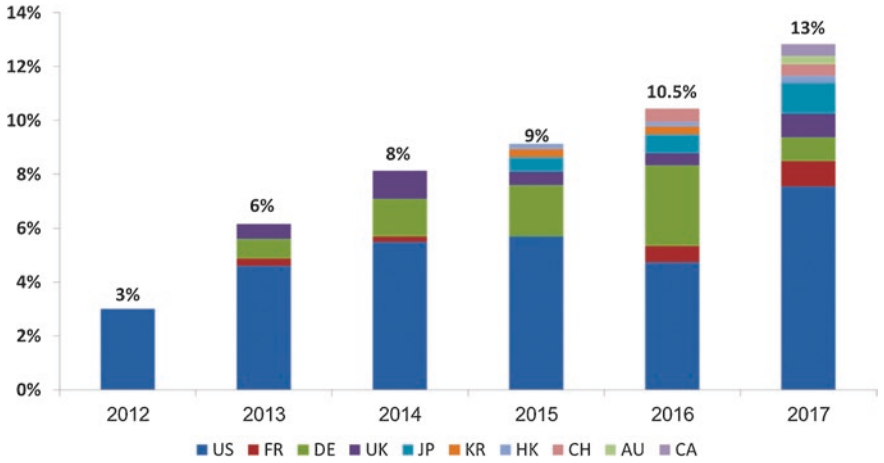

Fig. 24.7 Equity allocation by size and market 2012–2017

24.3 The Process of BOI's Investment in Equity[7]

The initial move into equities was started in 2012 as a pilot program of investing 3% of the reserves in US equities. By the end of 2017, the allocation to developed market equities had risen to 13.3%, while 61.6% were invested in government bonds,[8] the traditional asset class of reserve management.

To diminish the timing effect and to allow a learning process, the entry into equity markets was gradual. Diversification into equity markets other than the USA was also gradual. Currently, the Bank invests the 13% portion of the reserves in the equity markets of 9 countries (Fig. 24.7).[9] The proportion of the investment in equities is determined once a year by the Monetary Committee, as part of the Committee's strategic allocation of the reserves portfolio. The strategic composition of the reserves portfolio is selected with the aim of maximizing the expected return on the portfolio within a horizon of 1 year, subject to the risk profile and assessments of the macroeconomic environment and expected financial conditions (as it will be elaborated in Sect. 24.4 below).

Since 2017, the diversification of investment in equities among markets has been based on a broad-based index of equities in advanced economies (using the MSCI Developed Markets Index). Until that change was introduced, investments in equities were made in a gradual manner, in various major economies, which have the

[7] See also Bank of Israel (2017).

[8] Including deposits and cash at central banks, whose inherent risk level is equal to the country risk implicit in holding government bonds.

[9] The largest nine equity markets of the advanced economies.

required level of liquidity. The relative weight of investment in each market was determined on an ad hoc basis. The aim of the change was to closely track an accepted investment benchmark in the market, thereby maintaining the relative stability of the equities portfolio invested in a number of economies. We follow the new benchmark, investing in the individual shares, with a low tracking error, in what is essentially a passive equity investment style.

24.4 Investment Philosophy and Its Implications for Equity Investment[10]

Once the decision to invest in equity has been made, a number of other questions must be addressed: What should be the allocation to equity? How to diversify between the equity markets? How to invest in each equity market—passive vs active? Which external benchmark to track?

These decisions have been guided by BOI's investment philosophy. Investment philosophy is usually defined as a coherent set of investment principles which are based on the investor's assumptions about the behavior of the capital markets and on his own characteristics, such as his risk profile, investment horizon, and investment goals (Fig. 24.8). These principles refer to the investment objectives and to the emphasis that is put on each of the policy's basic elements, such as diversification, timing, and security selection, in formulating an investment strategy.

A central question in formulating an investment philosophy is whether the investor believes in market efficiency or not. In an efficient market, asset prices should reflect all available information, including historical data, public and private information. In this case, one cannot exploit any such information to achieve returns in excess of the market return. This in turn implies that an investor who believes in market efficiency has no reason to attempt to time the market, as prices follow a random walk. This also implies that such an investor has no reason to engage in security selection, as all information is already reflected in the securities' prices. Thus, such an investor should focus his investment strategy on achieving efficient diversification.

Furthermore, an investor who believes in market efficiency assumes that asset risk is fully reflected in the market prices. Thus, the excess return on a specific asset reflects the risk premium required by investors. The investment philosophy of such an investor should therefore focus on efficient diversification of risk.

The investor's investment philosophy will also be affected by individual characteristics. For instance, regardless of whether the investor believes in market efficiency, one should increase the weight put on diversification as the investment horizon becomes longer. This is due to the fact that the effect of diversification on

[10] See also Bank of Israel (2017).

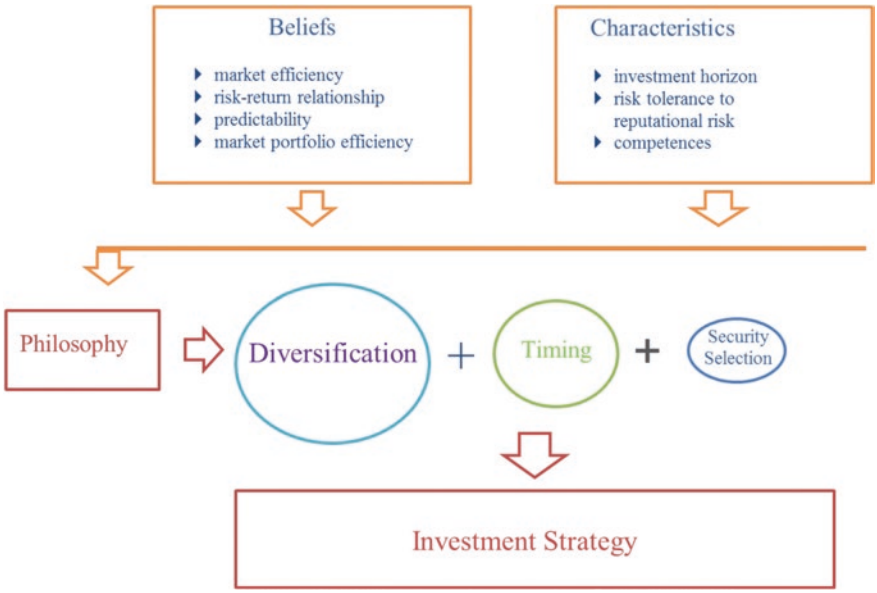

Fig. 24.8 The process of investment philosophy formulation

the portfolio's performance increases, while the effect of timing decreases, as the investment horizon becomes longer.

The question of whether the equity market is efficient is one of the most widely studied fields in finance. Empirical evidence reveals that there is some degree of inefficiency in the equity market (Schwert 2003; Degutis and Novickyte 2014). However, due to the costs involved in implementing strategies that attempt to exploit it, in practice they are not profitable.

Therefore, some researchers have concluded that the equity market is economically efficient, that is to say, although it does not behave according to the theory of market efficiency, one cannot exploit this behavior to achieve abnormal returns (Kalu 2017). The empirical evidence that may support this conclusion is that active portfolio managers typically underperform passive index investing (Fama and French 2008).

The extent to which a market is efficient depends on the extent to which it is economically perfect. A perfect market is a theoretical market that comprises a large number of heterogeneous investors, in which one can trade at any point in time without cost, and in which all information is available to all investors. Of course, in reality there are transaction costs and not all information is available to all investors. Nevertheless, it would be fair to say that some large equity markets in developing countries come close to being perfect, in particular given the recent technological developments which have reduced transaction costs and increased access to information.

To summarize, we can fairly assume that large equity markets are close to being efficient, which in turn implies low predictability of future returns. Based on this

assumption, and given the conservative nature of central banks and their long-term outlook, an investment philosophy that is suitable for reserves management probably should focus on efficient diversification, with the aim of harvesting the risk premium in the long term.

This philosophy led us to the conclusion that our developed market equity portfolio should be passively managed in each market and that the allocation among various equity markets should remain relatively stable over time. Given the low predictability of various markets' relative performance, large shifts between markets may lead to a loss of the risk premium over time. The actual investment was outsourced to external managers, who purchase the individual shares in a segregated account.

24.4.1 Which Benchmark to Track?

So far we have concluded that a central bank that believes in market efficiency should invest passively in equity. However, the question of which benchmark to track remains open. According to the Capital Asset Pricing Model (CAPM), one of the pillars of modern finance, all investors should select the market portfolio and mix it with a riskless asset according to their preferences. This result implies that the market portfolio is the optimal mean–variance portfolio. Another argument that supports the selection of the market portfolio is the fact that it reflects the average portfolio holdings of all investors, and thus resonates with the notion of the "wisdom of crowds."

While the perception that it is hard to beat the market portfolio is widespread, there is empirical evidence that may suggest that this perception requires a fundamental re-examination. For instance, a recent study (Levy 2015)[11] that compares the performance of the market portfolio with a large number of randomly constructed and passively held portfolios shows that 75% of these random portfolios yield higher Sharpe ratios than the market portfolio. The main reason for the market's underperformance is that its weighting is very skewed: most of the portfolio is concentrated in a small number of the largest stocks. For instance, the 10 largest stocks in the S&P 500 index account for 17.3% of the total S&P 500 market capitalization, and the 20 largest stocks account for 27.6% of the total S&P 500 market capitalization.

A very naïve approach to moving away from the highly concentrated market portfolio is to invest in a portfolio in which each stock is given an equal weight. Indeed, many institutional investors have decided to invest some portion of their equity portfolio in equally weighted indices.

A more sophisticated alternative to the market cap index is Factor Investing. We have looked into this approach and are presently running a small pilot investment

[11] Levy (2015).

through factors. This approach, which is also widely known as "smart beta," is based on the "multi-factor model" developed by Fama and French.[12] According to this model, a portfolio's return is linearly related to the market premium and to a number of other factors, which are based on the anomalies observed in financial markets, such as value, size, and momentum.

The smart beta approach suggests that instead of investing in the market portfolio one should invest in a portfolio that attempts to capture one or more factors, with the aim of harvesting over the long run the risk premium implied by these factors. Although this approach has been widely implemented by active portfolio managers since the mid-nineties, the major index providers, such as MSCI and S&P, started to launch indexes that attempt to capture one or more factors only a decade ago, while some of the indexes have been launched only recently, such as the MSCI Prime Value indexes, which were launched in 2015. Most of the indexes are rebalanced quarterly according to defined rules. Therefore, tracking these indexes is widely perceived as a form of passive investing, even though they could significantly deviate from the market portfolio in terms of their risk and return profiles.

The proportion of equity investment that is passively managed against smart beta indexes has grown dramatically over the last few years. Despite the promising performance of these indexes, they have a number of disadvantages which may raise concerns, particularly from a central bank's point of view:

1. There are not sufficient out-of-sample observations to assess whether these indexes are more efficient than the market portfolio. It is relatively easy after the fact to structure a strategy that beats the market portfolio.
2. Tracking these indexes is much more costly than tracking the market portfolio. The extra costs are composed of higher transaction costs, higher fees to index providers, and higher fees to external managers.
3. Even based on in-sample data there are no? indexes that constantly outperform the market. This may increase the reputational risk of a central bank, in years in which the indexes underperform. This is because the public usually compares the reserves portfolio's performance with that of the market portfolio.

For these reasons the BOI decided to allocate only a small portion of the equity portfolio to investment in smart beta indexes even though there are theoretical and empirical supports on this investment strategy. The pilot program on which we have embarked involves investing linked to an equal weight benchmark and also to a value benchmark.

24.4.2 What Should Be the Allocation to Equity?

The allocation to equity is influenced by three main factors: (1) The investor's investment horizon; (2) The investor's risk preferences; (3) The investor's view on equity and other asset class returns. Empirical and theoretical studies show that

[12] Fama and French (1996).

regardless the investor's risk preferences, the allocation to equity should increase as the investment horizon becomes longer.

Given a central bank's investment horizon and its risk preferences, the allocation to equity should be determined as a part of its strategic asset allocation (SAA), with the aim of achieving efficient diversification of its reserves portfolio. Over the years, we at the BOI have developed a well-structured SAA process. Our SAA process starts by assessing the global macroeconomic environment focusing on growth, inflation, and monetary policy. Based on our macroeconomic view and the current financial environment, we then assess conditions in the financial markets, and based on these factors, we develop a forecast for the assets' expected returns.

Given our forecast for the assets' expected returns and the variance–covariance matrix, which is often estimated based on historical data, we derive the efficient frontier (EF) using the mean–variance (MV) approach. The MV approach has several drawbacks, however, the most prominent among them being that: (1) the composition of a portfolio located on the EF is very sensitive to the assumptions made about the distribution of assets' returns, and particularly about their means; (2) imposing a "no-short-sales" constraint often causes the MV model to generate an EF comprised of portfolios which each includes a very small numbers of assets.

If the distribution of future asset returns were known with certainty, these drawbacks would be less severe, as selection of the portfolio located on the efficient frontier will be optimal when such certainty exists. However, in practice there is usually a great deal of uncertainty about the nature of this distribution, and particularly about the means of the assets' returns.

To address these limitations, we use two different tools, which have been developed internally. The first tool analyzes the portfolios that are located near the efficient frontier, and the second tool maps the asset allocation within a range of expected returns. These tools enable us to have a more robust investment decision-making process. Nevertheless, considering that there is a great deal of uncertainty involved in the SAA process, we believe that it is very important to employ sanity checks in addition to the quantitative analysis. One example of the sanity check is to run the suggested portfolios through a historical back test to see how they performed.

24.5 The Contribution of Equities to the Return on the Reserves[13]

The investment in equities has made a significant contribution to the return on the foreign exchange reserves portfolio, although it accounted for a relatively small share of the total assets. The cumulative return contribution of the investment in equities to the return on the foreign currency reserves portfolio since 2012 amounts

[13] See also Bank of Israel (2017).

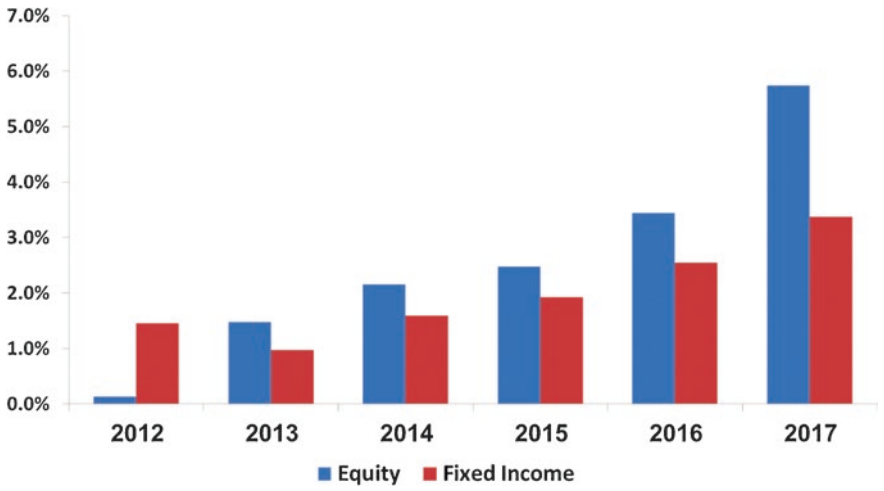

Fig. 24.9 The cumulative contribution of equities and fixed income instruments to the return on the reserves

to 64%. ((in this period, which totaled 9.2% (Fig. 24.9). Considering the relative scope of the investment, it can be stated that the cumulative contribution of each 1% of the reserves invested in equities since 2012 was 64 basis points, 18 times greater than the cumulative contribution of each percentage of the reserves invested in bonds and other financial instruments, which was just 3.6 basis points. Consequently, without an investment in equities, the cumulative return on the reserves portfolio would have totaled a mere 3.6%, compared to the portfolio's actual cumulative return of 9.2%.

These numbers indicate that the investment in equities increased the portfolio's cumulative returns by more than two-fold in the past 6 years. The considerable contribution by investment in equities stems from the substantial worldwide increases in equity prices recorded in recent years. As the equity markets are typically cyclical (negative annual returns once every 5 years, on average) some decline in prices can be expected in the future, which will generate losses for the reserves portfolio. Empirical findings indicate that the ability to predict the behavior of equity market is limited and therefore it is almost impossible to predict the exact timing of a decline in prices. Nonetheless, the returns accrued on the investment in equities in recent years constitute a safety cushion to absorb unexpected losses caused by declines in equity markets, even if the markets decline very sharply. For example, assuming the current share of investment in equities (13%), the cumulative contribution of equities to the foreign currency reserves portfolio will become negative only if the equity markets record a negative return of more than 36%. For the sake of comparison, the return on the US equity market in 2008 was −37% and equities prices corrected a substantial portion of this drop as early as in 2009.

24.6 Summary

The move into investing in risk assets as part of the foreign exchange reserves portfolio has been a result of the change in the risk profile as the size of the reserves grew. The process has been a gradual one as the Bank has built up expertise and comfort with the new risk profile. Clearly, the BOI has enjoyed a fortuitous period to start its investment in equities as it has taken place in a long bull market for equities. The investment in equities in recent years could therefore contribute considerably to the reserves portfolio returns due to the rising equity prices. As equity markets are typically cyclical in nature, it is reasonable to expect a drop in prices in the future, yet due to the limited ability to predict the behavior of equity prices, it is almost impossible to estimate the precise timing of a drop in prices. The real test for incorporating equities into the reserves portfolio, therefore, will be to see how it manages to deal with an inevitable bear market in the future.

In the long term, investment in equities generates excess returns and contributes to the greater diversification of risk in the portfolio, but in the short term such investment is volatile and therefore relatively risky and the capital preservation objective might not be completely met over short horizon. Nevertheless, since the BOI is a long-term investor, given the size of its reserves assets, the investment in equities is expected to contribute positively to the returns on the reserves portfolio.

However, investing in risky assets in general and equities in particular poses challenges within an inherently conservative organization such as a central bank. Risk taking is not normally associated with a central bank, whose staff is normally concentrated on identifying risks to be avoided rather than on identifying risks in order to earn the risk premium associated with them. The inevitable clash in culture needs to be managed so as to enable rational decision-making. This has to be done at the various levels of the organization—from the Board down to the individual portfolio and risk managers. This will determine to a great extent how the Bank will deal with a major correction in the equity market.

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Chapter 25
Renminbi Securities in Portfolios of Official Institutions: A Perspective from the Hong Kong Monetary Authority

Martin Matsui

Abstract The management of central bank reserves is a subject in which best practice does not remain constant but is continually evolving. As markets develop and overall levels of central bank reserves have grown, so the task of managing them has changed and become more complex. New instruments have been added to the universe of acceptable assets, and more markets have become open and investable for international investors. For a number of countries the reserves have become a significant national asset and potential income generator that needs to be invested wisely and profitably, and public scrutiny of the activities of central bank reserves managers in these countries is both legitimate and important. Even for countries whose reserves are more policy-orientated and less a store of national wealth, the reserves management function has often grown in significance, and today's reserves managers have responsibilities to their own senior management, to their wider national public, and to markets and other market participants. The traditional trilogy of objectives of "Security, Liquidity and Return" that has guided reserves managers over the years is still valid. But it needs updating and extending for today's more complex and multi-faceted challenges. This chapter seeks to do so.

25.1 Introduction

Investing in China has become a focus for foreign private and public investors in recent years as the pace of liberalization of the country's financial market continues to accelerate. China's currency, the Renminbi (RMB), has likewise gained greater acceptance in global capital markets. Against this backdrop, global investors need to revisit their asset allocation to mainland Chinese assets holistically since most

The views expressed here are those of the author and do not necessarily reflect the views of the Hong Kong Monetary Authority.

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investors are significantly underweight in their bond, equity, and currency allocations.

Over the last decade, the RMB has played an increasingly significant role in international trade and settlement. Global gross cross-border capital flows had collapsed by 65%[1] since 2007, while China has been going against this trend. In China, foreign investments[2] in equities and bonds are up to 44% over 2007 levels, suggesting significantly rising interest of foreign investors. The latest statistics by The Society for Worldwide Interbank Financial Telecommunication (SWIFT) show that in January 2019 the RMB was the fifth most-used currency for global customer-initiated and institutional payments, accounting for 2.15% of international payments. In the medium term we see expanded global usage. The inclusion of the RMB in the Special Drawing Right (SDR) basket by the International Monetary fund (IMF) in 2016 has underlined China's expanding role in global trade and has given recognition to the RMB as a freely tradable international currency, and such role will be further reinforced as the RMB becomes the dominant financing currency on the Belt and Road platform.

Along with the internationalization of the RMB, China's public financial markets have also been opening up. China now has the world's second-largest equity market and the third-largest sovereign bond market.[3] Private and public foreign ownership of RMB assets is on a steady rise due to recent liberalization efforts including the relaxation on QFII and RQFII[4] restrictions, mutual recognition of open-ended funds, the launch of Stock Connect and Bond Connect. The Hong Kong-Shanghai and Hong Kong-Shenzhen Stock Connect program, launched in 2014 and 2016, provide a feasible, controllable, and expandable channel for mutual market access between the Mainland and Hong Kong by a broad range of investors. The average daily trading volume on Stock Connect reached U.S. $6.6 billion[5] in February 2018 (Fig. 25.1). Northbound Trading of the Bond Connect program commenced on third July 2017, allowing investors from mainland China and overseas to invest in each other's bond markets through the Hong Kong Stock Exchange. Since launch, the number of overseas institutional investors on-boarded and the trading volume have been growing steadily. Partial inclusion of China A-shares into the MSCI EM Index and the addition of Chinese RMB-denominated government and policy bank securities to the Bloomberg Barclays Global Aggregate Index both highlight the rising importance of Chinese assets with their higher index weightings. This trend is expected to continue as index compilers increase the inclusion factors of Chinese assets in their benchmarks.

A more internationalized currency and a more liberalized financial market lay the groundwork for boosting foreign participation. RMB assets can provide the dual

[1] Source: McKinsey & Company, as of August 2017.

[2] Foreign investments encompass foreign direct investment (FDI), cross-border loans and deposits, and foreign portfolio investments in equities and bonds in China.

[3] As of 28th February 2019.

[4] (R)QFII stands for (RMB) Qualified Foreign Institutional Investors.

[5] Actual figure of HKD 51.4 billion converted into U.S. Dollar at exchange rate of 7.82. Source: HKEX.

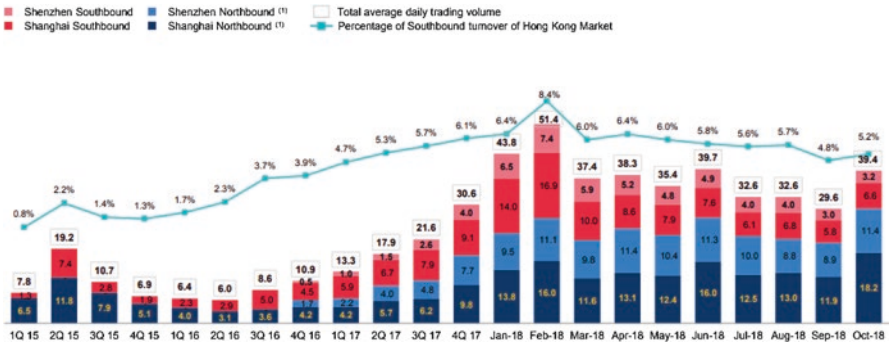


Fig. 25.1 Stock connect average daily trading volume (HKD billion). Source: HKEX Investor Presentation, as of November 2018

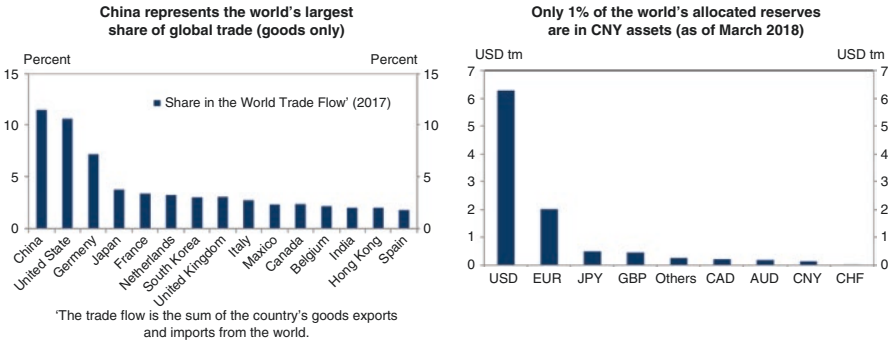
benefits of diversification and return enhancement to investor portfolios given their distinctive characteristics.

In this chapter, we will discuss the importance of RMB assets in central bank portfolios with the focus on China onshore equities (A-shares) and government bonds. We will examine the market size, returns, and outlook, as well as market access and developments to provide a broad-based view. We will also look into the risks and opportunities that exist within the overall investment environment.

25.2 Role of RMB Assets in Official Institution Portfolios

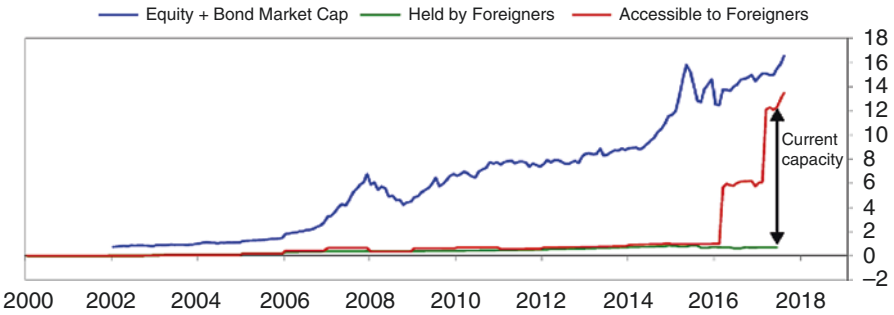
China's share of global output has soared in the last two decades. China is now the world's second-largest economy and the largest trading nation (in terms of the sum of exports and imports of goods). Despite China's size in global output and trade flows, central banks collectively hold only 1% of total global reserves in RMB assets (Fig. 25.2). Partly due to previous capital control regimes, onshore Chinese assets remain underinvested by foreign investors although China's public bond and equity markets are already among the largest in the world (Fig. 25.3). Weights in global indices are key determinants of foreign ownership growth. Despite improved accessibility, index weights do not reflect the size and significance of the Chinese economy and its markets. This is changing as global benchmarks in both equity and fixed income spaces are starting to bring Chinese markets into their indices at increasing weightings. The pace of index inclusion has relied on the progress made on market access and the foreign exchange market, and material improvements have already been observed. We expect this trend to continue and an increased allocation to Chinese assets will be strategically difficult to ignore.

As Chinese assets become increasingly available to global investors, meaningful opportunities for diversification and return enhancement emerge. China's assets



Source: Goldman Sachs Global Investment Research, 25th May 2018

Fig. 25.2 Importance of the CNY—trade and reserves. Source: Goldman Sachs Global Investment Research, 25th May 2018



Source: Bridgewater Daily Observations, 6th March 2018

Fig. 25.3 Chinese Asset Markets (U.S. dollar, trillions). Source: Bridgewater Daily Observations, 6th March 2018

have been historically proven to be less correlated to the world, which enables them to be an effective diversifier to a global multi-asset portfolio. China's economy is largely driven by domestic demand, with GDP growth largely in line with domestic corporate sales growth. China's economic fundamentals, such as growth and inflation, are also lowly correlated to the world. Divergent short- and long-term debt conditions from the rest of the world have driven independent policy responses in China. For example, for much of the last decade, China was tightening across monetary, fiscal, and regulatory fronts to curb financial leverage. In contrast, the U.S. Federal Reserve held rates near zero and engaged in unprecedented monetary stimulus (Fig. 25.4). As a result of this tightening, China has achieved a meaningful decline in credit and has subsequently started easing earlier in 2018. Meanwhile over that same period global yields have been on the rise—the U.S. continued its withdrawal of liquidity since 2017, pushing rates to recent highs (Fig. 25.5). Rates in other parts of the world have also risen, for example, the average yield on

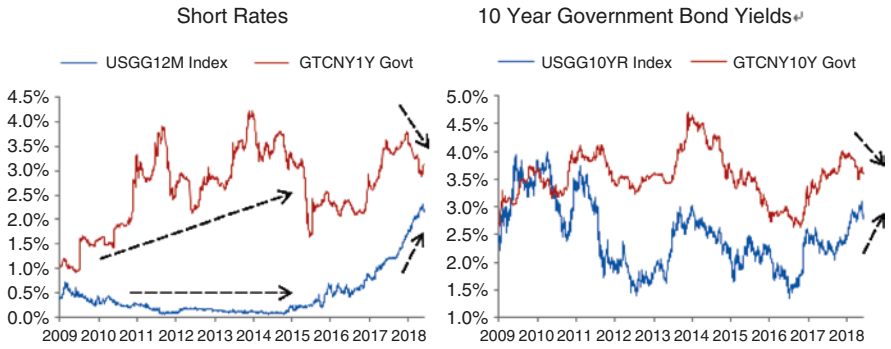
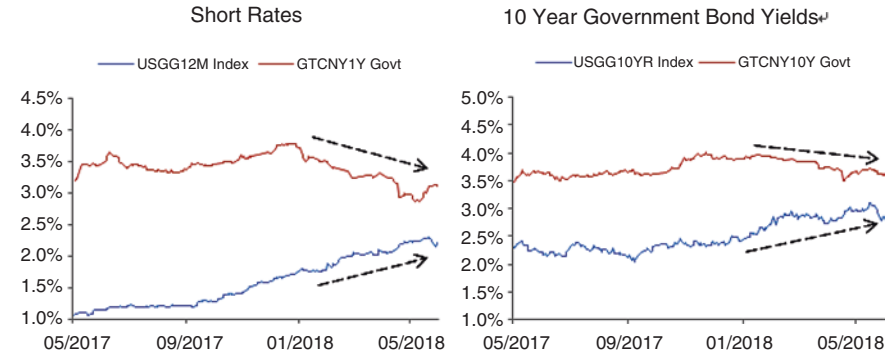


Fig. 25.4 China vs. U.S. short rates and 10 years Government Bond Yields, since 2009



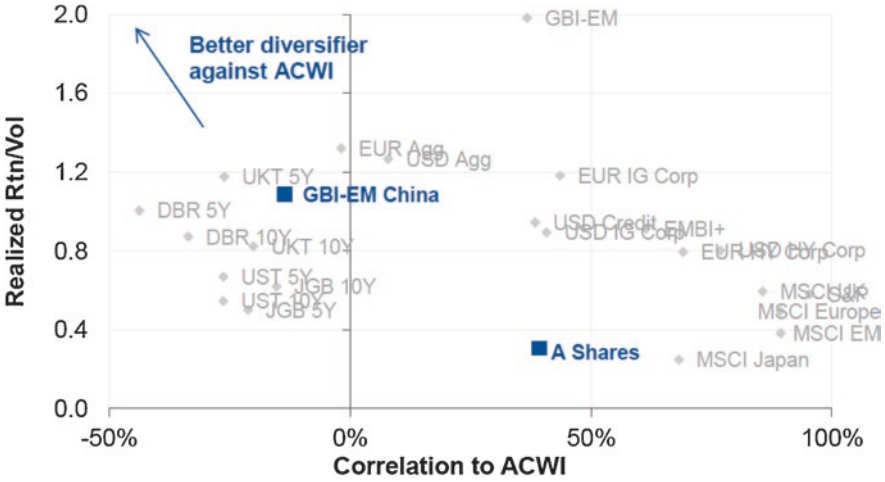
Source: Bloomberg, as of May 2018

Fig. 25.5 China vs. U.S. short rates and 10 years Government Bond Yields, since May 2017. Source: Bloomberg, as of May 2018

JPMorgan's benchmark index for emerging market local currency debt has also risen more than 60 basis points (from January to October 2018). This episode illustrates China's differing debt dynamics with other bond markets.

The domestically focused policies and idiosyncratic qualities of China's economy suggest that its bond market may react differently from global economic shifts such as a change in developed market bond yields. Such characteristics may provide diversification benefits to a globally invested portfolio.

To further illustrate Chinese assets' role as a diversifier, we look at the risk-adjusted returns and the correlation of Chinese assets. Chinese assets exhibit favorable diversification properties compared to the rest of the world (Fig. 25.6). China local rates have negative correlation with broad stock market indices and also offer a higher risk-adjusted return. A-shares also exhibit among the lowest correlations



Source: Morgan Stanley Research, as of March 2018

Fig. 25.6 Risk-adjusted returns vs. correlation with world equities, since 2004—March 2018. Source: Morgan Stanley Research, as of March 2018

with the broad MSCI ACWI[6] index across equity markets. Exposure to onshore securities would have been beneficial to portfolio risk/reward.

On top of their diversifying effects, Chinese onshore assets also offer meaningful return opportunities. China local rates offer higher nominal yields at similar level of credit quality compared to developed markets such as Japan and Europe where low to negative yields are expected to continue. We will review the two major onshore assets, China A-shares and government bonds, from various perspectives in the next two sections.

25.3 Accessing the China Domestic Bond Market

Over the last decade, China has significantly progressed in developing its bond market by steadily allowing market forces to determine the level of interest rates while at the same time gradually liberalizing capital controls (see Table 25.1). As a result, the domestic bond market is now the third-largest bond market in the world amounting to U.S. $12 trillion (Fig. 25.7). China's onshore bond market consists of the China Interbank Bond Market (CIBM) and the exchange-traded market. The CIBM represents more than 95%[7] of the total onshore value, dominated by domestic and to a smaller degree by foreign institutional investors. The exchange-listed bond market and the Commercial Bank Counter Market make up the rest, contributing less than

[6] MSCI All Country World Index (ACWI).

[7] Source: China Central Depository & Clearing Co., Ltd. (CCDC), Moody's.

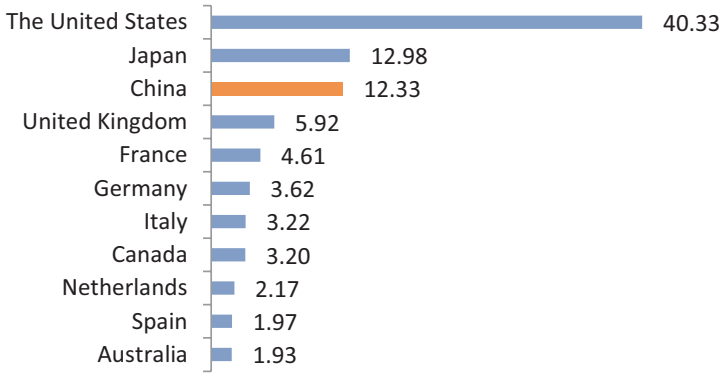
5% in total. Of all bonds issued, more than half are issued by governments and policy banks.

At present, foreign investors can access the China onshore bond market through four major channels, with China Interbank Bond Market (CIBM) Access and the Bond Connect program being the most popular (compared to QFII and RQFII) (see Table 25.1).

Table 25.1 Market access channels in comparison

	QFII	RQFII	CIBM direct access	Bond connect
Year of launch	2002	2011	2016	2017
Access method	Bond settlement bank as agent	Bond settlement bank as agent	Bond settlement bank as agent	Hong Kong stock exchange and central moneymarkets unit (CMU) as agents
Quota	Yes	Yes	No	No
Quota size (billions)	U.S. $300	U.S. $280	Unlimited	Unlimited
No. of investors	288	209	397 (71 central banks and 326 commercial entities)	503
Applicable markets/bonds	• On exchange bonds in SSE/SZSE • Cash bonds in CIBM		• Cash bonds in CIBM • Bond repurchase agreements (central banks and sovereign wealth funds only) • Interest rate swaps • FX derivatives	• Cash bonds in CIBM
Application procedure	CSRC and PBoC approval	CSRC and PBoC approval	Pre-filing with PBoC	Pre-filing with PBoC
FX management	FX onshore	FX offshore	Offshore to onshore via licensed settlement agents	FX (CNH/CNY) via offshore participant banks
Lock up period on principal repatriation	Upon tax clearance		CNY in = CNY out (± 10%)	Zero balance to be maintained onshore. Surplus RMB repatriated back to Hong Kong automatically on a daily basis

Source: CSRC, PBoC, SAFE, Goldman Sachs, State Street Global Advisors
As of February 2019 for QFII and RQFII, and December 2018 for CIBM and Bond Connect
CSRC China Securities Regulatory Commission
PBoC People's Bank of China



Source: Bank for International Settlements (BIS), as of September 2018

Fig. 25.7 Global bond market size (in terms of total outstanding debt securities in U.S. dollar, trillions). Source: Bank for International Settlements (BIS), as of September 2018

25.3.1 Qualified Foreign Institutional Investor (QFII)

The QFII scheme, launched in 2002, initially allowed foreign investors to access only the exchange-listed bond market. Over the years China has extensively relaxed restrictions on entry barriers and investment scope via this scheme, along with RQFII.[8] As of February 2019, U.S. $101.4 billion of investment quota were granted to 288 QFIIs.[9] The largest QFII quotas received to date are in excess of U.S. $1 billion. The HKMA, for instance, has a quota of U.S. $2.5 billion. Under the QFII scheme, investment quotas are granted to registered investors based on a certain ratio of the investor's total assets under management (AUM) in U.S. dollar. In order to trade in the onshore exchange or the interbank market, they will need to bring their offshore U.S. dollar capital onshore through conversion into the onshore RMB (CNY).

25.3.2 Renminbi Qualified Foreign Institutional Investor (RQFII)

The RQFII regime was introduced as an extension of the QFII scheme in December 2011. It follows similar registration procedures and the same quota-based investment regime. One of the main differences between QFII and RQFII is that—in RQFII—RMB can be obtained offshore (CNH) and remitted back to their onshore

[8] For example, QFIIs are allowed to access the interbank market in 2013 for trading cash bonds. In 2016, the "base quota" concept was introduced where investment quotas are allotted as a percentage of AUM for both QFII and RQFII. Principal lock-up period was also shortened to 3 months for both schemes.

[9] Source: State Administration of Foreign Exchange (SAFE), Shanghai Stock Exchange (SSE).

accounts for trading, whereas in QFII, CNY has to be converted and managed onshore with local custodians.

25.3.3 China Interbank Bond Market (CIBM) Direct Access

In 2016, the CIBM Direct Access Scheme was launched which allows medium-to-long-term institutional investors to access the interbank bond market with no quota restrictions. Eligible institutions include banks, insurance companies, asset managers and pension funds, foreign central banks, and sovereign wealth funds. Under CIBM, local custodians would typically open a China Foreign Exchange Trading System account and a clearing account on behalf of the registered investor.

25.3.4 Bond Connect

In 2017, trading via the newly launched Bond Connect commenced. Although it was not the first-time foreign investors were allowed access to China's bond market, it provides foreign investors access to China's local bond market via the Hong Kong Stock Exchange. Under Bond Connect, there is no quota or the need to stipulate an intended investment amount, which is required under the existing QFII schemes. Bond Connect also allows more efficient trading as offshore investors can trade directly with qualified onshore dealers via electronic platforms, while under the CIBM scheme, an onshore bond settlement agent bank has to be involved. This new arrangement is expected to enhance price discovery and liquidity in the onshore bond market.

Although the size of China's local bond market is among the largest in the world and access is increasingly fast and efficient, foreign ownership of Chinese local bonds is still low but will likely change for reasons described in the following sections.

25.4 Chinese Onshore Bonds' Inclusion in Global Bond Benchmarks Will Drive Significant Inflows and Boost Foreign Ownership in the Market

In January 2019, Bloomberg confirmed the inclusion of RMB-denominated China government bonds (CGBs) and policy financial bonds (PFBs) to its flagship Bloomberg Barclays Global Aggregate Index starting in April 2019, phased in over a 20-month period. When fully accounted for in the Global Aggregate Index, local currency Chinese bonds will be the fourth largest currency component following the U.S. dollar, Euro, and Japanese yen. Using data as of January 2019 the index would include 363 Chinese securities and represent 6.03% of a $54.07 trillion index upon

completion of the phase-in. The inclusion is expected to drive global capital reallocation as a number of official institutions track this index explicitly and use it (or variants) as benchmarks for their portfolios. As China continues to open up and liberalize its financial market, it will eventually be admitted to other global bond market indices and assigned increasing larger weights over time. China is currently being considered for inclusion in the FTSE World Government Bond Index[10] and the J.P. Morgan Government Bond Index. These inclusions will promote higher foreign participation in China's bond markets. Analysts have estimated the potential passive/tracker fund inflow from global flagship bond index inclusion into the China onshore bond market, mostly Chinese Government Bond (CGBs), to be around U.S. $250 billion[11] (Table 25.2). Such inflows will come at the expense of large developed markets (DM) (G4) and smaller emerging markets (EM), depending on the particular index. For instance, China bond inclusion in the Bloomberg Barclays Global Aggregate Index at a weight of 5.49% is likely to cause USD-, EUR-, and JPY- denominated bonds to lose approximately 2.4%, 1.4%, and 1% of their index share, respectively.[12] For J.P. Morgan Government Bond Index—Emerging Markets (GBI – EM), assuming China bond inclusion at the maximum 10% weight, a range of countries such as Thailand, and Malaysia will each lose index weight of around 1%, while some other larger markets such as Brazil and Mexico will be largely unaffected. With a significant amount of capital flowing into China's onshore bond markets as index inclusion progresses, investors will need to consider how these changes will affect the composition of their own fixed income allocations.

Table 25.2 Major global bond indices and the inclusion of China bonds

	Bloomberg Barclays Global Aggregate Index	J.P. Morgan Government Bond Index – Emerging Market (GBI-EM)	FTSE World Government Bond Index[a]
Tracking AUM estimate	U.S. $2 trillion	U.S. $200 billion	U.S. $2 trillion
Expected potential inflows	U.S. $100–110 billion	U.S. $20 billion	U.S. $100–110 billion
Instruments	Investment-grade sovereign and policy financial bonds	Investment-grade government bonds	Investment-grade government bonds
Potential weighting upon China inclusion	5.49% (announced) 6.03% (as of 24th January 2019)	10% capped	5.0–5.5%

Source: Western Asset Management, as of June 2018
[a]Formerly known as the Citi World Government Bond Index (WGBI)

[10] The FTSE World Government Bond Index was formerly known as the Citi World Government Bond Index before July 31, 2018.

[11] Source: Western Asset, Goldman Sachs, Morgan Stanley ranging from U.S. $240–320 billion, as of 1H 2018.

[12] Goldman Sachs Economics Research, as of August 2018.

As a result of index inclusion, foreign ownership of China onshore bonds, especially CGBs, is likely to rise. Foreign holdings in China's government bonds have increased to 6.8% from less than 3% 3 years ago. The pace of inflows even accelerated in 2018 amidst geopolitical uncertainties and this market, in U.S. dollar terms, was one of the top performing government bond markets on both a relative and absolute basis. In the scenario where China gets included in both the Bloomberg Barclays global aggregate and FTSE WGBI, Goldman Sachs estimates that foreign ownership in CGBs could reach 22% of outstanding debt by the end of 2022, which would translate into a 6% foreign ownership in the overall China bond market (Figs. 25.8 and 25.9).

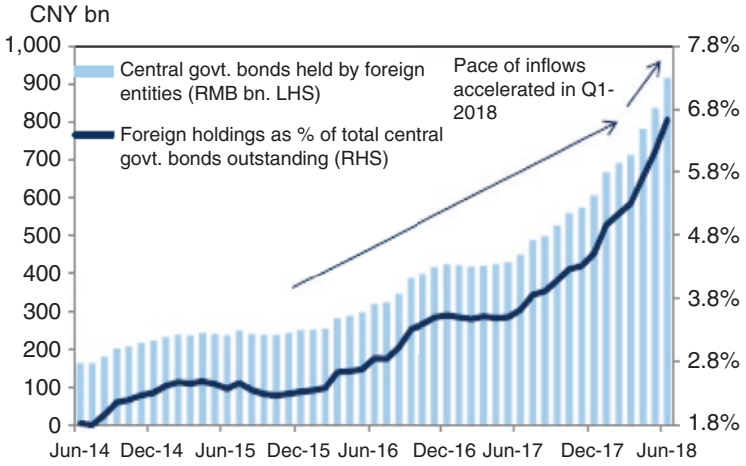


Fig. 25.8 Foreign holdings in China government bonds (June 2014–July 2018). Source: Goldman Sachs Economics Research, as of August 2018

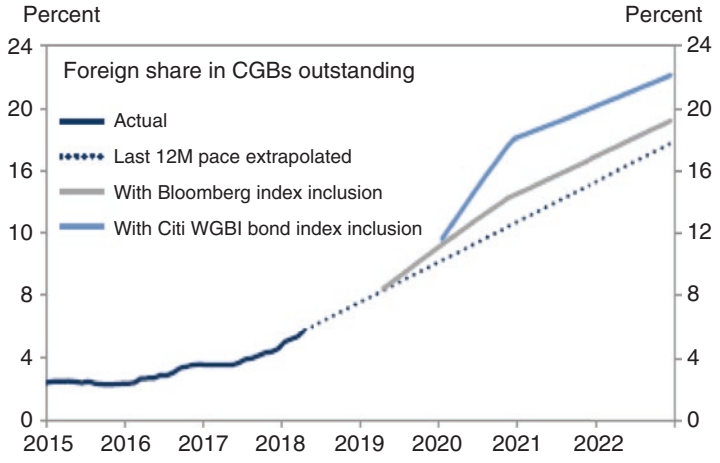


Fig. 25.9 Projected increase in foreign holdings in China government bonds by end 2022. Source: Goldman Sachs Economics Research, as of August 2018

25.5 China Government Bonds (CGBs) Offer Attractive Risk-Adjusted Returns

When we compare recent 10-year performance of onshore China government bonds against other major fixed income asset classes, we can see that CGBs have provided a higher risk-adjusted return (Fig. 25.10), largely due to their higher yield and lower volatility. In an environment of continued low government bond yields in most DMs such as Japan and the Eurozone, CGB yields provide an attractive pickup at similar credit quality. U.S. sovereign debt has also underperformed China local rates over the last decade, mainly due to the former's lower starting yields. In the long run, while returns of CGBs and other major fixed income assets will fluctuate in accordance with business cycles, monetary policies, and other factors, the fundamentally lower volatility and comparatively attractive yield of CGBs should remain.

One of the reasons for the relatively low credit risk associated with CGBs is China's low level of government debt compared to other developed or emerging economies. China has a general government debt to GDP ratio of less than 50% which is roughly half of that of most large developed markets (e.g., over 200% for

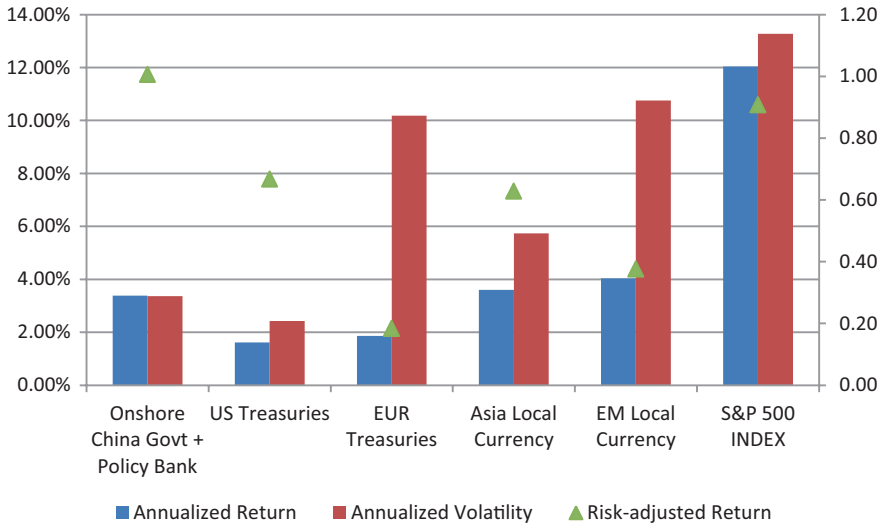


Fig. 25.10 Risk/return of major fixed income markets, 10-year annualized (2009–2018). As represented by the following indices: Bloomberg Barclays China Treasury and Policy Banks 1–10 Years Index Unhedged USD; Citi USBIG Treasury Index; Bloomberg Barclays Euro Aggregate Treasury Total Return Index Value Unhedged USD; iBoxx ABF Pan-Asia Unhedged Total Return Index; Bloomberg Barclays EM Local Currency Government TR Index Unhedged USD; S&P500 Total Return Index. Risk-adjusted return measures return per unit of risk represented by volatility. Source: Bloomberg, as of Dec 2018

Japan and 100% for the USA).[13] External financing dependence and idiosyncratic vulnerabilities such as twin deficits, high inflation, and high government debt faced by some emerging countries are also absent in China. China is a net creditor to the world with a net asset position of 14.7% of GDP, while holding the world's largest foreign reserve of approximately U.S. $3 trillion as of March 2018. As a result China's debt-servicing ability remains strong and the credit rating of its sovereign bonds remain stable. Currently China's local currency sovereign debt is rated A1 (Moody's)/A+(S&P)/A+ (Fitch), equivalent to that of Japan and higher than most emerging countries. In recent years, the weak economic fundamentals of many emerging countries have challenged investors' confidence in their debt-servicing ability and thereby contributed to the lackluster performance of those countries' sovereign debt despite generally higher yields compared to advanced economies. In contrast, China onshore bonds would be a good "within-EM safe haven" destination for public and private fixed income investors who would want exposure to the EM space with relatively attractive risk/return characteristics.

25.6 Low Correlation of China Government Bonds with Major Sovereign Bonds

China's bond market offers favorable diversification to developed world and other emerging markets fixed income assets. The recent price action of China and U.S. government bonds are illustrative of such diversifying effect. As an illustrative example during the U.S.'s last rate hiking cycle, from the summer of 2017 to the end of 2018, Chinese short rates were flat and then fell at the same time that U.S. short rates were edging higher. As previously mentioned, this broadly inverse relationship has also historical antecedents (Table 25.3). China's central bank policy actions are lowly correlated to those of the rest of the world. The Chinese bond market is primarily driven by domestic factors and is one of the least sensitive to U.S. interest rates, unlike EM local rates which are highly sensitive to U.S. rate cycles due to their high dependence on U.S. dollar inflows. Table 25.3 illustrates the low correlation to those of China sovereign bonds with U.S. treasuries, EUR treasuries, and to a lesser degree with other EM fixed income markets.

As China continues with its capital market liberalization and opens up to foreign investors, the correlation of its asset performance with that of the developed world may gradually rise, but fundamentally the diversifying factors should endure.

Overall because of the RMB's entry into the SDR basket, global indices inclusions, and the rapid opening up of its domestic financial markets to international private and public investors, China government bonds offer a good vehicle to diversify one's portfolio without adding significant credit risks.

[13] International Monetary Fund Global Debt Database, as of 2017.

Table 25.3 Correlation of China government bond with major fixed income assets, 2009–2018

	Ching Govt and Policy Bank Bonds	U.S. Treasuries	EUR Treasuries	Asia Local Currency Bonds	EM Local Currency Bonds
China Govt and Policy Bank Bonds		0.14	0.29	0.49	0.31
U.S. Treasuries	0.14		0.19	0.35	0.18
EUR Treasuries	0.29	0.19		0.61	0.72
Asia Local Currency Bonds	0.49	0.35	0.61		0.92
EM Local Currency Bonds	0.31	0.18	0.72	0.92	

* As represented by the following indices: Bloomberg Barclays China Treasury and Policy Banks 1–10 Years Index Unhedged USD; Citi USBIG Treasury Index; Bloomberg Barclays Euro Aggregate Treasury Total Return Index Value Unhedged USD; iBoxx ABF Pan-Asia Unhedged Total Return Index; Bloomberg Barclays EM Local Currency Government TR Index Unhedged USD

Source: Bloomberg, as of December 2018

As represented by the following indices: Bloomberg Barclays China Treasury and Policy Banks 1–10 Years Index Unhedged USD; Citi USBIG Treasury Index; Bloomberg Barclays Euro Aggregate Treasury Total Return Index Value Unhedged USD; iBoxx ABF Pan-Asia Unhedged Total Return Index; Bloomberg Barclays EM Local Currency Government TR Index Unhedged USD
Source: Bloomberg, as of December 2018

25.7 China Onshore Equities (A-Shares)

China's structural reform has passed its 40-year mark in 2018. Over this period, China's economic development has been remarkable. From a U.S. $219 billion economy, the country is now the world's second-largest economy at U.S. $12 trillion.[14] Although economic growth may be challenged by headwinds like trade uncertainty and a deleveraging program, the country's commitment to pursue market-based reform and policy actions will likely remain a constant for the foreseeable future.

25.7.1 China's Commitment to Pursue Market-Based Reform Will Be A Key Driver of its Equity Market

China's private sector contributed more than half of the nation's tax revenues, 60% of its GDP and fueled 70% of China's technological innovation. The private sector also provided 80% of the country's urban employment and 90% of its business and job creation. It is also the growth and return engine in the equity market. China's structural growth and equity return prospects will be tied to its commitment to support privately owned enterprises (POE) and pursue market-based reform. Chinese President Xi Jinping has promised "unwavering support" for private businesses.

[14] Goldman Sachs Portfolio Strategy Research, as of November 2018.

Chinese policy makers have identified multiple ways of aiding private enterprises, including easing taxation and administration costs, and helping private firms to source financial help. China's State Administration of Taxation (SAT) works with other government agencies to roll out targeted policies such as encouraging local governments to give private firms reduced taxes or tax holidays; and allowing businesses with sound tax-paying records to secure loans without the need to pledge collateral. Such policy initiatives towards private firms should help sustain private sector growth and provide support to corporate earnings.

25.7.2 Market Access Has Been Significantly Liberalized

There are multiple ways to access the China onshore equities market. As noted earlier, QFII allows qualified foreign participants to make investments in Mainland China's financial markets by remitting foreign currency into China and obtaining RMB onshore. RQFII, as an extension of QFII, enables participants from approved international domiciles to invest in Mainland China by sourcing RMB offshore. To participate in the onshore equities market, investors must receive a QFII or RQFII license from the China Securities Regulatory Commission (CSRC) and apply for an allocation of investment quota. This process has been significantly simplified and shortened, and limitations on eligibility, quota, and investment scope have also been lifted over the years. Table 25.4 summarizes some important reforms in 2016 and 2018 as an illustration of the pace of reform.

In February 2019, CSRC announced that it has begun to consult public opinion on new rules that will combine the QFII program and the RQFII program. The draft rules also loosen market access, expand the scope of investments, and enhance oversight, according to the CSRC. Regulators will also lower the threshold for overseas applicants and simplify the vetting process. The combining of the two schemes and related de-regulations aim to incentivize the growth of long term, overseas capital. These measures were followed by additional liberalization steps in May 2020. The People's Bank of China and State Administration of Foreign Exchange removed the quota mechanism for QFII and RQFII and increased flexiblity in currency management as well as introduced options to appoint multiple custodians. These new rules will take effect from June 2020.

Other than QFII and RQFII, foreign investors can access Mainland China's equities markets via Stock Connect whose orders are executed through the Hong Kong Stock Exchange. A-share securities eligible for Northbound trading via Stock Connect represent roughly 83% of the market capitalization and 74% of the average daily trading value for securities traded on the Shanghai Stock Exchange (SSE), and 75% and 70%, respectively, for securities traded on the Shenzhen Stock Exchange (SZSE) (Table 25.5). As a part of China's liberalization efforts, the Stock Connect daily trading quotas have been quadrupled to RMB 52 billion for Northbound trading in 2018. Heretofore, the offshore market represented mainly by H-shares, Red chips, and US ADRs used to be better-known and more accessible, but many

Table 25.4 QFII/RQFII accessibility enhancements

Year	Policy revisions
2016	1. Removed the total investment quota limit for each QFII/RQFII and introduced a "base quota" mechanism 2. Simplified the administration of quota approval 3. Removed the required time frame for QFIIs to make inbound remittance of investment principal 4. Allowed daily remittance and repatriation for QFII open-ended funds 5. Shortened the lock-up period for QFIIs/RQFIIs from 1 year to 3 months
2018	1. Removed the monthly fund repatriation limit of 20% of the previous year's total onshore assets for QFIIs 2. Canceled the three-month investment principal lock-up periods in respect of QFII/RQFII investors 3. Allowed QFII/RQFII participants to perform forex hedging with onshore investments

Source: Shanghai Stock Exchange, SAFE
Prior to this, investors of all cross-border schemes (QFII, RQFII, and stock connect) were only able to hedge foreign exchange risks with freely floating offshore RMB (CNH)

Table 25.5 Key features of northbound connect

		Shanghai northbound connect	Shenzhen northbound connect
Eligible stocks	Quantity	577 (one single board)	903 (main: 274, SME: 431, ChiNest:198)
	Market capitalization	RMB 26.9 trillion (83%)	RMB 17.4 trillion (75%)
	Average daily trading value	RMB 169 billion (74%)	RMB 176 billion (70%)
Quota	Aggregate quota	Removed	None
	Daily quota	RMB 52 billion	RMB 52 billion

Source: HKEX Investor Presentation, as of May 2018
SZ Northbound: Constituents of SZSE Component & SZSE Small/Mid Cap Innovation indexes with market capitalization of at least RMB 6 billion (average daily market cap in 6 months prior to the periodic review of relevant index, i.e., 1 May 2016 to 31 Oct 2016, to be reviewed half-yearly), and SZSE-SEHK A + H shares (except shares under "risk alert" or delisting arrangement)

private and public sector investors are now recognizing the opportunities the onshore market can provide. In addition to being bigger, deeper, and faster-growing compared to the broad H-share, Red chips, and US ADRs market, the A-share market contains the most dynamic emerging Chinese companies in the consumer, health care, and industrial sectors. An allocation to China onshore equities would capture a broader cross section of China's growth engines.

25.7.3 Local Equity Demand Will Be Supported by Larger Weightings in International Equity Indices

At U.S. $6 trillion in market capitalization, China's equity market is the world's second largest with more than 3000 publicly traded companies listed across a variety of sectors.[15] Recent liberalization efforts, including the launch of the Stock Connect program and the lifting of market restrictions imposed on foreign investors, demonstrate China's desire to open up its capital markets. Such efforts have also been recognized by index compilers such as MSCI which implemented an initial 5% inclusion of China A-shares in its MSCI Emerging Market Index in August 2018. Since the announcement of this inclusion, more than 7300 new Stock Connect accounts have been opened and the aggregate Northbound Connect flow value has grown by U.S. $84 billion.[16] In February 2019, MSCI announced an increase in the weight of China A-shares in the MSCI Indexes by increasing the inclusion factor from 5% to 20% in three steps, with the weighting of Chinese A-shares ultimately rising to 3.3% of the MSCI Emerging Markets (EM) Index in November 2019 from the current 0.72%. By the time the full integration of A-share market in the MSCI EM index is finished, China may likely represent more than 40% of the entire index (Fig. 25.11) and may have attracted more than U.S. $350 billion of capital inflows.[17] Separately, FTSE has also announced its intention to allocate a pro-forma weight of 5.6% to China A-shares in its EM index at March 2020. These ongoing increases in benchmark weightings should induce significant portfolio inflows into the onshore market.

As noted above, index compilers such as MSCI have started including China onshore equities in their flagship indices after positive validation of China's onshore market accessibility. However, any future weighting increase of China A-shares in global indices beyond current levels will likely require further alignment of this market's accessibility standards with the rest of the world. For example, the limited availability of listed futures and other derivatives products to foreign investors hampers their ability to manage risk and gain exposure beyond the cash market. This problem could become even more pronounced in case of a larger scale inclusion. The shorter settlement cycle of China A-share market[18] also induces operational risk and tracking challenges. Although Stock Connect currently presents market solutions for "buy" trades using pre-funding on T + 1/2 Delivery Versus Payment (DVP)/Real-time DVP (RDVP), the corresponding problem for "sell" trades remains unresolved. The short settlement cycle leaves little time for investors to validate sell orders, especially for those based outside Asian time zones. In the onshore universe,

[15] As of 28th February 2019.

[16] MSCI, HKEX, as of February 2019.

[17] Source: UBS: China Equity Strategy, as of May 2018. Estimated based on free float market cap of A-share stocks to be included and a 30% upper limit of foreign ownership.

[18] China currently operates on a T + 0/1 non-delivery versus Payment (non-DVP) settlement cycle. Almost all other markets in the MSCI AWCI operate on a T + 2/T + 3 DVP settlement cycle.

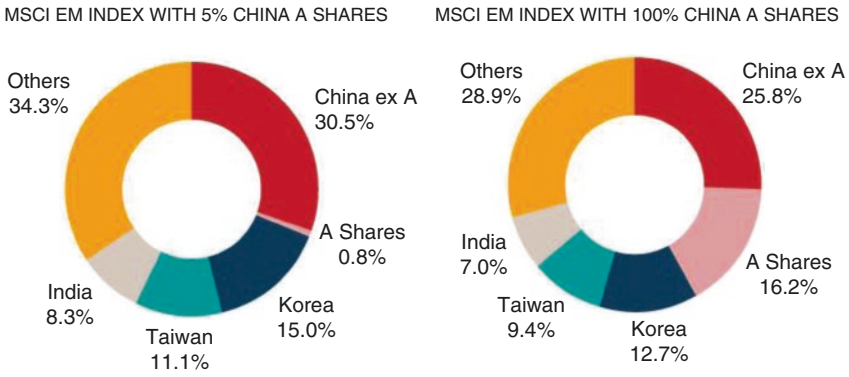


Fig. 25.11 Partial/complete inclusion of China A-shares into MSCI EM index. Source: MSCI

while short selling is technically allowed, there is no functioning stock lending and borrowing market. This hampers investors' ability to implement their investment views. Investors also look for direct access to CNY for a more efficient settlement of stocks. Other accessibility issues that remain include trading suspensions, misalignment of onshore and Stock Connect trading holidays, lack of access to initial public offerings (IPOs) and exchange traded funds (ETFs).

China has demonstrated a commitment to opening its capital market at a faster pace, especially in the past 5 years. The greater accessibility has resulted in a 5% inclusion of China A-shares into the MSCI Emerging Markets Index in 2018. The initial inclusion was successfully implemented without any investability issues, which provided positive evidence for an increase in the inclusion factor from 5% to 20% in 2019. However, if the index weight of China A-shares were to be further increased, investors would need to be allowed greater access to the broader onshore market for better risk management and expression of investment views. Accessibility standards such as settlement cycles would need to be aligned with the rest of the world. Based on the pace of liberalization, market participants can take the view that Chinese authorities see the benefits of further opening up the onshore capital markets and wider integration with global capital markets.

25.7.4 China Onshore Equities: A Favorable Diversifier for a Global Equity Portfolio

China's growth is mainly driven by its domestic economy. Companies listed on the A-share market derive 86% of their revenues from inside China and only 14% from abroad. In general companies are much more domestically focused than the U.S. (29% of sales outside the USA) and Europe (45% outside the Eurozone). Changes

Table 25.6 Average correlation of weekly U.S. dollar returns (Jan 2005 —Dec 2016)

	MSCI China H-Share Index	MSCI EM Index	MSCI World Index
MSCI China A-Share Index	0.50	0.28	0.17
MSCI China H-Share Index		0.82	0.63
MSCI EM Index			0.85

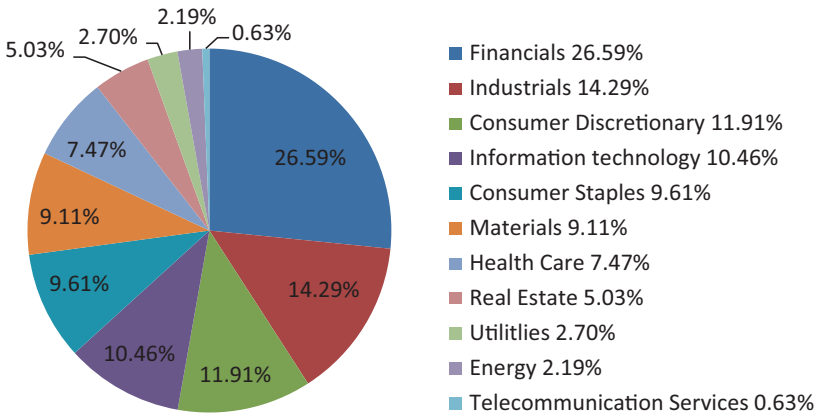
Source: Man Numeric, Bloomberg

in conditions overseas have relatively less influence on China asset prices compared to the rest of the world. This relationship in turn implies that the onshore market provides significant diversification from both developed and emerging markets. In statistical terms, the average correlation of the MSCI China A-Share Index with the MSCI Emerging Markets. Index and the MSCI World Index since 2005 has stayed below 0.3 and 0.2, respectively (Table 25.6).

It is note-worthy that China A- and H-shares are indeed only moderately correlated, though driven by the same economy. One reason for this is that the sector distribution of A-shares is more diversified than for H-shares, as well as for the broader emerging markets. The onshore market encompasses a greater variety of industries including machinery and construction, pharmaceuticals, consumer staples like baijiu (premium liquor) (Fig. 25.12), while the offshore H-share market is principally occupied by banks, internet software, and telecom services providers. Thus portfolios with China onshore focus are more balanced in terms of sector exposure and hence are more protected from shocks to specific sectors.

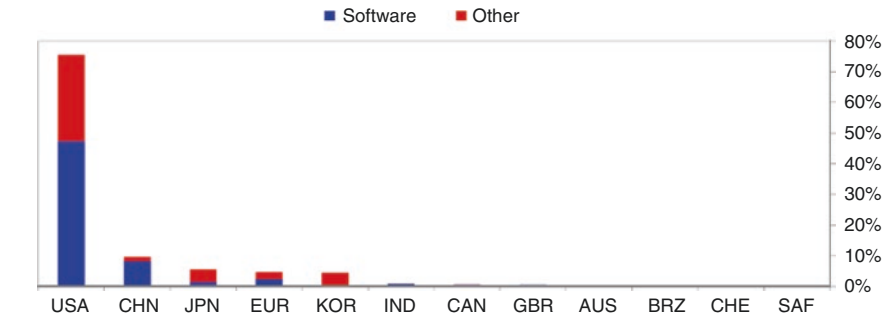
In addition to being a broader representation of the Chinese economy, the onshore equity market is also going through an important transition in favor of "new economy" sectors. The shift to a more consumer-driven and technology-led growth economy opens up opportunities for global investors. At present, China's tech sector market capitalization relative to its market size is second only to the U. S. (Fig. 25.13). In fact, China has already surpassed the latter in terms of the U.S. dollar volume of e-commerce transactions and mobile-based payments. It is also a leader in emerging economies for venture capital (VC) investment with the second largest share of global "unicorns." VC investment in China reached a record high in excess of U.S. $40 billion in 2017.[19] Going forward, the TMT (technology, media, and telecommunications) sector is expected to remain a key driver of the A-share IPO market. Meanwhile, continuing urbanization and the rise of the middle class will support the growth in consumer facing firms.

[19] Source: KPMG.



Source: MSCI, as of July 2018

Fig. 25.12 MSCI China A Onshore Index sector composition. Source: MSCI, as of July 2018



Source: Bridgewater Daily Observations, 23rd January 2018

Fig. 25.13 Distribution of global tech market cap (% of Information Technology Market Cap). Source: Bridgewater Daily Observations, 23rd January 2018

25.8 Concluding Thoughts

When we look into China's economy and its financial markets, we can see the need for further market opening initiatives (e.g., capital market institutionalization). At the same time, the country's asset markets in terms of their size and breadth as well as their return drivers (such as political stability and coordinated reform initiatives) have attractive attributes. This divergence gives rise to a mixed set of opportunities and risks. In the near term, Chinese growth will continue to face several headwinds including high system-wide leverage, fading credit impulses, trade tensions, and recovery from the virus pandemic. To date policy makers have undertaken coordinated reform steps which aim to stabilize its economy and financial markets.

An abiding concern among investors centers around China's high system-wide leverage. China's total debt[20] is currently over 250% of GDP. This level of indebtedness suggests limited room for further credit-induced growth. Since 2016, China's targeted tightening has been able to address areas of financial leverage and shadow bank lending without meaningfully reducing banks' lending to the real economy. Recent pressures on growth have prompted China's authorities to adjust the pace of deleveraging the economy and de-risking the financial sector. While system-wide leverage is an important barometer of risk, the country's economic fundamentals suggest an overall attractively priced credit profile. China has gross domestic savings totaling almost 50% of GDP. In addition the country benefits from large foreign reserve of U.S. $3 trillion, exceeding China's external debt. These financial resources could be used by the government to address external funding stresses facing its banking sector. China's relatively closed capital account allows its government to restrict capital outflow. These factors suggest China has substantive policy levers to address financial imbalances.

The volatility of China's financial market is likely to continue. We expect uncertainties around trade and tariffs to continue to slow economic growth and contribute to market volatility, particularly in the lead up to the 2020 U.S. election. Recently, we have seen policy makers taking gradual steps to offset market weakness—slowing regulatory tightening, increasing liquidity and monetary support, encouraging banks to lend to small enterprises, and accelerating targeted fiscal spending on infrastructure. China has relatively more room to conduct monetary easing compared to other developed economies since it is starting from a level of higher interest rates. The government is also putting into practice policies that aim to structurally change the stock market such as mixed ownership reforms of State Owned Enterprises, policy support for bond and equity issuance for Privately Owned Enterprises, which measures will be beneficial to the healthy development of its capital markets.

Fluctuation in the value of the Chinese currency is also an important risk in investing in the onshore market. While the RMB will remain sensitive to trade developments, fundamentally, the RMB should remain relatively stable on a trade-weighted basis given China's trade surplus and its status as a reserve currency.

The onshore Chinese fixed income and equity markets are developing quickly and exhibit many of the characteristics of expanding capital markets in earlier periods. Chinese onshore assets exhibit low correlation to other global asset classes and thus provide substantial diversification benefits. Higher yielding RMB government bonds provide carry to portfolios and A-share equities provide exposure to a different kind of growth asset. China is transitioning from a global exporter to a domestic consumer while emerging as a leader in many technological aspects. This economic rebalancing will create investment opportunities which should be reflected in its equity markets. Overall, Chinese financial markets are large, liquid, and readily accessible to global investors. With careful consideration of the unique risks and

[20] Inclusive of government, household, corporate, and bank debts. Source: Bloomberg Economics estimates, as of April 2018.

characteristics of the Chinese markets, the addition of Chinese onshore equities and government bonds to a central bank portfolio can help central banks keep pace with the evolution of global benchmark indices in which the inclusion of Chinese assets is gradual and sustained. It also allows central banks and official institutions to diversify their exposure with a broader set of investment factors. Offical institutions should consider, if they have not done so already, gaining exposure to China onshore assets in their portfolios.

Chapter 26
Responsible Investment and Central Bank Asset Management

Archie Beeching, Anna Georgieva, and Justin Sloggett

Abstract Over the last decade, responsible investment—the consideration of environmental, social and governance (ESG) issues in investment decision-making—has spread widely throughout the financial sector. Its adoption is due to its perceived usefulness in identifying risks and opportunities, particularly among larger asset owners, support from regulators and a vigorous supply-side response from investment service providers. Approaches pursued by investors include negative screening, thematic investing, ESG integration and active ownership. This chapter reviews recent trends in responsible investment and discusses how institutional investors are applying its techniques to both directly managed and third party-run portfolios. For the former, approaches vary by asset class. Responsible investment practices are more developed for listed equity, but they are becoming increasingly applied in corporate and sovereign fixed income and alternative investment markets. For indirectly managed portfolios, responsible investment practice is focused on managing the relationship between the asset owner and the investment manager to ensure the former effectively communicates expectations, and the latter is able to deliver against them.

26.1 Introduction

The adoption of the key concepts and practices of responsible investment by institutional investors has been one of the most striking developments in finance over the last decade. The Principles for Responsible Investment was launched in 2006. Since then, 2000 institutional investors and related service providers, representing over

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J. Bjorheim (ed.), *Asset Management at Central Banks and Monetary Authorities*, https://doi.org/10.1007/978-3-030-43457-1_26

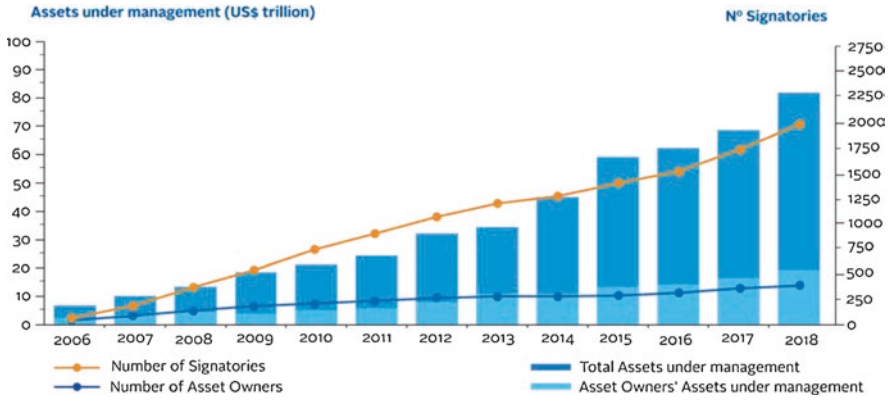

Fig. 26.1 PRI signatory growth since inception. PRI (2019) About the PRI. PRI website https://www.unpri.org/pri/about-the-pri

Table 26.1 The Six Principles for Responsible Investment

The principles for responsible investment are a voluntary and aspirational set of investment principles that guide possible responsible investment activities. Signatories commit to the following six principles:
Principle 1: We will incorporate ESG issues into investment analysis and decision-making processes
Principle 2: We will be active owners and incorporate ESG issues into our ownership policies and practices
Principle 3: We will seek appropriate disclosure on ESG issues by the entities in which we invest
Principle 4: We will promote acceptance and implementation of the principles within the investment industry
Principle 5: We will work together to enhance our effectiveness in implementing the principles
Principle 6: We will each report on our activities and progress towards implementing the principles

US$80trn of assets, have signed their commitment to the six Principles for Responsible Investment (see Fig. 26.1 and Table 26.1). In 2018, PRI signatories reported that they apply responsible investment strategies to 87% of the US$54.8trn of assets they directly manage.[1,2]

The following chapter provides an introduction to responsible investment, explores trends within this fast-evolving field and offers guidance as to how institutional investors—including central banks—might go about applying responsible investment in practice. It is worth noting that, although a number of central banks,

[1] PRI (2018) Annual Report. Available online https://www.unpri.org/annual-report-2018/blueprint-actions/responsible-investors/support-investors-incorporating-esg-issues.

[2] See also Chap. 2.

including the Bank of England and Banque de France, have been active in promoting responsible investment among the institutions they oversee as financial regulators, our discussion focuses on central banks' management of financial assets that fall under their direct control as investors.

26.1.1 Overview of Responsible Investment

Responsible investment is an approach to investment that incorporates environmental, social and governance (ESG) factors into investment decisions, with the aim of better managing risk and generating sustainable, long-term returns. There is no definitive 'ESG checklist' of factors that might be material to the way a company performs or its ability to repay bondholders. Instead, it is better to think of ESG as a framework through which to identify potential risks and opportunities in a systematic way. There are many different ways investors can consider ESG factors from both a top-down or bottom-up analytical position. Frequently analysed ESG factors are similar for shareholders and corporate bondholders, although the ways in which they may be material will typically vary depending on their sectoral or regional context and in the case of fixed income, their maturity. Table 26.2 shows a list of ESG factors commonly considered by equity and corporate bond analysts as part of their ESG analysis.

The common understanding of the key concepts of responsible investment has evolved since the 1980s when it focused mostly on excluding investments that were not aligned with investors' ethical concerns, was essentially a retail investment proposition, and was largely restricted to listed equity investments. Common exclusions were (and still are for many 'socially responsible' funds) linked to company products and services associated with the so-called sin stocks such as tobacco, alcohol, pornography, nuclear energy and weapons.

The practice has developed into a more holistic approach that is not limited to ruling out investment in any sector or company, but instead aims to take into account ESG factors that are likely to be material to the financial performance of a company (and/or fiscal performance of a government-related issuer) and therefore risk-

Table 26.2 ESG factors commonly considered in investment decisions

Environmental issues	Social issues	Governance issues
Climate change	Labour relations	Shareholder rights
Biodiversity	Human rights	Incentives structure
Energy resources and management policy	Community/stakeholder relations	Audit practices
Biocapacity and ecosystem quality	Product responsibility	Board expertise
Air/water/soil pollution	Health and safety	Board independence
Natural resources management	Diversity	Financial policy
	Consumer relations	Business integrity
	Access to skilled labour	Transparency and accountability

adjusted returns for investors. This broader approach can be applied to all asset classes, including alternatives, and has been embraced far beyond retail investors to some of the world's largest institutional investors.

26.1.2 Drivers for Growth in Responsible Investment Activity

26.1.2.1 Recognition that ESG Issues Can Be Material to Investment Performance

Responsible investment has gained in popularity largely due to the growing recognition that analysis of ESG factors can reveal potentially material risks and opportunities. One stumbling block for responsible investment has been the misconception that considering ESG factors might limit the investment universe and ultimately impact returns—which in turn will conflict with investors' fiduciary duty. The general consensus among investors and policy makers is that ESG considerations can in fact help investors to fulfil their fiduciary duty as it provides investors with greater insights into risks.[3] It also speaks to wider concerns within the financial community and society more broadly about the impact of short-termism on corporate behaviour and performance; about the stability and transparency of the financial system, prompted particularly by the global financial crisis of 2008–2009; and about the financial sector's role in delivering financial services that add value to the wider economy.

26.1.2.2 Larger Asset Owners Are Showing Demand

More directly, the growth of responsible investment has been driven by demand for responsible investment products and services from asset owners such as pension funds, insurance companies, central banks and sovereign wealth funds which sit at the top of the investment chain. This demand has been driven in part by growing recognition that responsible investment can provide insight into investment risks and opportunities, particularly over longer time horizons. Another part is in response to growing demand from their ultimate beneficiaries, many of whom are increasingly concerned about the environmental and social impacts of their investments. In the context of the burgeoning use of social media, investor concerns about protecting their own reputation are also encouraging a 'do no harm' mentality.

[3] There is a growing body of academic and practitioner research that argues the case that ESG integration can enhance investment returns and/or help monitor and manage risk. See Table 27.3 for a list of prominent studies.

26.1.2.3 The Regulatory Landscape Is Becoming more Favourable towards Responsible Investment

The policy and regulatory landscape relating to ESG factors has also changed dramatically since the 2008–2009 financial crisis. Financial market regulators, including central banks, are urging financial institutions to address economic uncertainty driven by climate change. Meanwhile policy makers around the world have introduced measures such as stewardship codes, anti-corruption legislation and disclosure requirements that have served to support the development of responsible investment.[4] Below, a selection of initiatives are listed (as of November 2018).

- At a major international summit in Paris at the end of 2017—marking two years since the forging of the UN's landmark Paris Agreement on climate change—eight financial regulators set up the Central Banks and Supervisors Network for Greening the Financial System (NGFS). Its goal is to 'help strengthen the global response required to meet the goals of the Paris agreement and to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development'.[5] The NGFS published its first progress report in October 2018.[6]
- Bank of England governor Mark Carney was instrumental in establishing the Task Force on Climate-related Financial Disclosures (TCFD), under the auspices of the Financial Stability Board, which has set out voluntary guidelines to help companies and investors disclose comparable information on the climate-related risks they face.[7]
- Dutch central bank De Nederlandsche Bank (DNB) published a report on the climate risks affecting the Dutch financial sector.[8] DNB has also published an energy transition stress test for its domestic economy.[9] In March 2019, DNB became the first central bank to sign the Principles for Responsible Investment.[10]

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[4] A map of global responsible investment policy is available at the PRI Regulation Map. Available online: https://www.unpri.org/sustainable-markets/regulation-map.

[5] Banque de France (2017) *Network for Greening the Financial System*. Available online https://www.banque-france.fr/en/financial-stability/international-role/network-greening-financial-system.

[6] NGFS (2018) First Progress Report. Available online https://www.banque-france.fr/sites/default/files/media/2018/10/11/818366-ngfs-first-progress-report-20181011.pdf.

[7] TCFD (2017) *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Available online https://www.fsb-tcfd.org/publications/final-recommendations-report/.

[8] De Nederlandsche Bank (2017) *Waterproof? An exploration of climate-related risks for the Dutch financial sector*. Available online https://www.dnb.nl/en/binaries/Waterproof_tcm47-363851.pdf?2017100609.

[9] De Nederlandsche Bank (2018) An energy transition risk stress test for the financial system of the Netherlands. Available online https://www.dnb.nl/binaries/OS_Transition%20risk%20stress%20test%20versie_web_tcm46-379397.pdf?2018111516.

[10] De Nederlandsche Bank (2019) Press release: DNB first central bank to sign the Principles for Responsible Investment. Available online https://www.dnb.nl/en/news/news-and-archive/Persberichten2019/dnb382879.jsp.

- In March 2018 Banque de France published a responsible investment policy that covers assets managed for its retirement fund and its internal treasury funds.[11]
- Early in 2018, the Central Bank of Ireland awarded its first ever external investment management mandate, of €240 m, to French asset manager Amundi, in a process that was restricted to PRI signatories.[12]
- In June 2018, Mario Draghi, president of the European Central Bank (ECB), wrote to MEPs to set out the ECB's position on sustainable finance. He stated that the bank's pension funds invest in assets 'that allow for different approaches to incorporate environmental, social and governance considerations', and that 'further ways of incorporating ESG principles into the management of other ECB euro-denominated non-monetary policy portfolios are currently being investigated'. He added that some Eurosystem central banks are examining, or have introduced, methods of applying responsible investment for their non-monetary policy portfolios, without elaborating.
- In the same month, the governor of the Bank of Finland announced that the bank had decided to apply responsible investment standards to the management of its investment portfolio.[13] Among other things, that involves investing in green bonds and only buying securities issued by entities who comply with the UN Global Compact.

As governments show ever more interest in addressing issues such as climate change, it seems likely that the asset management functions of central banks will increasingly be in the spotlight to reflect such moves via their investment decisions. They may face calls to align investments with climate-related Nationally Determined Contributions (NDCs) or commitments to the UN's 17 Sustainable Development Goals.

26.1.2.4 The Financial Sector Is Responding

As demand grows among investors for ESG information, products and services, capital markets are responding at many different levels:

- Investment managers have innovated in anticipation of and response to demand from their clients and regulators.
- Stock exchanges are increasingly requiring, to varying degrees, that listed companies disclose ESG information: 75 stock exchanges, including nearly all the

[11] Banque de France (2018) Responsible Investment Charter of the Banque de France. Available online https://www.banque-france.fr/sites/default/files/media/2018/03/29/818080_-charte-invest_en_2018_03_28_12h12m41.pdf.

[12] Responsible Investor (2018) Irish central bank awards €240 m responsible investment equities mandate to Amundi. Available online https://www.responsible-investor.com/home/article/irish_central_bank_amundi/.

[13] BIS (2018) Climate change and green finance. Available online https://www.bis.org/review/r180725b.htm.

world's major bourses, are members of the Sustainable Stock Exchanges initiative.[14]
- Data providers such as Bloomberg, FTSE, MSCI, S&P Global, and Thomson Reuters provide a growing range of ESG indexes and corporate data, analysis and ratings products.
- Credit rating agencies are increasingly incorporating ESG data into their assessment of issuer creditworthiness.[15]

This greater availability of ESG information and analysis has, in turn, helped to increase the efficacy of responsible investment approaches (Table 26.3).

26.2 Trends in Responsible Investment Approaches

A variety of approaches to responsible investment have emerged in recent years driven by different objectives (i.e. do no harm, manage financial risk, seek outperformance); regional investment cultures (relating to corporate governance, historic trends relating to transparency and investor collaboration); or different political contexts (e.g. regarding the willingness to tackle climate change). It stands to reasons that organizations that invest directly in companies have a different role to play relative to those that outsource their investment management to third-parties (see Table 26.4).

Responsible investment approaches can be categorized into three core areas.

- *Incorporating ESG* analysis into investment decisions via positive or negative screening (exclusions), thematic investments and ESG integration.
- *Engagement* or stewardship whereby investors leverage their influence as owners (including shareholder voting) or lenders to encourage changes in company/bond issuer behaviour in order to manage ESG risks and opportunities.
- *Investee and investor transparency* to improve the flow of ESG information up the value chain from company to investor to beneficiaries allowing for more informed decision-making.

Below we outline investor trends relating to ESG incorporation and engagement. Figure 26.2 shows how PRI signatories combine different ESG incorporation

[14] The Sustainable Stock Exchanges Initiative (2018) Website http://www.sseinitiative.org/about/about-the-sse/.

[15] For an in-depth discussion of the state of ESG integration within fixed income investing and among credit rating agencies, see https://www.unpri.org/credit-ratings.

Table 26.3 Practitioners' research on the investment case for ESG

Firm	Title	Asset class	Main findings
Deutsche Asset and Wealth Management	ESG and corporate financial performance: mapping the global landscape	Across asset classes	Analysis of around 2250 of studies of the relationship between ESG factors and corporate financial performance (CFP) found 62.6% of meta-studies showed a positive relationship. Only 10% of the studies display a negative ESG-CFP relationship
Bank of America Merrill Lynch	Equity strategy focus point: ESG: Good companies can make good stocks	US stocks	ESG scores can help predict bankruptcies: An investor who only held stocks with above average-ranks on both environmental and social scores would have avoided 15 of 17 bankruptcies seen since 2008. ESG scores shown to be strongly correlated with companies' future earnings volatility
AQR Capital Management	Assessing risk through environmental, social and governance exposures	US, world ex-US and emerging market stocks	Stocks with worst ESG exposures found to have total and stock-specific volatility up to 10–15% higher, and betas up to 3% higher, than stocks with the best ESG exposures
Barclays Research	Sustainable investing and bond returns: Research study into the impact of ESG on credit portfolio performance	US investment-grade corporate bonds	A positive tilt towards corporate bonds from issuers with higher ESG scores resulted in a "small but steady performance advantage". No evidence of a negative performance impact was found
Hermes Investment Management	Pricing ESG risks in credit markets	North American and European corporate bonds	Companies with the lowest ESG scores tend to have the widest credit default swap spreads and broadest distributions of average annual credit default swap spreads
Allianz Global Investors	Financial materiality of ESG risk factors for sovereign bond portfolios	Sovereign debt	The study found an inverse relationship between countries' ESG risk scores and their credit default swap and/or bond spreads. Developed and emerging country issuers with better ESG scores benefit from lower borrowing costs

Deutsche Asset & Wealth Management (2015). *ESG & Corporate Financial Performance: Mapping the global landscape*
Bank of America Merrill Lynch (2016). *Equity strategy focus point: ESG: good companies can make good stocks*
AQR Capital Management (2017). *Assessing Risk Through Environmental, Social and Governance Exposures*. https://www.aqr.com/-/media/files/papers/aqr_assessing-risk-through-environmental-social-and-governance-exposures.pdf
Barclays Research (2016). *Sustainable investing and bond returns: Research study into the impact of ESG on credit portfolio performance*. https://www.investmentbank.barclays.com/content/dam/

(continued)

Table 26.3 (continued)

barclaysmicrosites/ibpublic/documents/our-insights/esg/barclays-sustainable-investing-and-bond-returns-3.6mb.pdf?pwm=87
Hermes Investment Management (2017). *Pricing ESG risks in Credit Markets*. https://www.hermes-investment.com/ukw/wp-content/uploads/sites/80/2017/04/Credit-ESG-Paper-April-2017.pdf
Allianz Global Investors (2017). *Financial materiality of ESG risk factors for sovereign bond portfolios*. https://uk.allianzgi.com/en-gb/institutional/insights/esg-matters/2017-07-25-financial-materiality-of-esg-risk-factors-for-sovereign-bond-portfolios

Table 26.4 Responsible investment approaches and invested assets (based on signatory data reported in 2018)

Responsible investment approaches	Listed equity, actively managed (US$trn)	Fixed income, actively managed (US$trn)	Total (US$trn)
Integration	7.4	8.2	15.6
Screening	1.1	2.5	3.6
Thematic	0.1	0.5	0.6
Screening and integration	4.4	8.5	12.9
Thematic and integration	0.4	0.1	0.5
Screening and thematic	0.1	0.2	0.3
All three combined	1.8	2.2	4
No ESG/not reported	1.3	4	5.3
Total (US$trn)	16.6	26.2	42.8

approaches.[16] In addition, it shows that different ESG incorporation approaches can be complementary.[17]

26.2.1 Negative/Positive Screening and Thematic Investing

Screening approaches involve either excluding companies or sectors from an investment universe, based on their involvement in economic activities deemed unethical (negative screening) or, conversely, identifying a universe of potential investments based on their involvement in economic activities deemed desirable because of strong ESG performance (positive screening).

Screening is implemented through the application of policy that reduces the investment universe. The policy is applied at either the investment firm or the fund level. Typically, screening is implemented before any investment analysis takes place, and is therefore complementary with ESG integration.

[16] Based on PRI signatories that report on their listed equity holdings and fixed income holdings as part of the PRI's annual Reporting & Assessment process—a mandatory requirement for all PRI signatories.

[17] PRI (2018). Annual Report 2018. https://www.unpri.org/annual-report-2018.

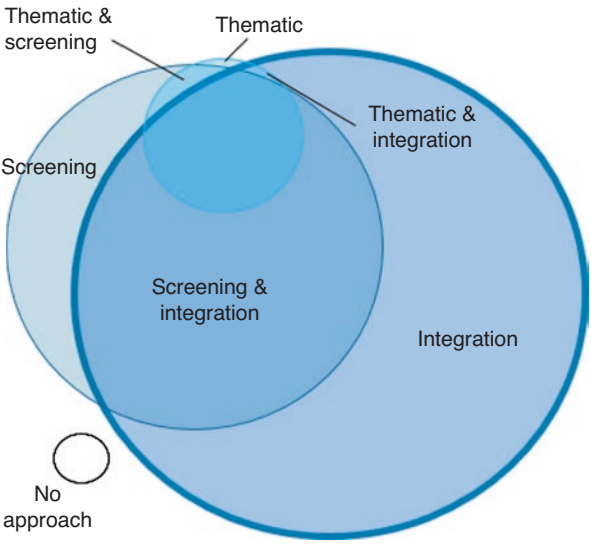

Fig. 26.2 Bubble sizes are for illustrative purposes

Common criteria for negative screening policies include absolute exclusions (e.g. exclude arms, tobacco, gambling); relative exclusions (e.g. exclude if 10% of revenue is derived from production or sales of arms, tobacco, gambling); and poor ESG management (e.g. companies with poor ESG scores or ratings or linked to major ESG controversies, such as pollution incidents or violations of bribery laws). A norms-based approach involves screening based on compliance with international standards and norms, such as the UN Global Compact's Ten Principles, the UN Guiding Principles on Business and Human Rights, and the OECD Guidelines for Multinational Enterprises.

Negative screening is also practiced by sovereign debt investors. Examples of absolute exclusion criteria include countries which practice the death penalty/torture, nuclear weapons proliferation, or have overarching shortfalls on their human rights and environmental protection policy. Relative exclusions focus on excluding sovereign issuers scoring below a certain threshold on their overall ESG performance.

Positive screening, meanwhile, seeks to identify companies that produce products and services that address social and environmental problems, or that demonstrate leading governance practices, or a combination. Positive screening is often combined with negative screens whereby negative screening is applied at a sector level and positive screening (i.e. best-in-class) is applied at an individual company level.

An alternative positive approach, best-in-class investing, involves investing in those companies from all industry sectors which score highest against ESG metrics. While this also reduces the investable universe, it allows investors to maintain exposure across the entire market, allowing for sector balance relative to the benchmark.

Thematic investment selects companies that provide products or services which make a positive contribution to specific ESG themes such as clean energy or water provision. Impact investing effectively uses positive screening processes to actively target companies or projects which deliver a measurable positive environmental and/or social outcome, with financial returns often (but not always) a secondary concern.

26.2.2 ESG Integration[18]

The PRI defines ESG integration as 'the explicit and systematic inclusion of ESG factors in investment analysis and investment decisions'. Investors use ESG integration techniques to uncover hidden risks that might otherwise remain undiscovered, or look for investment opportunities to enhance returns. For example, some practitioners analyse food retail companies to see how they are responding to trends in rising obesity and related policy shifts and factor this assessment into their revenue forecasts. It is the most common responsible investment approach applied by PRI signatories.

ESG integration typically has three components:

1. Research:
   - Information gathering, where investors source financial and ESG information from multiple sources (including, but not limited to, company reports and third-party investment research).
   - Materiality analysis, where relevant financial and ESG information is assessed to identify material financial and ESG factors affecting a company, sector and/or country.
   - Active ownership assessment, where investors include discussion of material ESG factors with companies/issuers and monitor the outcome of engagement and/or voting activities.
2. Security and portfolio analysis, where investors assess the potential impact of material financial and ESG factors on the investment performance of a company, sector, country and/or portfolio. This can lead to adjustments to their forecasted financials, valuation-model variables, valuation multiples, forecasted financial ratios, internal credit assessments and/or portfolio weightings.
3. Investment decision, where the material financial and ESG factors identified and assessed influence decisions to either buy/increase weighting, hold/maintain weighting, sell/decrease weighting or do nothing/not invest.

[18] This section draws upon the PRI publication: CFA Institute and PRI (2018). *Guidance and case studies for ESG integration: equities and fixed income*. Available online https://www.unpri.org/investment-strategy/guidance-and-case-studies-for-esg-integration-equities-and-fixed-income/3622.article.

26.2.3 *Active Ownership: Engagement and Voting*[19]

Another common responsible investment approach is active ownership involving investor engagement with current or potential investee entities and shareholder voting with the goal of influencing corporate ESG practices and/or improving ESG disclosure. It involves a structured process that includes dialogue and continuously monitoring companies and can be conducted at three levels:

- Direct engagement between investor and company.
- Collaborative engagement between multiple investors and a company or whole sector.
- Outsourced engagement carried out by an investment manager or specialized service provider.

Actively engaging with investee companies is one of the most effective mechanisms (for both passive and active investors) to manage ESG risks and encourage positive outcomes for society and the environment. When done effectively,

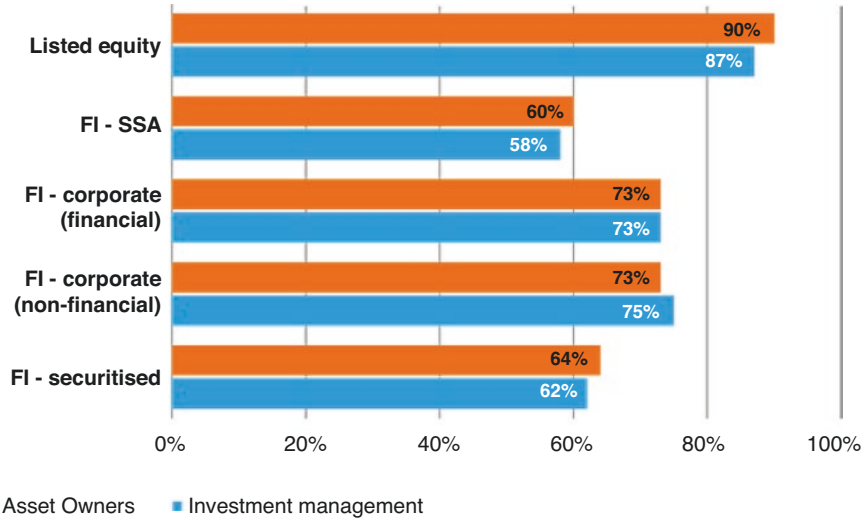

Fig. 26.3 PRI signatories that report engagement with their investee companies (listed equity and fixed income)—based on signatory data reported in 2018. PRI (2018). Annual Report 2018. Available online https://www.unpri.org/annual-report-2018

[19] This section draws upon the PRI publication: PRI (2018). *A practical guide to active ownership in listed equity*. Available online. https://www.unpri.org/listed-equity/a-practical-guide-to-active-ownership-in-listed-equity/2717.article and PRI (2018). *How ESG engagement creates value for investors and companies*. Available online https://www.unpri.org/esg-issues/how-esg-engagement-creates-value-for-investors-and-companies/3054.article.

engagement and proxy voting activities create value for both investors and companies, in terms of higher financial returns, enhanced communication, improved knowledge, stronger internal relationships and more integrated strategies.

While engagement practices were pioneered by listed equity investors, given the ownership rights and access to management accorded to shareholders, they are being increasingly adopted by investors in other asset classes—with corporate fixed income a primary focus due to the scale and importance of the world's debt markets. A growing number of PRI signatories engage with issuers across their fixed income holdings (Fig. 26.3).[20]

26.3 Applying Responsible Investment Techniques to Different Strategies and Asset Classes

Institutional investors have a choice to invest directly using in-house expertise, indirectly via external asset management firms, or via a combination of the two approaches.

26.3.1 Directly Managed Portfolios

While the fundamental concepts of responsible investment are common across different asset classes, the characteristics of listed equity, fixed income and alternatives investment strategies and markets are such that different approaches to responsible investment will be more appropriate or effective for each asset class.

26.3.1.1 Listed Equity[21]

ESG factors can be integrated throughout a listed equity portfolio, across the active-to-passive spectrum. As the level of human intervention and judgement changes from the active to passive approaches, so the application of integration techniques tends to move from the stock level to portfolio level.

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[20] PRI (2018). *ESG engagement for fixed income investors—managing risks, enhancing returns*. Available online https://www.unpri.org/fixed-income/esg-engagement-for-fixed-income-investors-managing-risks-enhancing-returns-/2922.article.

[21] This section draws upon the PRI publication: PRI (2016). *A practical guide to ESG integration for equity investing*. Available online https://www.unpri.org/listed-equity/a-practical-guide-to-esg-integration-for-equity-investing/10.article.

To achieve stock-level integration in quantitative and fundamental strategies, managers and analysts commonly adjust their forecasted financial statements and/or their models to reflect material ESG factors. Integrating ESG factors at the portfolio level is less practiced, but a small number of active managers apply this more advanced technique. Portfolio-level integration in enhanced passive, smart beta, quant and fundamental strategies requires managers to adjust the position size of shareholdings, in some cases to zero.

There are a variety of techniques available to integrate ESG factors across listed equity investment strategies. These include:

- *Fundamental or traditional strategies*, where investors can adjust forecasted financials (such as revenue, operating cost, asset book value and capital expenditure), valuation-model variables (including betas, discount rates and terminal values) and valuation multiples for the expected impact of ESG factors.
- *Quantitative or systematic strategies*, where quant managers can construct models that integrate ESG factors alongside factors such as value, size, momentum, growth and volatility, which adjust portfolio weightings.
- *Smart beta strategies* (also known as strategic beta, alternative beta and factor investing), where ESG factors and scores can be used as a weight in portfolio construction to create excess risk-adjusted returns, reduce downside risk and/or enhance portfolios' ESG risk profile.

Focus on ESG in Passive (Index) Investing

Some investors believe that, because a manager does not make active investment decisions in passive strategies, ESG factors cannot be integrated in passive investments as this may cause performance to deviate from the benchmark. Others, however, argue that passive strategies can incorporate ESG factors.

One approach involves reducing the ESG risk profile or exposure to a particular ESG factor by tracking an index that adjusts the weights of constituents of a parent index accordingly. Funds that use a partial replication approach—i.e. where the manager invests in a representative sample of index constituents rather than the entire index—can also exclude companies with high ESG risk or low ESG ratings. Often these benchmarks use portfolio optimization techniques to minimize tracking error.

Additionally, integration techniques can be applied to enhanced passive strategies. As enhanced passive strategies can make active investment decisions such as adjusting index constituent weights and excluding certain stocks altogether to lower downside risk or outperform the benchmark, managers can integrate ESG factors into these strategies.

26.3.1.2 Fixed Income[22]

While some central banks have diversified their foreign exchange reserves into equities—such as the Swiss National Bank, Hong Kong Monetary Agency and Bank of Israel—the majority hold investment grade sovereign or corporate bonds. Different considerations are required for ESG analysis in fixed income investing. The inherent complexity of bond markets—given their greater size, the variety of issuer and instrument types, and maturities—brings additional challenges to characterizing the relationship between ESG factors and credit risk, especially when assessing interest rate risk and liquidity risk in parallel. Bond prices are strongly influenced by fundamentals, macroeconomic factors, interest rates and liquidity, which can mute the apparent materiality of ESG factors. In addition, as lenders, not owners, corporate bondholders lack voting rights and find it harder to effectively engage without a formal communication process such as the AGM.

Views on these hurdles are gradually changing. A key application of ESG research is to inform the analysis of issuer credit risk and thus creditworthiness, by assessing the impact of ESG issues on a company's ability to repay its debt obligations and liabilities. This is mainly practiced through embedding third-party or proprietary ESG scores and research into internal credit assessments. To a lesser extent, the impact of ESG factors is incorporated into fundamental credit analysis (by using ESG metrics to adjust key credit ratios to take into account their potential impact on credit ratings and credit spreads) and in portfolio construction (by examining how ESG issues are influencing macroeconomic and market factors).

Some investors also integrate ESG factors into their interest rate risk analysis when assessing bonds with varying maturities issued by the same issuer. For example, the ESG factors deemed to be material to a two-year bond will differ from those associated with ten-year paper. And, while bondholders cannot vote at AGMs, they can engage with issuers to manage exposures to ESG risks, although it is still rare for fixed income practitioners to engage with companies collaboratively or for them to engage with sovereign debt issuers.[23]

Sovereign bond investors require extensions to existing frameworks or additional frameworks to incorporate country-specific ESG factors. Additional difficulties arise from sourcing and converting country ESG data into meaningful indicators to support their ESG integration practices. Most investors make qualitative assessments of ESG issues through publicly available third-party data (e.g. from the World Bank or International Energy Agency) combined with primary research to inform their investment research. Quantifying the impact of ESG issues is less common than in corporate credit analysis, but where it is practiced ESG research and/or scores may lead to adjustments to internal credit assessments or credit ratings.

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[22] This section draws upon the PRI publication: CFA Institute and PRI (2018). *Guidance and case studies for ESG integration: equities and fixed income*. Available online https://www.unpri.org/investment-strategy/guidance-and-case-studies-for-esg-integration-equities-and-fixed-income/3622.article.

[23] PRI (2018). *ESG Engagement for Fixed Income Investors – Managing Risks, Enhancing Returns*. Available online https://www.unpri.org/fixed-income/esg-engagement-for-fixed-income-investors-managing-risks-enhancing-returns-/2922.article.

26.3.1.3 Alternatives

The investment industry has traditionally focused the majority of its efforts to develop responsible investment techniques in the traditional asset classes—fixed income and equities. However, a 2017 survey conducted by Bank of New York Mellon shows that central banks are diversifying into other asset classes. Almost one-third of those surveyed said they planned to invest in new asset classes.[24] This has been driven largely by the constrained returns available from fixed income assets. While the same fundamental concepts apply to alternatives such as private equity, real estate, infrastructure and hedge fund strategies, there are subtle differences in the way responsible investment can be applied in practical terms.

In private markets, for example:

- The overall investment universe, and by association, investment opportunities, is relatively restricted in size. Investors tend to apply a common sense approach to screening rather than blanket exclusion policies.
- Illiquidity in private markets places greater emphasis on ESG during the due diligence and transaction phases to ensure exposures to specific ESG risks will be managed throughout the holding period.
- Private equity investment typically involves concentrated portfolios with relatively large shareholdings. This gives investors a stronger position from which to manage ESG risks and opportunities and enhance the ESG profile of a company during the holding period to create value.
- Weaker reporting requirements for private companies typically translate into less transparency and less ESG data available for investors to conduct desk-based ESG analysis or benchmarks. In contrast to public markets, investors apply a more relationship-based approach to engage senior management, identify and measure material ESG risks and opportunities, and report those to clients in an aggregated way.
- Holding periods for private equity investors are typically more defined from the beginning of the investment and are driven by fund structures and investor needs. This gives investors a clearer investment horizon when considering the importance of specific ESG issues.

[24] BNY Mellon (2018). Central Banks 2018: Trends and Investment Outlook. Available online https://www.bnymellon.com/emea/en/_locale-assets/pdf/our-thinking/central-banks-2018-trends-and-investment-outlook.pdf.

Fig. 26.4 Crafting an investment strategy

26.3.2 Indirectly Managed Portfolios[25]

Asset owners seeking to drive their responsible investment philosophy through external investment managers should ensure current and potential managers have the right policies, resources, procedures, reporting lines and contractual relationships in place to address ESG risks and opportunities in a meaningful way. Responsible investment should start and remain a core part of an asset owner's investment process from their statement of investment principles (or equivalent) down to ongoing monitoring of external managers. As with ESG incorporation at the manager level, there is no fixed formula for doing this but the PRI does provide high-level guidance on the key considerations. Selecting managers is part art and part science and ESG considerations should involve degrees of dialogue and evidence to reflect this. Figure 26.4 above outlines the steps asset owners should follow to embed ESG considerations within their investment process.[26]

[25] This section draws upon the PRI publication: PRI (2017). *Asset Owner Manager Selection Guide: Enhancing Relationships and Investment Outcomes with ESG Insight*. Available online: https://www.unpri.org/news-and-press/the-pri-launches-asset-owner-manager-selection-guide/2873.article.

[26] PRI (2018). *Asset Owner Strategy Guide: How to Craft an Investment Strategy*. Available online https://www.unpri.org/asset-owners/investment-strategy.

Key considerations for indirect investors:

- Clearly define what ESG means to your organization and communicate that to (prospective) investment managers and/or consultants to ensure alignment of interests.
- Articulate your expectations for investment managers in terms of ESG incorporation, engagement practices and reporting on responsible investment activities.
- Compare and contrast all of your (prospective) investment managers to ensure all are meeting a baseline of good practice and are ideally competing to enhance their responsible investment practices over time.
- Seek examples of investment decisions that have been guided by ESG analysis.
- Ask research teams and portfolio managers to explain their views and share existing research on specific ESG macro-themes such as climate change, diversity, board independence and remuneration.
- Review publicly available responsible investment reporting from investment managers, including a copy of their PRI Transparency Reports.
- Ask the investment team to demonstrate the key aspects of a replicable responsible investment procedure including how ESG features in investment decisions.
- Ensure asset managers can establish an investment governance process to implement their responsible investment approach.

Once an investment manager is selected, asset owners often include ESG terms in the investment management agreement to formalize their expectations. These often include clauses specifying how the investment manager will:

- Integrate ESG issues into investment decision-making, for example, by setting out a structured process for doing so.
- Exercise active ownership, whether through a program of engagement or by voting shares at company AGMs.
- Engage on public policy issues of relevance to the asset owner's responsible investment policies.
- Report to the asset owner regarding its resourcing relating to ESG, how its compensation structures align with the objectives of the mandate, and how its ESG-related activities have affected the value and strategy of the portfolio.

A legally enforceable side letter agreement, providing a formal record of the investor's wishes and the manager's intention to abide by them, is an alternative to writing ESG-specific requirements into the IMA. They can also be used to amend existing agreements.

Once a mandate has been confirmed, the monitoring phase is crucial to assess the actual delivery of the terms and conditions on which the manager was appointed. This covers a multitude of areas, including assessing the manager's investment approach and decisions and their ESG integration practices and performance, including their ability to manage the portfolio in line with the mandate and investment management agreement. To review investment performance and managers'

integration practices, asset owners will organize periodic monitoring meetings with investment managers, ask them to complete questionnaires/regularly report; and/or use methods such as peer analysis, internal scoring systems and portfolio analytic tools.

On signing the six Principles for Responsible Investment, over 2000 investment organizations have committed to taking ESG factors into account into investment decision-making. There are compelling reasons for central banks to systematically adopt responsible investment approaches not only for this reason, but also because of the role they play in regulating financial sector institutions around the world, in setting examples of best practice, and in aligning their investment activities with the policy priorities of their governments.

Further Reading

The PRI has produced a number of reports intended to help investors considering introducing responsible investment policies and practices, aimed at various types of investor, asset class, and responsible investment strategy.

PRI reports and guides:

- PRI (2018) ESG engagement for fixed income investors https://www.unpri.org/fixed-income/esg-engagement-for-fixed-income-investors-managing-risks-enhancing-returns-/2922.article
- PRI (2018) Guidance and case studies for ESG integration: equities and fixed income https://www.unpri.org/investor-tools/guidance-and-case-studies-for-esg-integration-equities-and-fixed-income/3622.article
- PRI (2017) A practical guide to active ownership in listed equity https://www.unpri.org/listed-equity/a-practical-guide-to-active-ownership-in-listed-equity/2717.article
- PRI (2016) A practical guide to ESG integration for equity investing https://www.unpri.org/listed-equity/a-practical-guide-to-esg-integration-for-equity-investing/10.article
- PRI (2015) Fixed income investor guide https://www.unpri.org/fixed-income/fixed-income-investor-guide/30.article

Case studies based on investor experiences can be found at:

- https://www.unpri.org/investor-tools/listed-equity
- https://www.unpri.org/investor-tools/fixed-income
- https://www.unpri.org/investor-tools/private-equity

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Chapter 27
BlackRock: Reserves Management with Factors and Reference Portfolios

Andrew Ang, David Chua, Katelyn Gallagher, and Stephen Hull

Abstract Factors—historically broad and persistent sources of return—can be used with simple equity-bond Reference Portfolios to meet the multiple challenges facing official reserve institutions. First, Reference Portfolios can be constructed to reflect the risk appetite of stakeholders, provide clear accountability, and benchmark the value added by institutional management. Second, institutions can use strategies designed to harvest factor premiums transparently and at low cost. When used at the total portfolio level, factors can inform the structure of a Strategic Portfolio, and help manage stakeholder expectations with scenario analysis. Factors can also be used at a more tactical level, in combination with other active strategies to seek incremental returns in excess of strategic benchmarks.

27.1 Introduction

Reserve managers face more than single investment objectives. The role that reserve managers play in economies, the transmission of government policy, and the large role of stakeholders in the operation of these institutions—all these are important considerations that interact with the investment policies of official institutions. Factors can play an important role in meeting both the investment objectives of reserve managers, as well as helping to meet their governance and management challenges.

Factors are historically *broad* and *persistent* sources of returns (see Ross 1976). The effects of factors are broad, in that they are observed across thousands of assets, such as individual equities and bonds, and also across asset classes. Exposure to factor risk has been rewarded, over the long run, with risk premiums. Macro factors—such as economic growth, inflation, and real rates—drive returns across asset classes; sovereign nominal bonds, for example, are exposed to inflation risk,

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but so are equities. Taking into account macro factors is therefore important for constructing multi-asset portfolios. Style factors—such as value, momentum, and quality—drive most of the variation of returns within asset classes, and can be used as active investment strategies in their own right or to benchmark traditional active strategies.

Importantly, economic theory suggests that the factor risk premiums exist in equilibrium to compensate investors for bearing potential losses during bad times.[1] Reserve managers may have comparative advantages for staying the course during some of these periods, so they may be able to harvest these factor risk premiums over the long run. Thus, factors naturally play a role in setting investment policy.

Factors, however, also play a major role in the other non-investment considerations relevant for reserve managers. In particular, factors can be combined with a Reference Portfolio concept—a simple, low-cost portfolio consisting of equities and bonds used by several reserve managers (see Ang et al. 2014).[2] The Reference Portfolio represents the necessary amount of systematic risk to achieve the reserve manager's objectives, and more than one Reference Portfolio can be used for different objectives. In turn, factors can be used to invest beyond the Reference Portfolio to achieve greater diversification and to inform the construction of a Strategic Portfolio. Factors can also be used to benchmark more tactical or more granular active management within asset classes.

In this chapter, we show both the investment and governance benefits of adopting a factor investing framework with Reference Portfolios. In Sect. 27.1, we give a brief outline of macro and style factors. In Sect. 27.2, we describe the Reference Portfolio and its benefits for governance. We can seek superior risk-adjusted returns by taking the amount of systematic risk captured in the Reference Portfolio in a more diversified Strategic Portfolio. Section 27.4 shows how scenarios can be used, with macro factors, to inform the construction of the Strategic Portfolio. In Sect. 27.5, we discuss how style factors can be used at a more granular level—perhaps in an Implemented Portfolio—to benchmark and select traditional active managers. Factor-based investing can also be used as a complementary investment strategy to traditional active management. Section 27.6 concludes.

[1] In the most basic factor model of the CAPM, bad times are represented by low returns of the market factor and stocks with high exposures to market factor risk (stocks with higher betas) have high expected excess returns. See Ang (2014) for a summary of factor theory and a discussion of individual factors.

[2] One of the first adopters of this framework was Canada Pension Plan Investment Board, who refer to this as an Opportunity Cost Model—where there the opportunity cost of investing in more expensive portfolios is the low-cost and transparent Reference Portfolio. See the Columbia Business School case study published in 2012, "Factor Investing: The Reference Portfolio and Canada Pension Plan Investment Board."

27.2 Factors

We separate investment factors into two groups: macro and style factors. Macro factors are fundamental, economy-wide, non-diversifiable variables which help explain movement across asset classes, and can be used in constructing a strategic asset allocation. Style factors help explain the relative movements of securities within a given asset class, and can be used at the investment-strategy level. Exhibit 27.1 illustrates this concept.

27.2.1 Macro Factors

We define six macro factors: real rates, inflation, credit, economic growth, commodities, and emerging markets. These macro factors are economically sensible and are the primary drivers of risk and return across both public and private asset classes.

Following Chen et al. (1986), we define each macro factor as a combination of different asset returns. Exposure to the real rate factor exposes a portfolio to the risk of changes in real interest rates, and is modeled using returns of inflation-linked bonds; the inflation factor, representing the risk of bearing exposure to changes in nominal prices, is modeled with global breakeven inflation spreads; credit, which represents the risk of spread widening or default, is modeled using the spread premia of credit bonds above nominal government bonds; economic growth is proxied using equity returns across developed market equity indices; the commodities factor spans all commodities subsectors; and the emerging market factor, capturing the additional risk

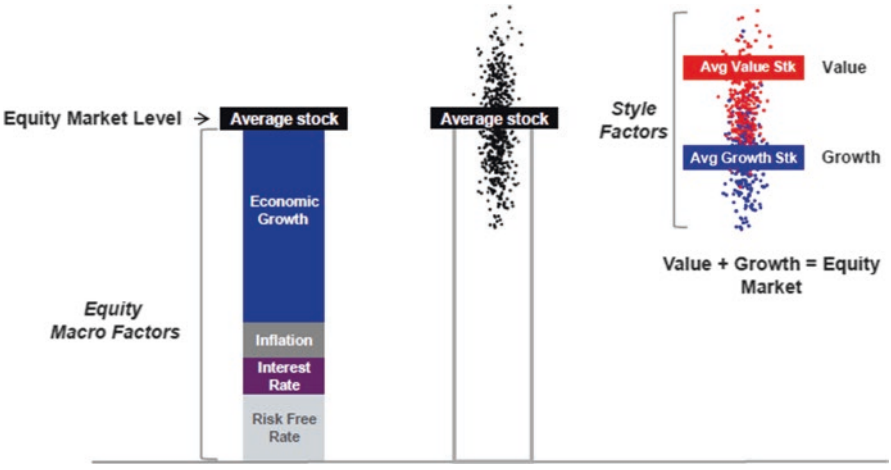


Exhibit 27.1 Macro factors determine asset class levels. Style factors determine dispersion within an asset class

embedded when investing in emerging sovereign regions, is modeled using a combination of emerging market (EM) equity, spread, and foreign exchange (FX) premia.

To summarize, we define macro factors in terms of baskets of assets which are sensitive to those underlying economic risks (Table 27.1):

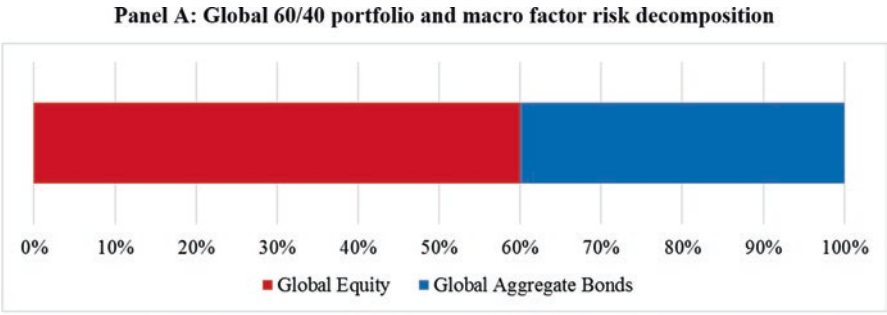
Table 27.1 Macro factors, economic rationale, and mimicking portfolios

Factor	Economic rationale	Factor mimicking portfolio	
Economic growth	Reward for taking exposure to the global economy	Long:	Developed equity indices
		Short:	Cash
Real rates	Reward for taking exposure to the risk of movements in interest rates	Long:	Basket of sovereign inflation-linked bonds
		Short:	Cash
Inflation	Reward for taking exposure to changes in prices	Long:	Basket of nominal sovereign bonds
		Short:	Basket of inflation-linked sovereigns of matching maturity
Credit	Reward for lending to corporations rather than governments	Long:	Investment grade bonds, high yield bonds
		Short:	Government bonds
Emerging markets	Reward for taking exposure to the additional political risk from emerging markets	Long:	Emerging market equity, emerging market debt
		Short:	Developed market equity, developed government bonds
Commodities	Reward for taking exposure to fluctuations in commodity prices	Long:	Broad basket of commodities across all subsectors
		Short:	Cash

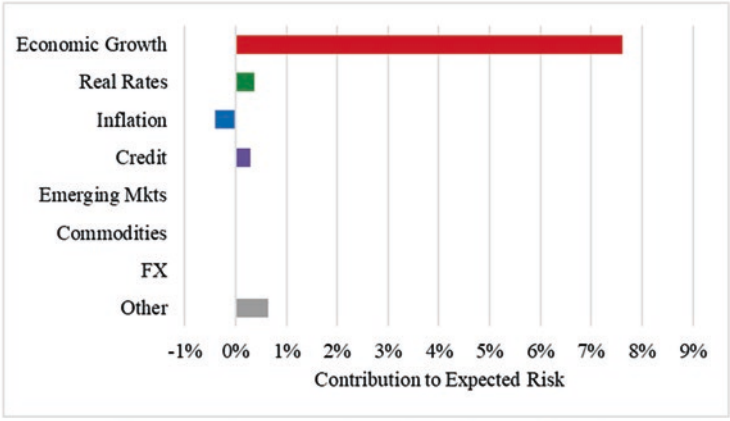
Decomposing asset classes into their fundamental factor building blocks can help an institution understand the true drivers of risk and return in a portfolio. A portfolio that appears diversified from an asset class standpoint may in fact have concentrated risks. For example, as we see in Exhibit 27.2, Panel A, almost 90% of the risk of a global 60/40 portfolio is driven by economic growth; despite 40% the portfolio's allocation to bonds, the risk from real rates, inflation, and credit drives less than 10% of the risk.[3] Even for portfolios which appear more diversified, such as the multi-asset portfolio shown in Exhibit 27.2, Panel B which holds 10% global private equity, 10% global real estate, and 5% in absolute return strategies, still we see that 65% of the portfolio is driven by economic growth.[4] Factors can highlight risk concentrations in seemingly diversified portfolios.

[3] Equities are proxied using the MSCI ACWI Index (Hedged to USD); bonds are modeled using the Barclays Global Aggregate Index (Hedged to USD).

[4] Equities are proxied by MSCI ACWI Index; Global Aggregate Bonds are proxied with Bloomberg Barclays Global Aggregate Bond Index; Global Private Equity is modeled using a BlackRock proxy; Absolute Return uses a BlackRock proxy; and Global Real Estate uses a BlackRock proxy.



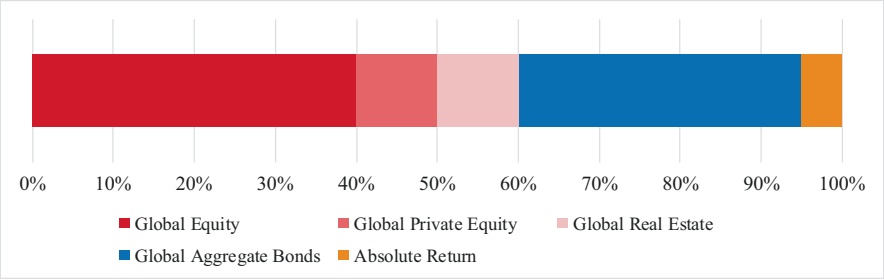
Source: BlackRock. Asset classes are represented by the following indices: Global Equity: MSCI ACWI Index, hedged to USD; Global Aggregate Bonds: Bloomberg Barclays Global Aggregate Bond Index, hedged to USD.



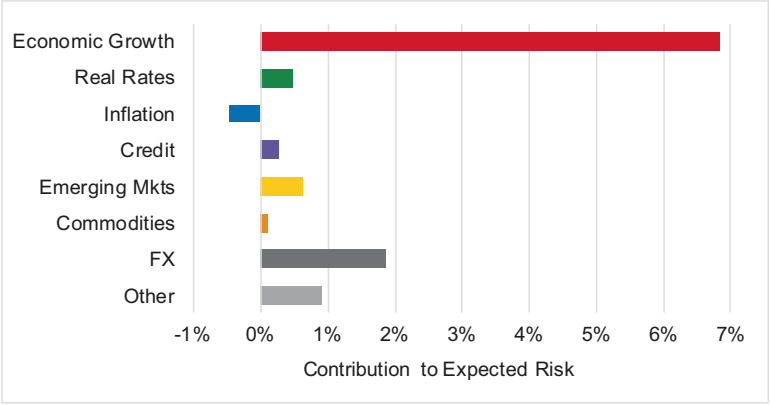
Source: Aladdin Factor Workbench, using the methodology outlined in Greenberg, Babu, and Ang (2016). December 29, 2017. Portfolio represented by the asset allocation in the previous graph within this exhibit. Assets are hedged to USD. Risk contribution is the risk decomposition of the portfolio by factor, taking into account the correlations between the factors and the benefits of diversification, using a lookback period of 15 years. "Other" includes risk contributions from style factor exposures and idiosyncratic risks.

Exhibit 27.2 Typical institutional portfolios are highly exposed to the economic growth factor. Panel A: Global 60/40 portfolio and macro factor risk decomposition. Panel B: Asset Allocation and Macro Factors risk decomposition of a hypothetical diversified multi-asset portfolio

Panel B: Asset Allocation and Macro Factors risk decomposition of a hypothetical diversified multi-asset portfolio



Source: BlackRock. Asset classes are represented by the following indices: Global Equity: MSCI ACWI Index; Global Aggregate Bonds: Bloomberg Barclays Global Aggregate Bond Index; Global Private Equity: BlackRock proxy; Absolute Return: BlackRock proxy; Global Real Estate: BlackRock proxy. Assets are not hedged to USD.



Source: Aladdin Factor Workbench, December 29, 2017. Portfolio represented by the asset allocation in the previous graph within this exhibit. Assets are not hedged to USD. Risk contribution is the risk decomposition of the portfolio by factor, taking into account the correlations between the factors and the benefits of diversification, using a lookback period of 15 years. "Other" includes risk contributions from style factor exposures and idiosyncratic risks.

Exhibit 27.2 (continued)

27.2.2 Style Factors

Style factors are well-understood drivers of risk and return within asset classes that have historically outperformed the broader market. These risk premia are grounded in economic intuition and are well-supported by academic research. In every case, there is a risk premium, structural impediment, or behavioral anomaly that justifies a return premium. Though these factors are often thought of in the context of equities, style factor premia can be found across asset classes, and can be harvested using long-only (sometimes referred to as "alternative beta" or "smart beta"), or long-short, beta-neutral implementation (see Davies et al. 2019).

In this chapter, we focus on four style factors: value, momentum, quality, and minimum volatility. Value strategies target assets which are inexpensive relative to

fundamentals (see Basu 1977); momentum strategies capture trends—prices moving up or down tend to continue to trend up or down, respectively (see Jegadeesh and Titman 1993); quality strategies favor securities with stable and high-quality earnings (see Sloan 1996); and minimum volatility strategies focus on assets with lower volatility (see Ang et al. 2006). The correlations between style factors, after removing the effects of the asset class, have tended to be low because common macro factors account for most of the variation across asset classes. The low correlations between style factors mean that a style factor approach to portfolio construction may be beneficial across various environments.

For every group of stocks which have positive exposure to rewarded style factors, there must be stocks on the other side which, over long time periods, underperform the market. These style factors exhibit long-run risk premia because of an economic rationale: a risk premium, structural impediment, or investors' behavioral biases (Table 27.2):

Table 27.2 Style factors, their focus and rationale

Factor	Focus	Economic rationale
Value	Companies that are inexpensive relative to fundamentals	Cheaper securities have outperformed due to a distress premium and investors' tendency to over-buy growth names
Momentum	Companies with higher relative performance	High momentum securities have outperformed low momentum securities, a result of the investor tendency to exhibit return-following behavior
Quality	Companies with healthy balance sheets & consistent earnings	Investors focus on consistent earnings and overvalue high accruals companies due to demand for growth and lottery-like securities
Minimum volatility	Companies with stable prices & lower risk	Many investors are leverage constrained, leading them to overpay for high volatility securities in an attempt to increase the risk in their portfolio in the absence of leverage

27.3 Reference Portfolios

For investors with long time horizons, such as reserve managers, adopting a Reference Portfolio framework can help improve both investment management and governance. The approach is based on a multi-level portfolio structure. First, we begin with the clear notion of a Reference Portfolio that reflects an investor's risk appetite. Second, relative to the performance benchmark we construct a Strategic Portfolio, which expands the universe of available factor exposures, resulting in improved portfolio diversification and, in turn, an improved long-term expected return-risk ratio. A concluding, and optional, step is to build a final Implemented Portfolio, which potentially rotates the holdings around the Strategic Portfolio and introduces more granular strategies or asset classes. This three-tiered framework allows investors to arrive at a final portfolio by combining their risk appetite level

(Reference Portfolio), with long-term views on compensated risk factors (Strategic Portfolio), and short-term views or asset class-specific implementation considerations (Implemented Portfolio).

This framework requires a long time horizon because there can be significant differences, sometimes stretching to a decade, between the returns of the vehicles used to implement the factor exposures, and the corresponding funding mix of Reference Portfolio assets. The investment manager must have considerable experience and skill, along with access to excellent information systems, to find, evaluate, and monitor attractive investments with return components that cannot be obtained via inexpensive index strategies.

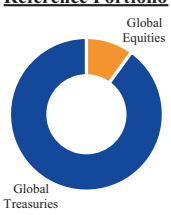
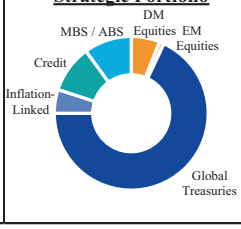
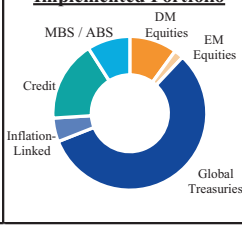
27.3.1 Reference Portfolio

A Reference Portfolio is a simple, highly scalable, inexpensive combination of passive equity and bond exposures that identifies reasonable and achievable levels of expected return and risk. The governing board selects the specific Reference Portfolio which represents the necessary amount of systematic risk to achieve the fund's objectives, or alternatively, the level of expected return a fund could achieve with the fund's risk budget.[5] The higher an investor's risk tolerance or need for return, the higher the proportion of equity. The board also specifies any investment constraints and determines an active risk limit governing the total deviation from the Reference Portfolio. Because this portfolio can be closely replicated at a low cost, it serves as a natural benchmark to evaluate the performance of more complex portfolios, including the Strategic Portfolio outlined below.

For reserve managers with multiple mandates, multiple Reference Portfolios can be constructed to reflect the different purposes of each pool of capital. For example, most reserve managers are tasked with managing safety and liquidity, with a tertiary goal of income generation. Reserve managers tasked with multiple mandates often tranche reserves into liquidity and investment portfolios. The priorities for an investment portfolio will be different from the liquidity portfolio; growth, preservation of spending power, and harvesting long-term returns are typical for the investment portfolio. Whereas the Reference Portfolio for the liquidity tranche would likely be dominated by bonds, the investment portfolio could have a significant allocation to equity. The board can define unique Reference Portfolios which best reflect each portfolio's unique investment goal, constraints, return objective, and risk tolerance.

In an institutional context, there are several advantages to adopting Reference Portfolios as performance benchmarks. First, these benchmark portfolios are simple to communicate, especially to non-investment professional stakeholders. The availability of index funds means that the Reference Portfolio can be implemented at low cost. Thus, the value-add of additional complexity, active management activities, or

[5] See also Chaps. 13 and 17.

Party	Board	Investment Committee	Portfolio Manager
Core Responsibility	Govern	Manage	Implement
Role	A board of governors is responsible for long-term investment performance. They set the target return and/or target risk which determines the relative allocation of equities and bonds in the Reference Portfolio (RP). This then serves as the context within which the investment professionals can build the portfolio. The Board is responsible to asset owners for long-term performance.	The Investment Committee is responsible for setting the strategic asset allocation (SAA) of the Strategic Portfolio (SP). The SP allocates to a broader range of macro factors to maximize diversification and improve on the risk/return profile of the RP. The Investment Committee is responsible to the Board for medium-term performance relative to the RP.	Implementation of the SP is handled by portfolio managers (PMs). In many cases, the PMs have discretion to hold tactical positions within a tight range around the SP, including explicit style factor allocations, or short-term tilts to selected geographies or sectors. The PM team is responsible for implementing and/or outperforming the SAA.
Portfolio Overseen by Party			

Source: BlackRock. Portfolio allocations are illustrative.

Exhibit 27.3 Reference, Strategic, and Implemented Portfolios enhance fund governance

tactical investment decisions which deviate from the equity-bond Reference Portfolio can be clearly measured. Identifying stakeholders' risk tolerance and building that into a performance benchmark also has benefits for governance and management, which we discuss further in Sect. 27.3.4.

Exhibit 27.3 includes a sample Reference Portfolio of a hypothetical liquidity tranche of a reserve manager. In this case, the Reference Portfolio consists of 90% bonds and 10% equity.[6] The high proportion of bonds reflects the low risk tolerance of a traditional liquidity tranche, which typically prioritizes stability above all else. In the case of a savings-like portfolio with a larger focus on growth, the proportion of equities within the Reference Portfolio would likely be significantly higher, potentially greater than 50%.

27.3.2 Strategic Portfolio

The second portfolio is referred to as the Strategic Portfolio, and is built relative to the Reference Portfolio. It has a similar risk profile as the Reference Portfolio, but allocates risk to more rewarded sources of potential returns than market capitalization-weighted equities and bonds.

[6] Bonds are represented by the Bloomberg Barclays Global Treasury Index, and equities are represented by the MSCI ACWI Index.

After the governing board identifies the mix of equity and bonds, the responsibility to invest beyond the Reference Portfolio is given to the investment manager, typically an investment committee. The investment committee is tasked with overseeing investments that provide superior risk-adjusted returns, net of costs, relative to the Reference Portfolio. Optionally, individual investment decisions can be benchmarked, net of costs, so that investment funding is specified in terms of the Reference Portfolio. For example, any dollar that could be invested in private real estate is benchmarked against the opportunity costs of investing that dollar in a mix of public equities and bonds. Thus, any active investment that deviates from the Reference Portfolio can be benchmarked net of fees against the public market securities in the Reference Portfolio used to fund that investment. It is worth noting that employing this opportunity cost model is non-trivial, and may be best suited for institutions that have significant resources.

While every institution faces a unique set of circumstances, a factor-based approach to building the Strategic Portfolio may provide benefits. By deliberately diversifying across macro factors, institutions may unlock potential sources of return that were previously underrepresented, or not represented at all, in their portfolios, such as credit and emerging markets. By expanding the universe of factors, the Strategic Portfolio benefits from increased diversification and, in turn, a higher long-term Sharpe ratio than the benchmark portfolio.

We measure active risk in the Strategic Portfolio relative to the Reference Portfolio. The decisions embedded in the Strategic Portfolio reflect long-term investment views, and serve as the Strategic Asset Allocation (SAA) for the investor.

The second column of Exhibit 27.3 illustrates a sample Strategic Portfolio for our hypothetical liquidity tranche. Here, the portfolio expands into new asset classes which provide exposure to additional sources of return. The inclusion of inflation-linked bonds increases the portfolio's exposure to real rates, which may further improve the defensive properties of the pool in the event of an economic downturn. Additionally, expanding the fixed income allocation to include credit and MBS/ABS exposes the portfolio to the credit premia, which acts as another diversifying source of return. Because economic growth and credit have tended to be correlated over long-term horizons, the Strategic Portfolio has a lower exposure to developed and emerging markets equities than did the Reference Portfolio, in an effort to maintain a consistent level of total portfolio risk. Below, in Sect. 27.4, we provide more details about how factors can be used in determining the Strategic Portfolio of the reserve manager.

27.3.3 Implemented Portfolio

While some investors will stop at the Strategic Portfolio—which is valid for a long-term investor who takes static strategic exposures and rebalances regularly—a further optional step is to construct an Implemented Portfolio which rotates positions around the Strategic Portfolio based on short- and medium-term return and risk

insights. Reserve managers who are resourced to actively manage their growth portfolio may choose to do this in an effort to earn additional return. The Implemented Portfolio can also contain more granular, fund-level, or perhaps even security-level positions taken by internal or external investment teams. Active risk and return in the final Implemented Portfolio are measured relative to the Strategic Portfolio.

The third column of Exhibit 27.3 provides a sample Implemented Portfolio for the hypothetical liquidity tranche. Here, we see a few material deviations from the Strategic Portfolio defined in the second column. Relative to the long-term factor weights, the Implemented Portfolio increases exposure to the credit factor by overweighting the credit and MBS/ABS allocation. Similarly, developed and emerging markets equities have a higher exposure than in the Strategic Portfolio, suggesting that—in this hypothetical example—the portfolio manager may expect an increased short- or medium-term premium associated with pro-cyclical investments.

The two-step construction process—moving from the Reference Portfolio to a more diversified Strategic Portfolio, and then from a long-term Strategic Portfolio to a final, Implemented Portfolio—helps attribute performance between the strategic and tactical views. We can measure the accuracy of our strategic views by comparing the performance of the Strategic Portfolio relative to the Reference Portfolio. Similarly, we can measure the efficacy of our tactical positioning by comparing the performance of the Implemented Portfolio relative to the Strategic Portfolio.

This Reference Portfolio framework, or similarly tiered frameworks, has been adopted by some of the leading sovereign institutions and reserve managers around the world. This approach represents a compelling alternative to traditional asset class portfolio construction and investing. It provides a consistent and coherent framework for analyzing and benchmarking investment decisions across both public and private markets. The focus of active management becomes the component of returns that cannot be obtained inexpensively and simply in public market investments, as captured in the Reference Portfolio benchmark. This raises the bar and accountability for active management. Finally, the portfolio manager is free to take any deviations from the Reference Portfolio based on a fair valuation outlook rather than being forced to maintain positions when the asset class valuations are very expensive or cheap.

27.3.4 Governance Benefits[7]

One of the most attractive features of this three-tiered model is a clear delineation of accountabilities. Particularly for reserve managers which can have complicated organizational structures with a wide range of stakeholders of varying financial backgrounds, its simple structure allows for ease of communication, and the tiered portfolio structure enhances governance and accountability in the decision-making

[7] See also Chaps. 18 and 20.

process by clearly defining baselines against which active decisions can be evaluated. Exhibit 27.3 also summarizes these benefits.

The governing board makes the most important decisions about return objectives and the required level of systematic risk by approving the composition of the Reference Portfolio and specifying the active risk budget and any other constraints. The investment committee ensures that the manager has the requisite capabilities in place before commencing investment programs, monitors the execution and results of those programs, and approves appropriate internal benchmarks. The portfolio manager then has the latitude to make investment decisions and shape the actual composition of the portfolio, subject to an active risk limit determined by the asset owner. Arguably, this places appropriate accountability with the party best able and positioned to make informed decisions. The onus is always on the fund manager to justify costs of active management and to outperform the Reference Portfolio.

In addition to accountability, the three-tiered model also addresses the challenge of multiple investment horizons. Successfully navigating the increased complexity of long-term portfolios and short-term pressures requires the right balance between governance and implementation of investment policy; investors must consider multiple timeframes and the separation of responsibilities helps to manage these. At one end, we have the long-term governance timeframe of the Reference Portfolio where stakeholders are primarily reliant upon long-term investment performance to meet their objectives. At the same time, many investors would like to adapt their investment portfolio to current market conditions, and reflect the different yields, spreads, and asset valuations that are available to their portfolio across the economic cycle in the Implemented Portfolio. In the middle may be a business-cycle view, which can be taken in the Strategic Portfolio. Because the objectives and responsibilities of each tier of governance are clearly defined and separated, each timeframe can be properly managed.

Unlike traditional asset allocation models with fixed allocations to asset classes, this framework provides portfolio managers with the flexibility needed to account for the time-varying nature of risk premiums. The portfolio manager has appropriate incentives to make the investments with the best marginal contribution to risk and return for the overall portfolio rather than the best available investment within each asset class.

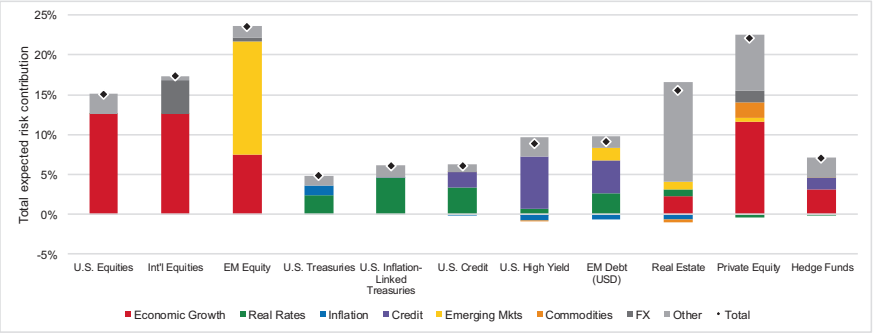
27.4 Constructing Strategic Portfolios with Factors

In this section, we give an example of how to construct a Strategic Portfolio. We take the risk specified in a given Reference Portfolio and use macro factors to more efficiently redeploy that risk across a parsimonious set of asset classes.

27.4.1 Macro Factors across Asset Classes

Broad macro factors are relevant for the design and construction of the Strategic Portfolio. In fact, a parsimonious set of macro factors is more useful for strategic asset allocation than dozens, and possibly hundreds or thousands, of individual security returns or characteristics. The focus on factors allows an investor to understand commonalities across private and public markets, such as growth, inflation, and real rate risks, which manifest in both public and private investments. Using macro factors allows reserve managers to understand common factor drivers across those portfolios.

Exhibit 27.4 decomposes the risk of 11 common asset classes into our six macro factor contributions to risk, as computed using the methodology of Greenberg et al. (2016). We see that there are large commonalities to these macro factors across seemingly unrelated asset classes. Economic growth, for example, accounts for 83% of the variation of US large cap equities, but we see that EM equity (32%), real estate (15%), private equity (53%), and hedge funds (43%) are also exposed to this factor. US Treasuries are exposed to real rates, as are global inflation-linked bonds, global credit, hard currency EM bonds, global real estate, and global infrastructure. We report the risk attributions to another factor, developed market foreign exchange rates (FX). Over the long run, exposure to currency risk has added little in terms of returns (see, for example, Campbell et al. 2010, Perold et al. 1988), but FX has contributed significantly to the volatility of global investment portfolios and is of first-order concern to reserve managers.



Source: Aladdin Factor Workbench, December 29, 2017. Assets are not hedged to USD. Risk contribution is the risk decomposition of the asset class by factor, taking into account the correlations between the factors and the benefits of diversification, using a lookback period of 15 years. "Other" includes risk contributions from style factor exposures and idiosyncratic risks. Asset classes are represented by the following indices: U.S. equities, MSCI U.S. Index; International equities, MSCI World Ex U.S. Index; Emerging markets equity, MSCI Emerging Markets Index; U.S. Treasuries, Bloomberg Barclays Government Index; U.S. Inflation-linked Treasuries, Bloomberg Barclays U.S. Government Inflation-Linked Bond Index; U.S. Credit, Bloomberg Barclays U.S. Credit Index; U.S. high yield, Bloomberg Barclays U.S. High Yield Index, Emerging Markets debt, JP Morgan EMBI Global Diversified Index; Real estate, BlackRock Proxy; Private equity, BlackRock Proxy; Hedge funds, HFRI Composite Index.

Exhibit 27.4 Decomposing asset class risk into macro factors (All analysis run as of December 29, 2017. All assets assumed to be unhedged)

By examining their total asset allocation—including both liquid and illiquid holdings—through a factor lens, reserve managers can gain new insights into their risk and diversification. A factor lens can also aid in the evaluation of new asset classes by highlighting the factor exposures each brings to the portfolio. Factors can help break traditional asset class silos and create synergies between asset classes by providing a common language.

Finally, factors can help in rebalancing portfolios with illiquid assets. Funds invested in strategic holdings, or illiquid assets such as private equity and real estate, are committed for multi-year periods and as such they cannot be easily traded when it is time to rebalance the portfolio. Unable to trade the illiquid assets, some institutions will simply rebalance the liquid assets on a pro-rata basis (proportional to their target allocations), but this form of rebalancing can cause the factor allocation of the portfolio to drift away from target. Using a common set of factors across the liquid and illiquid assets allows investors to identify the liquid asset trades needed to bring the total portfolio to its target factor allocation. Factors can facilitate conversations around total portfolio asset allocation and risk management by providing a common language across otherwise seemingly disparate asset classes.

27.4.2 Macro Factor Returns in Various Market-Driven Scenarios

Examining the behavior of factors in different hypothetical regimes can inform the construction of robust Strategic Portfolios. Market-driven scenarios, as introduced by Golub et al. (2018), rigorously and quantitatively model forward-looking scenarios of adverse, one-off market events which cannot be calibrated using past data. These scenarios are often highly publicized political events (such as Brexit), informed by headlines (such as a pending interest rate hike), or intuitive market conditions themselves (such as a pickup in inflation). By evaluating how each of the six factors might perform under these scenarios, investors can decide how to adjust their portfolio to potentially mitigate losses they cannot bear.

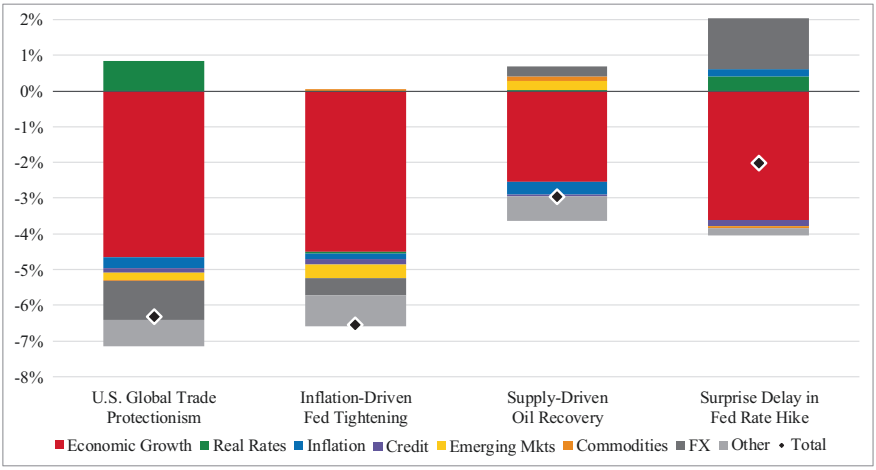
Suppose a reserve manager adopts the multi-asset portfolio in Exhibit 27.2, Panel B, to serve as the Strategic Portfolio for their investment portfolio. Because the primary goal of the fund is harvesting long-term returns, the portfolio contains a 60% allocation to growth assets across both liquid (public equities) and illiquid (private equity, real estate) assets. The remaining 40% comprises a 35% allocation to fixed income, and a 5% allocation to absolute return assets.

Exhibit 27.5, Panel A, examines the performance of this portfolio across four market-driven scenarios: US Global Trade Protectionism, Inflation-Driven Fed Tightening, Supply-Driven Oil Recovery, and Surprise Delay in Fed Rate Hike. Across all four scenarios, the portfolio loss is driven by the large allocation to the economic growth factor, the largest contributor to not only public equities, but also private equity and real estate. Other factors are more defensive: the exposure to real

rates offsets some of the portfolio loss in three out of the four scenarios, and emerging markets, commodities, and inflation each proves defensive in one of the scenarios.

Recognizing the fund is tripling up on economic growth exposure by investing in public equities, private equities, and real estate, we reduce global equity by 15% and reallocate to a combination of infrastructure equity (10%) and absolute return (5%), as seen in Exhibit 27.5, Panel B. This has the effect of reducing the portfolio's exposure to economic growth while increasing the exposure to the other five factors,

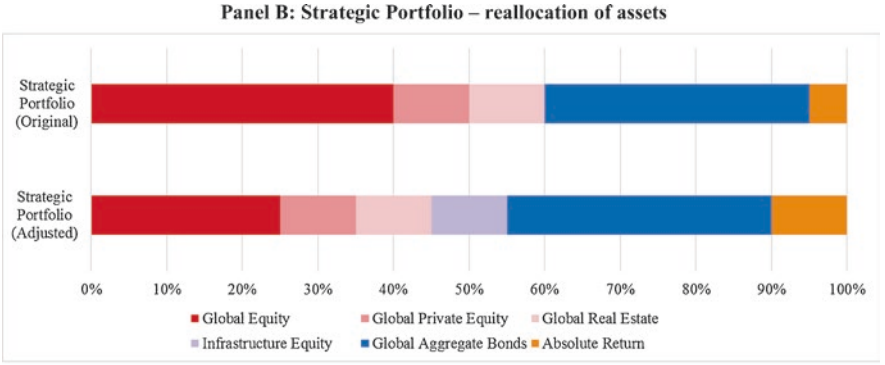
Panel A: Strategic Portfolio performance in different scenarios



For illustrative purposes only. The sample strategic portfolio reflects the asset allocation shown in Exhibit 2, Panel B. No representation is being made that any account, product or strategy will or is likely to achieve results similar to those shown. Actual performance may vary significantly from these hypothetical market-driven scenarios. Scenario analysis is performed by parametrically shocking the underlying risk factor exposures of the portfolio by a set of instantaneous changes to those factors and deriving the resulting hypothetical return. The total return in the scenario is expressed as a hypothetical percentage change in value if those shocks were to be realized. The scenarios are forward looking potential shocks created by BlackRock. No representation is made as to the accuracy or completeness of the scenario analysis shown or the validity of the underlying methodology. The scenario analysis should not be misinterpreted as constituting the actual performance of, or a prediction or projection of the performance of, any portfolio nor should this information be relied upon in connection with any investment decision relating to any product or strategy.

***U.S. Global Trade Protectionism** is modeled using the following policy variables: S&P (-8%), MSCI China (-20%), 10-year U.S. government yields (-35 bps), U.S. 10-year inflation (+20bps), USD (+3%), copper (-10%), gold (+6%). **Inflation-Driven Fed Tightening** uses the following policy variables: S&P (-10%), S&P financials (-5%), MSCI Europe (-5%), U.S. IG credit spreads (+15bps), 2-year U.S. government yields (+60bps), 10-year U.S. government yields (-10bps), U.S. 10-year inflation (+10bps), EUR (-3%), oil (+10%). **Supply-Driven Oil Recovery** is modeled using the following policy variables: MSCI World (-5%), 10-year U.S. government yields (+20 bps), European government bond yields (+15bps), U.S. 10-year inflation (-25bps), HY spreads (-100bps), oil (+30%). **Surprise Delay in Fed Rate Hike** is driven by the following policy variables: broad U.S. equity markets (-5%), U.S. financial sector (-20%), U.S. consumer staples (+7%), 10-year U.S. government yields (-40bps), USD (-4.3%), EM debt spreads (-15bps).*

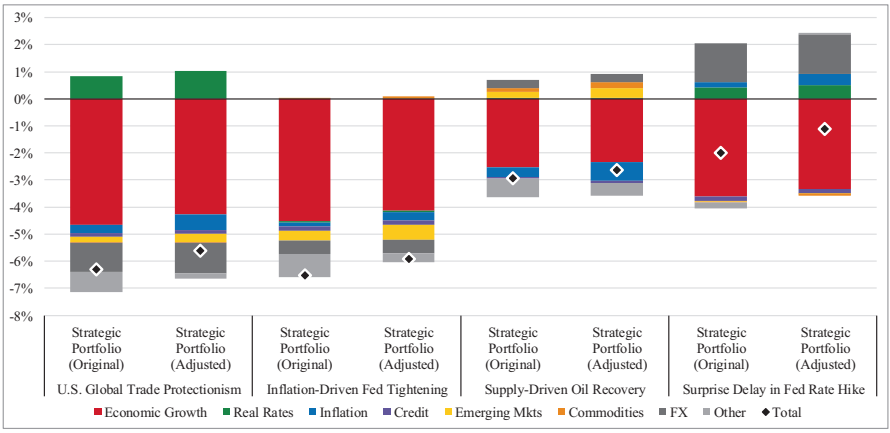
Exhibit 27.5 Factors in Market-Driven Scenarios can help inform the construction of a Strategic Portfolio. Panel A: Strategic Portfolio performance in different scenarios. Panel B: Strategic Portfolio—reallocation of assets. Panel C: Scenario results before and after reallocation



Source: Aladdin Factor Workbench, December 29, 2017. The "Original Portfolio" is a hypothetical Strategic Portfolio as introduced in Exhibit 2, Panel B. The hypothetical "Adjusted Portfolio" reduces Global Equity by 15% and reallocates to a combination of Infrastructure Equity (10%) and Absolute Return (5%). Asset classes are represented by the following indices: Global Equity: MSCI ACWI Index; Global Aggregate Bonds: Bloomberg Barclays Global Aggregate Bond Index; Global Private Equity: BlackRock proxy; Absolute Return: BlackRock proxy; Global Real Estate: BlackRock proxy; Infrastructure Equity: BlackRock proxy. Assets are not hedged to USD.

Exhibit 27.5 (continued)

Panel C: Scenario results before and after reallocation



The "Original Portfolio" is a hypothetical Strategic Portfolio as introduced in Exhibit 2, Panel B. The hypothetical "Adjusted Portfolio" reflects the hypothetical portfolio introduced in Panel B of this exhibit. Both portfolios represented by the asset allocation shown in Exhibit 5, Panel B. For illustrative purposes only. No representation is being made that any account, product or strategy will or is likely to achieve results similar to those shown. Actual performance may vary significantly from these hypothetical market-driven scenarios. Scenario analysis is performed by parametrically shocking the underlying risk factor exposures of the portfolio by a set of instantaneous changes to those factors and deriving the resulting hypothetical return. The total return in the scenario is expressed as a hypothetical percentage change in value if those shocks were to be realized. The scenarios are forward looking potential shocks created by BlackRock. No representation is made as to the accuracy or completeness of the scenario analysis shown or the validity of the underlying methodology. The scenario analysis should not be misinterpreted as constituting the actual performance of, or a prediction or projection of the performance of, any portfolio nor should this information be relied upon in connection with any investment decision relating to any product or strategy.

***U.S. Global Trade Protectionism** is modeled using the following policy variables: S&P (-8%), MSCI China (-20%), 10-year U.S. government yields (-35 bps), U.S. 10-year inflation (+20bps), USD (+3%), copper (-10%), gold (+6%). **Inflation-Driven Fed Tightening** uses the following policy variables: S&P (-10%), S&P financials (-5%), MSCI Europe (-5%), U.S. IG credit spreads (+15bps), 2-year U.S. government yields (+60bps), 10-year U.S. government yields (-10bps), U.S. 10-year inflation (+10bps), EUR (-3%), oil (+10%). **Supply-Driven Oil Recovery** is modeled using the following policy variables: MSCI World (-5%), 10-year U.S. government yields (+20 bps), European government bond yields (+15bps), U.S. 10-year inflation (-25bps), HY spreads (-100bps), oil (+30%). **Surprise Delay in Fed Rate Hike** is driven by the following policy variables: broad U.S. equity markets (-5%), U.S. financial sector (-20%), U.S. consumer staples (+7%), 10-year U.S. government yields (-40bps), USD (-4.3%), EM debt spreads (-15bps).*

Exhibit 27.5 (continued)

while maintaining a similar expected return. We demonstrate the drawdown-mitigating effects of this change in Exhibit 27.5, Panel C: in each scenario, the improved factor diversification, notably the increased exposure to real rates, improves the simulated outcome of the investment Strategic Portfolio.

In practical asset management, particularly in the case of reserve mangers, communication and support of an investment strategy is often just as, and sometimes more, important than the investment strategy itself. When stakeholders have limited investment experience, concentrating on a few key, intuitive macro drivers in the context of real-life scenarios, provides a simple and transparent framework for communicating risks in the investment portfolio. For example, the addition of a new asset class to the Strategic Portfolio can be interpreted, and communicated, in terms of changes to the handful of existing factor exposures.

27.5 Factors in Implemented Portfolios

In this section, we illustrate two ways style factors can be used in the Implemented Portfolio. We focus on equities to demonstrate how incorporating style factors alongside traditional index and active strategies has the potential to enhance returns. In particular, we show how investors can leverage style factors to better understand the drivers behind active manager returns, and determine whether managers are delivering true excess returns (true alpha).

27.5.1 Style Vs. Macro Factors

In Sect. 27.4 we use macro factors to build the Strategic Portfolio. Because macro factors drive returns *across* asset classes, they are appropriate when setting the long-term strategic exposures. Conversely, style factors drive dispersion *within* asset classes, and as such have exhibited little correlation with macro factors. Exhibit 27.6 reports the correlation between macro and style factors; the average correlation between any macro and style factor is zero. This makes them well suited for the Implemented Portfolio: we can maintain the strategic macro factor allocations set by the Strategic Portfolio and utilize style factors to seek incremental return, either in response to changing market conditions or via static exposure to these uncorrelated long-term sources of return.

	Momentum	Value	Quality	Min Vol	Economic Growth	Real Rates	Inflation	Credit	Emerging Markets	Comm.
Momentum	1	-0.3	0.1	-0.1	0.1	0.1	-0.2	0.0	0.0	0.1
Value		1	0.3	0.3	0.1	-0.2	0.0	0.2	0.0	-0.1
Quality			1	0.4	0.1	-0.1	0.0	0.1	-0.1	-0.2
Min Vol				1	0.2	-0.1	0.1	0.1	-0.1	0.0

Source: BlackRock, as of June 29, 2018. Factors represented by hypothetical BlackRock factor-mimicking portfolios. Correlations are calculated over five years of monthly data. Macro factor returns are adjusted to ex-ante annualized risk level of 10%. Style factor returns are adjusted to ex-ante annualized risk level of 5%. Factor returns are based on underlying exposures to the particular factor premium, based on BlackRock's models. Exposures include broad index exposures across markets. This analysis is limited to the index universe available to BlackRock in Aladdin. Factor returns are gross of all fees and transaction costs. Past performance is not a guarantee of future results.

Exhibit 27.6 Correlations between Macro and Style factors

27.5.2 Using Style Factors to Select Active Managers

Style factors can enhance the manager selection process by helping investors better understand the drivers behind active manager returns and identify those managers who are delivering "true" alpha. We utilize the manager sample featured in Exhibit 27.7 to illustrate how.

First, we quantify the active risk and return of each manager. On the surface, a positive active return at a reasonable level of active risk indicates a successful manager—the manager is delivering above-benchmark returns. Exhibit 27.7, Panel A shows six such managers: each has a positive active return, with active risk between 4% and 6%. However, a closer look at the outperformance in Exhibit 27.7, Panel B reveals the high correlation of active returns between some of the managers. This suggests there may be some commonality in their performance.

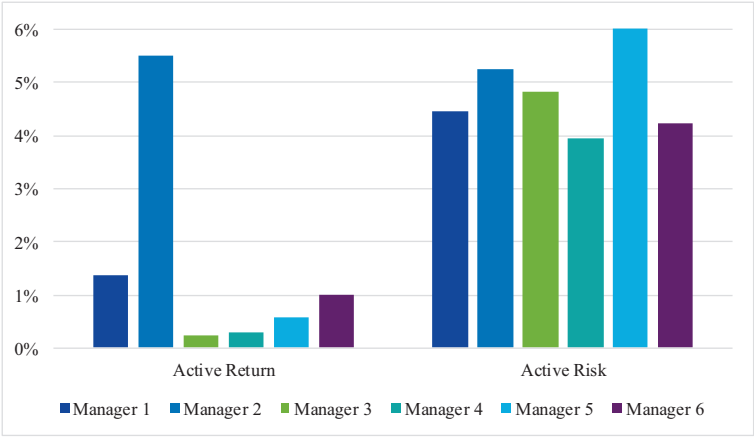
In Panel C, further analysis with style factors uncouples the true active returns of the managers in excess of their factor exposures. We compute these by regressing each manager's active returns against four prominent style factors: minimum volatility, value, momentum, and quality.[8] Panel C shows that five of the six managers exhibit meaningful tilts to one or more factors, and two of these managers, Manager 3 and Manager 5, have not delivered any statistically significant alpha; only one manager, Manager 1, has delivered statistically significant returns in excess of factor exposures.

Investors whose primary goal is to improve risk-adjusted returns may find it worthwhile to replace managers delivering only factor returns with statistically insignificant alphas, such as Managers 3 and 5, with an allocation to an index-based multifactor strategy. This has the added benefit of offsetting the negative factor exposures present in some alpha-producing managers, such as Manager 1. Often, replacing under-performing active managers with factor strategies also reduces manager correlation, thereby increasing diversification. Of course, replacing factor-reliant active managers with an index-based strategy may also reduce fees.

Applying this type of portfolio construction lens complements traditional criteria in manager selection: fees, outperformance targets, capacity, and qualitative considerations. We can use factors as a lens to better understand manager exposures, identify managers delivering true alpha and create cost-effective portfolios of managers with complimentary strategies.

[8] As represented by the excess return of the following indices: MSCI World Equal Weighted Index (Minimum Volatility), MSCI World Enhanced Value Index (Value), MSCI World Momentum Index (Momentum), and MSCI World Sector-neutral Quality (Quality). Please see case study methodology and index disclosures for additional information.

Panel A: Active returns and active risk



Sources: eVestment Alliance, MSCI, March 2018. Information shown is calculated using net of fees composite monthly return data (April 2013 to March 2018) for six equity managers identified as being benchmarked to the MSCI World Index. Reflects trailing five year annualized active manager correlations, excess returns and annualized active risk. Past performance is not a guarantee of future results. Please see "Case Study Methodology" at the end of the document for additional information. Portfolio and analysis provided for illustrative purposes only to demonstrate a potential approach to using factors to enhance manager structure. It is not representative of any actual client's portfolio and is not a recommendation of an investment strategy or allocation.

Panel B: Active return correlations

	Mgr 1	Mgr 2	Mgr 3	Mgr 4	Mgr 5	Mgr 6
Mgr 1	1					
Mgr 2	-0.5	1				
Mgr 3	-0.4	0.4	1			
Mgr 4	-0.3	0.5	0.3	1		
Mgr 5	-0.4	0.5	0.8	0.3	1	
Mgr 6	-0.2	0.4	0.3	0.4	0.4	1

Sources: eVestment Alliance, MSCI, March 2018. Information shown is calculated using net of fees composite monthly return data (April 2013 to March 2018) for six equity managers identified as being benchmarked to the MSCI World Index. Reflects trailing five year annualized active manager correlations, excess returns and annualized active risk. Past performance is not a guarantee of future results. Please see "Case Study Methodology" at the end of the document for additional information. Portfolio and analysis provided for illustrative purposes only to demonstrate a potential approach to using factors to enhance manager structure. It is not representative of any actual client's portfolio and is not a recommendation of an investment strategy or allocation.

Exhibit 27.7 Style factors can be used to help select active managers. Panel A: Active returns and active risk. Panel B: Active return correlations. Panel C: Factor exposures in active returns

Panel C: Factor exposures in active returns

	R^2	Alpha net of style factors	Minimum Volatility	Value	Momentum	Quality
Mgr 1	47%	0.27%	-0.30	0.23	-0.29	-0.63
Mgr 2	40%	0.24%	0.54	0.04	0.21	1.13
Mgr 3	33%	0.00%	0.22	-0.52	-0.07	0.54
Mgr 4	39%	-0.17%	-0.18	0.36	0.19	0.82
Mgr 5	33%	0.03%	-0.09	-0.64	-0.10	0.58
Mgr 6	16%	0.06%	0.04	-0.28	-0.04	0.35

Sources: eVestment Alliance, MSCI, March 2018. Information shown is calculated using net of fees composite monthly return data (April 2013 to March 2018) for six equity managers identified as being benchmarked to the MSCI World Index in eVestment. Reflects trailing five year annualized excess returns. Past performance is not a guarantee of future results. Please see "Case Study Methodology" at the end of the document for additional information. Manager excess returns were regressed versus four single factor MSCI indices as follows: MSCI World Equal Weighted Index (Minimum Volatility), MSCI World Enhanced Value Index (Value), MSCI World Momentum Index (Momentum) and MSCI World Sector-neutral Quality (Quality). R-squared is the coefficient of determination, a measure of how close data is to the fitted regression. Values for the four factors reflect factor loading (coefficient). Dark gray represents statistical significance at the 95% confidence level. Light gray is 90%. This analysis contains back tested index data from MSCI. Please see Index Disclosures at the end of the document for index inception dates. Portfolio and analysis provided for illustrative purposes only to demonstrate a potential approach to using factors to enhance manager structure. It is not representative of any actual client's portfolio and is not a recommendation of an investment strategy or allocation.

Exhibit 27.7 (continued)

27.5.3 Combining Factors with Traditional Index and Active Strategies

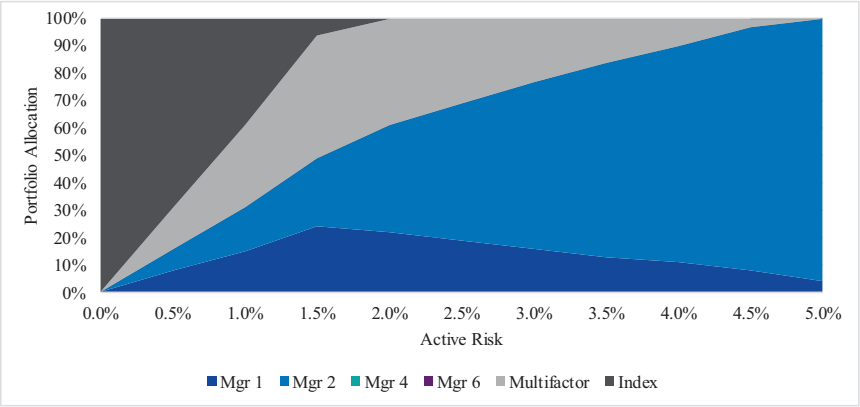
After investors select their lineup of active managers, looking at the total equity portfolio through a factor lens can guide the appropriate blend of index, factor, and active strategies based on investment objectives and risk targets.

Investors have long adopted a barbell approach, with low-fee index funds making up the bulk of the equity allocation and high-conviction active strategies rounding out the portfolio. Combining alpha and beta in this fashion is a logical approach, as the individual risk tolerance of an investor can be recognized along the continuum between active and index. But portfolio construction is evolving to include style factor strategies alongside conventional index and active choices. In such a portfolio, each investment approach fills a unique role:

Market cap-weighted index strategies seek to provide low cost, diversified market exposure and can serve as the anchor for strategic benchmarks in target risk allocations.

Style factor strategies seek to provide incremental returns by exploiting top-down insights to target historically broad, persistent, well-documented sources of return such as value, momentum, and quality that exist within asset classes.

Alpha-seeking strategies seek to provide differentiated, uncorrelated alpha after accounting for factor exposures, by exploiting bottom-up insights to target unique, transitory sources of return.



Tracking Error:	0.0%	0.5%	1.0%	1.5%	2.0%	2.5%	3.0%	3.5%	4.0%	4.5%	5.0%
Mgr 1	0%	8%	15%	24%	22%	19%	16%	13%	11%	8%	4%
Mgr 2	0%	8%	16%	25%	39%	50%	61%	71%	79%	89%	96%
Mgr 4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mgr 6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Multifactor	0%	15%	30%	45%	39%	31%	23%	16%	10%	3%	0%
Index	100%	69%	39%	6%	0%	0%	0%	0%	0%	0%	0%

Sources: eVestment Alliance, MSCI, March 2018. Information shown is calculated using net of fees composite monthly return data (April 2013 to March 2018) for six equity managers identified as being benchmarked to the MSCI World Index in eVestment. Multi-Factor strategy is proxied by the MSCI World Diversified-Multiple Factor Index Net USD. Index is represented by MSCI World Index. Please see "Case Study Methodology" at the end of the document for additional information. Portfolio and analysis provided for illustrative purposes only to demonstrate a potential approach to using factors to enhance manager structure. It is not representative of any actual client's portfolio and is not a recommendation of an investment strategy or allocation.

Exhibit 27.8 Optimal combinations of index, factors, and alpha strategies

The optimal mix of active managers, factors, and cap-weighted index strategies will differ across different investors and be a function of return target, risk tolerance, fee budget, investment philosophy, and resources available to monitor managers. Intuitively, investors targeting lower active risk will have an optimal portfolio which relies heavily on index exposures. Investors who look to maximize expected return, and are comfortable with high tracking error and fee budgets, may have an optimal portfolio dominated by active managers. Investors seeking a balanced portfolio which maximizes diverse sources of return tend to gravitate toward a portfolio composed of index, alpha-seeking, and factor strategies.

Exhibit 27.8 illustrates the optimal portfolios at different levels of targeted active risk. We use the same active managers from Exhibit 27.7, and run an optimization which allocates between these active managers, factor strategies, and index funds.

Because the optimization process looks for high information-ratio strategies, it has retained Managers 1 and 2 while replacing Managers 4 and 6 with the diversified multifactor strategy. For the investor targeting an active risk level of 1%, the portfolio is split across factor (30%), index (39%), and the two active strategies (31%). At higher active risk targets, investors increasingly move away from the index strategy and toward greater allocations to the active and multifactor strategies. Conversely, at lower risk targets, index strategies play an increasingly prominent role.

27.6 Conclusion

Reserve managers must balance long-term and short-term investment objectives, require transparency in their actions, and have hierarchical governance structures. Factors combined with a Reference Portfolio framework can help meet these challenges.

A governing board can set the Reference Portfolio based on risk appetite or return needs; an investment committee can approve the Strategic Portfolio, which is a long-term strategic asset allocation which allocates to a broader array of factors for increased diversification; and the day-to-day portfolio managers can have responsibility for the Implemented Portfolio, which could include short-term, tactical views, or active management. Multiple Reference Portfolios can be constructed to reflect the various mandates of the reserve manager: a liquidity tranche, for example, would have a materially lower allocation to equities than a tranche with a growth objective. This structure aligns purpose, role, expertise, and time horizon: the board maintains a long-term perspective, while the investment committee and portfolio managers can take advantage of medium- and shorter-term investment opportunities in the market.

Factors play an important role in creating the Strategic Portfolio and can be used to complement traditional active manager selection in the Implemented Portfolio. At the Strategic Portfolio, reserve managers can more efficiently allocate risk and obtain better diversification; allocating strictly to asset classes can mask common risk sources in the portfolio. Reserve managers can use drawdowns of certain scenarios to help shape the Strategic Portfolio. At the Implemented Portfolio, a factor framework for portfolio construction and manager selection presents an opportunity for investors to construct portfolios that are better suited to target a variety of outcomes, from higher risk-adjusted returns to improved diversification to lower fees.

Acknowledgements The views expressed here are those of the authors alone and not of BlackRock, Inc. We thank the editor, Jacob Bjorheim, and Bob Bass, Trey Heiskell, Sunil Shah, and Kaitlyn Piper for helpful comments.

27.7 Annex

27.7.1 Case Study Methodology

Portfolio and analysis provided for illustrative purposes only to demonstrate a potential approach to using factors to enhance manager structure. It is not representative of any actual client's portfolio and is not a recommendation of an investment strategy or allocation. For the case study the following steps were undertaken. All data is as of 3/31/2018.

- The top 25 active equity strategies by AUM that self-benchmarked to the MSCI World Index in eVestment were used as the starting point for manager selection.
- Of the 25 managers, only those that self-reported net of fees strategy returns were used in the analysis.
- Managers that used factor-based or lower tracking error (3% or less) investment approaches were excluded, as were managers that pursued niche investment strategies (ex. ESG, REIT). Managers with negative trailing five-year returns were also excluded.
- Trailing 5 year annualized active risk, annualized active return, and managers correlations were calculated using net of fee returns as reported in eVestment.
- MSCI World and MSCI Diversified Multiple-Factor (DMF) Indices were used to proxy "Index" and "Multi-Factor" strategies, respectively. These are unmanaged indices that do not reflect any management fees, transaction costs, or expenses.
  - Note: For investors wishing to utilize this framework, we recommend it be done while taking into account the effective fees that an active or indexed portfolio manager may charge for the share class or vehicle available to the specific investor.
- Regression analysis was performed on excess manager and DMF returns over the MSCI World
- Index vs. four single factor indices: MSCI World Equal Weighted Index, MSCI World Enhanced Value Index, MSCI World Momentum Index, and MSCI World Sector Neutral Quality. Included in the returns were the R-squared (coefficient of determination), monthly alpha after style factor loadings, and the factor loadings for each strategy. Results that exhibited a confidence level of 95% and 90% were highlighted in gray.
- Based on correlation and regression results, a decision was made as to whether to retain or eliminate each manager. Managers that generated alpha were retained. Managers with no alpha but with statistically significant negative factor loadings and high excess return correlation were removed. As some managers exhibited multi-factor tendencies, the DMF Index was added to the potential mix of investment choices as a potential replacement as it purposely targets diversified factor exposures.

- Using Markov Processes International, an efficient frontier was created for both the initial screened set off managers plus the MSCI World Index, as well as the revised manager set (including DMF).
- Finally, we plotted the resulting portfolio allocation at varying levels of active risk.

27.7.2 Index Disclosures (as of September 30, 2018)

- This analysis contains back-tested index data.
- Index returns are for illustrative purposes only and do not represent any actual fund performance.
- Index performance returns do not reflect any management fees, transaction costs, or expenses.
- Indexes are unmanaged and one cannot invest directly in an index.
- Past performance does not guarantee future results.
- Data for time periods prior to the index inception date is hypothetical and is provided for informational purposes only to indicate historical performance had the index been available over the relevant time period.
- Hypothetical data results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for risk factors that may affect the actual fund performance.
- Actual performance of the fund may vary significantly from hypothetical index performance due to transaction costs, liquidity, or other market factors

Index name	Index inception date	Dates of back-tested returns	1-year (%)
MSCI World Minimum Volatility (USD) Index	4/14/2008	5/31/1988–4/14/2008	10.35
MSCI World Index	5/31/1986	12/31/1969–5/31/1986	11.24
MSCI World Diversified Multi-Factor Index	3/19/2015	11/30/98–3/19/15	10.88
MSCI World Sector Neutral Quality Index	8/11/2014	11/30/98–08/11/14	13.68
MSCI World Enhanced Value Index	8/11/2014	11/28/97–08/11/14	7.13
MSCI World Equal Weighted Index	1/22/2008	11/28/75–1/22/08	7.59
MSCI World Momentum Index	12/11/2013	11/28/75–12/11/13	22.69

Index returns do not reflect any management fees, transaction costs, or expenses. Indexes are unmanaged and one cannot invest directly in an index. Data for time periods prior to the index inception date is hypothetical and is provided for informational purposes only to indicate historical performance had the index been available

over the relevant time period. Hypothetical data results are based on criteria applied retroactively with the benefit of hindsight and knowledge of factors that may have positively affected its performance, and cannot account for risk factors that may affect the actual fund performance. The actual performance of the fund may vary significantly from the hypothetical index performance due to transaction costs, liquidity, or other market factors. Index methodology is available at www.msci.com.

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