Nominal and Real Shocks in the EURALL Exchange Rate. (A SVAR Guide)

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Abstract: - Exchange rates are one of the most important topics in the economic and financial sectors. Considering the exchange rate as the price between currencies, financial theories aim to understand the behavior of exchange rates from a more rational viewpoint. Domestic and foreign inflation has a direct impact on the real interest rates and the exchange rates. This paper aims to analyze the nominal and real shocks of the exchange rate between the Euro and Albanian lek [EURALL]. As the most important foreign currency used in the Republic of Albania, the euro is becoming more and more a stable determinant of prices and asset values in the Albanian economy. The vast majority of import and export is dependent on the EURALL trend. That is one of the main reasons why it is so important to study the shocks in the EURALL exchange rate. The Structural Vector Autoregressive (SVAR) models can be used to understand the effects of imposing some long-run restrictions. In addition, some short-run shocks play a major role and continue to have effects even in the long run. This paper takes into consideration the monthly data of exchange rates and inflation of Albania and the Eurozone from 2016 – 2022 (the last 7 years). As one of the most important models, SVAR models can be used in both fiscal and monetary policymaking. Studying nominal and real exchange rates means studying inflation in the eurozone and Albania. Real shocks have a significant impact on both nominal and real exchange rates. Meanwhile, there is no evidence that the nominal shocks (such as institutional interventions or central bank operations) have an important impact on the nominal and real exchange rates. Referring to that, we can conclude that policymaking institutions should be cautious about the real exchange rate.

Keywords: - Exchange rate, real and nominal shocks, SVAR Model

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1 Introduction

Exchange rates are one of the most important topics in the economic and financial sectors. Due to its importance, researchers and economists are often attracted to study the role of the exchange rates in potential economic growth, the correlation between exchange rates and national trade balance, etc. Meanwhile, considering the exchange rate as the price between currencies, financial theories aim to understand the behavior of exchange rates from a more rational viewpoint.

Macroeconomic indicators and systematic risks impact almost every other variable in the economy. Due to their unavoidable presence, indicators like inflation, unemployment, and interest rates need to be analysed very carefully as they change the context of the macroeconomic framework. Domestic and foreign inflation has a direct impact on the real interest rates and the exchange rates. This paper aims to analyse the nominal and real shocks of the exchange rate between the Euro and Albanian lek [EURALL].

As the most important foreign currency used in the Republic of Albania, the euro is becoming more and more a stable determinant of prices and asset values in the Albanian economy. The vast majority of import and export is dependent on the EURALL trend. That is one of the main reasons why it is so important to study the shocks in the EURALL exchange rate. Nominal and real shocks in the

exchange rate may have an impact on both nominal and real exchange rates. The Structural Vector Autoregressive (SVAR) models can be used to understand the effects of imposing some long-run restrictions. In addition, some short-run shocks play a major role and continue to have effects even in the long run.

This paper takes into consideration the monthly data of exchange rates and inflation of Albania and the Eurozone from 2016 – 2022 (the last 7 years). These years are chosen to have the possibility to study some potential shocks [if happened] in a comparison way before and after the Covid-19 pandemic situation. The methodology is based on using the SVAR model and variance structural decomposition of EURALL exchange rates. As one of the most important models, SVAR models can be used in both fiscal and monetary policymaking. Structural vector autoregressive models have been previously used in other papers and studies to create a better understanding of exchange rates. A study of the Japanese Yen and US Dollar exchange rates have been published in 1998 to measure the effects of the real and nominal shocks. The same Studying nominal and real exchange rates means studying inflation in the eurozone and Albania. Beyond quantitative parameters, some qualitative interpretations should be made for a deeper understanding of the nominal and real shocks in the real exchange rate of EURALL.

2 Understanding the Trend: Exchange Rate and Inflation

The nominal exchange rate between the euro and the Albanian lek is one of the most important indicators regarded financial operations with foreign currencies in Albania. In the last seven years, it has shown a clear downward trend having high volatility and moving from 120.81 lek/euro up to 138.51 lek/euro [as a monthly average exchange rate]. Taking into consideration some predictable moments where the EURALL nominal exchange rate surprisingly has risen or fallen, the other daily movements have shown a clear trend. A better understanding framework can be seen throughout Figure 1.

The nominal exchange rate between the euro and the Albanian lek has had a clear downward trend since 2016. In 2018, the European currency marked the biggest drop against the Albanian lek. There are a lot of reasons behind this trend. The year after has shown the same phenomenon, but with smoother volatility. Since the pandemic started in March 2020, the nominal value of the EURALL exchange rate started to rise again and at the end of 2022, the exchange rate level stood in the same narrow interval [2020 -2022]. The same situation but with minor changes can be also seen in the real exchange rate. For more than four years repeatedly (2016 – 2020), the real exchange rate has also dropped. During the pandemic, the real exchange rate overcame the nominal exchange rate for the first time. This situation changed in 2021 and 2022 as the EURALL real exchange rate fell against the nominal exchange rate.

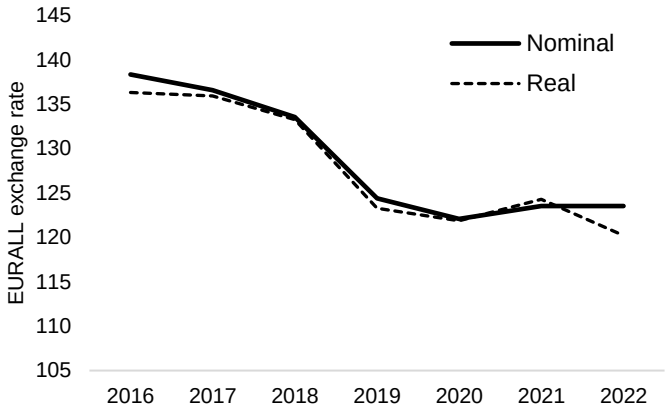

Fig. 1: EUR ALL exchange rate in Albania

To determine real exchange rates, inflation in the eurozone and inflation in the Albanian economy should be taken into consideration. The real EURALL exchange rate is calculated as the equation below:

$$\mathbf{R}_{\text{EURALL}} = \boldsymbol{\epsilon}_{\text{EURALL}} \cdot \frac{(1+\boldsymbol{\pi}_{\text{ALL}})}{(1+\boldsymbol{\pi}_{\text{EUR}})} \qquad [1]$$

where $\mathbf{R}_{\text{EURALL}}$ – real EURALL exchange rate
$\boldsymbol{\epsilon}_{\text{EURALL}}$ – nominal EURALL exchange rate
$\boldsymbol{\pi}_{\text{ALL}}$ – inflation (%) in Albania
$\boldsymbol{\pi}_{\text{EUR}}$ – inflation (%) in the eurozone

To make a deeper analysis of the real exchange rate, it is suggested that the study of inflation can be useful to identify the oscillations in real exchange rates and which of the inflation level have a greater impact on real exchange rates. Figure 2 makes a simple comparison between inflation in the eurozone and inflation in Albania.

Inflation in the eurozone has experienced a sustainable movement between 0% - 2% for more than five years (2016 – 2020). Starting in 2021, the inflation started to "jump" higher reaching up to 8% (monthly average core inflation). The consequences of the pandemic situation, energetic crisis, and shortage in the supply chain were the main reasons for this new trend of inflation. Furthermore, the Russo – Ukrainian war and the dependence of European countries on the Russian oil and gas supply created a new double-digit level of inflation at more than 10%. Meanwhile, the inflation in Albania has been lower all the years, except in 2020 when it overcame the inflation in the eurozone. It has remained below the objective of the central bank of Albania [2% - 4%]. The trend has been almost the same as the pattern of inflation in the eurozone, having a strong positive correlation at 93.1%. The absolute difference between eurozone inflation and Albanian inflation has a standard deviation of 1.06%. Since 2021, the monthly inflation rate rose to 9% but it remained lower than the euro inflation rate. Higher inflation in Albania can be explained by some different reasons compared to inflation in the eurozone. Real estate high demand, an increase in private expenses after the pandemic, and shocks in the supply chain are some of the main reasons causing inflation in the last two years.

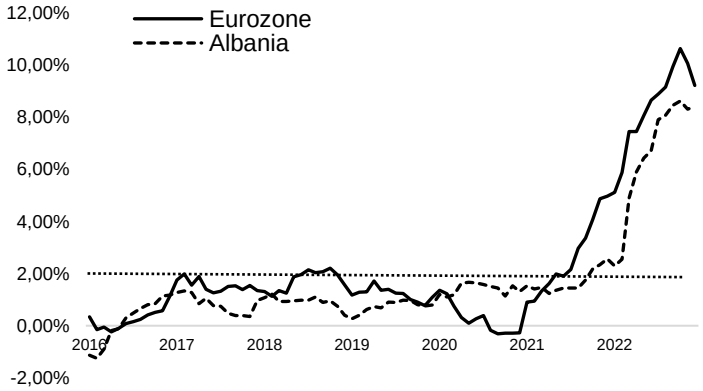

Fig. 1: Inflation in Eurozone and Albania

3 Literature Review

The exchange rate has been the focus of researchers for a long time. Policymakers, governmental institutions, financial markets overall, and other third parties, investors are always interested in understanding the spirals of exchange rates and the factors impacting them. The nominal exchange rate expresses the *de jure* price of a currency compared to other currencies. IMF defines *the nominal exchange rate as the price of a coin in terms of another*, [1]. While considering inflation, there can be a slight difference between the nominal and real exchange rates. Xiao et. al. affirms that the real exchange rate measures the real purchase power, and it is considered one of the most significant relative prices in an economy and one of the key factors influencing economic growth, [2].

Other authors have analyzed the effects of other factors mainly impacting the real exchange rate. Baxter and other authors have defined the most important factors impacting the real exchange rates. The business cycle is one of the substantial factors impacting the exchange rate since it is one of the crucial macro indicators in a specific economy, [3], [4], [5]. In addition, factors impacting the business cycle itself tend to impact the real exchange rate. Previous studies have generally been unable to reject the hypothesis that the real exchange rate follows a random walk. Meanwhile, Abuaf and Jorion doubt the random walk hypothesis and they proclaim that there is no tendency for purchasing power parity (PPP) to hold in the long run, [6]. Moreover, the real exchange rate and foreign currency can be transformed into a burden in cases of foreign currency mortgages, [7].

Progressively, nominal, and real shocks in different economic situations have an important impact on both nominal and real exchange rates. Authors like Evans and Su Zhou have primarily analyzed the responses of the real exchange rates to different shocks, [8], [9]. That is, changes in the real values of many currencies tend to persist for a very long period. This persistence implies that fluctuations in the real exchange rates are largely due to the long-lasting effect of real disturbances. Lastrapes has studied the source of fluctuations in the nominal and real exchange rates. As imposing the long-run restrictions, the findings indicate that real shocks dominate nominal shocks for both exchange rate series over short and long frequencies, [10]. Similar studies from King et. al. suggest that the stochastic trends and economic fluctuations should be studied carefully as the aggregate indicators can impact the business cycle at the same time, [11]. In one of his papers, Kollman suggests that in a model of a small open economy, the predicted variability of the

nominal and, especially, of the real exchange rate is noticeably higher than in standard Real Business Cycle models with flexible prices and wages, [12]. Fiscal shocks have also been studied to measure the effects on both nominal and real exchange rates. Since fiscal policies tend to contribute faster to the economy (compared to monetary policies), their effects on the real exchange rates can be analyzed. Benetrix and Lane, Perotti, and other authors affirm that fiscal shocks have a palpable effect on the real exchange rates in small open economies. Fiscal shocks are one of the major shocks in a certain economy, so governmental expenditures can significantly impact the exchange rate, [13], [14] [15], [16]. Other authors like Enders and Müller and Scholl have analyzed the effects of technological shocks on real exchange rates. They found that both the real exchange rate and the terms of trade - whose responses are left unrestricted - depreciate in response to expansionary government spending shocks and appreciate in response to positive technology shocks, [17].

The discussion about the econometric models that can be used to analyze the nominal and real shocks in exchange rates recommends that VAR or Structural VAR models can be used for this purpose. Huang and Guo assert that studying exchange rates from the econometrical viewpoint can lead to the SVAR models as they seem to be effective and worthwhile tools in decomposing the nominal and real shocks. Similar studies from Wang also counsel that SVAR models are powerful instruments to analyze variance decompositions. In addition, he concludes that supply chain shocks are also crucial and with the same effects as nominal shocks, [18], [19].

4 Methodology

One of the most frequently used methods for explaining economic phenomena is the econometrical one. Although these models can create a tremendous logical framework for explaining causes and consequences, the impact of the variables on each other, etc., sometimes they are not able to give a direct economic interpretation. For example, the innovations in a reduced form of VAR do not have a straightforward interpretation. At this point, studying nominal and real shocks and their effects on nominal and real exchange rates requires a more complex model. Structural vector autoregression models (SVAR) can be very helpful at this point.

Firstly, SVAR models rely on economic theory to enumerate the contemporaneous link between the variables in the model. Some assumptions are required to fulfill the general theoretical framework. In addition, SVAR models are used for both monetary and fiscal policy purposes. Since this model allows us to impose an ad-hoc structure, it will prevent us to reach the wrong conclusions. Moreover, imposing long-run restrictions is in full accordance with a classical macroeconomic hypothesis (CMH). This CMH specifies that in the long run, permanent changes in the nominal variables do not affect real variables. This phenomenon will be analyzed in this paper regarding the nominal and real shocks on the EURALL exchange rate.

The model presented in this paper will analyze the exchange rate movements decomposition, studying real and nominal factors. These movements will be decomposed into the components produced by real and nominal shocks. Nominal shocks can only affect the exchange rate in the short run, while real shocks can cause permanent effects on real exchange rates.

4.1 Data Evaluation

Nominal and real exchange rates combine mixed data of exchange rates and inflations in Albania and the eurozone. As both indexes are economic ones, while preparing data to evaluate the model, it is suggested (by literature and other authors) that the best method is to convert them into logarithm data values. After that, the model estimation and other data tests are evaluated as logs. Let's assume we have a bi-variate model for $y_{1,t,}$ and $y_{2,t}$. We may wish to allow the $y_{1,t}$ to be affected by current and past realizations of $y_{2,t}$, while $y_{2,t}$ is affected by past and current realizations of $y_{1,\ t.}$ Where we also want to incorporate autoregressive lags of the dependent variables, we could write the equations as below:

$$y_{1,t} = b_{10} - b_{1,2}\,y_{2,t} + \gamma_{11}\,y_{1,t-1} + \gamma_{12}\,y_{2,t-1} + \varepsilon_{1,t}$$

$$y_{2,t} = b_{20} - b_{2,1}\,y_{1,t} + \gamma_{21}\,y_{1,t-1} + \gamma_{22}\,y_{2,t-1} + \varepsilon_{2,t}$$

To express the above *structural form* of the model as a *reduced-form* expression, we could take all the contemporaneous variables to the left-hand-side, before inserting them in the vector Y_t. This would allow us to write the model above as,

$$\boldsymbol{B}\boldsymbol{y}_{\mathbf{t}} = \boldsymbol{\Gamma}_{\mathbf{0}} + \boldsymbol{\Gamma}_{\mathbf{1}}\,\mathbf{y}_{\mathbf{t-1}} + \boldsymbol{\varepsilon}_{\mathbf{t}} \qquad (1)$$

where,

$$B = \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}, \qquad y_t = \begin{bmatrix} y_{1,t} \\ y_{2,t} \end{bmatrix},$$

$$\Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}, \Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \text{ and } \varepsilon_t = \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix}$$

As this study needs to identify the long-run effects of nominal and real shocks on nominal and exchange rates, at least one of the variables needs to be non – stationary because if the data analysed are stationary, the long–run impact of shocks on the levels of the series are always zero. Although we require at least one of the variables to be non-stationary, when estimating the model, the variables must be turned into stationary.

Testing the stationarity

The time series stationarity test is the first and most important test in the preparation and validity of the data form. The stationarity of the time series is estimated as follows. Augmented Dickey-Fuller (ADF) is the most common and important test for assessing the stationarity of time series. A variable is non-stationary if it is a function of time. A time series variable is stationary, i.e., stable if its mean and variance are constant over time and the covariance between the two values depends only on the length of the period that separates them and not on the time moments when they occur. The first technical element that needs to be implemented is the conversion of data we receive from time series into stationary data. Once time series data have been converted to stationary data, they can be used in econometric models. It often happens that most of the data for the examined variables are stationary. Even in cases where the data is not stationary, it can be converted to stationary by the first or second differences of the unit root test. The stationarity test (Augmented Dickey-Fuller) results are presented in Table 1.

Table 1. Stationarity test (Augmented Dickey-Fuller)

Unit Root Test Variable	Level		First difference (Δ)	
	F – stat.	*p.* value	*F – stat.*	*p.* value
log(nominal)	-1.51	0.52	-7.83	**0.00**
log(real)	-1.13	0.69	-7.48	**0.00**

From the data analysis, the time series of the variables are not stationary, but they are turned into stationary series of the first difference. Specifically, nominal and real exchange rates are stationary series in the first difference ($p < 0.05$). Now that the series has passed the stationarity test, the data can be used to construct the SVAR model. The lag length selection is presented in Table 2.

Table 2. Lag length selection

Endogenous variables:
Δ (LNominal) Δ (LReal)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	585.21	NA	7.4e-10*	-15.34*	-15.28*	-15.33*
1	586.96	3.37	7.86e-10	-15.28	-15.10	-15.21
2	589.98	5.63	8.07e-10	-15.26	-14.95	-15.14
3	591.29	2.38	8.66e-10	-15.19	-14.71	-15.02
4	592.97	2.96	9.22e-10	-15.13	-14.57	-14.91

From the analysis, it is noticed that the optimal lag is equal to zero (0). This indicates that variables must be taken for granted that have an immediate impact without a delayed time period. Since the data have become stationary, we can assume that the optimal lag can be three (3), as these variables have a strong trimestral significance. In this model, it is chosen 3 lags as optimal lag length.

Correlograms of the variables

The correlogram represents the correlation for all pairs of variables and it is one of the most important tests regarding the residuals. Figure 3 shows the correlograms for the nominal and real exchange rates of EURALL from 2016 – 2022.

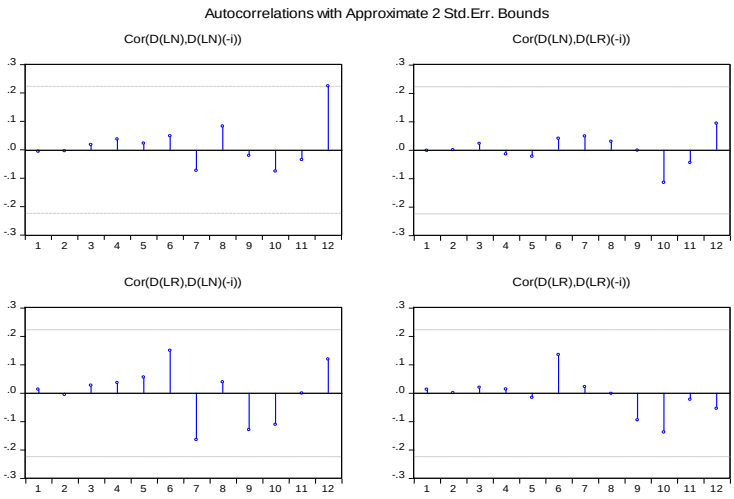

Fig. 2: Correlograms of the residuals

As it is seen from the charts, all the residuals of the variables are within the interval of 2 standard error bounds, so it indicates that the model is appropriate and there is no residual problem.

4.2 Imposing the Long Run Restriction

The identification process of nominal and real shocks on EURALL exchange rates consists firstly in defining what are the possible situations impacting the exchange rate. As described by literature and general macroeconomic theories, the nominal and real shocks, in the long run, tend to be neutralized. Furthermore, we expect the real shocks to have a greater and more relevant impact on the exchange rate, compared with the nominal ones. Imposing the long-run restriction is expressed by the equation:

$$\begin{bmatrix} \Delta r_t \\ \Delta e_t \end{bmatrix} = \begin{bmatrix} B_{11}(L) & B_{12}(L) \\ B_{21}(L) & B_{22}(L) \end{bmatrix} * \begin{bmatrix} \epsilon r_t \\ \epsilon n_t \end{bmatrix}$$

The first *2x1* vector is the real and nominal exchange rate variables in the first difference. The last *2x1* vector represents the zero mean mutually uncorrelated real and nominal shocks. Moreover, the B_{ij} coefficients represent the time path of the effects of the real and nominal shocks on the real and nominal exchange rates. The long-run restriction implies that the cumulative effect of nominal shocks on real exchange rates is zero. Technically we are imposing:

$$B_{12}(1) = \sum_{j=0}^{\infty} b_{12}(j) = 0$$

Taking into consideration the long-run restrictions, the charts below represent the accumulated responses of nominal and real shock in nominal and real EURALL exchange rates.

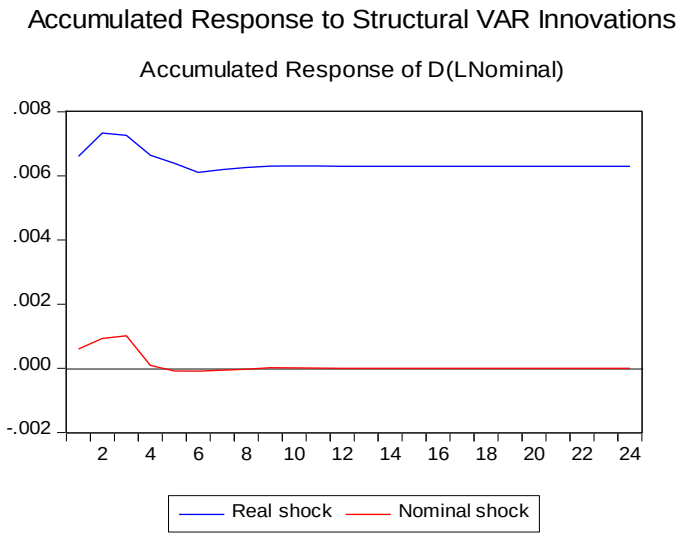

Fig. 3: Accumulated responses of Log Nominal EURALL exchange rate

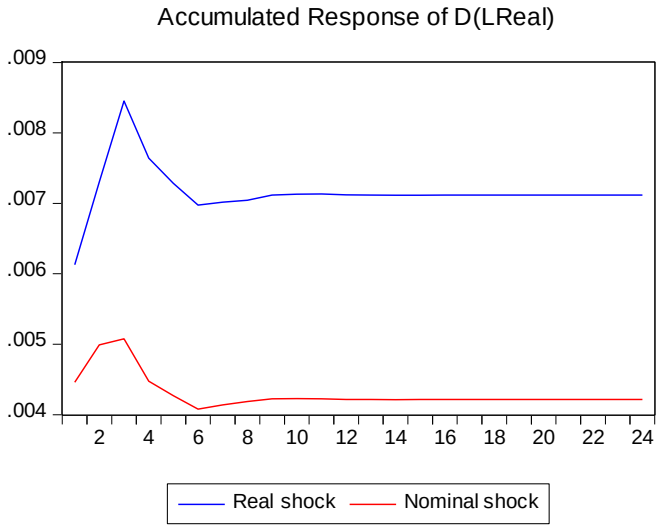

Fig. 4: Accumulated responses of Log Real EURALL exchange rate

5 Discussion

Firstly, let's analyze the effects of nominal shocks on the nominal exchange rate. There is no impact of the nominal shocks on the nominal exchange rate. Furthermore, the effects of nominal shock in the real EURALL exchange rate have an immediate impulse response but tend to vanish expeditiously. We can confirm that the nominal shocks have no significant impact on both the nominal and real EURALL exchange rates. Nominal shocks such as central bank purchase of foreign currency in exchange markets,

the usage of euro in goods and services markets, or other central bank interventions seems to have little or no impact on the nominal and real EURALL exchange rate. Since the exchange market in Albania is driven by the market demand-and-supply mechanism, we can expect nominal shocks not to have an impact on the nominal and real exchange rates. A completely different framework can be seen in the real shock effects. These shocks have an important and statistically relevant impact on the nominal and real EURALL exchange rates. Even though these effects exist, real shocks have a greater impact on real exchange rates, compared to nominal ones. Real shocks create an immediate response that decreases continuously. Meanwhile, the real exchange rate is impacted more by real shocks, and these effects seem to last longer. The drastic price of oil fluctuations impacted by the post-Covid-19 situation and the Russo – Ukrainian conflict created a non-stable situation in the EURALL exchange rate. Since Albania imports more than 75% of the oil and crude oil, these shocks have both impacted the nominal and real exchange rates. Furthermore, the export and import of energy (since Albania is both importer and exporter of hydro-energy) have also impacted the nominal and real exchange rates. In addition, the cyclical movements of the euro supply coming from tourism and immigrants have also impacted the real EURALL exchange rate.

To create a complete analysis of the nominal and real shocks, we have to analyze the structural decomposition of the SVAR model. The structural decomposition shows the accurate impact of the nominal and real shocks on the EURALL nominal and real exchange rates. It explains the percentage of the impact that every shock has on the exchange rates, as explained in Table 3.

Table 3. Variance decomposition of economic shocks

Shock	***D(LNominal)***		***D(LReal)***	
Period	*Real*	*Nominal*	*Real*	*Nominal*
1	99.1695	0.83041	65.3772	34.6227
2	98.9474	1.05256	65.8741	34.1258
3	98.9318	1.06810	66.6132	33.3867
4	97.0988	2.90117	66.5821	33.4178
5	97.0412	2.95873	66.6048	33.3952
6	97.0464	2.95356	66.6169	33.3830
□	□	□	□	□
21	97.0387	2.96130	66.6132	33.3867
22	97.0387	2.96130	66.6132	33.3867
23	97.0387	2.96130	66.6132	33.3867
24	97.0387	2.96130	66.6132	33.3867

Author's summary from E Views 10.

The EURALL nominal exchange rate is affected by more than 97% from the real shocks in the economy, compared to up to 3% by the nominal shocks. Almost all the fluctuations of the nominal exchange rate are explained by the real shocks and there is no significant impact of the nominal interventions on the nominal exchange rate. Meanwhile, the real exchange rate is impacted by both nominal and real shocks, even though the real shocks impact more than 66% of the EURALL real exchange rates. As the nominal shocks do not have an impact on the nominal exchange rate, these shocks tend to have a relevant impact on the real exchange rates. When analyzing the EURALL exchange rate, nominal shocks should be taken into consideration as an effective instrument that impacts the real exchange rate. Finally, the structural decomposition of real and nominal shocks in the EURALL exchange rate is presented in Table 4.

Table 4. Structural decomposition of real and nominal shocks in the EURALL exchange rate

Shocks	**[Δr**	**Δr]**	**[Δe**	**Δe]**
	r	*e*	*r*	*e*
3 months	66.613	33.386	99.169	0.83
6 months	66.617	33.383	97.046	2.954
1 year	66.617	33.383	97.04	2.96
2 years	66.617	33.383	97.039	2.961

Notes: Δr – the first difference of real exchange rate; Δe – the first difference of nominal exchange rate; r – real shock; e – nominal shock
Author's summary from variance decomposition

6 Conclusions and Recommendations

Exchange rates are one of the most important macroeconomic indexes that indicate the relationship between two currencies. As an exposition of the price of a currency, the exchange rate is subject to oscillations and fluctuations that are caused by different economic factors, to which in this paper we are referring as economic shocks. In this context, the exchange rate between the euro and the Albanian lek can be analyzed in terms of the nominal and real exchange rates. Factors impacting the EURALL real exchange rate are the nominal rate, inflation in the eurozone, and inflation in Albania. Excluding the effects of inflation, the EURALL exchange rate can be affected by nominal and real shocks.

A Structural VAR model can be used to decompose the effects of the nominal and real shocks that impact the real and nominal exchange rates. After testing the model parameters and their significance and statistical relevance, we conclude that SVAR econometric models can be used to analyze these shocks in the EURALL exchange rate. In addition, the trend of inflation in Albania has a strong correlation with the eurozone inflation, since the euro have also a positive correlation with the Albanian lek.

As described in the econometric model, real shocks have a significant impact on both nominal and real exchange rates. Meanwhile, there is no evidence that the nominal shocks (such as institutional interventions or central bank operations) have an important impact on the nominal and real exchange rates. Referring to that, we can conclude that policymaking institutions should be cautious about the real exchange rate. The Albanian central bank should also have a more active role in the foreign exchange market to soften and minimize the EURALL exchange rate fluctuations especially driven by real shocks. In addition, we recommend that the Ministry of Finance and Economy of the Republic of Albania and other institutions impacting the fiscal policy should make policies considering the exchange rate as a variable that is impacted immediately by fiscal policies. Moreover, other qualitative studies should be made to complete the conceptual framework of understating how the EURALL exchange rate fluctuates.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

-Blisard Zani has worked the statistical processing using EViews 10 software and summarizing data about inflation and exchange rate.
-Ingrid Konomi has worked on the literature review, economic analysis of the data's statistical processing results, and summarizing the conclusions.

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Conflict of Interest

The authors have no conflict of interest to declare.