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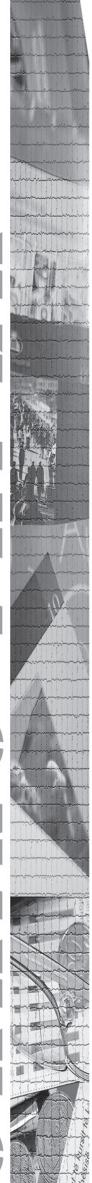

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CONTENTS

ABSTRACT

This study aims to assess the sensitivity of exchange rate to real and monetary shocks in Albania during the last 20 years. The identification of these shocks provides a better understanding on the sources of exchange rate volatility. It also provides useful information whether exchange rate acts as a shocks absorber or as a source of instability in the economy. The analysis uses a structural vector autoregression method with permanent and transitory shocks, along the lines of Ouliaris, Pagan and Restrepo (2018). The model is based on Weber (1997) and includes employment, output, real exchange rate, money and prices. The first two variables aim at identifying the supply shocks; the third is identified as a real demand shock; whereas monetary indicators are intended to capture nominal shocks respectively money demand and money supply effects. The results suggest that monetary shocks account for around 28 percent of the real exchange rate fluctuations in Albania. Meanwhile their effects are found to be negligible in the last couple of years, in which real exchange rate appreciation stems from real economic factors.

JEL classification codes: C32, E41, E51, F31

Keywords: Albania, exchange rate, real shocks, monetary shocks, cointegrating structural VAR, exchange rate regime

1. INTRODUCTION

The swift developments of the exchange rates volatility have always raised concerns among policymakers in Albania, about the sources of this currency fluctuations and potential implications for macro and economic stability. Albania has adopted a freely floating exchange rate regime since 1992. Leaving behind the period of economic instabilities in the late 1990s, the subsequent couple of decades have evidenced a rather good performance of the Albanian currency, even if compared with other floating currencies in the CESEE countries. During the 2001-18 period, the exchange rate has fluctuated between 123-140 lek per euro while its volatility has been fairly contained. Nevertheless, public perception and sensitivity to such tolerable volatility (relative to the rest of CESEE economies) are considerable and periods of market pressures and discontent toward the free floating exchange rate regime have not been absent. During the episodes of lek appreciation in the beginning of 2000s until the financial crisis of 2008, and again during the appreciation in the last couple of years, an increasing number of local exporters have muttered in discontent about their shrinking revenues from selling abroad. In general, appreciation brings anxieties in the real sector about potentially adverse exchange rate effects stemming from losing competitiveness in international trade. During the episodes of depreciations, central bank is put under strains mainly by unhedged foreign-currency borrowers and savers who demand intervention in the foreign exchange markets, as the depreciation of lek raises their installment loan payments denominated in foreign currency or reduces the value of their savings. These sentiments are usually followed by a debate on the role of exchange rate, the causes of its fluctuations and the nature of exchange rate regime.

This paper tries to contribute to the ongoing discussions on the exchange rate role in the economy by analyzing the overall sensitivity of the lek-euro exchange rate to the real and nominal factors. The distinction between the real and nominal/monetary effects with our empirical strategy based on SVAR methodology, provides a formal evidence-based explanation for the nature of shocks that drive exchange rate fluctuations and cost-benefits analysis of the exchange rate flexibility for the Albanian economy. The Bank of Albania has always held the view that currency fluctuations are mainly driven by real economic factors and the free floating exchange rate is not a source of instability in the economy, but rather acts as a shock absorber that stabilizes the distortionary economic shocks. Our results confirm both these views.

The prejudice over the floating regime emerges from the findings of the theoretical and empiric literature and the stylized facts analyses which have conventionally focused on the monetary factors as the main driver of real exchange rate movements. In a survey of the purchasing power parity (PPP) theory, Rogoff (1996, p. 647) stressed that "most explanations of short-term exchange rate volatility point to financial factors as changes in portfolio preferences, short-term asset price bubbles, and monetary shocks," suggesting that real shocks to productivity, technology or demand preferences are not sufficiently volatile to explain the PPP puzzle. The findings by Rogers (1998), among others, lend support to the argument of monetary shocks. But, many empirical studies inspired by the works of Lastrapes (1992) and Clarida and Gali (1994) have downgraded the importance of nominal shocks. To distinguish between the real and monetary effects on the real exchange rate, Clarida and Gali estimate a small macro model with relative output, relative prices and the real exchange rate. They find that monetary factors account for 44 and 35 percent of the real exchange rate movements in Germany and Japan, respectively, and less than a meager 3 percent in the UK and Canada.

Our theoretical model follows Weber (1997), which is an extended version of the Clarida-Gali's (1994) framework. The identification of real and monetary shocks on the real exchange rate is based on the estimation of a five-equation structural VAR with long-run restrictions. The model variables consist of relative output, employment, money, prices and the real exchange rate, hence largely resembling the monetary approach to exchange rate modeling. In this system, real shocks are identified by supply and demand shocks, which are represented by relative output, relative employment, and by the real exchange rate itself respectively; whereas nominal shocks, the effects of money demand and money supply, are captured by shocks to the broad money and consumer prices, respectively. The identification scheme is adjusted to reflect the presence of cointegration relationship among our five variables as suggested by Ouliaris, Pagan and Restrepo (2018).

To preview the results, we find that real factors are the main source of the exchange rate fluctuations in Albania, driven substantively by real demand (56%) and much less by supply (16%). Meanwhile, monetary shocks appear considerable but not dominant. They explain about 28 percent of the real exchange rate against euro. The larger influence of real factors suggests us that exchange rate has a rather stabilizing role in Albania. Therefore, benefits from the actual floating exchange rate regime outpace rather than provoke fear from output and price volatility.

The rest of the paper is organized as follows. Sections 2 describes the theoretical background. Section 3 presents some stylized facts and conducts some preliminary data tests. Following the test results, Section 4 defines the cointegrating structural VAR framework using long-run restrictions. Section 5 discusses the main empirical results, while Section 6 offers some concluding remarks.

2. THEORETICAL BACKGROUND

A number of studies on the sources of real exchange rate fluctuations have been inspired by the pioneering work of Blanchard and Quah (1989), which use the theoretical long-run relationships to identify the structural shocks. Lastrapes (1992) makes one of the earliest attempts to use the Blanchard and Quah identification technique to estimate the effects of real and nominal factors on real exchange rate fluctuations. Lastrapes estimates a structural VAR with two variables, namely the real and the nominal exchange rates to distinguish between real and nominal shocks. Another popular work along the same line is that by Clarida and Gali (1994), who try to distinguish between supply shocks (such as productivity), real demand or absorption shocks (such as public consumption) and nominal factors (such as monetary policy, money demand and financial liberalization). These three factors are detected in their SVAR model by the relative output, real exchange rate and relative price shocks, respectively. Indeed, the stochastic specification of the Clarida and Gali's model follows the open economy model developed by Obstfeld (1985), where the long-run equilibrium of GDP is determined solely by supply factors. The other theoretical foundations for their SVAR restrictions are borrowed from the Mundell-Fleming-Dornbusch model that basically assumes output and prices adjust sluggishly to various shocks, while foreign and domestically-produced consumption goods are imperfect substitutes.

Unconvinced by Clarida and Gali's concluding results of the predominance of real demand shocks in explaining RER movements, Weber (1997) extends their analysis by splitting supply shocks into labor supply and technological shocks, and separating nominal shocks into money demand and money supply shocks. Therefore, his stochastic rational expectations open economy model basically consists of the following five equations:

(1) IS equation: $y_t^d = \eta(s_t - p_t) - \sigma[i_t - E(p_{t+1} - p_t)] + \phi(w_t - p_t) + d_t$
(2) Labor supply: $l_t^s = \varphi[i_t - E(p_{t+1} - p_t)] + \gamma(w_t - p_t) + \omega_t$, where
(3) Price formation: $p_t = (1-\theta)E_{t-1}p_t^e + \theta p_t^e$
(4) LM equation: $m_t^d - p_t - y_t = -\lambda i_t + (\varepsilon_t^m - d_t)$
(5) UIP condition: $i_t = E_t(s_{t+1} - s_t) + rp_t$

where y^d_t is gross domestic product, d_t represents the real demand shock such that $d_t = d_{t-1} + \varepsilon^{\delta}_{t}$; l^s_t is labor supply (proxied by the inverse of unemployment), ω_t represents the labor supply shock such that $\omega_t = \omega_{t-1} + \varepsilon^{\omega}_{t}$; s_t is the nominal exchange rate; p_t is the price level; p^e_t is the equilibrium price level; m^s_t is money supply; i_t is the nominal interest rate; rp_t stands for the risk premium; whereas ε^{δ}_t, ε^{ω}_t and ε^{m}_t denote permanent components of aggregate demand, labor supply and money demand shocks, respectively, which 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 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). The second equation displays labor supply as a function of real interest rate and the real wages. The price setting equation introduces some nominal rigidities, which are represented by parameter θ: if it is equal to one, prices adjust immediately to their level and output is driven by supply; otherwise, zero means that prices are fixed at the previous period level. In the short run, prices might adjust only sluggishly (Dornbusch, 1976), so that parameter θ could be between zero and one. The fourth equation represents the traditional LM curve, expressed here as the inverse of income velocity of money $(m_t^d-p_t-y_t)$ in relation to nominal interest rates and the inverse of velocity shock $(\varepsilon_t^m-d_t)$. Interest rates are determined by the uncovered interest parity condition. Although domestic and foreign bonds can be considered as imperfect substitutes – particularly in this analysis – the risk premium is for simplicity omitted from the model, as is generally done in the bulk of the literature.

To capture the permanent shifts in the fundamentals, Weber estimates a structural VAR model that is identified by imposing restrictions on the long-run effects of shocks. The main identifying assumptions of the model are such that:

a. supply shocks determine all the variables in the long run;
b. aggregate demand shocks have a permanent impact on the

(real and nominal) exchange rate, money stock and prices, but only a temporary effect on employment and output; and,

c. nominal shocks have no long-run effect on employment, output and the real exchange rate.

Table 1 presents the long run and short run expected response of the SVAR model. By construction of the traditional long-term restriction SVAR, the long run equilibrium has a lower triangular structure, whereas in the sluggish-price-adjustment equilibrium all shocks are allowed to exert influence on any variable. Following the Weber's theoretical framework[1] it is expected that both employment and output are determined only by supply shocks in the long run. A positive supply shock (which implies new technologies, permanent changes in relative productivity or exogenous terms-of-trade) leads to a rise in the supply of domestic goods and investment rate of return. Capital flows in, thus putting pressure on the domestic currency to appreciate. In the long run equilibrium, output is raised to a higher potential level, prices go down and real money balances improve, whereas real exchange rate depreciates. A positive absorption or aggregate demand shock raises demand for domestic goods in the short run, pushes prices upward and leads to a real exchange rate appreciation. In the long run, however, output returns to its trend as predicted by most Keynesian-type models. Yet, real appreciation becomes permanent and prices remain at the higher level, leading to a decline in real money balances.

A positive money supply shock (such as monetary policy) causes a reduction in home nominal interest rates. In short run, nominal and real exchange rate depreciate, relative price increases, and domestic production of goods goes up. In contrast, a positive money demand shock (such as money demand velocity due to liquidity preference shifts or access to credit) raises interest rates, leading to an exchange rate appreciation, relative price falls, and domestic output declines. In the long run, output, employment and the real exchange rate come back to their long-run trends.

[1] *For the details of the long-run and short-run solutions of the model please see Weber (1997).*

Table 1. Implications for long-run and short-run equilibrium

1A. Flexible-price rational expectations equilibrium, long-run restrictions						1B. Short-run sluggish-price-adjustment equilibrium					
Shocks εj:	Supply		Demand	Nominal		Shocks εj:	Supply		Demand	Nominal	
	Labor supply	Aggreg. Supply	Aggreg. Demand	Money Demand	Money Supply		Labor Supply	Aggreg. Supply	Aggreg. Demand	Money Demand	Money Supply
l_t	+	0	0	0	0	l_t	+	+	+	-	+
y_t	+	+	0	0	0	y_t	+	+	+	-	+
s_t-p_t	-	-	+	0	0	s_t-p_t	+	+	+	+	-
m_t-p_t	+	+	-	+	0	m_t-p_t	+	+	-	+	-
p_t	-	-	+	-	+	p_t	-	-	+	-	+

3. PRELIMINARY DATA ANALYSIS

Albania's economic fundamentals in the last two decades are in line with model assumptions, such as having flexible exchange rates, free capital mobility and an economy operating close to its potential). After the adoption of 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 the rules on administrative price and capital controls. Although unemployment rate has always fluctuated above 12 percent, it represents a permanent structural problem rather than a potential labor force readily available to respond to positive supply and demand shocks in the short run. The rest of this section discusses briefly some stylized facts on the exchange rate developments and its links with the relative economic fundamentals at home and abroad, including statistical analysis of stationarity and tests for the presence of cointegration, which are important for determining the correct identification scheme of our SVAR.

By the end of 1990s, the Albanian currency had fully recovered from its losses against the European common currency that followed the 1997 financial turmoil. Since then, the lek performance has been rather sound. During the 2001-18 period, volatility has been fairly contained while the exchange rate has fluctuated between 123-140 leks per euro. Most of the 2004-08 exchange rate movements were gravitating towards the lower interval, while from 2010-15 period that corresponds to the post-global and European financial crises they were swinging fairly close to the upper interval. From June 2015 to December 2018, lek has registered a cumulative appreciation of around 12 percent against euro, tending therefore towards its historical low levels.

According to the PPP theory, exchange rates are determined by the ratio of prices. Chart 1 shows, however, that the relative price between Albania and the Eurozone has followed a pronounced trend throughout the period and has been exhibited much less fluctuations than the lek-euro exchange rate. That makes the real exchange rate experience more volatility (similar to the nominal exchange rate) and take a trend, therefore contrasting the PPP theory predictions. Chart 2 replaces relative prices with monetary aggregates, in line with the monetary approach to exchange rate determination under the assumption of flexible prices. The nominal exchange rate seems to mirror broad money movements much better than prices. Though there appears some divergence in the first half of the sample during the economic structural changes in early 2000s and the 2004-07 financial sector booming, money and the nominal exchange rate have moved in concert after the global financial crisis, suggesting that monetary factors might be important in explaining exchange rate fluctuations in Albania. Charts 3 and 4 present the relationship between the real exchange rate and real economic variables. Both, output and labor market performance have similar long-term trends with the real exchange rate, in spite of persistent divergences of the latter in the medium run.

Chart 1. Relative CPI and the Lek-Euro Exchange Rate

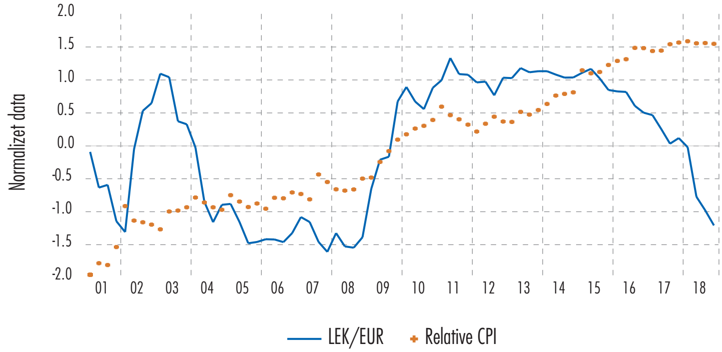


Chart 2. Relative M2 and the Lek-Euro Exchange Rate

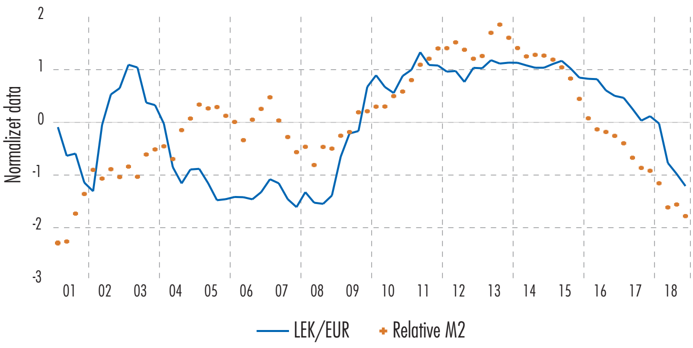


Chart 3. Relative GDP and Real Exchange Rate

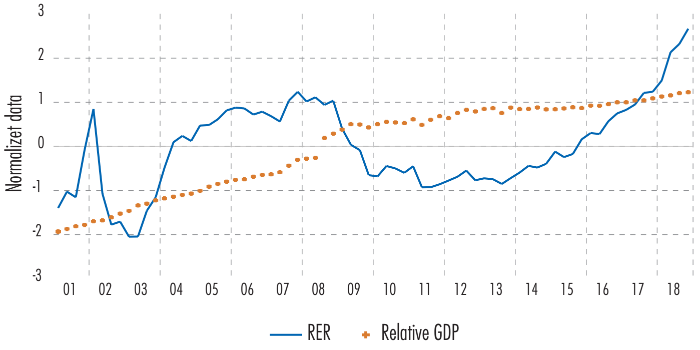
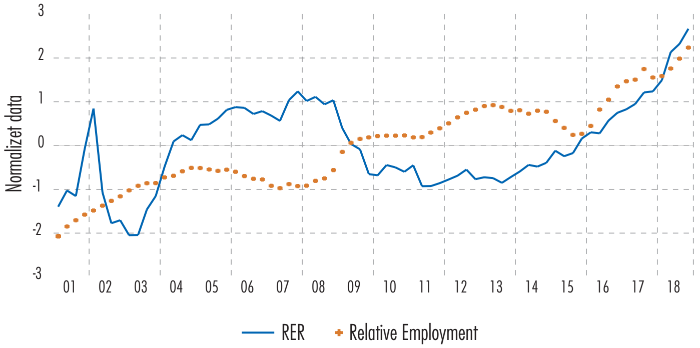


Chart 4. Relative Employment and Real Exchange Rate



A quick view on the graphs above gives us the impression that all variables could be integrated, especially the relative logs of CPI, employment and output. Therefore, it is important to examine the time-series properties of our variables before proceeding with the econometric framework. The stationarity test should determine whether the variables can enter the model in levels or they need to be changed as first difference. Table 2 shows the stationary tests conducted through the Augmented Dickey Fuller unit root tests. The high probabilities for the variables in levels indicate that they have unit roots, but they can become stationary if transformed in first difference.

The presence of unit roots means that there are five different stochastic trends among our five variables. However, in the presence of cointegration (assuming r cointegration relationships), the number of stochastic trends will be smaller (exactly n - r), and this will have significant effect for the identification of our SVAR. In addition, entering the integrated I(1) variables as first differences in the VAR model would result in spurious estimations and a loss of information if some linear combination of the series is stationary, i.e. they are cointegrated. In that case, the long-run relationship among the variables could be used to estimate more efficient parameters for the short-run dynamics. Therefore we run cointegration tests to test for presence of potential cointegration among our variables). Table 3 reports a summary of the Johansen test for cointegration based on various assumptions. Running the test with only one time lag as suggested by the Schwartz lag length criteria, both the trace statistic and the maximum eigenvalue tests evidence at most one cointegrating vector among the five variables in consideration.

Table 2: Augmented Dickey Fuller unit root test results (Probabilities)

Sample: 2002Q1 2018Q4						
Null Hypothesis: Variable X has a unit root						
Lag Length: (Automatic - based on SIC, maxlag=10)						
	Levels			1st difference		
Exogenous	Constant	Const&Trend	None	Constant	Const&Trend	None
Relative Employment	0.95	0.35	0.98	0.00	0.01	0.00
Relative GDP	0.16	0.94	0.00	0.04	0.00	0.04
Real LEK-EUR Exch. Rate	0.69	0.75	0.42	0.00	0.01	0.00
Relative Real M2	0.99	0.99	0.93	0.00	0.00	0.00
Relative CPI	0.81	0.15	0.01	0.00	0.00	0.00

Table 3: Johansen cointegration test summary of all 5 sets of assumptions

Sample: 2002Q1 2018Q4					
Included observations: 68					
Series: Relative employment, GDP, real M2, CPI and the real exchange rate.					
Lags interval: 1 to 1					
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	1	1	1	1
Max-Eig	1	1	1	1	1
*Critical values based on MacKinnon-Haug-Michelis (1999)					

Table 4: VAR lag length criteria

Endogenous variables in levels: Relative employment, GDP, real M2, CPI and the real exchange rate.						
Included observations: 68						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1029.93	NA	11.40	30.44	30.60	30.50
1	-530.98	909.84	10.10	16.50	17.48*	16.88
2	-484.96	77.14*	5.51*	15.88*	17.68	16.59*
3	-461.98	35.15	6.03	15.94	18.55	16.98
4	-438.26	32.80	6.64	15.98	19.41	17.34
* 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.						

4. ECONOMETRIC FRAMEWORK

The long-run identification scheme was originally developed by Blanchard and Quah (1989) to decompose real output into its permanent and temporary components in a bivariate VAR model. Although their method of using long-run restrictions to identify structural shocks has been criticized for possible biasness in small samples (see Faust and Leeper, 1997; Lippi and Reichlin, 1993), a large number of papers have relied on the long-run restriction structure as more theoretically justified than its contemporaneous counterpart, and also useful for discriminating among competing economic models (Christiano et al., 2006).

It is often the case that some of the permanent shocks have an effect on one variable but not on others, i.e. there is a zero longrun effect. The identification scheme makes use of this fact. Among all permanent shocks in a VAR some have long run effect on all variables and some have long run effects only on one or a subset of variables. The long-run response matrix identifies and orders all permanent shocks. This is done by ordering variables of the VAR and imposing "0" restrictions on the elements of the long-run matrix "C" in all cases when a particular shock does not bear long term effects on a particular variable as described briefly below.

Starting with an unrestricted reduced-form VAR, it follows:

$$\text{(6)} \qquad \Delta X_t = A(L)u_t$$

where ΔX_t is a vector containing the first differences of our endogenous $I(1)$ variables, namely relative employment, relative output, the real exchange rate, and relative real money balances, except relative consumer prices for which the error correction term is entered instead. $A(L)$ is a quadratic matrix polynomial A_i with the lag operator L, and u_t is the vector of the unknown disturbances.

To find out the influence of each structural shock, the unrestricted estimation in (6) is used to estimate the parameters C in the following structural VAR model:

(7) $$\Delta X_t = C(L)\varepsilon_t$$

where ε_t is a vector of the uncorrelated structural shocks that could be interpreted to represent the labor supply, technology, real demand, money demand and money supply shocks. From equations (6) and (7) it is possible to derive a linear relationship between the disturbances and the structural shocks:

where C_0 is a 5 × 5 matrix that defines contemporaneous structural relations among the variables. The structural shocks are identified by imposing long-run restrictions in the elements of the lower triangular C(1) matrix:

$$C(1) = \begin{bmatrix} \lambda_{11} & 0 & 0 & 0 & 0 \\ \lambda_{21} & \lambda_{22} & 0 & 0 & 0 \\ \lambda_{31} & \lambda_{32} & \lambda_{33} & 0 & 0 \\ \lambda_{41} & \lambda_{42} & \lambda_{43} & \lambda_{44} & 0 \\ \lambda_{51} & \lambda_{52} & \lambda_{53} & \lambda_{54} & \lambda_{55} \end{bmatrix}$$

where $C(1)$ is then used to recover $C(0)$. In principal, the matrix is interpreted as follows: the first variable is permanently influenced only by its own shocks, the second variable is influenced permanently by the shock of the first variable and its own shock and so on, until the last variable that is influenced by all shocks in the system including its own. This empirical method that makes use of the long-term restrictions introduces in the system $(n*(n-1))/2$ "zero" restrictions, which is the exact number of restrictions for correct identification of our system. Such identification scheme allows short-term dynamics to be freely determined since the system is now just identified. This method of identification has been applied by a number of studies like Clarida and Gali (1994), Ahmed et al. (1993), Weber (1997), and Rogers (1999).

Recently, however, the discussion of identification scheme has received additional considerations, bringing to attention a particular and purely statistical trait that might be embodied in the data and which might provide a significant improvement in the long run restriction scheme. Ouliaris, Pagan and Restrepo (2018) (hereafter OPR, 2018) observe that some discussion on the long-run restrictions have overlooked an important and significant fact: the potential presence of cointegration in VAR models with $I(1)$ variables. As previously explained, the identification scheme focuses on a triangular matrix that is based on the theoretic prediction as well as the understanding of the author of how the economy works and what shocks are transmitted to what variables. However, cointegration among variables is often a common feature of vector autoregressions. For a given VAR system, assuming the correct functional form and endogeneity status, existence of cointegration is identified purely on statistical considerations and not influenced by the theoretic or understanding of the researcher.

Therefore, the existence of cointegration itself would mean a set of additional restrictions in the VAR system. Once cointegration is identified the number of long-run shocks (i.e. stochastic trends) in the system is equal to the number of variables in VAR minus the number of cointegrating relationships. OPR (2018) observe that identification problem has not taken full advantage of the cointegration analysis in VARs. Finding cointegration implies that the number of permanent shocks in the system is smaller than the number of $I(1)$ variables in VAR, so reducing the number of possible restriction in $C(1)$ matrix. This transforms the SVAR into a hybrid model of permanent shocks corresponding to $I(1)$ variables and transitory shocks corresponding to cointegration relationships (alternatively $I(0)$ variables). OPR (2018) suggest that the long-run identification scheme takes into consideration the cointegrating vectors to identify the correct number of shocks and imposes long-run restrictions only on the corresponding $I(1)$ variables. The cointegrated variables should be replaced by the cointegration relationship(s). The cointegrating vector does not have a persistent shock of his own, but follows the shock of the variables in the cointegrating relationship. Imposing this new constrain on the number of restrictions might not allow for correct identification of the system with the Blanchard and Quah (1989) long-run restrictions, thus requires additional constrains to be imposed in the contemporaneous behavior in the form of short-run restrictions. This is a significant improvement as it brings the model closer to the DGP. However, the correct specification of the model with this new identification scheme depends on the ability to identify the correct cointegration relation in the given VAR. Our empirical exercise follows a similar identification scheme.

To summarize, the five variables in our VAR model were found to be integrated of order one ***I(1)*** and the cointegration analysis in Table 3 confirms the existence of at most one cointegrating relationship in our system. For that reason, the SVAR analysis with long-run restrictions has to proceed with four stochastic trends and a transitory trend that represents the cointegrating relationship ***I(0)***. With this information, the relative price series is substituted by the cointegration relationship. The cointegrating vector is estimated separately and that enables the construction of the error-correction term as suggested by OPR (2018). This will eventually turn our SVEC into a traditional SVAR and the steps of constructing and analyzing the system follow the common procedure as in a structural vector autoregression model described above. Consequently, the order of the shocks in the lower triangular ***C(1)*** matrix of long-run coefficients has not changed, but the relative price series is now transformed into an error correction term by estimating a fully-modified OLS equation. Such identification scheme introduces a total of ten "zero" restrictions. This is just the exact number of restrictions for correct identification of our system of five variables, allowing short-term dynamics to be freely determined.[2]

[2] *For details please see Chapter 7 in Ouliaris, Pagan and Restrepo (2018).*

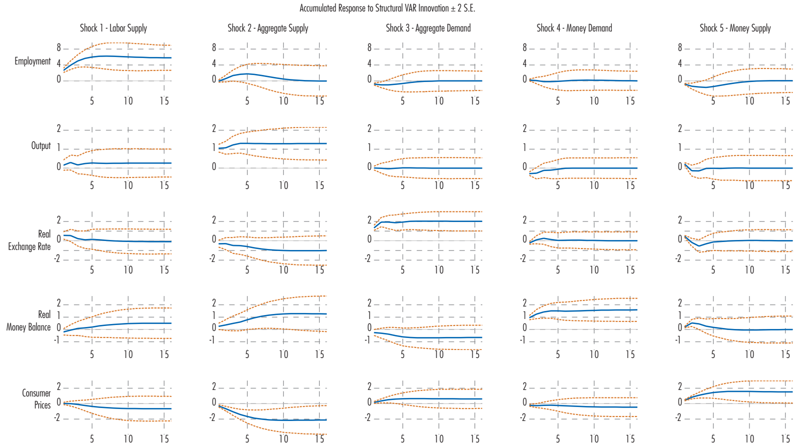
5. ESTIMATION RESULTS

The structural VAR with long-run identification was estimated using two lags with quarterly data from 2002Q1 to 2018Q4. As commonly in the literature, all variables are expressed as home relative to foreign indicators; transformed in natural logarithms and adjusted for seasonal components; employment is proxied by the inverse of unemployed persons; also, the real exchange rate is expressed such that an increase indicates appreciation. It is necessary that the VAR model behaves in line with theoretical considerations, therefore we will first analyze the impulse response functions for each of the variables, and then apply the variance decomposition method to uncover the importance of different sources of real exchange rate fluctuations.

Chart 5 exhibits the impulse response functions of the relative variables in our model to one standard deviation of structural innovations. Because the variables have entered the model as changes in natural logs, the IRFs are computed as accumulated responses and indicate percent changes. Most of the shocks seem to have the predictable long-run and short-run effects. Aggregate supply shocks lead to higher employment and output ratios, lower relative prices, higher real money balances and real depreciation, as advocated by Clarida and Gali. Labor supply shocks have similar impact on monetary indicators but not on the exchange rate, for which they seem to induce a certain degree of real lek appreciation in the first 2-3 quarters and vanish afterwards. Despite the incapability to increase output in the short run, a positive real demand shock causes a permanent rise in the price level, a reduction in real money balances and a significant real exchange rate appreciation. By construction, money supply drives only the price level in the long run and has zero effect on the others. In the short run, however, it appears to depreciate the exchange rate in the first three quarters or so, instigate a slight increase in output in the first quarter and seemingly discourage the supply of labor. Finally, a positive shock on money demand pushes the price level permanently down, it hardly strengthens the real exchange rate while temporarily downsizes economic activity, as expected.

The impulse response functions suggest that real exchange rate is highly sensitive to real economic factors, particularly to aggregate demand. But does the latter pass the duck test?[3] The effects of aggregate demand shocks on prices, real balances and the real exchange rate are in line with theoretical predictions, but the non-responsiveness of output and the employment contraction in particular may cast some doubts on the interpretation of these shocks as representing "real demand."

Chart 5. Impulse responses to real and nominal structural shocks



While IRFs are important to assess the signs and magnitudes of responses of each variable to various innovations, the variance decomposition is useful to measure their relative contributions to a specific variable. Table 5 presents the relative importance of the real versus nominal shocks to real exchange rate fluctuations. It turns out that real economic factors are the main source of real exchange rate changes, accounting for nearly three-fourth of the variance. Aggregate demand shocks are found the most important driver of the variations as compared to supply shocks (56.3 versus 16.0 percent, respectively). Monetary factors are also considerable, accounting for 27.7 percent of exchange rate fluctuations, but not as dominant

[3] *To test the relative demand shock, Clarida and Gali (1994) use the abducting reasoning: "If it walks like a duck and quacks like a duck, it must be…."*

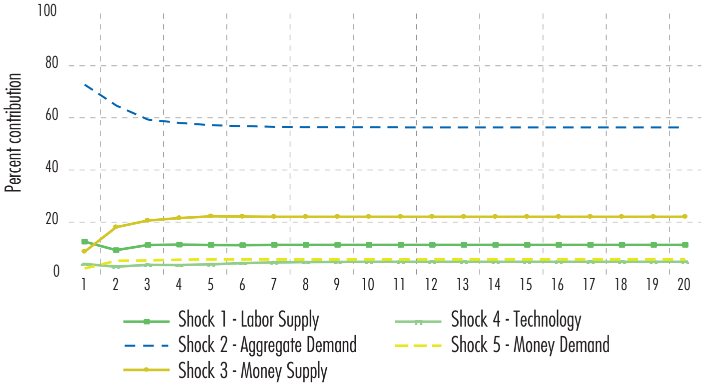
as the exchange rate theory predicts. Chart 6 shows the share of each type of shocks in the forecast error of the real exchange rate changes at different forecast horizons. Apparently, real demand shocks gradually lose some of their importance within a year, while the vacuity is mostly filled by the rising share of money supply shocks. Interpretations from the variance decomposition analysis are robust to various exercises (not shown here) with changing sample periods, or using various expressions of variables and proxies.

The dominance of real shocks suggests that exchange rate has a rather stabilizing role in the Albanian economy, and the benefits of holding to the currently flexible exchange rate regime might downplay the fears of inflation and economic volatility. The results are similar to the empirical findings for Poland (Stazka-Gawrysiak, 2009), Croatia (Erjavec et al, 2012), and for some new EU member states, namely Slovenia, Slovakia, Estonia, Lithuania and Latvia that were participating in the Exchange Rate Mechanism II (Stazka, 2006).

Table 5: Forecast error variance decomposition of the real lek-euro exchange rate changes

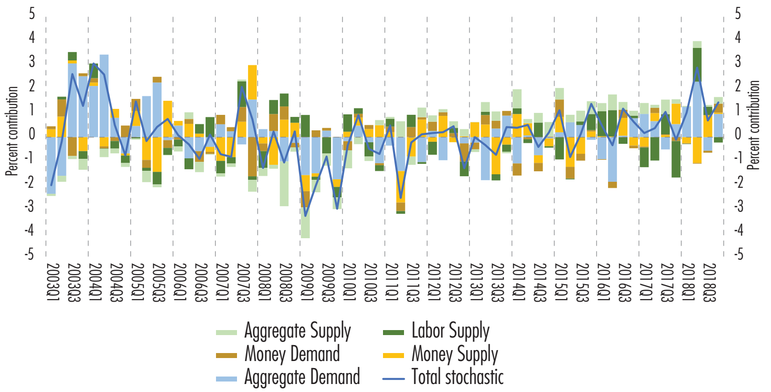
	Labor market	Aggregate Supply	Aggregate Demand	Money Demand	Money Supply
1 quarter	12.5%	3.9%	72.8%	2.2%	8.6%
1 year	11.4%	3.5%	58.1%	5.5%	21.5%
3 years	11.3%	4.7%	56.3%	5.7%	22.0%

Chart 6. Forecast error variance decomposition of changes in RER using SVAR factors



Using the model's parameters and the history of structural shocks we can compute the historical decomposition of the estimated forecast errors, which is useful to examine the contribution of each of the identified structural shocks during particular periods. The decomposition, for example, can shed light on the drivers of the real exchange rate behavior during certain historical episodes, such as the sharp appreciation in 2003-04, the swift depreciation in 2009-10 and the hasty 2018 return to the levels before the global crisis. Chart 7 displays the historical contribution of real and nominal factors to real exchange rate changes. Surely, real demand factors seem to explain most of the foreign exchange movements in these episodes, especially during the real currency swings in 2003 and the real appreciation in the subsequent quarters. Supply factors' shocks have apparently played a considerable role in the depreciation of lek in the midst of the 2009 global crisis, and perhaps paved the way for the appreciating trend that started in the middle of 2015. As the recent real appreciation can be largely attributed to real factors, which are "permanent" by definition, the newly low historical levels of the lek exchange rate against euro should not be seen as unusual. On the other hand, despite being relatively sensitive to nominal shocks in certain periods, monetary factors do not seem to bear much responsibility for the real exchange rate (under-)performance during these three episodes. Moreover, it seems that the lek-euro exchange rate has weathered pretty well the external shocks stemming from the ECB quantitative easing program in the recent decade.

Chart 7. Historical contribution of real and nominal factors in RER movements



6. CONCLUSION

To identify the sources of real exchange rate developments in Albania, we have used a cointegration structural VAR of analysis with long-run restrictions. The five-variable model structure follows Weber's (1997) stochastic rational expectations open economy model, which displays the neoclassical long-run properties as well as the standard Mundell-Fleming-Dornbusch framework with short-run sluggish-price-adjustment equilibrium. The empirical method is adjusted to account for the existence of a cointegration relationship among the variables of the model in line with the suggestions of Ouliaris, Pagan and Restrepo (2018). Empirical results presented in the form of impulse response analysis are generally in line with model expectations. In the long run, the real exchange rate depreciates in response to aggregate supply shocks and appreciates in the face of real demand shocks. Money supply shocks seem to cause a real depreciation of lek and vanish after the first year.

Variance decomposition suggests that monetary shocks have considerable effects on the real lek-euro exchange rate fluctuations. Nevertheless, real economic factors, dominated by aggregate demand, are found to be the main source of currency movements. Labor market and aggregate supply disturbances appear to only have moderate effects, in line with empirical findings in advanced as well as emerging economies. Yet again, the historical decomposition analysis reveals that the real lek appreciation seen in the last years is mostly explained by real economic shocks. Since these fators, are 'permanent' by definition, the recent lek positions against euro in the vicinity of the lowest historical values in the past two decades should not be regarded as abnormal.

The rapid appreciation of lek in 2018 has reawakened the fear of floating in Albania. As the persistence of real exchange rate movements in Albania is estimated here to be in large part explained by real economic fundamentals, any ambition for changing the actual free-floating exchange rate regime should involve a thoroughgoing cost and benefits analysis. Because each econometric technique has advantages and disadvantages, it could be useful to explore alternative estimation methods along with parametric restrictions, such as the identification strategy in a structural VAR with sign restrictions as recommended by Farrant and Peersman (2006), or using time-varying setting to check for the evolution of persistence and volatility in economic fundamentals over time.

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