# Is the floating exchange rate a shock absorber in Albania? Evidence from SVAR models

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## Abstract

The choice of a foreign exchange regime hinges primarily on whether the real exchange rate acts as a shock absorber or reverberator for macroeconomic fluctuations. This policy choice is considered central especially prior to joining currency areas such as the Eurozone. We investigate whether Albania's current floating exchange rate regime contributes to macroeconomic stability, or generates volatility. Using three different structural vector autoregression techniques, and an expanded five-variable model, we show that the real exchange rate has played a shock absorbing role, buffering the Albanian economy primarily from real demand shocks. The analysis reveals that monetary shocks and supply-side shocks have modest contributions in real exchange rate volatility. This evidence in favor of the "shock absorbing" view of exchange rates lends support to Albania's policy choice of a flexible exchange rate system. If in future Albania considers joining a currency area, its monetary authority will need to pay attention to real currency misalignments as well as the availability and flexibility of alternative adjustment mechanisms.

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## 1 Introduction

Whether the real exchange rate acts as a shock damper or reverberator for the business cycle, this is a key question in the policy choice of the optimal exchange rate regime. This policy question would be essential for example when evaluating a decision to join a currency area such as the Eurozone. Several central and eastern European (CEE) countries—also referred to as transformation or transition economies—have joined the Eurozone. Croatia is slated to join in 2023 (European Council 2022), and a few other European Union members from the CEE group (e.g., Bulgaria, Czech Republic, Hungary, Poland, Romania) may be considering membership in the near future. Countries that have relinquished floating exchange rates to join the euro may be facing macroeconomic stabilization costs, as may other future accession countries. A good amount of useful empirical work has already been done on the contribution of real exchange rates to macroeconomic volatility for most CEE countries, but no such studies have been done for Albania, an economy aspiring to European Union membership[1] and potentially Eurozone accession.

Our paper answers the question: Is Albania's current floating exchange rate regime the most appropriate given its business cycle volatility? In other words, we investigate whether a potential eurozone membership will contribute to macroeconomic stability, or create more volatility. The insulating properties (i.e., shock absorbing properties) of floating exchange rates against international shocks, combined with the freedom they afford the central banks to pursue their domestic macroeconomic goals are common arguments in favor of a floating regime (Mundell 1963; Johnson 1969). But opposing views see flexible exchange rates as a troubling source of shocks and volatility, particularly for economies well integrated in global financial markets. According to these views, exchange rates are not the shock absorbers they have been assumed in traditional macroeconomic theory. Flexible exchange rates have also been identified as a destabilizing instrument transmitting monetary and financial shocks onto the real economy (Buiter 2000; Gabaix and Maggiori 2015).

In this study, we examine the role of real exchange rates in Albania's business cycle volatility offering five main contributions. First, we add to a limited literature of empirical structural vector autoregressive (SVAR) studies on the contribution of real exchange rates to macroeconomic volatility in CEE countries. Evidence about the case of Albania adds value as its economy is both similar in its transition aspects to other CEE countries, but also unique, not least because of its heavily euroized (and dollarized) economy without deep financial markets and with a considerably less open capital account than most other CEE countries.[2]

Second, we employ a novel approach to estimate an SVAR with zero long-run restrictions taking into account the presence of cointegration among the variables. This enables us to reduce the number of restrictions needed for identification and a more efficient estimation. Third, by using a Bayesian SVAR model, in addition to

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[1] EU opened accession negotiations with Albania in July 2022.

[2] Albania is ranked 92nd in the Chinn-Ito Financial Openness Index (Ito and Chinn, 2021)

the SVAR with zero long-run restrictions, we do not solely rely on a single model specification but can leverage results from the most probable specifications of the Bayesian model averaging method. Our Bayesian sign restrictions estimation technique is particularly suited to limited-length time series, which is an issue for all CEE economies. Fourth, we expand the VAR dimension to five variables so we can identify more shocks, or be able to better distinguish among them. No other SVAR study of CEEs on this topic, that we know of, uses a 5-variable model. Identification with five variables makes estimation challenging, but we use one of the longest data sample with about 20 years of quarterly data. Fifth, we contribute findings that are stable under three robustness checks: a simple SVAR with zero long-run restrictions; an SVAR with cointegration and zero long-run restrictions; and a Bayesian SVAR with sign restrictions. No other CEE studies that we are aware of have employed all three SVAR models as a way to check for the stability of their estimates.

Typically, the most direct way to determine whether the floating exchange rate is a shock absorber or a shock reverberator involves measuring the contribution of real and nominal shocks to real exchange rate fluctuations. If real demand or supply shocks are responsible for a large proportion of the movements in the real exchange rate, then the exchange rate is a shock absorber. But, if exchange rate movements are primarily the result of monetary shocks or the foreign exchange market, then the exchange rate is a shock reverberator (Artis and Ehrmann 2006; Farrant and Peersman 2006).

Our results show that real exchange rate movements in Albania are driven mainly by real economic factors, with modest effects from monetary shocks. We conclude that the real exchange rate plays a shock absorbing role in Albania, adding to macroeconomic stability and making their current flexible exchange rate regime a sensible policy choice. In addition we find that real factors, particularly aggregate demand, were mostly responsible for three episodes of large real exchange rate movements, which explains the persistent real appreciation of the LEK against the euro in the last decade. Our main findings are stable under all three SVAR specifications, but they are not always in line with what research on other CEE countries has revealed (Borghijs and Kuijs 2004; Stazka-Gawrysiak 2006; Shevchuk 2014).

The paper is laid out as follows: Sect. 2 includes the literature review; Sect. 3 presents the model and methods; Sect. 4 reports our empirical findings; and Sect. 5 summarizes our conclusions and policy recommendations.

## 2 Literature review

The abandonment of fixed exchange rates of the Bretton Woods era was followed by increased volatility in real exchange rates with persistence similar to that of nominal exchange rates (Stazka 2006). It was this stylized fact that encouraged many researchers to look into a causality question: is it the volatility of nominal exchange rates which makes real exchange rates more unstable, or the other way around? Research work in this area was both needed and consequential for policy.

In the nascent phase of this literature, examining the first decade of floating after the Bretton Woods collapse, Musa (1986) concludes that real exchange rate

volatility stems from nominal exchange rate volatility because relative national price levels do not adjust to offset the nominal exchange rate. In the literature, this is referred to as the "disequilibrium view." Stockman (1983) argues that, even in light of more volatile real rates under floating, the direction of causality might be misunderstood. That is, more volatile real rates may be a consequence: economies buffeted by severe real shocks may tend to opt for a floating currency regime as a counterweight. Referred to as the "equilibrium view" (a.k.a. the "real economy view") this is where the real exchange rate becomes a shock absorber against real supply or demand jolts. So, while in the disequilibrium view causality runs from the nominal to the real exchange rate, in the real economy view causality runs in reverse.

In the "equilibrium view," real exchange rates act as a balancing force ensuring relative price adjustment in the face of asymmetric real shocks. Consequently, when prices are sticky, giving up nominal exchange rate flexibility can be costly for macroeconomic management (MacDonald 1998). By contrast, according to the disequilibrium view, the lion's share of real exchange rate volatility under floating is attributed to nominal and financial market disturbances. Thus, in the "disequilibrium view," because the floating rate propagates shocks, choosing a fixed exchange rate would contribute to macroeconomic stability (Stazka-Gawrysiak 2006).

The literature has used primarily four empirical approaches to examine the role of exchange rates in business cycle volatility (Macdonald 1998): (i) examining the relationship between real exchange rates and real interest rates; (ii) isolating permanent and transitory components of the real exchange rate; (iii) decomposing the real exchange rate movements on the basis of the dynamics in external and internal prices; and (iv) decomposing real exchange rate movements with the use of VAR models to identify structural shocks and their effects on business cycle volatility and in the real exchange rate itself. The latter approach—involving structural VAR (SVAR) models—was initially based on a long-run identification method owed to Blanchard and Quah (1989) and is the focus of this empirical study.

Empirical structural VAR work from authors such as Lastrapes (1992), Clarida and Gali (1994), Thomas (1997), and Farrant and Peersman (2006) has paved the way for numerous studies using these models to identify structural shocks for various economies, time periods, and identification strategies. In general, these approaches are based on two-country models with relative variables (i.e., ratios of domestic to foreign variables). In one of the earliest SVAR analyses on the sources of exchange rate fluctuations, Lastrapes (1992) makes use of the Blanchard and Quah (1989) methodology in a bivariate VAR model with real and nominal exchange rates for six industrialized countries over two decades. He identifies a nominal shock affecting the nominal rate in the short run only, and a real shock with long-run effects on both variables. The study concludes that real shocks are the main source of volatility in both exchange rates, thus supporting the "real economy" view. Clarida and Gali (1994), in a seminal article for this literature, use an open macroeconomics model à la Mundell-Fleming-Dornbusch to construct a tri-variate SVAR with output, real exchange rates, and prices for Canada, Germany, Japan, and UK (vis-à-vis the US) during the floating period leading up to 1992. Of the three shocks they identify, aggregate demand is found to be an important source of volatility in two

countries, nominal shocks the main source in the other two, and supply shocks are mostly irrelevant.

Building on these first models, other studies designed higher dimension VAR models to identify more structural shocks. Weber (1997) builds a five-variable SVAR with employment, output, the real exchange rate, real money supply, and price level, which identifies five types of shocks stemming from labor supply, productivity, aggregate demand, money demand, and money supply. Using US–Germany, US–Japan, and Germany–Japan data covering the period 1971–1994, Weber identifies demand shocks as the main source of short-term volatility in the real exchange rate. Another extended SVAR by Rogers (1999) for 100 years of US–UK data finds support for nominal shocks as a main source of short-run fluctuations in the real exchange rate.

For the small open economies of central and eastern Europe transitioning to market economy structures over the last three decades, accepting prima facie the proposition that floating exchange rates are on the net harmful to macroeconomic stability (McKinnon 1963), may be a leap of faith as both the equilibrium and disequilibrium view are not only theoretically plausible but also supported by empirical evidence for different scenarios. As to which view holds for a particular country, we think it should be answered as an empirical question. Indeed, there is a good number of studies taking up this question, particularly as it relates to the decision to give up the floating exchange rate (or the option to have one) in favor of joining the Eurozone, as several CEE countries have already done. If this decision were made on macroeconomic grounds alone, one would expect that only CEE countries with real exchange rates reflecting mainly nominal shocks would be joining the eurozone. The stakes of this decision are particularly high for transition economies because they are often dissimilar from most of the eurozone countries in terms of labor market flexibility, financial markets, and industrial structures. Such differences may imply more asymmetric shocks for these economies, which could make a floating exchange rate a valuable shock absorber.

In one of the earliest CEE-focused studies, Dibooglu and Kutan (2001) examine the case of Poland and Hungary with a bivariate SVAR for 1990–1999 and discover that nominal shocks explain most fluctuations in the real exchange rate for Poland, but real shocks are the main source of volatility in Hungary's real exchange rate. Upon studying five CEE economies over the 1993–2003 period with a tri-variate SVAR, Borghijs and Kuijs (2004) conclude that during the period with more flexible exchange rates, the exchange rate is not very responsive to shocks that affect output, and that LM shocks have a large impact on nominal exchange rate variability, especially in the smaller open economies. With these results, they are skeptical about the effectiveness of the exchange rate as an absorber of IS shocks and claim that the costs of giving up floating exchange rates in the CEEs may be small.

Stazka-Gawrysiak (2006) uses an SVAR framework based on Clarida and Gali (1994) for eight CEE new European Union member states. Counterintuitively, the study reveals that the real exchange rate volatility in most Exchange Rate Mechanism (ERM II) participants supports the equilibrium view, which would justify floating rates, while that of the ERM II "outs" supports the disequilibrium approach in favor of fixed exchange rates. Thus, the real rates of the ERM II participants are

affected mainly by permanent shocks, which makes Eurozone membership less sensible from this perspective. Erjavec et al. (2012) investigate Croatia's real exchange rate fluctuation sources during 1998–2011 using a structural VAR model and find demand shocks to be a main short-run and long-run driver of volatility. From this narrower perspective, the impending accession of Croatia into the eurozone in 2023 seems harder to justify given the shock absorption qualities of its real exchange rate.

In more recent studies of CEE economies, evidence on the shock absorbing properties of the exchange rate continues to be contested. Casting doubt on the ability of the flexible exchange rate to absorb asymmetric real shocks, Shevchuk (2014), with a two-variable SVAR using data for 10 CEE countries and four former Soviet Union countries for the 1999–2013 period, finds that more than 80% of variability in the nominal exchange rate is explained by neutral shocks, while output fluctuations are primarily driven by permanent shocks. Dabrowski and Wroblewska (2016) examine the role of exchange rates in Poland and Slovakia during 1998–2013 and conclude that identification of shocks in overly parsimonious SVAR models is problematic. Their Bayesian SVAR results reveal that a higher exchange rate flexibility in Poland was helpful in absorbing real shocks. Audzei and Brázdik (2018) use an SVAR model to analyze ten CEE economies, either new eurozone members or preparing for accession. Their evidence for most countries shows that the real exchange rate does not create much business cycle instability, supporting the "real economy" view that real exchange rates are shock-absorbing. Dabrowski and Wroblewska (2020) study the effects of exchange rates in eight CEE economies with fixed and floating regimes employing Bayesian SVAR models with data for the 1998–2015 period. They show that regardless of the exchange rate regime, output is mainly driven by real shocks, but its sensitivity to real shocks is considerably lower under more flexible exchange rates. For comparison purposes, Table 1 presents a summary of the most relevant CEE-focused studies mentioned here.

The wide range of outcomes—in some cases serving as shock absorber and in others as a source of volatility—implies that the role of exchange rates may be context dependent due to market structures and macroeconomic management policies in each country. It is also possible that the varying outcomes could be the result of econometric modeling and methodological choices, which we discus in more detail below. Our work intends to provide more evidence for the literature on the role of exchange rates for one particular transition economy, Albania, which has not been included in any of the CEE studies to date.

# 3 The model, methodology, and estimation procedure

## 3.1 Macroeconomic model and SVAR background

As multivariate linear representations of a vector of observed variables on its own lags, structural VARs rely on identifying assumptions to isolate the effects of macroeconomic policy on the economy. The pioneering work of Blanchard and Quah (1989) inspired a great number of studies on the sources of real exchange rate fluctuations, leveraging a theoretical understanding of long-run relationships among

**Table 1** Selected studies on the role of exchange rate in CEE countries. *Source* Authors' summary

| Studies | Countries | Period | SVAR methodology | Role of exchange rate |
|---|---|---|---|---|
| Dibooglu and Kutan (2001) | Poland, Hungary | 1990–1999 | Bivariate SVAR | Shock absorber in Hungary |
| Borghijs and Kuijs (2004) | Czech Republic, Hungary, Poland Slovak Republic, Slovenia | 1993–2003 | Tri-variate SVAR | Mainly shock reverberator |
| Stazka-Gawrysiak (2006) | Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia | 1995–2005 (longest sample) | Tri-variate SVAR | Shock absorber in ERM participants; reverberator in ERM non-participants |
| Erjavec et al. (2012) | Croatia | 1998–2011 | Tri-variate SVAR | Shock absorber |
| Shevchuk (2014) | Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovak Republic, Slovenia, Estonia, Latvia, Lithuania, Belarus, Georgia, Russia, Ukraine | 1999–2013 | Bivariate SVAR | Mainly shock reverberator |
| Dabrowski and Wroblewska (2016) | Poland, Slovakia | 1998–2013 | 3- and 4-variable SVAR | Shock absorber in Poland (with flexible exch. rate) |
| Audzei and Brázdik (2018) | Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia | 1998–2017 | SVAR with 7 structural shocks | Mostly shock absorber |
| Dabrowski and Wroblewska (2020) | Bulgaria, Romania, Poland, Slovakia, Croatia, Czech Rep., Hungary, Slovenia | 1998–2015 | 4-variable SVAR | Mostly shock absorber |

macroeconomic variables as a way to identify structural shocks driving the endogenous variables in the system. For example, the stochastic specification used by Clarida and Gali (1994) follows the open economy model developed by Obstfeld (1985), where long-run output is solely determined by aggregate supply factors. In similar fashion, a vast number of studies in the literature rely on Mundell-Fleming-Dornbusch models with sluggish price adjustment for their SVAR assumptions (i.e., restrictions).

Therefore, a successful identification of shocks depends to a great extent on the theoretical foundation of the underlying macroeconomic model, including the dimension of the SVAR given by the number of variables included. To reinvestigate Clarida and Gali's (1994) conclusions regarding the predominance of real demand shocks in explaining real exchange rate movements, Weber (1997) extends their analysis by deconstructing their shocks into more specific disturbances. Weber separates aggregate supply shocks into labor supply and technological shocks. He separates nominal shocks into money demand and money supply shocks. We build our investigation on Weber's stochastic rational expectations open economy model, consisting of the following seven equations:

$$\text{IS equation}: y_t^d = \eta(s_t - p_t) - \sigma\left[i_t - E(p_{t+1} - p_t)\right] + \phi(w_t - p_t) + d_t \quad (1)$$

$$\text{Cobb} - \text{Douglass technology}: y_t^s = A_t + \alpha l_t + (1 - \alpha)k_t \quad (2)$$

$$\text{Labor supply}: l_t^s = \varphi\left[i_t - E(p_{t+1} - p_t)\right] + \gamma(w_t - p_t) + \omega_t \quad (3)$$

$$\text{Price formation}: p_t = (1 - \theta)E_{t-1}p_t^e + \theta p_t^e \quad (4)$$

$$\text{LM equation}: m_t^d - p_t - y_t = -\lambda i_t + \left(\varepsilon_t^m - d_t\right) \quad (5)$$

$$\text{Uncovered interest parity}: i_t = E(s_{t+1} - s_t) + rp_t \quad (6)$$

$$\text{Money supply target}: m_t^s = m_{t-1} + \varepsilon_t^\mu \quad (7)$$

In the equations above, $y_t^d$ represents gross domestic product, $d_t$ the real demand shock where $d_t = d_{t-1} + \varepsilon_t^\delta$; in the labor supply equation, $l_t^s$ is proxied by the inverse of unemployment, and $\omega_t$ represents the stochastic component of labor supply affected by permanent labor supply shocks ($\varepsilon_t^\omega$), such that $\omega_t = \omega_{t-1} + \varepsilon_t^\omega$; $s_t$ is the nominal exchange rate and $p_t$ the price level; $p_t^e$ denotes the equilibrium price level; $m_t^s$ is money supply and $i_t$ the nominal interest rate; $rp_t$ stands for the risk premium; whereas $\varepsilon_t^\delta$, $\varepsilon_t^\omega$, and $\varepsilon_t^m$ represent aggregate demand shocks, labor supply shocks, and money demand shocks, respectively. The shocks are assumed to be normally distributed with zero mean and constant finite variance. All variables except interest rates are in natural logarithms and have been constructed as the difference between home and foreign levels.

　　The IS equation represents the goods market, where output ($y^d_t$) is related to the real exchange rate ($s_t$-$p_t$), the real interest rate differential ($i_t$-$E(p_{t+1}$-$p_t)$) and the real wage rate ($w_t$-$p_t$). In the same equation, $d_t$ represents the real demand shock where $d_t = d_{t-1} + \varepsilon^\delta_t$. Next, the Cobb–Douglas technology Eq. (2) represents the aggregate supply ($y^s_t$) of the open economy model as a function of technology ($A_t$), labor input ($l_t$), and capital stock ($k_t$). In the long run, the ratio of capital to output is assumed to be constant and therefore omitted from the model, whereas the dynamics of technology are captured by introducing a permanent stochastic technology innovation ($\varepsilon^z_t$) in $A_t = A_{t-1} + \varepsilon^z_t$. Next, labor supply ($l^s_t$), proxied by the inverse of unemployment, is related to the real interest rate, real wages and $\omega_t$. The latter includes the stochastic component of labor supply affected by permanent labor supply shocks ($\varepsilon^\omega_t$), such that $\omega_t = \omega_{t-1} + \varepsilon^\omega_t$. The price setting Eq. (4) introduces nominal rigidities. The price level ($p_t$) is a function of the expected clearing price and the equilibrium price level ($p^e_t$). In the short run, prices are sticky (Dornbusch 1976) with a parameter $\theta$ between zero and one. When $\theta = 1$ prices adjust immediately to their equilibrium level ($p^e_t$), whereas for $\theta = 0$ there is no price adjustment.

　　Equation (5) models the money market by relating money demand ($m^d_t$) to income ($y_t$) and nominal interest rates ($i_t$). The difference between the money demand shock ($\varepsilon^m_t$) and the demand shock component ($d_t$) in brackets captures the inverse of velocity shock ($\varepsilon^m_t - d_t$), while the left-hand side expression $m^d_t - p_t - y_t$ in the equation denotes the inverse of the income velocity of money. Interest rates are determined by the expected changes in the nominal exchange rate ($E(s_{t+1} - s_t)$) and a risk premium ($rp_t$) in the uncovered interest parity condition in Eq. (6). Following Weber (1997), and for the sake of simplicity, the risk premium variable is omitted in our model. Finally, Eq. (7) introduces money supply ($m^s_t$) with a stochastic trend ($\varepsilon^\mu_t$). To summarize, $\varepsilon^\omega_t$, $\varepsilon^z_t$, $\varepsilon^\delta_t$, $\varepsilon^m_t$ and $\varepsilon^\mu_t$ are the five stochastic shocks that represent innovations in labor supply, technology, aggregate demand, money demand and money supply shocks, respectively. These shocks are assumed to be normally distributed with zero mean and constant finite variance. All variables in our model, except interest rates, are in natural logarithms and have been constructed as the difference between home and foreign levels.

　　To capture the structural shocks Weber estimates a structural VAR model that is identified through restrictions on the long-run shock effects: supply shocks impact all the variables in the long run; aggregate demand shocks have a permanent impact on the real and nominal exchange rates, money stock and prices, but only a temporary effect on employment and output; and finally, nominal shocks have no long-run effect on employment, output and the real exchange rate.

　　Table 2 summarizes the expected short- and long-run responses of the VAR variables. Following Weber's theoretical framework, it is expected that both employment and output are determined solely by supply shocks in the long run. A positive supply shock (e.g., a technology shock, or exogenous terms-of-trade shocks) boosts the supply of domestic goods and raises the investment rate of return, which ushers in capital flows, generating a short-run domestic currency appreciation. In the long-run equilibrium, actual and potential output are higher, but the real exchange rate depreciates, and real money balances increase due to lower prices. A positive absorption shock pushes prices upward and leads to a real exchange rate appreciation in both

**Table 2** Expected long- and short-run effects. *Source* Authors' summary based on Weber (1997)

| Variables | Supply shocks | | Demand shocks | Nominal shocks | |
|---|---|---|---|---|---|
| | Labor supply | Aggreg. supply | Aggreg. demand | Money demand | Money supply |
| *1A. Flexible-price rational expectations equilibrium, long-run restrictions* | | | | | |
| $l_t$ | + | 0 | 0 | 0 | 0 |
| $y_t$ | + | + | 0 | 0 | 0 |
| $s_t\text{-}p_t$ | – | – | + | 0 | 0 |
| $m_t\text{-}p_t$ | + | + | – | + | 0 |
| $p_t$ | – | – | + | – | + |
| *1B. Short-run sluggish-price-adjustment equilibrium* | | | | | |
| $l_t$ | + | + | + | – | + |
| $y_t$ | + | + | + | – | + |
| $s_t\text{-}p_t$ | + | + | + | + | – |
| $m_t\text{-}p_t$ | + | + | – | + | – |
| $p_t$ | – | – | + | – | + |

time horizons. While long-run output returns to trend, real appreciation becomes permanent and prices remain at the higher level, resulting in lower real money balances. A positive nominal shock, such as a boost in money supply, reduces home nominal interest rates, leading to a short-run nominal and real depreciation, but also higher relative prices and domestic output. In the long-run, output, employment and the real exchange rate return to trend. In Weber's supply-determined model, monetary shocks affect relative prices and the nominal exchange rate equally, thus leaving the real exchange rate unchanged in the long run.

In contrast to Clarida and Gali's (1994) three-variable model, Weber's decision to include the labor market has the added benefit of enabling labor productivity ($y/l$) endogenization for an evaluation of the Balassa–Samuelson hypothesis (Balassa 1964), relating real exchange rate deviations to productivity differentials.

## 3.2 Econometric methodology

The moving average representation of our vector $x$ of five variables is given by $x = C(L)\varepsilon$, where $\varepsilon$ are the structural shocks. The reduced form moving average representation is given by $x = E(L)\eta$, where $\eta$ are the estimates of structural shocks. The reduced form autoregressive representations are $A(L)x = \varepsilon$ and $B(L)x = \eta$, respectively (for more details see Weber 1997). The polynomial matrices are related as $B(L) = E(L)^{-1}$ and $A(L) = C(L)^{-1}$. If $A(0) = S^{-1}$, the reduced form innovations can be used to recover the structural shocks via $\eta = S\varepsilon$. So, matrix $C(L)$ can be uniquely identified if matrix $S$ is just-identified with a sufficient number of assumptions, i.e., restrictions. Weber shows that for an SVAR with $k = 5$ structural shocks, $k^2 = 25$ restrictions are required, of which $k(k\text{-}1)/2 = 10$ restrictions must be from economic theory. Given the flexible-price solution in Weber's model where only the price level is affected by all five shocks, the matrix of long-run multipliers is restricted to lower triangular to make identification possible.

Notwithstanding the widespread use of VARs in macroeconomics, the literature has kept a watchful eye on potential estimation issues and continues to advance strategies to mitigate them. We summarize a few relevant criticisms here.

Firstly, if more primitive shocks exist than structural disturbances identified in the SVAR, then some of the latter may be linear combinations of the primitive shocks. Bivariate SVARS, for example, can only identify two structural shocks. Faust and Leeper (1997) consider this issue especially problematic when the shocks affect system variables in opposite directions. In those cases, the estimated linear combination of shocks could be mistaken for a single structural disturbance, whose estimated effect size could be quite misleading. For this reason, we choose to expand the number of variables included in the system to five. This strategy can capture more shocks, but at a cost: it requires considerably more identification restrictions.

Secondly—and amplifying the first concern—Faust and Leeper (1997) argue that leveraging long-run identification restrictions could be problematic in finite order VAR models and limited-length data series, as in most CEE studies. Thirdly, long-run neutrality assumptions have also been criticized. For example, as argued by Buiter (1995), demand shocks can have long-run effects on output and employment,

therefore creating a potential problem when restricting that long-run multiplier to zero in the SVAR identification. To address this concern, Farrant and Peersman (2006) employ sign restrictions. They point out that the traditional zero long-run restrictions are nested in the tails of the distribution of all possible impulse responses generated by sign restrictions.

Finally, Oularis et al. (2018) observe an issue with SVAR models related to the presence of cointegration among VAR variables—a commonplace occurrence in macroeconomic data series. If one or more long-run cointegrating relationships exist in the VAR variable set, the number of permanent shocks in the system should be smaller than the number of $I$ (1) variables in the VAR. Being stationary, the cointegrating vector does not have a persistent shock of its own, therefore enabling us to reduce the number of long-run restrictions needed for identification.

Based on these concerns from the literature, we use a three-pronged strategy in this study. First, we employ sign-restrictions in addition to zero-long run restrictions to examine whether it affects robustness. Second, while we expand the VAR dimension to five variables, we use a Bayesian estimation technique to address the issue of higher estimation requirements with limited data series. We also make use of a longer data set than most other SVAR studies examining this issue for CEE economies. Finally, to see whether the presence of cointegration can allow us to reduce the number of overall long-run restrictions imposed, we also use an approach by Oularis et al. (2018), where the long-run identification strategy takes into account cointegration. We briefly explain each of these techniques in Sects. 3.3, 3.4, and 3.5.

### 3.3 SVAR with sign restrictions

The most common strategy to identify an SVAR model is to impose short- or long-term restrictions (typically zero constraints) dictating how variables respond to shocks. Often this is implemented through recursive ordering, which as Uhlig (2005) and Farrant and Peersman (2006) have argued can lead to distortions from small sample biases and measurement errors. In Farrant and Peersman's (2006) sign restrictions approach, instead of imposing zero constraints on the contemporaneous or on the long-run effects matrix, shocks are identified based on the direction of their impact on the system variables. Therefore, the sign restrictions strategy generates a distribution of responses consistent with a given theoretical model. Peersman (2005) demonstrates that impulse responses generated from zero restrictions can often be located in the tails of the distributions of impulse responses consistent with the expected sign. This more general approach has the advantage of avoiding possible bias from zero restrictions. In this study, we implement the sign restrictions approach with the BEAR Toolbox (Bayesian Estimation Analysis and Regression) developed by the European Central Bank (see Dieppe et al. 2016).

### 3.4 The Bayesian approach to SVAR

In addition to the sign restrictions approach, the BEAR Toolbox employs a Bayesian estimation method.

Miranda-Agrippino and Ricco (2018) refer to VARs' highly parametrized nature as the "curse of dimensionality." The "curse" becomes more problematic with limited-length data series, especially short for transition economies. The overparameterization makes VAR estimation with conventional frequentist methods challenging. Yet, Bayesian VARs are better at handling overparameterization by using prior information about the model parameters, treating them as random variables with a mechanism for updating the "prior" probability distributions of unobserved parameters conditional on the observed data. "Prior" parameter distributions can be sourced from other datasets or theoretical macroeconomic models.

### 3.5  Cointegration in VARs

Because a cointegrating relationship represents a long-run stationary linear combination among a set of variables, when cointegration is present in the VAR, fewer persistent shocks are expected in the system. More specifically, the number of persistent shocks would be equal to the difference between the number of variables in the VAR and the number of cointegrating relationships. This is because the cointegrating vector does not have a persistent shock of its own but follows the shocks of its own variables. So, cointegration transforms the SVAR into a hybrid model of permanent shocks, corresponding to $I$(1) variables and transitory shocks corresponding to cointegrating relationships, which enables us to reduce the number restrictions needed for identification. A summarized version of the procedure followed by Oularis et al. (2018) includes the following steps: when there is only integration but no cointegration, the $I$(1) variables are first-differenced and the $I$(0) variables are used in levels. When there is cointegration, then we have a structural vector error correction model (SVECM), which has the same structural shocks as the SVAR, but needs to be transformed to an SVAR so impulse responses can be obtained.

To implement the Oularis et al. (2018) procedure, we have to select a variable to be substituted with the cointegration relationship. Studies of money demand for Albania, such as Shijaku (2016), and Bahmani et al. (2020), confirm the existence of cointegration among money, economic activity, inflation, interest rate, and the exchange rate. Bank of Albania adjusts the money supply to accommodate shocks in money demand and other relevant variables. Indeed, Bank of Albania's implementation of monetary policy framework (Monetary Implementation Framework 2022 ) explains that it evaluates the banking system liquidity to ensure the effectiveness of the monetary policy transmission and provides the market with the amount of liquidity consistent with a desired level of short-term interest rates. Since our model's money supply shock figures in the price equation, as is specified by the long run solution of the flexible price equation in Weber (1997), we substitute the price variable for the cointegration relationship.
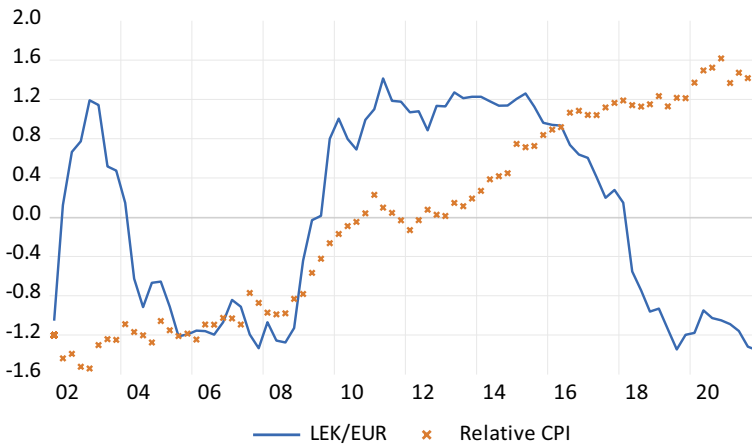
**Fig. 1** Relative CPI and the Lek-Euro exchange rate. *Source* Bank of Albania

## 4 Variable properties

In this section we briefly outline some relevant features of the Albanian economy, some stylized facts related to exchange rate developments, and some relative economic fundamentals at home and abroad which inform our empirical investigation. We also present the results of stationarity and cointegration tests, which have implications for the SVAR estimation.

### 4.1 Preliminary data analysis

Upon starting its transition to a market-oriented economy in the early 1990s, Albania adopted a flexible exchange rate regime, opened up to trade and financial markets, and gradually relaxed administrative price controls and capital controls. Its relatively high unemployment rate of about 12 percent, is widely considered to be a structural issue rather than a potential labor force readily employable in the short run. A large depreciation caused by the collapse of fraudulent pyramid schemes 1997 was largely reversed by the end of 1990s. During the 2001–2018 period, exchange rate volatility has been moderate in a range of 123–140 lek per euro. During 2004–2008 the exchange rate hovered close to the lower bound, followed by a stronger lek after the European financial crisis. Since 2015, lek has reached historically strong levels, with a cumulative appreciation of around 12 percent against euro.

To provide a simple visual representation of purchasing power parity (PPP), Fig. 1 juxtaposes Albania's relative price (ratio of CPI indexes in each country) to its exchange rate with the Eurozone (here defined as lek per euro). The exchange rate is considerably more volatile than the relative price level, causing the real exchange rate to have persistent and long-lived deviations contrary to PPP hypothesis expectations.

In line with the monetary approach of the exchange rate, Fig. 2 plots relative M2 against the nominal exchange rate, showing a closer relationship than Fig. 1.
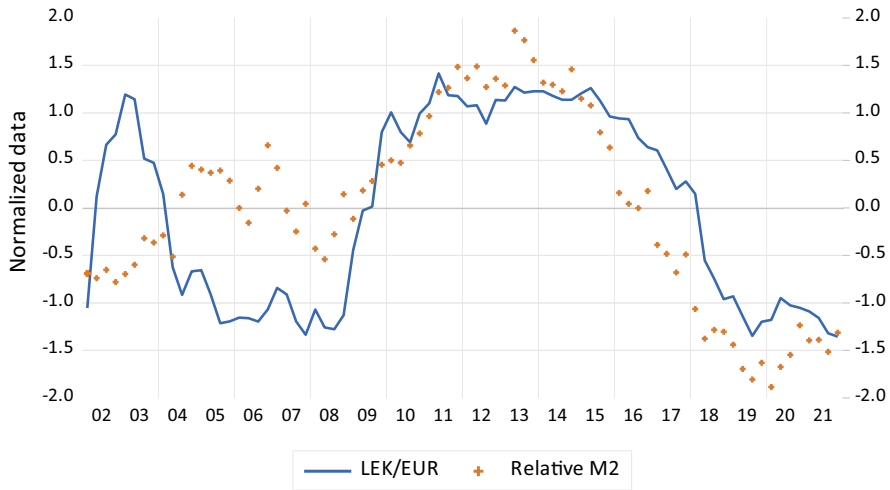
**Fig. 2** Relative M2 and the Lek-Euro exchange rate. *Source* Bank of Albania and ECB
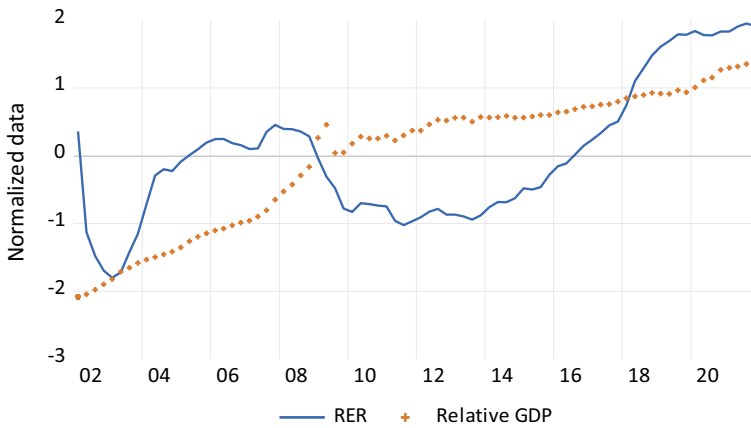


**Fig. 3** Relative GDP and the real exchange rate. *Source* Bank of Albania, Albanian institute of Statistics (INSTAT), ECB, and Eurostat

The closer relationship between broad money and the nominal exchange following the global financial crisis may suggest that monetary factors might have an important role in explaining exchange rate fluctuations. The divergence of the first decade could be due to lingering effects of the massive economic structural changes of the transition and deviations caused by a booming financial intermediation in foreign currency (mainly in euros and US dollars) following the privatization of Savings Bank by Raiffeisen Bank International, the last and the largest state-owned bank. Upon acquisition, Raiffeisen made use of large inherited
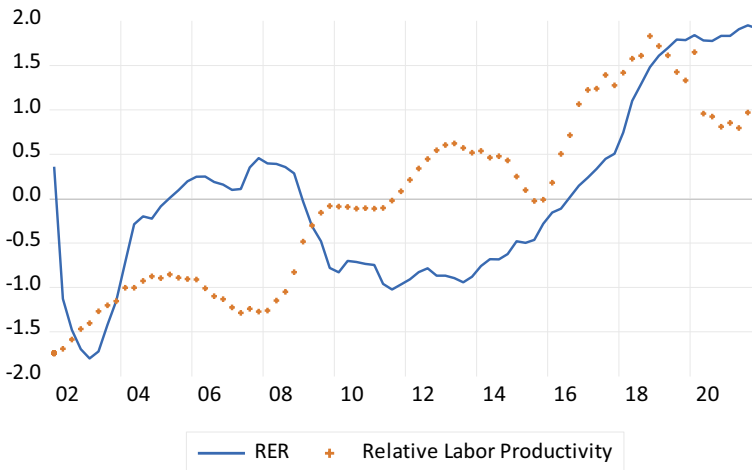
**Fig. 4** Relative productivity and the real exchange rate. *Source* Bank of Albania, Albanian institute of Statistics (INSTAT), ECB, and Eurostat

deposits to initiate loans to the private sector. The rest of the banking system followed suit and soon the annual credit growth rate exceeded 70 percent.

Figures 3 and 4 present the relationship between the real exchange rate (real appreciation is defined as an increase in the real exchange rate) and relative real GDP and relative productivity, respectively. Despite persistent medium-term divergences, both output and productivity appear to track well the long-term trend of the real exchange rate.

In the case of productivity (Fig. 4), this is in line with the Balassa-Samuelson hypothesis, according to which an increase in relative productivity is expected to lead to real appreciation. This visual analysis indicates that beyond monetary factors, the exchange rate is affected also by real economic variables. The observations of this visual analysis can be refined further with the SVAR model, which includes all the real and nominal variables discussed here: employment, output, money, and price levels.

To better understand the persistence of real exchange rate volatility and deviations we will now turn to the SVAR analysis, where we will first report our findings on the integrative and cointegrative properties of the series, followed by an analysis of impulse response functions and variance decompositions for real exchange rates using two SVAR configurations in the results section.

## 4.2 Data properties: unit roots and cointegration

Albania was a centrally planned economy until 1990. Given that the lion's share of the transition to a market-based economy continued for at least a decade, but also considering the availability and quality of national statistics during that first decade of transition, we have made an arbitrary judgment to start our data set in 2002. This starting point has the added advantage of avoiding the synthetic data for the lek-euro

**Table 3** Endogenous SVAR variables

| VAR variables | Definition | Source |
| --- | --- | --- |
| $\Delta l = \Delta(l^{home} - l^{EA})$ | $l$: log of the inverse of unemployed persons | Albanian institute of Statistics (INSTAT) and ECB and Eurostat |
| $\Delta y = \Delta(y^{home} - y^{EA})$ | $y$: log of the gross domestic product | Albanian institute of Statistics (INSTAT) and ECB and Eurostat |
| $\Delta q = \Delta(e - p^{home} + p^{EA})$ | $q$: log of real exchange rate; $e$: log of nominal exchange rate against the euro (euro per unit of home currency) | Bank of Albania |
| $\Delta m = \Delta(m^{home} - m^{EA})$ | $m$: log of real M2 monetary aggregate | Bank of Albania and ECB |
| $\Delta p = \Delta(p^{home} - p^{EA})$ | $p$: log of consumer price index | Albanian institute of Statistics (INSTAT) and ECB and Eurostat |

**Table 4** Augmented Dickey Fuller Unit Root Test Results. *Source* Authors' calculations

| Exogenous | Levels | | | 1st Difference | | |
|---|---|---|---|---|---|---|
| | Constant | Const + trend | None | Constant | Const + trend | None |
| Relative employment | 0.47 | 0.15 | 0.20 | 0.00 | 0.01 | 0.00 |
| Relative GDP | 0.15 | 0.86 | 0.00 | 0.00 | 0.00 | 0.00 |
| Real LEK-EUR exch. rate | 0.88 | 0.85 | 0.24 | 0.00 | 0.00 | 0.00 |
| Relative real M2 | 0.98 | 0.85 | 0.95 | 0.00 | 0.00 | 0.00 |
| Relative CPI | 0.62 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 |

Numbers reported are probabilities

exchange rate prior to the euro inception. The variables in our data set (Table 3) span the 2002Q1–2021Q4 period with quarterly observations. All variables are expressed as home relative to foreign, transformed in natural logarithms and adjusted for seasonal components. Employment is proxied by the inverse of unemployed persons and the real exchange rate is defined such that an increase indicates a real appreciation of the home currency.

Following standard practice, ahead of VAR specification, we test variables to determine the order of integration, but also to check for presence of cointegration. Stationary variables enter the VAR in levels whereas $I(1)$ variables in first differences. We use the Augmented Dickey Fuller (ADF) unit root tests and report its results in Table 4. The high probabilities for the variables in levels indicate that they have unit roots. All variables become stationary when transformed in first differences.

Assuming absence of cointegration, the presence of unit roots implies five different stochastic trends. However, if $r$ cointegrating relationships exist, the number of stochastic trends will be $n—r$, which would allow us to reduce the number of identification restrictions for the SVAR model accordingly. Otherwise, entering the cointegrated $I(1)$ variables as first difference in the VAR model could result in spurious estimation and loss of information if some linear combination of the series is stationary (i.e., they are cointegrated). Factoring in the long-run relationship among the variables helps to correctly identify long run restrictions and yield more efficient estimates for the parameters of short-run dynamics. Table 5 reports a summary of the Johansen test for cointegration based on several assumptions.

As suggested by the Schwartz lag length criterion in Table 6, a test with one time lag for both the trace statistic and the maximum eigenvalue tests suggests at most one cointegrating vector among the five variables in consideration.

## 5 Results

Because our cointegration tests indicate the presence of at most one cointegrating relationship, we first estimate an SVAR with cointegration, followed by an SVAR without cointegration.

**Table 5** Johansen cointegration test results. *Source* Authors' calculations

Sample: 2002Q1 2021Q4

Included observations: 80

Series: Employment, GDP, real M2, CPI, real exchange rate

Lags interval: 1–3

Selected (0.05 level*) Number of cointegrating relations by model

| Data trend: | None | None | Linear | Linear | Quadratic |
|---|---|---|---|---|---|
| Test Type | No intercept | Intercept | Intercept | Intercept | Intercept |
| | No trend | No trend | No trend | Trend | Trend |
| Trace | 1 | 2 | 1 | 1 | 2 |
| Max-Eig | 1 | 1 | 1 | 1 | 1 |

*Critical values based on MacKinnon-Haug-Michelis (1999)

**Table 6** VAR lag length criteria. *Source* Authors' calculations

Endogenous variables in levels: Relative employment, GDP, real M2, CPI and the real exchange rate

Included observations: 80

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | − 1236.11 | NA | 2.1E+07 | 31.03 | 31.18 | 31.09 |
| 1 | − 669.67 | 1047.92 | 27.21 | 17.49 | 18.38* | 17.85* |
| 2 | − 647.59 | 38.09 | 29.49 | 17.56 | 19.20 | 18.22 |
| 3 | − 614.71 | 52.60* | 24.67* | 17.37* | 19.75 | 18.32 |
| 4 | − 602.57 | 17.91 | 35.26 | 17.69 | 20.82 | 18.94 |

*indicates lag order selected by the LR test statistic (LR), final prediction error (FPE), and Akaike (AIC), Schwartz (SC) and Hannan-Quinn (HQ) information criteria

## 5.1 Estimation results from SVAR with cointegration

Since our tests found at most one cointegrating relationship, there will be one fewer persistent shock in the system, allowing us to reduce the number of restrictions needed for identification. The cointegrating vector is estimated separately and that enables the construction of the error-correction term as suggested by Oularis et al. (2018). We include the $I(1)$ variables in first-difference and replace the relative price variable with the I(0) error-correction term (ECT). The remaining restrictions will be zero long-run restrictions imposed through recursive ordering as follows: employment, output, real exchange rate, real $M2$, and ECT. Such identification scheme introduces a total of 10 "zero" restrictions, the exact number needed for correct identification, allowing short-term dynamics to be freely determined.

Figure 5 presents the impulse response functions (IRF) to one standard deviation of each structural innovation for the relative variables in our model. Because the variables have entered the model as changes in natural logs, the IRFs are computed
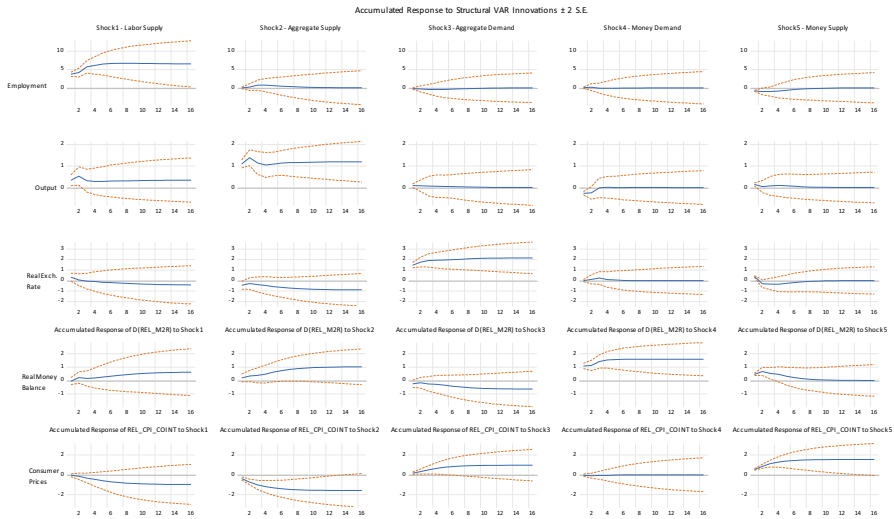
**Fig. 5** Impulse responses to structural shocks. *Source* Authors' calculations

as accumulated responses and indicate percent changes. Most of the shocks have the expected long- and short-run effects. Consistent with Clarida and Gali (1994), our IRFs show that aggregate supply shocks lead to higher employment and output ratios, lower relative prices, higher real money balances and real depreciation. Labor supply shocks have a similar impact on money and prices but not on the exchange rate, where they bring about a short-lived and modest real lek appreciation.

As expected, a positive real demand shock leads to a permanent price level increase, a reduction in real money balances, and a significant real exchange rate appreciation. However, contrary to expectations, the real demand shock fails to affect output at all time horizons. Whether the disturbance we have labeled as "real demand" shock is indeed a demand shock, is primarily a matter of how it affects the model variables. As described above, its effects on prices, real money balances, and the real exchange rate are consistent with broad theoretical expectations. But the non-responsiveness of output and the minor employment contraction calls into question the simple interpretation of this shock as "real demand." We would rather interpret this as a shock with no long run impact on real output, but which can impact the other variables in the system. Therefore, while we will be referring to it as a "real demand shock," we do so with the understanding that it is merely a convenient description. Other papers in this literature have followed similar practices (see Stazka-Gawrysiak 2006).

By construction, money supply only drives the price level in the long run, with zero long-term effects on all other variables. Money supply shocks, for the first four quarters, produces a first a small short-lived appreciation, followed by a small real depreciation and a minor short-term increase in output. Finally, a positive shock on money demand produces a minor short-term real appreciation and a small economic recession as expected.

**Table 7** Forecast error variance decomposition for the real exchange rate. *Source* Authors' calculations

| Labor Supply (%) | Aggregate Supply (%) | Aggregate Demand (%) | Money Demand (%) | Money Supply (%) | Total Real Variables (%) | Total Monetary Variables () |
|---|---|---|---|---|---|---|
| *1 quarter* | | | | | | |
| 3.9 | 8.0 | 82.1 | 0.0 | 6.0 | 94.0 | 6.0 |
| *1 year* | | | | | | |
| 5.5 | 7.4 | 66.5 | 1.5 | 19.0 | 79.5 | 20.5 |
| *3 years* | | | | | | |
| 5.7 | 8.1 | 65.3 | 1.6 | 19.2 | 79.2 | 20.8 |

The impulse response analysis brings out two important observations. First, the real exchange rate in Albania is primarily sensitive to the real factors of aggregate supply and especially aggregate demand. This finding is in line with the "real economy" view that exchange rates serve as a shock absorber. Second, nominal shock effects on output variability seem unimportant, which does not lend any support to the hypothesis that the increased exchange rate variability fuels macroeconomic volatility via nominal shocks. Thus, so far there is little evidence of the floating exchange rate reverberating shocks.

To measure the relative contributions of each shock to any given variable, we proceed by analyzing the forecast error variance decomposition. Table 7 presents the relative importance of the real versus nominal shocks to real exchange rate fluctuations. Combined, the real factors account for 94 percent of the very short-term volatility in the real exchange rate, and almost 80 percent of the longer-term volatility (i.e., up to 3 years). With almost 21 percent of exchange rate fluctuation in the 3-year horizon, the contribution of monetary factors (i.e., money demand and money supply shocks) is also sizable, though not as influential as the monetary approach to exchange rate determination would predict. Looking at the individual factors, real demand shocks are by far the most important driver of real exchange rate variance dominating the short-run with 82 percent, and the longer-term fluctuations with 65 percent.

For a more visual representation, in Fig. 6 we show the share of each shock in the forecast error of the real exchange rate changes for a forecast horizon of 0–5 years. The declining contribution of real demand shocks within the first year is mostly offset by the rising contribution of money supply shocks.

The dominance of real shocks suggests that the real exchange rate is a stabilizing mechanism in the Albanian economy and lends support to the "equilibrium" or "real economy" view of exchange rates consistent with evidence from Erjavec et al. (2012), Dabrowski and Wroblewska (2016) findings for Poland, Audzei and Brázdik (2018), and Dabrowski and Wroblewska (2020). Our findings contradict evidence from Shevchuk (2014), where more than 80% of variability in the nominal exchange rate is explained by nominal shocks.

Using the estimated model parameters and the identified structural shocks, we now compute the historical decomposition of the estimated forecast errors to
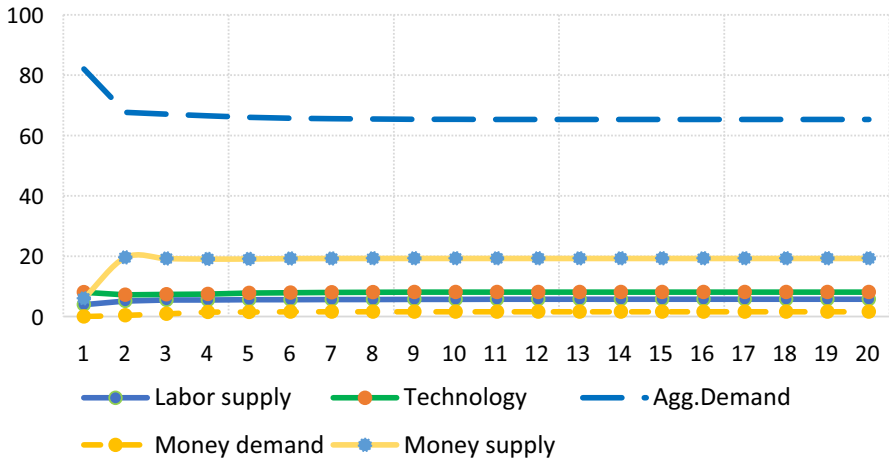
**Fig. 6** Forecast error variance decomposition of changes in the real exchange rate. *Source* Authors' calculations
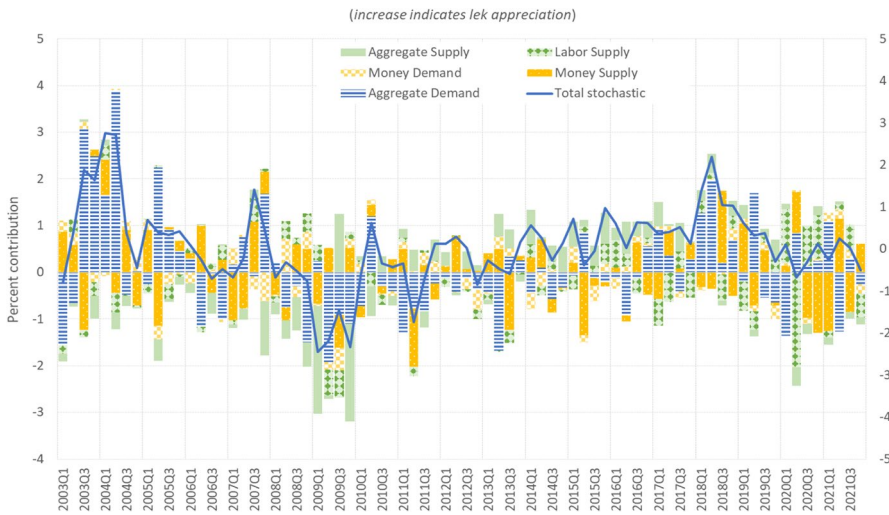


**Fig. 7** Historical contribution of real and nominal factors in real exchange rate changes (SVAR with long-run restrictions and cointegration). *Source* Authors' calculations

examine the contribution of each of the identified structural shocks over time. This historical decomposition can shed light on the drivers of real exchange rate behavior during key historical episodes, such as the sharp lek appreciation of 2003–2004, the swift depreciation during the global financial crisis in 2009, and the 2018 reversal to pre-financial crisis levels. Figure 7 presents this historical contribution of the real and nominal factors to real exchange rate movements.

The contribution of real demand factors stands out explaining the largest share of the foreign exchange movements in all three episodes. More specifically, aggregate demand shocks strongly dominate the appreciations of 2003–2004 and 2018. Aggregate supply shocks had a hefty impact during the depreciation episode following the global financial crisis and labor supply shocks unsurprisingly exerted their strongest pull during the COVID-19 recession. We conclude that the dominance of real factors in exchange rate fluctuations, by their permanent nature, could be the reason behind a persistently strong lek for close to two decades. At the same time, the role of monetary factors in these three historical episodes of large real exchange rate movements is rather limited, evidence that monetary policy is not adding to real exchange rate volatility. A notable episode is the immediate period after the onset of COVID-19 (2020Q3–2021Q1 in Fig. 7), where expansionary monetary policy interventions with purchases of euros in the foreign exchange market seem to have slowed down the pace of lek's real appreciation and likely assisted with the pace of recovery.

For a robustness check, we also tested a traditional SVAR model with long-run zero-restrictions, à la Clarida and Gali (1994) with a recursive ordering of our five variables as follows: Employment, Output, Real Exchange Rate, Real Money Balances, and CPI. The impulse responses (not presented here for brevity, but available upon request) are similar, as is the issue with the definition of our aggregate demand shock, which does not affect employment or output. The response of the real exchange rate to all the shocks is similar to our model with cointegration. In the forecast error variance decomposition of the real exchange rate, the weight of aggregate demand shocks remains dominant, followed by money supply and aggregate supply. In conclusion, the overall findings of our analysis with cointegration are confirmed, corroborating the view that a flexible exchange rate has been a sensible policy choice for Albania.

## 5.2 Estimation results from Bayesian SVAR with sign restrictions (BEAR).

Employing more than one SVAR model is an essential part of our robustness analysis. Because the testing for cointegration suggested at most one cointegrating relationship, we also consider the case where there may not be a long run relationship and estimate a structural VAR with sign restrictions. The Bayesian SVAR with sign restrictions, is less restrictive and nests the outcomes of the SVAR with zero long-run restrictions in its distribution of all possible solutions. Table 8 lays out the configuration of the Bayesian VAR we have used.

By using prior information about the model parameters, Bayesian VARs perform better with overparameterization. In our study, we use the theoretical expectations laid out in Table 2 for prior parameter information and proceed to check impulse response functions against these expectations. For more details on the implementation of sign restrictions in SVAR models please see Peersman (2005). In brief, we take a joint draw for the VAR parameters from the unrestricted posterior. Next, we produce IRFs to use as a filter for retaining the draw only when the imposed sign restrictions are satisfied. For all the retained draws, we report the

| Table 8 Bayesian VAR specifications | Specifications | Value |
|---|---|---|
| | Prior distribution | Normal-Wishart (sigma as univariate AR) |
| | Auto-regressive coefficient | 0.8 |
| | Overall tightness $\lambda 1$ | 0.1 |
| | Cross-variable weighting $\lambda 2$ | 0.5 |
| | Lag decay $\lambda 3$ | 2 |
| | Exogenous variable tightness $\lambda 4$ | 100 |
| | Block exogeneity shrinkage $\lambda 5$ | 0.001 |
| | Sum-of-coefficients tightness $\lambda 6$ | 1 |
| | Dummy initial observation tightness $\lambda 7$ | 0.0001 |
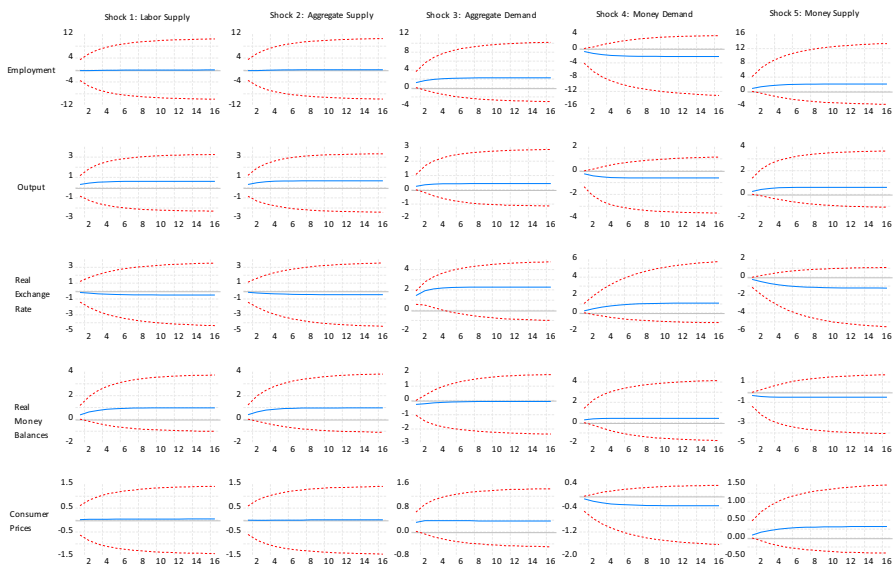


**Fig. 8** Impulse responses to structural shocks (SVAR with Sign restrictions). *Source* Authors' calculations

median impulse responses (blue line in Fig. 8) and the 84th and 16th percentile error bands (red lines).

By and large, the impulse responses are generally similar to our first model with zero long-run restrictions and cointegration. One exception is the null effect of the employment and aggregate supply shocks on prices. Worth noting on the response of the real exchange rate is that the effects of supply factors are smaller, while the real appreciation caused by positive demand shocks is both sizable and persistent, as in our first model. In this model nominal shocks produce larger and more sustained effects on the real exchange rate compared to our first model,

**Table 9** Forecast error variance decomposition for the real exchange rate. *Source* Authors' calculations

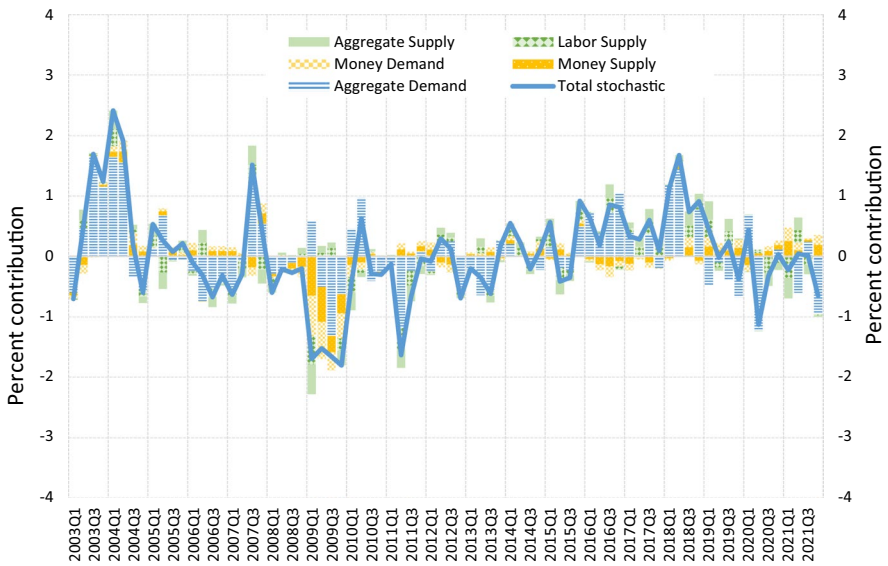| Labor supply | Aggregate supply (%) | Aggregate demand (%) | Money demand (%) | Money supply (%) | Total real variables (%) | Total monetary variables (%) |
|---|---|---|---|---|---|---|
| *1 quarter* | | | | | | |
| 8.5% | 7.8 | 79.6 | 1.8 | 2.3 | 95.9 | 4.1 |
| *1 year* | | | | | | |
| 11.0% | 11.4 | 65.1 | 6.0 | 6.5 | 87.5 | 12.5 |
| *3 years* | | | | | | |
| 11.5% | 11.8 | 62.5 | 6.8 | 7.4 | 85.8 | 14.2 |



**Fig. 9** Historical contribution of real and nominal factors in RER changes (SVAR with sign restrictions). *Source* Authors' calculations

which is important for drawing a conclusion on the role of the flexible exchange rate.

For perspective on the role of real and nominal shocks on the real exchange rate at different time horizons, we turn to forecast error variance decompositions in Table 9. At 96 percent, the effect of real factors in real exchange rate volatility is even larger than in our first model. Aggregate demand shocks continue to contribute the lion's share in these fluctuations with almost 80 percent in the very short run. Nominal shocks have a somewhat reduced weight compared to our fist model, at all time horizons.

The historical contribution of the real and nominal factors to changes in the real exchange rate is shown in Fig. 9. Compared to our first model, real demand

factors stand out even more with the largest effect on the three focal episodes of dramatic foreign exchange changes: 2003, 2009, and 2018. Nominal factors only stand out in the real depreciation of 2009, likely also a consequence of the loss of confidence in Greek and Italian banks operating in Albania and facing large withdrawals of euro denominated deposits at the onset of the Greek debt crisis.

Our general findings for both the SVAR with zero long-run restrictions and the Bayesian SVAR with sign restrictions are consistent: as a shock absorber, the flexible exchange rate in Albania has benefited macroeconomic stability. The nominal shocks do contribute a decent amount to exchange rate volatility, but not enough to trigger shock reverberation.

In agreement with our findings, Stazka-Gawrysiak (2006) reports that the real exchange rate has more shock absorbing properties for several CEE countries participating in the ERM II, which is counterintuitive policy wise. They find that the effect of nominal shocks on real exchange rate fluctuations vary considerably across countries: with the highest effect in the Czech Republic (72–80%) and the lowest in Lithuania (5–19%). In our study, at 21 percent (and 14 percent for the Bayesian SVAR) of exchange rate fluctuations in the 3-year horizon, monetary factors contribute a considerable share to real exchange volatility, but not a dominating one. The wide differences observed across various CEE countries could stem from vastly different market structures, monetary policies, or stages of economic development and financial markets.

Dibooglu and Kutan (2001), who use a bivariate SVAR on data from Poland and Hungary, demonstrate that nominal shocks explain most fluctuations in the real exchange rate for Poland, but real shocks are the main source of volatility in Hungary's real exchange rate. Because their bivariate model allows them to identify only real and nominal shocks, their results cannot be easily compared to our study which is able to distinguish between real demand, real supply, and nominal shocks. Nonetheless, their finding about the importance of nominal shocks for Poland is not in line with our findings for Albania.

Stazka-Gawrysiak (2009) reaches the same conclusion in their study of Poland: the real exchange rate responds primarily to IS shocks, therefore making a floating exchange rate a useful stabilizing force in the face of asymmetric shocks for the Polish economy. Similar to our findings for Albania, their IS shocks account anywhere from 57 to 74% of the real exchange rate variation depending on model specification and time horizon.

Erjavec et al. (2012) measures the contribution of demand shocks on the real exchange rate for Croatia at 85–89% depending on the time horizon. Most of the remaining contribution comes from aggregate supply shocks, as opposed to monetary shocks. The importance of real demand shocks is similar to our findings. But in contrast with our estimates and theory, they find that a positive real aggregate demand shock produces a real depreciation, which was also observed by Stazka-Gawrysiak (2006) for eight CEE economies. They argue that this unexpected finding is possibly the result of using only three variables in their VAR, which may make it difficult to capture all the main primitive disturbances affecting the variables. This is an important difference with our 5-variable VAR model,

which in this particular aspect is consistent with theory: a positive aggregate demand shock leads to a real appreciation.

In line with our findings, after examining ten CEE countries during 1998–1917, Audzei and Brázdik (2018) conclude that the real exchange rate is a shock absorber and that in none of the countries is the real exchange rate a major source business cycle volatility. Similarly, Dabrowski and Wroblewska (2020), who study the effects of exchange rates in eight CEE economies with fixed and floating regimes, show that in spite of the exchange rate regime, output is driven mainly by real shocks, but it is less responsive to these shocks under more flexible exchange rates.

Our findings are also in line with the majority of the literature which does not identify supply shocks as a significant source of real exchange rate fluctuations, a stylized fact identified by MacDonald (1998). This is unexpected in the face of the Balassa-Samuelson hypothesis, where productivity growth gaps affect real exchange rate adjustments. For example, Weber (1997) finds labor supply to be an important determinant of real exchange rate behavior only in the case of Japan in his study of G3 exchange rates.

The shock absorbing or reverberating role of exchange rates in CEE (or transformation) economies has been contested in the literature, but our results from three different types of 5-variable SVAR models (i.e., Simple SVAR with zero long-run restrictions; SVAR with cointegration and zero long-run restrictions; and Bayesian SVAR with sign restrictions) are consistent with the larger part of the literature where flexible exchange rates reduce macroeconomic volatility.

## 6 Conclusions and policy recommendations

How useful is the real exchange rate as a buffering mechanism against macroeconomic shocks? While a commonly held view, the real exchange rate as a shock absorber is not unequivocally supported by empirical evidence. The real exchange rate can also be a shock reverberator. The "disequilibrium view" maintains that real exchange rate volatility stems from nominal exchange rate volatility. By contrast, the "equilibrium view" sees the real exchange rate as a shock absorber against real economic shocks involving supply and/or demand. A rich literature on this issue demonstrates that the answer varies across countries, making empirical investigations for every country a necessity, especially when policymakers consider a change in the exchange rate regime, or when they evaluate decisions to join a currency area. Depending on the role of the real exchange rate, these policy decisions can have important implications for economic stability and macroeconomic management.

In this study we use an extended SVAR model with five variables following Weber's (1997) stochastic rational expectations open economy model with a sticky-price Mundell–Fleming–Dornbusch framework to investigate whether the exchange rate in Albania is a shock absorber or shock reverberator. Our findings consist of four main points.

First, real economic factors, dominated by aggregate demand, are what largely drives real exchange rate movements in Albania. This finding is in agreement with the majority of SVAR studies of CEE economies. The dominating role of

real shocks suggests that the real exchange rate is a stabilizing force in the Albanian economy, strengthening the "equilibrium view" of exchange rates. Second, monetary shocks have modest effects on the real lek-euro exchange rate fluctuations; they are overshadowed by real shocks and do not amount to a level where they can make the exchange rate a shock propagator. Third, supply side factors also have modest effects on the real exchange rate, which is in line with empirical studies in advanced and emerging economies. Fourth, historical decomposition identifies the real factors as the main force behind three episodes of large movements in real exchange rates, which could explain the persistent real appreciation of the lek against the euro in the last decade. Our robustness analysis, corroborated these main findings across all three SVAR models we used.

From a policy perspective, we believe that the question we investigate in this study is of consequence. As a small and mostly open economy, Albania's choice of exchange rate regime, both now and in future (i.e., if it is accepted into the European Union and then invited to join the Eurozone) can produce vastly different outcomes for macroeconomic stability. From a macroeconomic stability perspective, our main policy conclusion is that the flexible exchange rate has been a sensible policy choice for the Albanian economy.

Following this main policy implication, we stress three important considerations. First, as Dąbrowski et al. (2015) have explained, shock resilience is not merely a question of having the right exchange rate regime, but also a question of the array of policy tools deployed to alleviate the effects of shocks. Second, in light of our findings for the case of Albania, it may be useful to consider one of Stockman's (1987) main policy implications from the equilibrium view of exchange rates: policies such as foreign exchange market interventions should be judged based on their inflation effects but also on how they incentivize policymakers in pursuing other policies. In this sense, foreign exchange market interventions by the bank of Albania in recent years have been consistent with achieving their main inflation targets and seem in line with this very policy principle. Third, if and when Albania ever considers a less flexible exchange rate regime, or decides to join a currency area, our analysis and conclusions would not automatically invalidate such a decision. Our empirical investigation is narrowly focused on the shock-reverberating or absorbing properties of the flexible exchange rate, but it does not consider a wider range of potential benefits (or costs) to joining a currency area such as improved trade due to lower transaction costs and enhanced price transparency among others.

Although we have used a longer data set than most CEE studies on this issue, still our investigation has a limited span of 80 quarters. Notwithstanding our use of three different SVAR models to ensure robustness of results, we are aware that our findings could be sensitive to the use of a different set of shocks (e.g., global financial shocks), or model specifications. As such, these findings should be taken with caution and interpreted only in the context of other findings of this varied and useful literature.

## Declarations

**Conflict of interest** All authors contributed to the study conception and design; they have been listed in alphabetical order. The final manuscript includes equal work from all three authors, and it represents their research and opinions, the position or opinions of their institutions. Any errors in the article are the authors'.

## References

Artis M, Ehrmann M (2006) The exchange rate—a shock-absorber or source of shocks? A study of four open economies. J Int Money Finance 25:874–893

Audzei V, Brázdik F (2018) Exchange rate dynamics and their effect on macroeconomic volatility in selected CEE countries. Econ Syst 42(4):584–596

Bahmani M, Miteza I, Tanku A (2020) Exchange rate changes and money demand in Albania: a nonlinear ARDL analysis. Econ Chang Restruct 53(4):619–633

Balassa B (1964) The purchasing power parity doctrine: a reappraisal. J Polit Econ 72(6):584–596

Blanchard O, Quah J, Quah D (1989) The dynamic effects of aggregate demand and supply disturbances. Am Econ Rev 79(4):655–673

Borghijs A, Kuijs L (2004) Exchange rates in central Europe: a blessing or a curse? IMF Working Paper WP/04/2, pp 1–28

Buiter WH (1995) Macroeconomic policy during a transition to Monetary Union. Center for Economic Performance Discussion paper no. 261. Retrieved from SSRN https://ssrn.com/abstract=289491

Buiter WH (2000) Optimal currency areas, Scottish Economic Society/Royal bank of Scotland annual lecture, 1999. Scott J Polit Econ 47(3):213–250

Clarida R, Gali J (1994) Sources of real exchange rate fluctuations: how important are nominal shocks? NBER working paper no 4658, Cambridge, MA

Dąbrowski M, Wróblewska J (2016) Exchange rate as a shock absorber in Poland and Slovakia: Evidence from Bayesian SVAR models with common serial correlation. Econ Model 58(C):249–262

Dąbrowski M, Wróblewska J (2020) Insulating property of the flexible exchange rate regime: a case of Central and Eastern European countries. Int Econ 162:34–49

Dąbrowski MA, Smiech S, Papiez M (2015) Monetary policy options for mitigating the impact of the global financial crisis on emerging market economies. J Int Money Finance 51:409–431

Dibooglu S, Kutan A (2001) Sources of real exchange rate fluctuations in transition economies: the case of Poland and Hungary. J Comp Econ 29(2):257–275

Dieppe A, van Roye B, Legrand R (2016) The BEAR toolbox. Working paper series 1934, European Central Bank

Dornbusch R (1976) Expectations and exchange rate dynamics. J Polit Econ 84:1161–1176

Erjavec N, Cota B, Jaksic S (2012) Sources of exchange rate fluctuations: empirical evidence from Croatia. Privred Kretanjua Ekon Polit 22(132):27–46

European Council (2022) Joining the Euro area. Retrieved 18 Nov 2022 from https://www.consilium.europa.eu/en/policies/joining-the-euro-area/

Farrant K, Peersman G (2006) Is the exchange rate a shock absorber or source of shocks? New empirical evidence. J Money Credit Bank 38:939–962

Faust J, Leeper E (1997) When do long-run identifying restrictions give reliable results? J Bus Econ Stat 15(3):345–353

Monetary Implementation Framework (2022) Bank of Albania. Retrieved 23 Feb 2022 from https://www.bankofalbania.org/Monetary_Policy/Monetary_Implementation/Monetary_Implementation_Framework/

Gabaix X, Maggiori M (2015) International liquidity and exchange rate dynamics. Q J Econ 130(3):1369–1420

Ito H, Chinn M (2021) Notes on the Chinn-Ito financial openness index 2019 update. Manuscript available at https://web.pdx.edu/~ito/Readme_kaopen2019.pdf

Johnson HG (1969) The case for flexible exchange rates. Federal Reserve Bank of St. Louis Review. 51(6):12–24

Lastrapes WD (1992) Sources of fluctuations in real and nominal exchange rates. Rev Econ Stat 74(3):530–539

MacDonald R (1998) What do we really know about real exchange rates? Oesterreichische Nationalbank working paper no. 28

McKinnon RI (1963) Optimum currency areas. Am Econ Rev 53:717–725

Miranda-Agrippino S, Ricco G (2018) Bayesian Vector Autoregressions. Bank of England working paper no. 756

Mumtaz H, Sunder-Plassmann L (2010) Time-varying dynamics of the real exchange rate. A structural VAR analysis. Bank of England working paper no. 382, March

Mundell R (1963) Capital mobility and stabilization policy under fixed and flexible exchange rates. Can J Econ Polit Sci 29:475–485

Musa M (1986) Nominal exchange rate regimes and the behavior of real exchange rates: evidence and implications. In: Carnegie-Rochester conference series on public policy 26

Obstfeld M (1985) Floating exchange rates: experience and prospects. Brook Pap Econ Act 16(2):369–450

Oularis S, Pagan AR, Restrepo J (2018) Quantitative macroeconomic modeling with structural vector autoregressions—an EViews implementation, August 2018. Manuscript available at https://www.eviews.com/StructVAR/structvar.pdf

Peersman G (2005) What caused the early millennium slowdown? Evidence based on autoregressions. J Appl Economet 20:185–207

Rogers JH (1999) Monetary shocks and real exchange rates. J Int Econ 49(2):269–288

Rogoff K (1996) The purchasing power parity puzzle. J Econ Lit 34:647–668

Shevchuk V (2014) Shock-absorbing properties of the exchange rates in transformation economies: SVAR estimates. In: Proceedings of the 8th Professor Aleksander Zelias international conference on modelling and forecasting of socio-economic phenomena, pp 155–164

Shijaku G (2016) The role of money as an important pillar for monetary policy: the case of Albania. MPRA paper 79088. University Library of Munich, Germany

Stazka A (2006) Sources of real exchange rate fluctuations in central and eastern Europe—temporary or permanent? CESifo Working paper series no. 1876

Stazka-Gawrysiak A (2009) The shock-absorbing capacity of the flexible exchange rate in Poland. Focus Eur Econ Integr 4:54–70

Stockman A (1983) Real exchange rates under alternative nominal exchange-rate systems. J Int Money Finance 2(2):147–166

Stockman AC (1987) The equilibrium approach to exchange rates. FRB Richmond Econ Rev 73(2):12–30

Thomas AH (1997) Is the exchange rate a shock absorber? The case of Sweden. IMF working papers 97/176, International Monetary Fund

Uhlig H (2005) What are the effects of monetary policy on output? Results from an agnostic identification procedure. J Mon Econ 52(2):381–419

Weber A (1997) Sources of purchasing power disparities between the G3 economies. J Jpn Int Econ 11(4):548–583