



An empirical examination of the effect of domestic monetary policy on external commercial borrowings to India

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Abstract

This paper empirically examines the effect of domestic monetary policy shock on external commercial borrowings (ECBs) to India for the period 2000:Q2 to 2019:Q4. The impact of domestic monetary policy shock on ECBs is assessed using two variables: interest rate differential and domestic money supply growth. The paper employs a structural VAR model and utilizes impulse response functions and forecast error variance decomposition analysis to derive empirical results. The empirical results based on impulse response functions indicate that the interest rate differential has a positively significant effect on external commercial borrowings to India, while the effect of domestic money supply growth is found to be negative. The forecast error variance decomposition analysis indicates that the interest rate differential explains about 14.6% and domestic money supply growth explains about 2% of the total variation in external commercial borrowings, implying that domestic monetary policy variables together explain about 16.6% of the total variation in ECBs to India. The results suggest that the central bank, through monetary policy interventions, can influence and manage the flow of external commercial borrowings to India. Furthermore, the study finds that the exchange rate, domestic industrial activity, domestic output growth, domestic country's creditworthiness, and domestic macroeconomic instability are other significant determinants of external commercial borrowings.

Keywords Monetary Policy · External Commercial Borrowings · Interest rate differential · SVAR · India

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1 Introduction

India is a major emerging economy that needs a constant flow of external funds to support its investment requirements. External commercial borrowings (ECBs) by domestic corporates are an important source of external funds to India. ECBs comprise commercial loans in the form of bank loans, suppliers' credit, buyers' credit, securitized instruments such as floating rate notes, securitized commercial borrowings, and fixed rate bonds from non-resident lenders. One of the major advantages of ECBs is that they provide an additional source of funds for Indian corporates to expand their existing capacity and finance new investment ventures, thereby contributing to the country's economic growth (Sur et al., 2019; Verma & Prakash, 2011). However, due to their significant share in India's total external debt,¹ ECBs have sparked concerns about debt repayments, raising fears of widespread crisis and threatening financial stability, particularly in the event of external shocks (Pradhan & Hiremath, 2019). Moreover, volatility in ECB flows, as observed in Fig. 1, has the potential to disrupt India's balance of payments position and create significant fluctuations in the foreign exchange market. Maran (2023) discusses the need for macroprudential policies to address such financial risks.

Figure 1 illustrates the considerable volatility in net ECB flows to India over the years. Despite the volatility, the total outstanding stock of ECBs in India has consistently grown. ECBs constitute a substantial proportion of India's total external debt and this proportion has been continuously increasing over the years, increasing from 13.7% in 1991–92 to 20.3% in 1990–00, 27.8% in 2007–08, 33.5% in 2013–14 and further to 37.9% in 2018–19 (Table 1). Given the volatility and the growing significance of ECBs in India, it is essential to understand what determines ECB flows in general and how a domestic monetary policy shock affects such flows, in particular, to help domestic policymakers, including the central bank, formulate appropriate policies to manage them. Hence, the current study aims to empirically examine the effect of the domestic monetary policy shock and other domestic factors on ECB flows to India.

In this study, the impact of the domestic monetary policy shock on external commercial borrowings to India is explored using two variables: interest rate differential and domestic money supply growth. The empirical analysis is conducted through the application of the structural VAR model. This methodology allows for an examination of the dynamic behaviour of external commercial borrowings in response to a domestic monetary policy shock, and it also helps determine the relative contribution of the domestic monetary policy shock in explaining external commercial borrowings to India.

¹ Approximately 30% of the total external debt to India over the period 1990–91 to 2018–19 is in the form of external commercial borrowings by domestic corporations, with the share further rising to around 35% in recent years. Refer to Table 1.

Table 1 Share of External Commercial Borrowings in India's Total External Debt. Source: Reserve Bank of India

Year	Total External Debt	Total ECBs Outstanding	Total ECBs Outstanding (% of External Debt)
1990–91	83,801	10,209	12.2
1991–92	85,285	11,715	13.7
1992–93	90,023	11,643	12.9
1993–94	92,695	12,363	13.3
1994–95	99,008	12,991	13.1
1995–96	93,730	13,873	14.8
1996–97	93,470	14,335	15.3
1997–98	93,531	16,986	18.2
1998–99	96,886	20,978	21.7
1999–00	98,263	19,943	20.3
2000–01	101,326	24,408	24.1
2001–02	98,843	23,320	23.6
2002–03	104,914	22,472	21.4
2003–04	112,653	22,007	19.5
2004–05	134,002	26,405	19.7
2005–06	139,114	26,452	19
2006–07	172,360	41,443	24
2007–08	224,407	62,334	27.8
2008–09	224,498	62,461	27.8
2009–10	260,935	70,726	27.1
2010–11	317,891	100,476	31.6
2011–12	360,766	120,136	33.3
2012–13	409,374	140,125	34.2
2013–14	446,178	149,375	33.5
2014–15	474,675	180,295	38
2015–16	484,791	180,480	37.2
2016–17	471,012	172,045	36.5
2017–18	529,278	201,821	38.1
2018–19	543,135	205,804	37.9

The existing studies on ECB flows to India (Dev, 2014; Misra et al., 2022; Patnaik et al., 2016; Sur et al., 2019; Pradhan & Hiremath, 2019; Pradhan & Hiremath, 2020; Singh, 2007; Singh, 2009) have mainly focused on analysing the trends and determinants of ECBs. The role of domestic monetary policy in affecting ECB flows to India is not well researched in the literature. By examining the role of the domestic monetary policy shock and a wider set of other domestic factors in influencing ECB flows to India, this study makes an effort to bridge this gap. Furthermore, by employing the structural VAR model, the current study is able to determine how much proportion of the total variation in ECBs to India

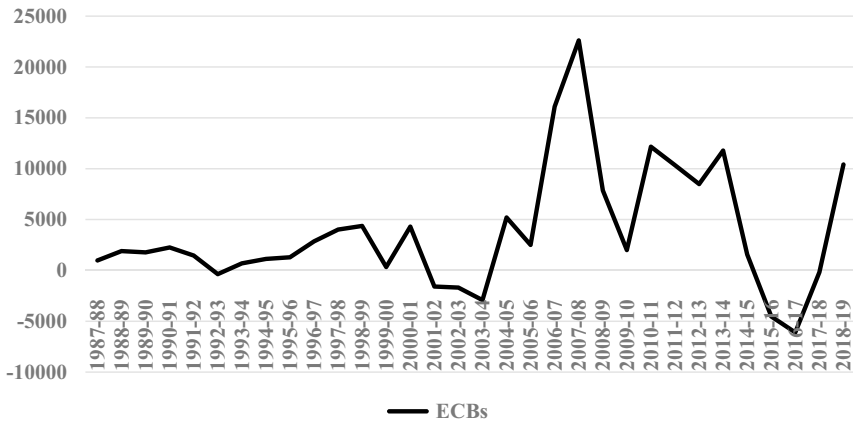


Fig. 1 Net External Commercial Borrowings to India, US\$ Million. Source: Reserve Bank of India (RBI)

is explained by the domestic monetary policy shock, something that previous research has not explored.

The following section discusses the trends in external commercial borrowings to India and how it relates with domestic monetary policy shocks. Section 3 reviews the existing literature and discusses the theoretical outline. Section 4 details the empirical model, data, and methodology. Section 5 presents and examines the empirical results. At last, Sect. 6 concludes.

2 Trends in external commercial borrowings to India and how it relates to domestic monetary policy shocks

External commercial borrowings are an additional source of funds for Indian corporates to expand their existing capacity and finance new investment ventures, taking into account interest rate differential between domestic and global markets as well as associated market risks (Verma & Prakash, 2011). The ECB policy in India has been designed to provide Indian corporates with flexibility in borrowings while maintaining judicious limits for total external borrowings, subject to conditions on maturity, cost, and end-use restrictions. Unlike FPI and FDI flows, ECB flows in India are modulated based on the overall cycle of capital flows, through the use of price-based measures (such as linking interest costs to LIBOR) and administrative measures (such as end-use restrictions for ECBs).

The use of ECBs began in the 1970s but remained modest due to the dominance of external aid from multilateral and bilateral entities. In the 1980s, as external aid started to decline and the trade deficit widened, the importance of ECBs in meeting India's foreign exchange and investment requirements increased. The bulk of the increase in ECB flows was observed during the second half of the 1980s when there was a significant surge in demand for foreign currency due to a widening trade

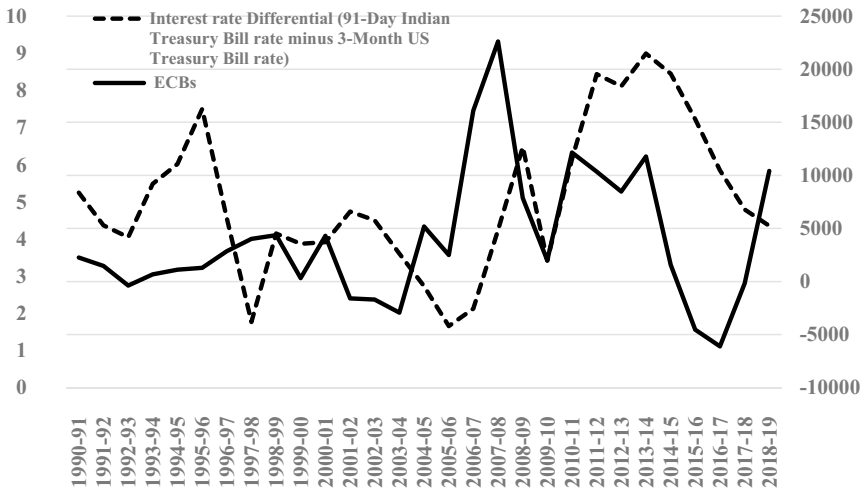


Fig. 2 Trends in net external commercial borrowings to India and interest rate differential (91-Day Indian Treasury Bill rate minus 3-Month US Treasury Bill rate). Source: Reserve Bank of India and Federal Reserve

deficit caused by higher oil prices, increased import demand, and a sharp depreciation of the domestic currency against the dollar. This led to a substantial rise in India's external liability by 1990, which eventually culminated into the balance of payment crisis of 1991. Following the crisis, external commercial borrowings dried up in response to a fall in India's credit rating. The Indian government also adopted a conservative ECB policy to address the external debt situation, imposing an annual ceiling on additional external borrowings, particularly on short-term debt, and placing restrictions on the end-use of ECBs. ECBs were mainly permitted for importing capital goods, with priority given to the infrastructure sector.

Figure 2 shows the trends in Net ECB flows and domestic monetary policy shocks, as represented by the change in 91-Day Indian Treasury Bill rate relative to 3-Month US Treasury Bill rate, i.e., the interest rate differential. We observe that net ECB flows to India exhibited a declining trend in the initial years of liberalization from 1990–91 to 1992–1993, accompanied by a decrease in the interest rate differential. However, net ECB flows began to rise thereafter and continued to do so till 1998–99. This continuous rise in ECBs was the result of improved credit ratings, enhanced domestic demand, and the liberalization of ECB policy with respect to maturity, amount and eligible borrowers in the mid-1990s. As shown in Fig. 2, the interest rate differential also experienced an upward trend during this period till 1995–96, suggesting that, if allowed, domestic corporates tend to borrow more from external sources when borrowing costs in the domestic country are higher relative to the foreign country. The turbulence in global financial markets triggered by the East Asian crisis, economic sanctions on India due to Pokhran nuclear test, global slowdown in the early 2000s, highly volatile credit markets, and lower investor confidence, interrupted developments in India's capital account, leading to fluctuations and a decline in ECB flows until 2003–04. Figure 2 shows that this period was also

Table 2 Net external commercial borrowings to India, US\$ Million. Source: Reserve Bank of India

Year	ECBs	Year	ECBs
1987–88	976	2003–04	– 2925
1988–89	1894	2004–05	5194
1989–90	1777	2005–06	2508
1990–91	2254	2006–07	16,103
1991–92	1462	2007–08	22,610
1992–93	– 366	2008–09	7861
1993–94	686	2009–10	2000
1994–95	1124	2010–11	12,160
1995–96	1284	2011–12	10,344
1996–97	2856	2012–13	8485
1997–98	4010	2013–14	11,777
1998–99	4367	2014–15	1570
1999–00	333	2015–16	– 4529
2000–01	4303	2016–17	– 6102
2001–02	– 1585	2017–18	– 183
2002–03	– 1692	2018–19	10,416

characterized by a declining trend in the interest rate differential, which may mean that, *ceteris paribus*, domestic corporates tend to borrow less from external sources when borrowing costs in the domestic country fall relative to the foreign country.

The period from 2004–05 to 2007–08 proved to be golden years for global capital flows as well as for domestic GDP expansion, reflected in an increased net flow of ECBs from \$5194 million in 2004–05 to an all-time peak of \$22,610 million in 2007–08 (Table 2). The period witnessed an important policy change in the form of the issuance of a new set of policy guidelines on ECBs on January 31, 2004. The objective was to establish “more transparent and simplified policies and procedures” on external commercial borrowings. As shown in Fig. 2, this period was also marked by an upward trend in the interest rate differential up to 2008–09 as the central bank followed a contractionary monetary policy to control speculation and inflation, making borrowings from external sources cheaper. Encouraged by cheaper international liquidity, simplified policies and procedures, increasing domestic demand, and a favorable exchange rate, many Indian firms increasingly raised funds through ECBs during this period.

There was a sharp reversal in net ECB flows in 2008–09 due to the global financial crisis whose impact was felt all over the world. Net ECBs fell in 2009–10 as well. Although ECB flows recovered strongly in 2010–11, they continued to fluctuate around that level until 2013–14 before following a downward trend for the next three years, reaching their lowest point in 2016–17. The interest rate differential also exhibited a similar pattern during 2008–09 to 2016–17. The following year, 2017–18, also witnessed a net outflow of external commercial borrowings. Nevertheless, due to reform measures taken by the government, further liberalization of the ECB policy, and the huge demand for cheaper funds by Indian corporates to support their expansion, there was a sharp recovery in net ECB flows in 2018–19.

Overall, it can be stated that ECB flows to India have demonstrated substantial volatility, particularly in the aftermath of the 2008–09 financial crisis. Additionally, as shown in Fig. 2, a rise in ECB flows has often been associated with monetary policy shocks causing an increase in the interest rate differential, whereas a fall in ECB flows has been associated with monetary policy shocks causing a decrease in the interest rate differential. Hence, to explore this further, it is necessary to examine the effect of domestic monetary policy shocks on ECB flows empirically.

3 Review of literature

3.1 Empirical literature

One of the initial studies focusing on analysing external commercial borrowings to India in the post-liberalization period was conducted by Singh (2007). Using Johansen co-integration and VECM mechanisms, the study revealed that long-term external borrowings by Indian corporates were influenced by the pace of domestic real activity, interest rate differentials, and credit conditions. In terms of magnitude, it was the real variable, i.e. domestic real activity, that had the greatest impact in attracting ECB flows to India compared to price variables such as interest rate differential. Singh (2009) also concluded that external commercial borrowings to India were primarily driven by domestic real economic activity, interest rate differential, and credit constraints in the global market. The study found a strong co-movement between overseas borrowings and domestic real activity. It also observed that during normal periods, ECBs were predominantly driven by domestic real demand shocks, while during the periods of crisis, global credit shocks played a more significant role in affecting ECBs.

Verma and Prakash (2011) employed the Granger causality and Johansen co-integration methods to examine the impact of interest rate differential and other potential determinants on ECB flows to India. The co-integration analysis revealed a positive and statistically significant impact of interest rate differentials on ECBs. The granger causality test also indicated that ECB flows were granger caused by interest rate differential. The study further identified domestic currency appreciation, improvement in the current account balance, and domestic industrial activity as the other important factors attracting ECB flows to India. Dev (2014) also applied the Johansen co-integration and Granger causality to investigate the ECB flows to India and its relationship with imports, exports, interest rate differential, exchange rate, the index of industrial production, and foreign investment. The study found a significant long-term positive relationship between ECBs and the index of industrial production, exchange rates, and interest rate differentials. The granger causality test indicated a unidirectional causality running from these variables to ECB flows. Through variance composition analysis, the study observed that most of the variation in ECB flows was caused by interest rate differential, followed by the index of industrial production. On similar lines, Sur et al. (2019) analysed the determinants of ECB flows to India using Johansen cointegration and vector error correction techniques and revealed that both domestic and external factors played a role in ECB

inflows to India. The study highlighted that regulatory changes related to the capital account had the most significant impact on ECB flows. Additionally, the study identified exchange rates, India's sovereign rating, interest rate differential, and international credit conditions as other significant determinants of ECB flows to India.

Parnaik et. al (2016) talked about existing regulations, reviewed the outcomes and discussed areas of concern and recent policy changes related to foreign currency borrowings by Indian firms. They concluded that in an emerging country with incomplete markets and a managed floating exchange rate, there are systemic risks associated with foreign currency borrowings if left unhedged by large firms, hence emphasizing for a new policy framework. Pradhan and Hiremath (2019) also talked about the risks and financial stability concerns associated with foreign currency borrowings by Indian firms and recommended implementing a targeted policy approach that includes a focus on the domestic bond market, effective hedging mechanisms, and appropriate regulatory decisions regarding the cap and level of ECBs. Misra et al. (2022) also emphasized on hedging against risks associated with foreign currency borrowings and suggested firms to employ hedging strategies to cover a pre-defined minimum portion of their currency risk while obtaining funds via ECBs. Pradhan and Hiremath (2020) investigated reasons for external borrowings by Indian firms using a dynamic panel regression approach and concluded that both macroeconomic and firm specific factors are important in explaining external borrowings by Indian firms. Thus, we note that existing studies have mainly focused on analysing the trends and determinants of ECBs. None of the studies has specifically focused on determining the impact of domestic monetary policy shock on ECB flows to India, particularly when we want to know how much of the total variation in ECB flows to India is explained by the domestic monetary policy shock.

3.2 Literature on theoretical linkage between domestic monetary policy and ECBs

According to the open market portfolio balance theory (Branson, 1972; Kouri & Porter, 1974; McKinnon & Oates, 1966), international debt flows such as external commercial borrowings respond to interest rate differential. Therefore, an Indian company's decision to borrow from the foreign market as compared to the domestic market primarily depends on the interest rate differential between the domestic and foreign markets.

The higher the interest rate differential, the greater the incentive for domestic firms to access low-cost funds from the international market. Singh (2007), Verma and Prakash (2011), Dev (2014) and Sur et al. (2019) have empirically observed the positive association between interest rate differential and ECB flows to India. Therefore, a domestic monetary policy shock (measured through shocks in domestic money supply growth and interest rate differential) is expected to have a significant influence on external commercial borrowings. While the interest rate differential is expected to positively impact ECB flows, domestic money supply growth, by inversely influencing the interest rate differential, is likely to have a negative impact.

However, ECB flows are also likely to be influenced by other domestic and external variables (Dev, 2014; Singh, 2007, 2009; Sur et al., 2019; Verma & Prakash, 2011). It is important to control for these variables while investigating the role of the domestic monetary policy shock. Accordingly, domestic variables that we control for include domestic output growth, foreign exchange reserves to import ratio representing domestic country's creditworthiness, domestic fiscal deficit to GDP ratio representing domestic macroeconomic instability, exchange rate defined as the rupee price of a US dollar, index of industrial production representing domestic industrial activity, and the degree of openness. External variables that are controlled include foreign output growth and volatility in the global market.

4 Empirical model, data and methodology

Drawing from the theoretical idea presented in the previous section, we obtain the following empirical model for external commercial borrowings:

$$ECB_t = \lambda + \lambda_1(i_t - i_t^*) + \lambda_2Mg_t + \lambda_3y_t + \lambda_4rm_t + \lambda_5(fd/y)_t + \lambda_6ex_t + \lambda_7IIP_t + \lambda_8open_t + \lambda_9y_t^* + \lambda_{10}globalVol_t + \mu_t \quad (1)$$

where ECB_t : External Commercial Borrowings, $(i_t - i_t^*)$: Interest Rate Differential, Mg_t : Domestic Money Supply Growth, y_t : Domestic Output Growth, rm_t : Foreign Exchange Reserves to Import ratio representing Domestic Country's Creditworthiness, $(fd/y)_t$: Domestic Fiscal Deficit to GDP ratio representing Domestic Macroeconomic Instability, ex_t : Exchange Rate defined as the Rupee price of a US Dollar, IIP_t : Index of Industrial Production representing Domestic Industrial Activity, $open_t$: Degree of Openness, y_t^* : Foreign Output Growth, $globalVol_t$: Volatility in the Global Market.

The study applies the structural VAR (SVAR) model to empirically examine the effect of domestic monetary policy variables ($i-i^*$ and Mg) and other explanatory variables included in the empirical model on external commercial borrowings to India. Additionally, the study includes two dummy variables, specifically EUcrisis and UScrisis, to control for the effects of the Eurozone debt crisis and the US crisis on the flow of external commercial borrowings to India. Considering India's status as a small open economy, certain variables such as foreign output growth (y_t^*), global market volatility ($globalVol_t$), and the aforementioned dummy variables (EUcrisis and UScrisis) are regarded as exogenous factors within the system. Degree of openness ($open_t$) is also assumed to be exogenous. Thus, we estimate the empirical model (1) with eight endogenous variables, namely, interest rate differential ($i-i^*$), domestic money supply growth (Mg), foreign exchange reserves to import ratio (rm), domestic fiscal deficit to GDP ratio (fd/y), domestic output growth (y), exchange rate (ex), index of industrial production (IIP) and external commercial borrowings (ECB) after controlling for all exogenous variables in the framework of Structural VAR.² As discussed in the previous section, the interest rate differential

² Structural VAR model includes endogenous variables only.

is expected to positively impact ECB flows, i.e., $\lambda_1 > 0$, and domestic money supply growth, by inversely influencing the interest rate differential, is likely to have a negative impact, i.e., $\lambda_2 < 0$. The expected signs of coefficients associated with other endogenous explanatory variables are $\lambda_3 > 0$, $\lambda_4 > 0$, $\lambda_5 < 0$, $\lambda_6 < 0$, $\lambda_7 > 0$, which we have discussed below:

- *Domestic Output Growth (y)* Higher domestic growth indicates rapidly growing domestic economic activity and a larger market size, which creates demand for funds by local firms both for expansion and new investment ventures. It also boosts the confidence of foreign lenders by making them feel safe about their investments. Thus, domestic output growth is expected to have a positive influence on ECB flows.
- *Foreign Exchange Reserves to Import Ratio (rm)* A country with greater foreign reserves relative to its import requirements can easily repay its external liabilities and hence is considered more creditworthy. A high level of creditworthiness lowers the sovereign credit risk of the domestic country, boosts the confidence of foreign creditors, and thus allows domestic firms easier access to international debt markets. Therefore, a rise in foreign exchange reserves to import ratio is likely to attract greater ECB flows to the domestic country.
- *Domestic Fiscal Deficit to GDP Ratio (fd/y)* A higher domestic fiscal deficit to GDP ratio indicates greater macroeconomic instability in the domestic country, which increases investment risk and thereby discourages domestic corporates from expanding their existing capacity or undertaking new investment ventures. It also discourages foreign lenders from supplying more debt capital to the domestic (host) country. Therefore, the domestic fiscal deficit to GDP ratio is expected to have a negative effect on ECBs.
- *Exchange Rate (ex)* The depreciation of the domestic currency is likely to discourage external borrowings by Indian corporates. Depreciation of the rupee means a higher repayment burden in terms of rupee and a higher effective cost of external borrowings for Indian corporates. Thus, the depreciation of the rupee is expected to negatively influence ECB flows to India.
- *Index of Industrial Production (IIP)* Index of industrial production represents the level of industrial activity in the domestic country. An increasing domestic industrial activity involves an increasing need for funds to finance new investments or expansion of existing capacities, and this, in turn, induces greater external borrowings by domestic corporates. Thus, index of industrial production is expected to have a positive influence on ECB flows.
- *Degree of Openness (open)* A highly open domestic economy means greater flexibility for domestic corporates to access funds internationally at a lower cost. It also means fewer restrictions on all types of capital inflows, including debt inflows. Further, foreign lenders feel more secure about their money in an open market. Thus, a high degree of openness is likely to facilitate greater external commercial borrowings.

4.1 Model specification and empirical strategy

This study applies the structural VAR model to empirically examine the effect of domestic monetary policy shock on external commercial borrowings to India. Innovation accounting analysis under the structural VAR model (impulse response function and forecast error variance decomposition function) is utilized to derive empirical results. The impulse response function (IRF) enables tracking the dynamic path of one variable in response to one standard error shock in another variable. The forecast error variance decomposition (FEVD) function indicates the proportion of overall variation in one variable that can be attributed to shocks from other variables in the model. These two applications together assist in determining the impact and the relative contribution of domestic monetary policy shock in explaining external commercial borrowings to India.

To perform innovation analysis, we follow Han and Kim (2023), wherein we first identify the contemporaneous relation matrix (C_0).³ This helps recover structural shocks (ε) from the reduced form shocks (e), which as per Sims (1986) and Blanchard and Watson (1986) requires imposition of at least $(n^2-n)/2$ identification restrictions on the matrix C_0 of structural VAR model.⁴ In the structural VAR model, such restrictions come from the economic theory. Once C_0 suitably is restricted, the SVAR model is labelled identified, and the structural shocks (ε_t) are recovered from the reduced form shocks (e) using the following equation: $\varepsilon_t = C_0 e_t$. Additionally, in this study, Monte Carlo Integration is employed for innovation accounting analysis. Monte Carlo Integration, a Bayesian method, is utilized to statistically determine the significance of impulse responses by computing confidence bands around them (Doan, 1990).

As discussed earlier, the empirical model has 8 endogenous variables, interest rate differential ($i-i^*$), domestic money supply growth (Mg), foreign exchange reserves to import ratio (rm), domestic fiscal deficit to GDP ratio (fd/y), domestic output growth (y), exchange rate (ex), index of industrial production (IIP) and external commercial borrowings (ECB). The vector of variables (X) for the structural VAR model is therefore given as:

$$X = [Mg, (i - i^*), y, ex, (fd/y), rm, IIP, ECB]$$

With $n=8$, a minimum of $(8^2-8)/2=28$ restrictions must be imposed on matrix C_0 in order to recover or identify the structural shocks. The required identification is achieved using the equation $\varepsilon_t = C_0 e_t$ by implementing the following restrictions on matrix C_0 :

³ C_0 is a matrix having ones in the diagonal, which represents contemporaneous relationships among variables (variables in vector X) included in the structural VAR model.

⁴ The formal structural VAR methodology is explained in the appendix.

$$\begin{bmatrix} \varepsilon_{Mg} \\ \varepsilon_{i-i^*} \\ \varepsilon_y \\ \varepsilon_{ex} \\ \varepsilon_{fd/y} \\ \varepsilon_{rm} \\ \varepsilon_{IIP} \\ \varepsilon_{ECB} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \gamma_{21} & 1 & \gamma_{23} & \gamma_{24} & 0 & 0 & 0 & 0 \\ 0 & \gamma_{32} & 1 & \gamma_{34} & 0 & 0 & 0 & 0 \\ 0 & \gamma_{42} & \gamma_{43} & 1 & 0 & 0 & 0 & \gamma_{48} \\ 0 & 0 & \gamma_{53} & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & \gamma_{63} & \gamma_{64} & 0 & 1 & 0 & 0 \\ 0 & \gamma_{72} & \gamma_{73} & 0 & 0 & 0 & 1 & 0 \\ \gamma_{81} & \gamma_{82} & \gamma_{83} & \gamma_{84} & \gamma_{85} & \gamma_{86} & \gamma_{87} & 1 \end{bmatrix} \begin{bmatrix} e_{Mg} \\ e_{i-i^*} \\ e_y \\ e_{ex} \\ e_{fd/y} \\ e_{rm} \\ e_{IIP} \\ e_{ECB} \end{bmatrix}$$

In the above specification, it is assumed that shocks to other variables in the model do not contemporaneously affect domestic money supply growth. This is because domestic money supply growth is assumed to be determined exogenously by the central bank, which consequently produces following restrictions: $\gamma_{12}=\gamma_{13}=\gamma_{14}=\gamma_{15}=\gamma_{16}=\gamma_{17}=\gamma_{18}=0$. On the contrary, shocks to all variables are assumed to have a contemporaneous impact on ECB flows to India. Hence, none of the gammas (γ 's) in the eighth row are zero. The zeroes in the matrix presented above indicate the restrictions imposed based on the theoretical considerations. As there are 36 zeros, the SVAR model has a total of 36 restrictions, indicating that the model is over-identified.

4.2 Data and variables definition

The study uses quarterly data from 2000:Q2 to 2019:Q4 for the analysis.⁵ The Reserve Bank of India, OECD database and the Federal Reserve Economic Data are the main data sources. The study defines external commercial borrowings (ECB) broadly as the sum of net external commercial borrowings and net short-term credit to India, both denominated in US\$ million. The difference between yield on Indian Treasury Bills (91-Day) and yield on US Treasury Bills (3-Month) is taken as the interest rate differential ($i-i^*$). Domestic money supply growth (Mg) is given by rate of growth of broad money supply in India. Domestic output growth (y) is defined by growth rate of GDP in India. Foreign exchange reserves to import ratio (rm) representing domestic creditworthiness is defined as the ratio of total foreign exchange reserves and imports, both denominated in US\$ million. Domestic fiscal deficit to GDP ratio (fd/y) representing domestic macroeconomic instability is defined as the ratio of gross fiscal deficit and GDP.

The rupee price of a US dollar is taken as the exchange rate (ex). Index of industrial production (IIP) for India is used to measure domestic industrial activity. The degree of openness ($open$) is assessed through two factors: trade openness and

⁵ To remove the impact of the unexpected shock associated with COVID, the study has only considered the pre-COVID period for analysis.

financial openness. Trade openness is captured by calculating the ratio of trade to GDP, while financial openness is captured using financial openness index for India by Chinn and Ito (2008). Foreign output growth (y^*) is measured through output growth of OECD countries. The CBOE volatility index (VIX) for the United States is utilized to capture the level of volatility in global market (*globalVol*).

5 Empirical results

5.1 Unit root results

The unit root tests reveal that external commercial borrowings and the degree of financial openness are stationary variables. On the other hand, the remaining variables, namely domestic money supply growth, foreign exchange reserves to import ratio, interest rate differential, domestic fiscal deficit to GDP ratio, domestic output growth, exchange rate, index of industrial production, degree of trade openness, volatility in the global market, and foreign output growth, are found to be non-stationary.^{6,7}

Typically, when estimating Structural VAR (or VAR) models, it is necessary for all variables to exhibit stationarity. However, this study has incorporated all variables in levels, even though most of them are level non-stationary. This is because the study utilizes Monte Carlo Integration for innovation analysis, as mentioned earlier. Since Monte Carlo Integration is a Bayesian technique, the presence of non-stationary variables does not influence the statistical inferences, as established by Sims and Uhlig (1991), and Kim and Roubini (2000). Consequently, all variables in the SVAR model have been incorporated in levels.

5.2 Structural VAR results

We estimate the structural VAR model at lag length two,^{8,9} In Sect. 5.2.2, it was established that the structural VAR model for ECB is over-identified. To assess the validity of the imposed restrictions, we employ the likelihood ratio test of over-identifying restrictions. The outcome of the test is shown in Table 3. We observe that the likelihood ratio test does not reject the validity of the restrictions at a significance level of 1%, thus marginally confirming the validity of the imposed restrictions.

⁶ The study has employed three unit root tests, KPSS, DF-GLS and PP, to check for the unit root, the results of which are available in the appendix.

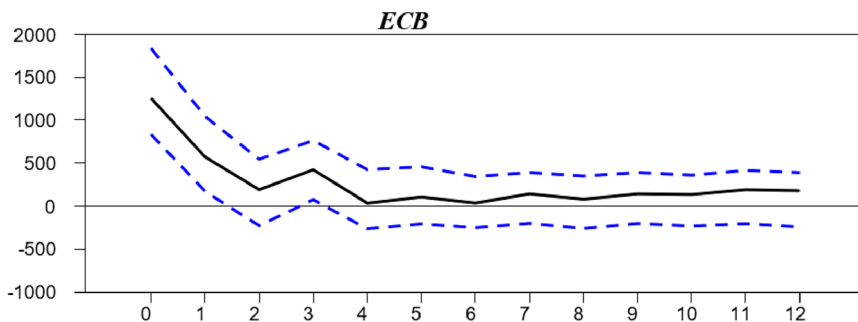
⁷ The descriptive statistics of all these variables has also been presented in the Appendix.

⁸ Optimal lag length is chosen using the lag length criteria under VAR.

⁹ Note that the structural VAR is estimated only with endogenous variables (interest rate differential, domestic money supply growth, foreign exchange reserves to import ratio, domestic fiscal deficit to GDP ratio, domestic output growth, exchange rate, index of industrial production, and external commercial borrowings) after controlling for all the exogenous variables (UScrisis dummy, foreign output growth, EUcrisis dummy, degree of openness, volatility in global market).

Table 3 Likelihood Ratio Test of Over-identifying Restrictions

	ECB
Log Likelihood	- 1166.884
Log Likelihood Unrestricted	- 1150.779
Chi-Squared	32.208
Significance level	0.022



Responses to Interest Rate Differential ($i-i^*$)

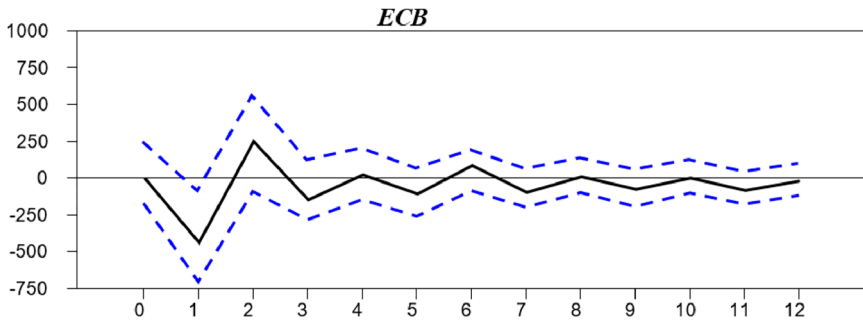
Fig. 3 Impulse response of external commercial borrowings (ECB) to one standard error shock to interest rate differential ($i-i^*$)

5.2.1 Impulse response function

The impulse response function (IRF) is an econometric tool that traces the dynamic movement in one variable when there is a unit standard error shock in another variable. In this study, it helps trace the dynamic (over time) response of external commercial borrowings where there is one standard error shock to monetary policy variables and other variables in the SVAR model. Figure 3 shows that the impulse response of external commercial borrowings to one standard error shock to Interest rate differential. As expected, the response is positive and statistically significant¹⁰ for up to three quarters, indicating that an increase in the interest rate differential has a positive and statistically significant influence on external commercial borrowings to India. The impulse response of external commercial borrowings to a unit standard error shock to domestic money supply growth is shown in Fig. 4. It should be noted that while the response is negligible on impact, it turns negative and statistically significant in the first quarter, which is as expected. However, the response becomes insignificant thereafter.

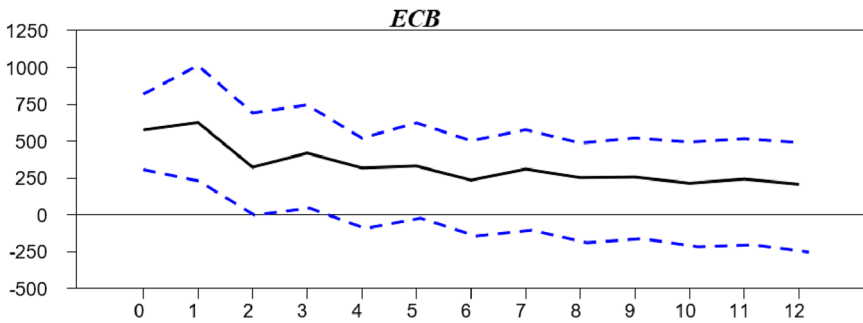
The results in Fig. 3 and Fig. 4 suggest that domestic monetary policy shock has a statistically significant influence on external commercial borrowings to India. In particular, interest rate differential has a positive, and the

¹⁰ 90% confidence interval based on Monte Carlo Integration is used to check the significance of the impulse responses.



Responses to Domestic Money Supply Growth (Mg)

Fig. 4 Impulse response of external commercial borrowings (ECB) to one standard error shock to domestic money supply growth (Mg)

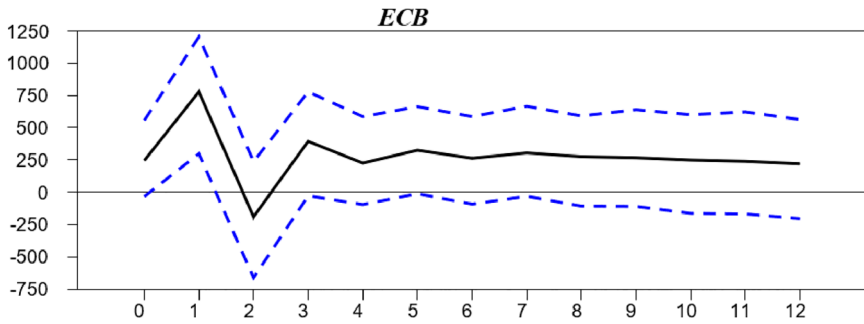


Responses to Index of Industrial Production (IIP)

Fig. 5 Impulse response of external commercial borrowings (ECB) to one standard error shock to index of industrial production (IIP)

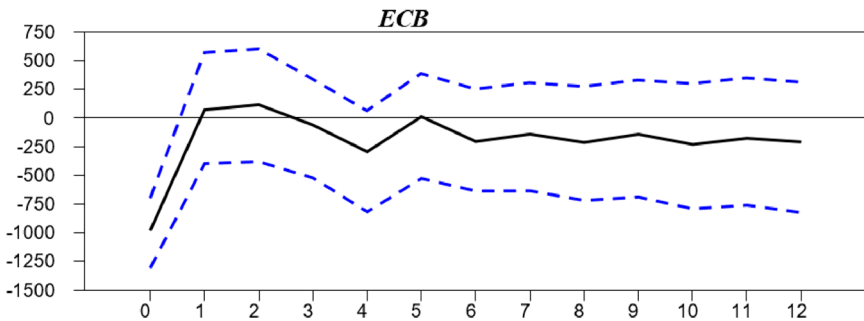
domestic money supply growth has a negative influence on external commercial borrowings.

The impulse response of external commercial borrowing to one standard error shock to index of industrial production representing domestic industrial activity is depicted in Fig. 5. Note that the response is positive and statistically significant for about three quarters and continues to be positive after that. This positive response indicates that an increasing domestic industrial activity induces greater external borrowings by domestic corporates to finance new investments or expand existing capacities. The response of external commercial borrowings to one standard error shock to foreign exchange reserves to import ratio representing domestic country’s creditworthiness is positive and statistically significant on impact and in the first quarter (Fig. 6). We also find that the response has become persistently positive from the third quarter. This positive response indicates that a highly creditworthy country



Responses to Foreign Exchange Reserve to Import Ratio (rm)

Fig. 6 Impulse response of external commercial borrowings (ECB) to one standard error shock to foreign exchange reserves to import ratio (rm)



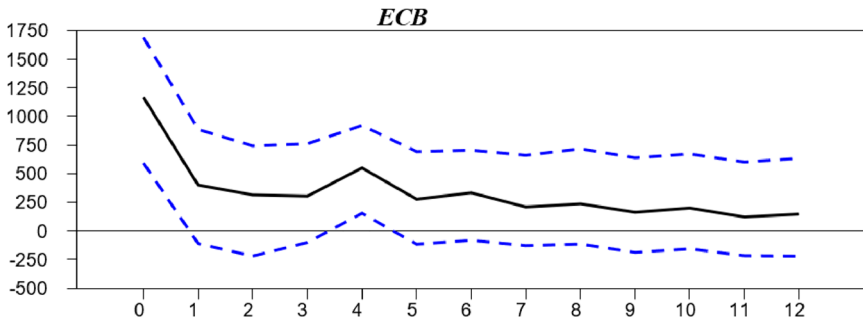
Responses to Domestic Fiscal Deficit to GDP Ratio (fd/y)

Fig. 7 Impulse response of external commercial borrowings (ECB) to one standard error shock to domestic fiscal deficit to GDP ratio (fd/y)

has easier access to international debt markets, allowing domestic corporates to raise more funds from external sources.

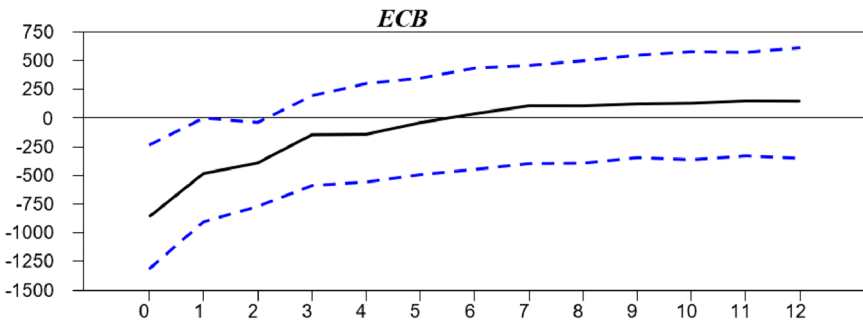
Figure 7 shows the impulse response of external commercial borrowings to one standard error shock to domestic fiscal deficit to GDP ratio. Note that the immediate response is highly negative and statistically significant, implying that a higher domestic fiscal deficit to GDP ratio discourages external commercial borrowings. A higher domestic fiscal deficit to GDP ratio indicates greater domestic macroeconomic instability, which increases investment risk and discourages domestic corporates from borrowing abroad to finance new investment ventures.

The impulse response of external commercial borrowings to a unit standard error shock to domestic output growth is shown in Fig. 8. We note that the response is positive and significant in initial quarters and continues to be positive even afterwards, which is in line with theory. This result indicates that an expanding domestic output provides a greater incentive for expansion and new investment ventures,



Responses to Domestic Output Growth (y)

Fig. 8 Impulse response of external commercial borrowings (ECB) to one standard error shock to domestic output growth (y)



Responses to Exchange Rate (ex)

Fig. 9 Impulse response of external commercial borrowings (ECB) to one standard error shock to exchange rate (ex)

inducing domestic corporates to borrow more internationally. As expected, one standard error shock to the exchange rate, i.e., depreciation of the rupee, is found to have a negative and statistically significant impact on external commercial borrowings to India (Fig. 9). This result indicates that a rupee depreciation discourages external commercial borrowings by increasing the effective cost of overseas borrowings for Indian corporates.

5.2.2 Forecast error variance decomposition

The forecast error variance decomposition (FEVD) function indicates the proportion of overall variation in one variable that can be attributed to shocks from other variables in the model. In this study, it helps determine how much proportion of the total variation in ECBs to India is explained by the domestic monetary policy variables

Table 4 Forecast error variance decomposition

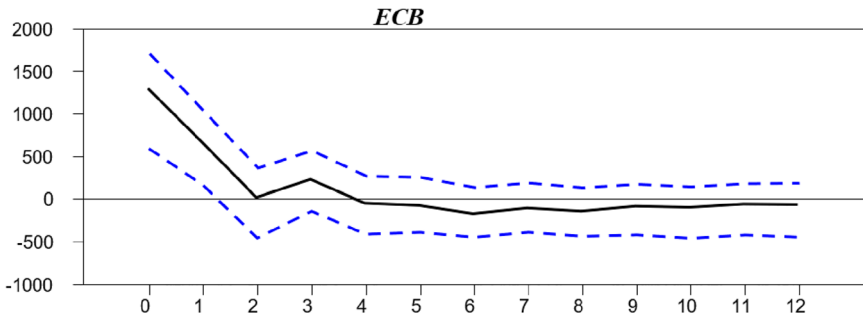
<i>Period</i>	<i>Mg</i>	<i>(i-i*)</i>	<i>y</i>	<i>ex</i>	<i>fd/y</i>	<i>rm</i>	<i>IIP</i>	<i>ECB</i>
1	1.306	15.961	10.937	6.804	5.084	0.930	3.726	55.252
2	1.955	15.036	10.823	7.556	5.258	6.412	5.912	47.048
3	2.210	15.267	10.942	8.351	4.545	6.211	5.948	46.526
4	2.215	15.137	10.297	8.269	4.144	7.064	6.345	46.529
5	2.401	15.299	10.139	8.021	4.359	7.181	6.172	46.428
6	2.386	13.367	10.520	7.866	4.128	7.621	6.228	47.884
7	2.048	13.628	10.855	7.744	4.035	7.823	6.112	47.755
8	2.046	13.858	11.014	7.683	3.942	8.198	6.033	47.226
9	2.081	14.162	11.150	7.685	3.907	8.342	5.949	46.724
10	2.075	14.474	11.118	7.747	3.859	8.501	5.886	46.340
11	2.087	14.737	10.048	7.859	3.878	8.555	5.847	46.989
12	2.076	14.948	10.948	8.146	3.907	8.592	5.817	45.566

and other variables in the SVAR model. The FEVD analysis (presented in Table 4) indicates that the interest rate differential explains about 14.6% and domestic money supply growth, on average, explains about 2% of the total variation in external commercial borrowings, implying that domestic monetary policy variables together explain about 16.6% of the total variation in ECBs to India. Other variables such as domestic industrial activity (represented by domestic IIP) explain about 5.8%, the exchange rate about 7.8%, domestic output growth about 10.7%, domestic macroeconomic instability (represented by domestic fiscal deficit to GDP ratio) about 4.2%, and domestic creditworthiness (represented by foreign exchange reserves to import ratio) about 7.1% of the total variation in external commercial borrowings to India.

5.2.3 Robustness Check

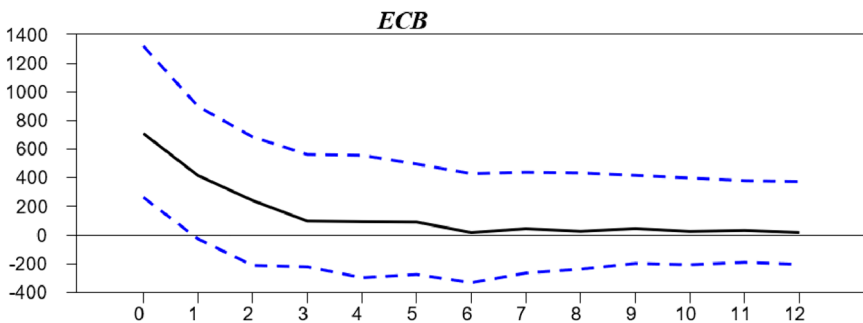
Interest Rate Differential We checked the robustness of the result using an alternative measure of interest rate differential, defined as the Call money rate minus 3-Month US dollar LIBOR. Figure 10 represents the impulse response of external commercial borrowings to one standard error shock to ‘Call money rate minus LIBOR’. We note that the response is positive and significant, which verifies the results found in Fig. 3.

Exchange Rate We also checked the robustness of the result using an alternative measure of the exchange rate, the nominal effective exchange rate (NEER). Figure 11 represents the impulse response of external commercial borrowings to one standard error shock to the NEER. We note that the response is positive and significant for up to three quarters, suggesting that a shock to NEER (i.e. appreciation of the rupee) has positive impact on external commercial borrowings to India. This result is qualitatively similar to the result in Fig. 9.



Responses to (Call Money Rate minus LIBOR)

Fig. 10 Impulse response of external commercial borrowings (ECB) to one standard error shock to (call money rate minus LIBOR)



Responses to Nominal Effective Exchange Rate (NEER)

Fig. 11 Impulse response of external commercial borrowings (ECB) to one standard error shock to nominal effective exchange rate (NEER)

6 Conclusion and implication

This paper empirically examined the effect of domestic monetary policy shock on external commercial borrowings to India using the structural VAR methodology. Innovation accounting analysis under the structural VAR model (impulse response function and forecast error variance decomposition function) was utilized to derive empirical results.

The empirical results indicate that domestic monetary policy shock (measured through shocks in domestic money supply growth and interest rate differential) has a significant effect on external commercial borrowings to India, explaining about 16.6% of the total variation in ECBs to India. To be specific, the interest rate differential has a positive significant influence on external commercial borrowings (explaining about 14.6% of the total variation), and domestic money supply growth has a negative significant influence on external commercial borrowings (explaining

about 2% of the total variation). The results further indicate that the exchange rate, domestic industrial activity, domestic output growth, domestic country creditworthiness, and domestic macroeconomic instability are the other significant determinants of external commercial borrowings to India, in the decreasing order of their importance.

The results suggest that the central bank, through monetary policy interventions, can influence and manage the flow of external commercial borrowings to India. Specifically, by implementing a contractionary monetary policy that results in a rise in interest rate differential, the central bank can persuade more ECBs, whereas by implementing an expansionary monetary policy that leads to a reduction in interest rate differential, the central bank can dissuade ECBs. The results further suggest that domestic policymakers should maintain adequate foreign exchange reserves to improve creditworthiness, follow policies to support economic and industrial growth, work on lowering macroeconomic instability, and control depreciation in the domestic currency to reduce the volatility associated with ECB flows.

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Declarations

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