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Exchange Rate Pass-Through to Prices: VAR Evidence for Albania

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Abstract

This paper estimates the impact of exchange rate shocks to prices in Albania from 2000Q1 to 2017Q1. The empirical analysis is based on a Vector Autoregressive approach for Albanian economy following Cholesky decomposition scheme. Impulse-response functions give evidence for an incomplete "pass-through" of exchange rate shocks to prices. Impulse-response functions to oil shocks indicates initial positive values for import and producer prices and negative value for consumer prices and interest rates. Variance decomposition reveal that the highest fluctuations of import prices is triggered by growth rate and oil prices shocks, whereas the variance of producer prices and consumer prices is explained by its own innovations. Exchange rate's innovations are less aggressive to import prices and producer prices then to consumer prices. We perform the robustness check allowing interest rate to be ordered before exchange rates and the results do not change from the previous findings.

Keywords: Exchange Rate, Pass Through Effect, Inflation, Vector Autoregressive

JEL Class: C32, E31, E41, F41

1. Introduction

Albanian economy has undergone under significant structural changes, which have strengthened economic incentives and fuelled economic growth over the last 20 years. In the early stages of [post-communist] transition, internal migration – coupled by a rapid and significant transformation in the labour and later the capital markets – helped shift all factors of production toward more productive sectors. This shift contributed to higher productivity levels and consequently faster economic growth. Albania is an example that international institutions failed to prevent the impact that economic shocks might bring to economy (Fullani, 2012). Winding up the pyramid schemes, Republic of Albania had to face social cost, instability and preceding civil war within the country. The decree of 1997, after a formal meeting of ex-president Berisha[2]and representatives of IMF and World Bank brought clashes among the government and the foreign administrators (Jarvis, 2000). The factors that brought the collapse of the "shining star" were: The increase in unemployment, collapse of industrial production, inefficiency of the banking system, limitations and drawbacks of foreign investment, failure of mass privatization, falling living standards, and rising poverty (Vaughan-Whitehead, 1999).

After more than two decades, Albanian economy still seems to be "hurt" due to traces marked from the past. Republic of Albania is often viewed in the groups of "late reformers" or "late performers"[3]

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[2] The costs for the foreign administrators were borne by the government, based on the grants and conncessional loans from donors and World Bank. The new law for administrators appointment which was drafted as a decree was refused to be signed by ex-president Berisha. It brought one month delay until the newly elected parliament passed the law. Further delay , was on adiministrators appointment, and even after that the owners of pyramid schemes did not give up, challenging the courts and threating for violence.

[3]The group is composed of Moldova, Azerbaijan, Kyrgyz Republic and Albania

in terms of economic development and general competitiveness. While it moved forward with its policy reforms, economic development levels are still relatively low when measured by per capita income, direct investment, and other indicators that point to rising incomes and future growth. This suggests that policy reform alone is not sufficient for sustainable economic growth (Siegelbaum, 2002). The budget deficit is actually assessed at 2.0 per cent of the GDP, while public debt counts for 69.6 per cent of GDP in 2017. Whereas Albania's pre-crisis growth was among the highest in the Western Balkan region, post-crisis growth has decelerated to around the regional average (Cabezon, 2016). Economic growth of Republic of Albania increased by 3.9 percent during the first nine months of 2017. The monetary policy stance of the Bank of Albania remained accommodative, economic growth was mainly supported by the expansion of investments. The average inflation rate rose to 2.0 percent during 2017 and domestic inflationary pressures were still insufficient to offset the low inflation rate in our trading partner countries, the effects of the exchange rate appreciation, and the growing inertia of the price formation process over the last years. (Central Bank of Albania, 2017)

Actually, Albania's growth momentum remained strong and real GDP grew 3.8 percent during 2017. Domestic demand strengthened, reflecting a revival in construction, a recovery in the labour market and household credit, and large energy-related FDI projects. Despite the surge of drought-induced electricity imports, the current account deficit narrowed supported by tourism and other services exports. The deficit is predominantly funded by concessional borrowing and large FDI inflows. Gross international reserves are comfortable, covering more than 6 months of imports. Inflation remained below target at 1.8 percent and core inflation is still weak reflecting limited wage pressures with rising labor participation, nominal LEK/EUR appreciation (4 percent), and sluggish nonfuel international commodity prices (IMF, 2018).

This paper estimates the exchange rate pass-through on prices from 2000Q1 to 2017Q1 which corresponds to the period of indirect instruments of monetary policy followed by BOA[4] using a recursive vector autoregressive approach. We estimate the pass-through using recent data and we add producer prices in our VAR model, which to our best knowledge has not been captured in the existing "pass-through" literature for Albania.

Impulse response functions indicate incomplete pass-through of exchange rates shocks on prices. Variance decomposition suggests that the greatest fluctations to import prices is triggered by growth rate and oil prices shocks whereas the variance of producer prices and consumer prices is explained by its own innovations. Additionally, exchange rate's innovations are less aggressive to import prices and producer prices then to consumer prices.

The reminder of the paper is structured as follows: Section 2 explains the literature review. Section 3 represents the methodology, estimation and results in section 4, section 5 robustness check and section 6, concluding remarks.

2. Literature review

In literature, the term "pass-through" refers to the sensitivity of the the country's merchandise import prices to changes in its currency's foreign exchange values.Other researchers, indicate "pass-through" as the sensivity of consumer prices of a country to changes to its import prices. The relation between exchange rates and consumer prices dates since ealry 60s, but nowayds economists emphasize that

[4] Bank of Albania

there are some microeconomic factors that indicate that the pass through fluctations are not completely reflected in the consumer prices of a country. Existing literature suggest that these factors are related to stuctural aspects of international trade such as : the role of substitution among goods to changes in the exchange rate (Burstein, 2002), (Corsetti, 2002) or price setting , because of distribution services the price elasticity of demand is specific for every country and depends on exchange rate fluctations.

(Dornbusch, 1987) and (Krugman, 1987) proposed price-setting to the market. For better understanding of incomplete pass-through in the model, the market should be thought as oligopoloistic, if the mark-up of a firms decreases and the prices of the goods icrease, then the exchange rate pass-through is not complete. Indeed, this is a response in order to maintain the market share (Hooper, 1989) (Kasa, 1992) (Froot, 1989) or towards the perceptions of temporary foreign currency misalignments (Marston, 1991).

(McCarthy, 1999) studied the impact of exchange rate changes and import prices on producer and consumer price using a recursive vector autoregressive model on 6 OECD countries. The results indicate that exchange rate movements have negligble impact on consumer prices.

(Muço et al, 2001) focused on the monetary policy transmission mechanism in Albania and indicate a modest correlation between money supply and inflation, but a strong link between exchange rate and inflation. The findings reveal that is not any strong causality running from inflation to M3 growth, while the political dummy positively affects both inflation and money growth.

(Choudri, 2002) focused on exchange rate pass-through to different prices in non-US G-7 countries using a vector autoregressive model which is composed of seven endogenous variables and two exogenous variables. Results reveal that the best fitting model incorporates: sticky prices, sticky wages, distribution costs and a combination of local and producer currency pricing.

(Leigh, 2002) estimate the exchange rate pass-through on prices in Turkey and they find that the impact of exchange rate is felt over one year, but mostly is felt in the first four months.According to the results, the pass-through to wholesole prices is more pronounced than to consumer prices and the estimated pass-through is larger than the one estimated for other emerging countries.

(Muço et al, 2004) examine the transition from direct instruments to indirect instruments of monetary policy in Albania. The authors indicate a weak link between money supply and inflation up to mid-2000 while the switch from direct to indirect instruments of monetary control increase the predictability of transmission link from money supply to inflation.

(Peeters, 2004) focused into the details of the monetary policy transmission mechanism in Albania and tests the hypothesis that the exchange rate is the most important channel in the monetary policy process. The findings show that there are strong shifts in the monetary policy transmission channel and these shifts point at a diminishing role of the exchange rate at the benefit of the credit channel.

(Luci, 2005) estimated the impact of monetary policy changes on the volume of new deposits and credits and importance of commercial banks characteristics on this transmision process. The results indicate that credit supply was not affected by changes in monetary policy and that there were no significant differences among individual banks. The results also show that the effectiveness of the credit channel in Albania is modest due to cash transactions, undeveloped interbank market, preference of banks to lend in foreign currency and low penetration of credit services in the economy.

(Istrefi, 2007) estimate the extend and the speed of exchange pass-through to consumer prices in Albania. Findings show that exchange rate pass-through on prices is not easily captured based on the data used for exchange rate and consumer prices the pass-through is complete within a year.

(Kolasi, 2010) estimate how monetary policy impacts aggregate output and headline and core inflation. The findings indicate that the exchange rate channel is not as strong as reported in previous works, and that the money and expectations channel play the most important role within the transmission mechanism.

(Macellari, 2011) estimates the effect of fiscal policy on Gross Domestic Product, Prices and Interest Rates in Albania. The study reveals that a tax cut stimulus has the highest cumulative GDP multiplier and the interest rates do not respond significantly to fiscal spending shocks, but they do increase after a tax cut.

(Shijaku, 2015) examine the transmission mechanism of monetary policy and the findings show that a stimulus in the monetary policy supports economic activity and increase price levels.

(Ouchchikh, 2017) studied the monetary policy transmission mechanism under fixed exchange rate and the findings confirm for credit and interest channels which transmit monetary policy shocks.

This study is similar to (Istrefi, 2007) and there are three main gaps that this study fills. First, we estimate our model using recent data (quarterly) in order to avoid the noise. Secondly, we order the reaction of monetary policy last in order to allow for the monetary policy to react contemporaneously to all shocks in our system. Thirdly, we include producer price index which to our best knowledge has not been captured before in the existing literature of exchange rate pass-through.

3. Methodology

In a VAR model, the dependent variable is regressed on its own lags and other lags which are involved in the model. General framework of a VAR model is:

$$y_t = c + \sum_{i=1}^{w} \beta_i y_{t-i} + u_t \quad (1)$$

Where y_t denotes an nx1 vector of endogenous variable which are :oil price, real gdp rate, real effective exchange rate, import prices, producer price index, consumer prices and repo rate, t denotes time (quaterly), c is a vector of constant terms, β_i are $n_x n$ matrices of coefficients, w is the maximum lag length in the model, u_t refers to reduced form disturbance term with zero mean and covariance matrix $\sum$.

3.1 Data

The study is based on the work of (McCarthy, 1999) and adapted by (Leigh, 2002). We estimate the exchange pass-through using a seven variable VAR approach instead of the eight-variable model of (McCarthy, 1999) or five-variable model by (Leigh, 2002). The variables are ordered as follows: oil prices[5], real gross domestic product rate, real effective exchange rate, import prices[6], producer price index, consumer prices and repo rate.

[5]We use Benchmark cruide oil price, converted into Albanian Lek by multiplying by the ALL/dollar exchange rate.
[6] Import price denominated in euro is calculated based on the price index/unit values of export to main partners

The inclusion of oil price and gross domestic product are intended to capture the real side of the economy. We include repo rate in order to directly capture the movements of monetary policy.

Table 1. Descriptive Statistics

Variable	Levels		First Difference	
	Mean	Std. Dev.	Mean	Std. Dev.
OIL	8.757044	.3576466	.0012957	.1742937
GDP	1.331383	.5993254	.0087724	.1861911
REER	5.01999	.0513797	.0014602	.0164022
IMP	4.848742	.1847499	.0043916	.0352684
PPI	4.554521	.11086	.0046321	.0317258
CPI	.1922705	.7665419	.0171569	1.164191
REPO	1.439882	.7547001	.0108304	1.161329

Source: Author's Calculation

We conduct the analysis using quarterly data in order to avoid the unnecessary noise in our data series. Time series variables spanning from 2000Q1-2017Q1 was taken from sources like the WDI[7], BOA[8], IMF[9], and INSTAT[10]. We estimate a seven-variable recursive VAR approach oil price, annual growth rate, real effective exchange rate, import price, producer price, consumer price index, and repo rate.[11] The model is specified as follows:

$$\Delta\pi_t^{oil}=E_{t-1}[\pi_t^{oil}]+\varepsilon_t^{s} \quad (1)$$

$$\Delta gdp_t=E_{t-1}[\Delta y_t]+\rho_1\varepsilon_t^{s}+\varepsilon_t^{d} \quad (2)$$

$$\Delta REER_t=E_{t-1}[\Delta e_t]+\varphi_1\varepsilon_t^{s}+\varphi_2\varepsilon_t^{d}+\varepsilon_t^{REER} \quad (3)$$

$$\Delta IMP_t^{nf}=E_{t-1}[CPI_t^{nf}]+\psi_1\varepsilon_t^{s}+\psi_2\varepsilon_t^{d}+\psi_3\varepsilon_t^{REER}+\varepsilon_t^{IMP\,nf} \quad (4)$$

$$\Delta PPI_t=E_{t-1}[PPI_t]+\eta_1\varepsilon_t^{s}+\eta_2\varepsilon_t^{d}+\eta_3\varepsilon_t^{REER}+\eta_4\varepsilon_t^{IMP\,nf}+\varepsilon_t^{PPI} \quad (5)$$

$$\Delta CPI_t=E_{t-1}[CPI_t]+\alpha_1\varepsilon_t^{s}+\alpha_2\varepsilon_t^{d}+\alpha_3\varepsilon_t^{REER}+\alpha_4\varepsilon_t^{IMP\,nf}+\alpha_5\varepsilon_t^{PPI}+\varepsilon_t^{CPI} \quad (6)$$

$$\Delta REPO_t=E_{t-1}[\Delta i_t]+\delta_1\varepsilon_t^{s}+\delta_2\varepsilon_t^{d}+\delta_3\varepsilon_t^{REER}+\delta_4\varepsilon_t^{IMP\,nf}+\delta_5\varepsilon_t^{PPI}+\delta_6\varepsilon_t^{CPI}+\varepsilon_t^{REPO} \quad (7)$$

All variables are in first log difference except CPI inflation .Supply, demand and exchange rate shocks are captured by ε_t^{s}, ε_t^{d},ε_t^{REER} whereas ε_t^{REER} ,$\varepsilon_t^{IMP\,nf}$, ε_t^{PPI}, ε_t^{CPI}, ε_t^{REPO} are shocks to import prices, producer price , consumer price and money market respectively. E_{t-1} is the

[7] World Development Indicator
[8] Bank of Albania
[9] International Monetary Fund
[10] Instituti i Statistikave
[11] The ordering of the variables is consistent with (McCarthy, 1999) and (Leigh, 2002)

expectation operator that refers to expectation about a variable which is subject to information available at time $t-1$.We estimate a recursive VAR model using STATA based on Cholesky identification scheme which means that the identified shocks affect the variables ordered afterwards, but do not impact the variables ordered before them. Hence, we order first the most exogenous variable, which is oil price. Next, we order growth rate and exchange rate with the implicit assumption of a contemporaneous effect of demand shock on exchange rate while exchange rate will affect growth rate with a certain time lag. We order price variables, followed by import prices, producer price and consumer price. The last variable that is ordered is interest rate which allows the monetary policy to respond to all shocks in the system. The ordering can be summarized as follows:

$$\Delta\pi_t^{oil} \rightarrow \Delta gdp_t \quad \rightarrow \Delta REER_t \rightarrow \Delta IMP_t^{nf} \rightarrow \Delta PPI_t \rightarrow \Delta CPI_t \rightarrow \Delta REPO_t$$

4. Estimation and Results

We perform diagnostic tests and results show that the errors are not serially correlated; Jarque-Bera results reveal that jointly in the errors in the VAR system are normally distributed. Our VAR system satisfies the stability condition that all the roots lie inside the unit root circle (appendix).

4.1. Unit Root Test

When time series variables are non-stationary implying that they may exhibit the tendency to provide spurious estimates. We perform standard ADF[12]unit root test following (Granger C, 1974), (Phillips, 1986), (Dickey, 1979), (Dickey, 1981).We perform PP [13]test as a robustness check as ADF test might be bias when estimating small samples and in the case of structural breaks.

Table 2. Unit Root Test for 2000-2017

Variable	ADF				PP			
	I(0)	Prob.	I(1)	Prob.	I(0)	Prob.	I(1)	Prob.
LOIL	2.046	2.920	5.869	3.566***	7.602	13.412	44.014	19.116***
LGDP	1.478	2.916	5.617	3.558***	3.912	13.444	67.026	19.206***
LREER	1.898	2.916	5.673	3.558***	4.885	13.444	67.1741	19.206***
LIMP	1.330	2.916	5.752	3.558***	2.014	13.444	67.233	19.206***
LPPI	2.283	2.916	6.403	3.558***	4.387	13.444.	63.704	19.206***
CPI	12.405	3.556***	11.069	3.558***	51.739	19.224***	67.018	19.026***
LREPO	3.917	3.562***	12.972	3.563 ***	91.872	19.152***	109.525	19.1344***

Source: Author's Calculations

Note: *, **, *** refer to 1 %, 5 % and 10 % level of significance

4.2. Lag Order Selection Criteria

Before we estimate our VAR model, we define the number of the optimal lags. Our decision for the number of lags is based on Akaike Information Criterion, Likelihood Ratio Criterion and Final

[13] Phillips-Pherron Test

Prediction Error Criterion which indicate that the number of lags used in our VAR system is five. We estimate our VAR model in the first difference.

Table 3. VAR Lag Order Selection Criterion

Lag	LogL	LR	FPE	AIC	HQIC	SBIC
0	466.513	NA	5.0e-17	-17.6736	-17.5729*	-17.4109*
1	497.143	61.259	1.0e-16	-16.967	-16.1614	-14.8657
2	521.912	49.54	2.9e-16	-16.0351	-14.5246	-12.0951
3	613.574	183.32	7.4e-17	-17.6759	-15.4605	-11.8972
4	726.031	224.91	1.2e-17	-20.1166	-17.1962	-12.4992
5	792.985	133.91*	2.0e-17*	-20.8071*	-17.1819	-11.3511

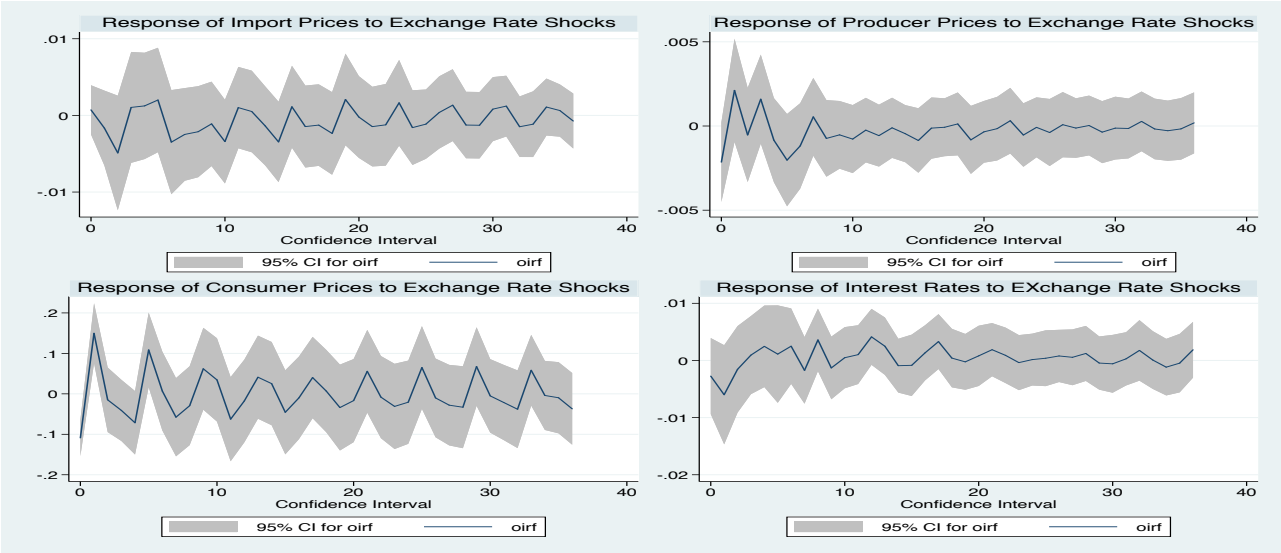
Source: Author's Calculations

The empirical results will be based on impulse impulse-response functions and variance decomposition.

4.3 Impulse Responses

Impulse-response functions indicate the effect of exchange rate on price fluctuations. The estimated orthogonalized impulse response functions to import, producer, consumer prices and interest rates to a one standard deviation innovation in the exchange rate are shown in the figure below. The shade indicates the confidence bond whereas the line indicates the response of our variables to exchange rate/oil shocks.[14]

Figure 1. Response to Exchange Rate Shocks



Source: Author's Calculations

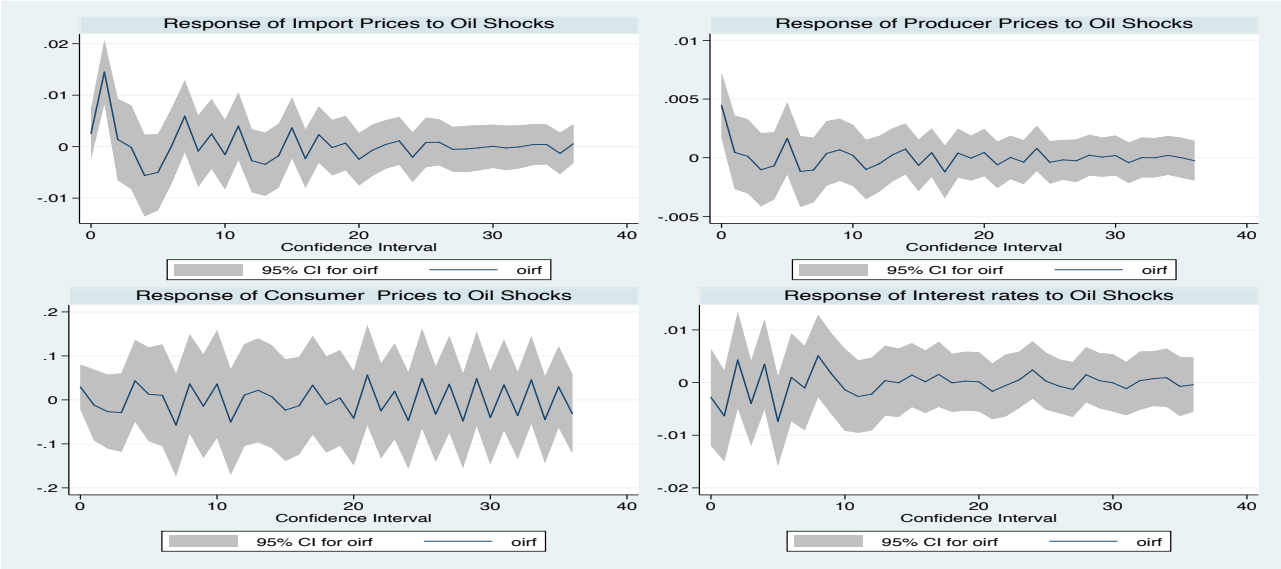
Our findings show that a one-standard deviation shock of exchange rates to import prices in the second month decreases import prices by 0.4 per cent before it turns positive from the third to the fifth month. Producer and consumer prices show initial negative values as a response to exchange

[14] Other impulse functions are not reported as the main focus is the impact of the exchange rate shocks on domestic prices but are available upon request.

rate shocks but for consumer prices the impact is more "aggressive". A one standard deviation exchange rate shock decreases producer prices by 0.2 per cent while producer prices increase by 10 per cent in the fifth month. Impulse-response functions reveal for an incomplete pass-through of exchange rates to prices in Albania.

Impulse-response functions to oil shocks indicates initial positive values for import and producer prices and negative value for consumer prices and interest rates. A one standard deviation of oil shocks decreases import and producer prices by 0.27 per cent and 0.05 per cent while CPI inflation and interest rates increase by 1.1 and 0.02 per cent as a response to exchange rate impulses in the first year.

Figure 2. Response to Oil Shocks



Source: Author's Calculations

4.4 Variance Decomposition

Variance decomposition helps to better understand the importance of exchange rate shocks in the behaviour of our variables of interest, import prices, producer prices and consumer prices. If one variable (A) explains the fluctuations of the forecast error variance of another variable (B), then it meant that variable A explains a large proportion of its variance decomposition. Therefore, we decompose the variations of import prices, producer prices and consumer prices into the shocks to the endogenous variables in our VAR system.

The results of the variance decomposition reveal that exchange rate movements accounts for a small proportion of the fluctuations in import and producer inflation. The variation of import prices is explained mainly by the shocks of growth rate and oil prices by 20.7 and 20.4 per cent. Its own shocks count for approximately 18.6 per cent at the end of the horizon period, exchange rate account for 6 .2 per cent. CPI and producer prices explain 13.8 and 5 per cent of import prices variance while interest rate 14.9 per cent. [15]

[15] Table 4 Appendix

The results for variance decomposition of producer prices show that its own innovations explain approximately 37 per cent in the 12 month of the horizon period. Exchange rate shocks explain 8.4 per cent of the variance of producer prices, CPI only 2 per cent. Growth rate, interest rate and oil prices account for about 17.5 , 15.7 and 12.2 per cent of the variation. [16]

The effect of exchange shocks on CPI fluctations is more "aggressive" then for import and producer prices. CPI inflation variation is explained by the exchange rate shock about 14.6 per cent , import prices and producer prices for about 11.7 per cent. Its own innovations explain about 59 per cent in the first month, falling to 21.2 per cent in the last month. [17]

5. Robustness Check

In this section, in order to ascertain the robustness of our results we re-estimate the model on the alternative ordering of the variables in the Cholesky decomposition as follows: oil prices, gdp, interest rates, exchange rate, import prices, producer prices and CPI inflation. In our new model, interest rate is ordered before the exchange rate as proposed by (Choudri, 2002). This implies that exchange rate can impact monetary policy and interest rates can influence money market; the pressure on the local currency is reduced meaning that investments in securities are becoming more attractive. We follow the ordering of the variables below:

$$\Delta\pi_t^{oil} \rightarrow \Delta gdp_t \quad \rightarrow \Delta REPO_t \rightarrow \Delta REER_t \rightarrow \Delta IMP_t^{nf} \rightarrow \Delta PPI_t \rightarrow \Delta CPI_t$$

We estimate our VAR model again and results do not differ from the previous results.[18]

6. Concluding remark

We use a recursive VAR model based on the work of (McCarthy, 1999) and (Leigh, 2002) to estimate the exchange rate pass-through on prices in Albania from 2001Q1 to 2017Q1. Our model consists on seven variables which are ordered as follows: oil prices, growth rate, exchange rate, import prices, producer prices, consumer prices and money market interest rates. Based on impulse-response functions and variance decomposition of the pass-through of import prices, producer prices and consumer prices, we draw the following conclusions:

The effect of real effective exchange rate shocks on prices is incomplete . The impact of the exchange rate shocks on CPI inflation is more aggressive then for import prices and producer prices. This is a clear evidence that import prices involve a greater share of tradable goods and services in comparison to CPI inflation. Moreover, this meant that producers do not have the power to fully adjust their prices to reflect the exchange rate shocks.

Oil prices explain the variance of import prices and producer prices, reflecting the automatic adjustment of domestic prices of oil to the conditions in the international market. Evidence from the variance decomposition suggest that the variance of import prices is explained by growth rate and oil prices whereas producers and consumers prices are explained by its own shocks. Exchange rate shocks impact on import and producer prices is modest and counts for approximately 15 per cent of

[16] Table 5 Appendix
[17] Table 6 Appendix
[18] The results are not shown for brevity purposes, but available upon request.

CPI inflation variance. We advocate that Central Bank of Albania should pay more attention to volatilies of exchange rate as its main aim is price stability.

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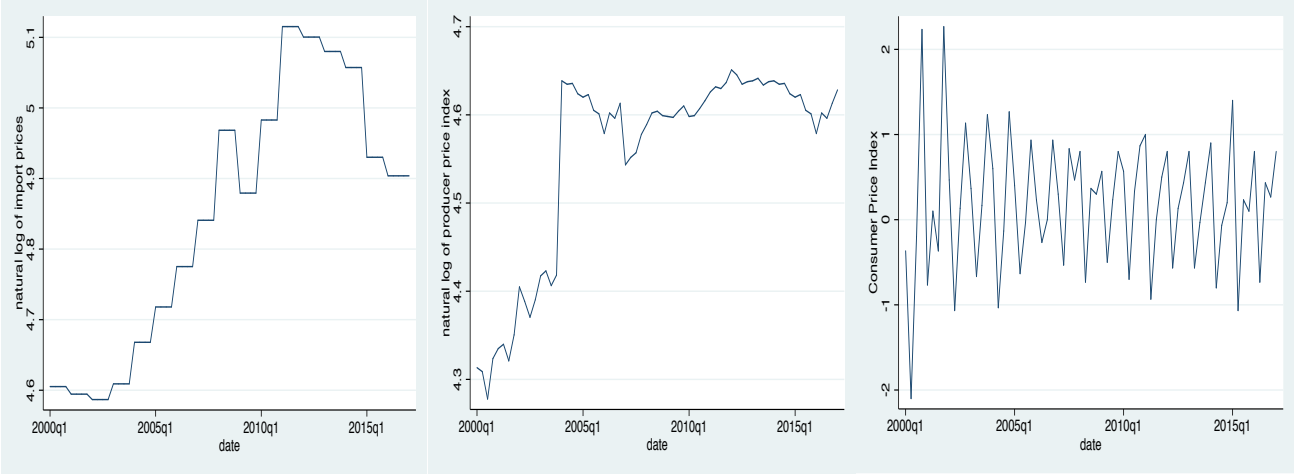
APPENDIX

Figure 3. Time Series at levels



Source: Author's Calculations

Table 4. Variance decomposition of import prices

Forecast Horizon	Oil Prices	GDP	Exchange rate	Import Prices	Producer Prices	Consumer Prices	Interest Rate
1	0.0199	0.54343	0.00164	0.4349	0	0	0
2	0.3132	0.38672	0.0046	0.2369	0.0014	0.0281	0.0288
3	0.2210	0.2782	0.0275	0.1940	0.0076	0.1935	0.0779
4	0.1900	0.2745	0.0245	0.2148	0.0068	0.1669	0.1222
5	0.1997	0.2538	0.0238	0.2351	0.0066	0.1556	0.1251
6	0.2089	0.2440	0.0257	0.2248	0.0135	0.1508	0.1320
7	0.2041	0.2399	0.0341	0.2196	0.0156	0.1493	0.1370
8	0.2095	0.2357	0.0369	0.2096	0.0163	0.1494	0.1323
9	0.2107	0.2346	0.0384	0.2246	0.0176	0.1440	0.1298
10	0.2106	0.2331	0.0384	0.2233	0.0174	0.1485	0.1283
11	0.2053	0.2277	0.0447	0.2177	0.0243	0.1438	0.1362
12	0.2011	0.2239	0.0442	0.2141	0.0256	0.1416	0.1402
13	0.2126	0.2217	0.0439	0.2152	0.0256	0.1404	0.1402
14	0.2150	0.2214	0.0441	0.2111	0.0260	0.1444	0.1377
15	0.2104	0.2159	0.0498	0.2054	0.0324	0.1445	0.1413
16	0.2149	0.2142	0.0497	0.2028	0.0329	0.1429	0.1423
17	0.2165	0.2127	0.0565	0.2015	0.0350	0.1419	0.1414
18	0.2177	0.2126	0.0511	0.2010	0.0348	0.1419	0.1406
19	0.2136	0.2115	0.0532	0.1977	0.0383	0.1393	0.1460
20	0.2113	0.2099	0.0549	0.1961	0.0415	0.1385	0.1474
21	0.2137	0.2091	0.0547	0.1953	0.0415	0.1379	0.1475
22	0.2128	0.2098	0.0556	0.1994	0.0413	0.1389	0.1469
23	0.2113	0.2094	0.0560	0.1929	0.0430	0.1409	0.1461

24	0.2107	0.2082	0.0571	0.1919	0.0456	0.1401	0.1461
25	0.2112	0.2064	0.0580	0.1906	0.0470	0.1392	0.1472
26	0.2105	0.2089	0.0584	0.1898	0.0468	0.1385	0.1468
27	0.2099	0.2102	0.0582	0.1890	0.0471	0.1390	0.1462
28	0.2089	0.2092	0.0588	0.1880	0.0489	0.1382	0.1477
29	0.2081	0.2083	0.0594	0.1878	0.0492	0.1378	0.1490
30	0.2071	0.2094	0.0602	0.1871	0.0490	0.1392	0.1488
31	0.2066	0.2091	0.0602	0.1871	0.0490	0.1392	0.1485
32	0.2059	0.2083	0.0607	0.1864	0.0499	0.1399	0.1497
33	0.2050	0.2079	0.0616	0.1864	0.0507	0.1387	0.1494
34	0.2046	0.2081	0.0621	0.1867	0.0505	0.1384	0.1492
35	0.2044	0.2079	0.0627	0.1866	0.0505	0.1384	0.1492
36	0.2049	0.2075	0.0627	0.1864	0.0506	0.1382	0.1493

Source: Author's Calculations

Table 5. Variance decomposition of producer prices

Forecast Horizon	**Oil Prices**	**GDP**	**Exchange rate**	**Import Prices**	**Producer Prices**	**Consumer Prices**	**Interest Rate**
1	0.1731	0.1482	0.0341	0.0364	0.6020	0	0
2	0.1247	0.1602	0.0564	0.1126	0.4764	0.0055	0.0637
3	0.1212	0.1558	0.0565	0.1188	0.4773	0.0068	0.0633
4	0.1168	0.1429	0.0658	0.1161	0.4657	0.0067	0.0856
5	0.1176	0.1415	0.0686	0.1143	0.4586	0.0079	0.0910
6	0.1241	0.1394	0.0853	0.1073	0.4303	0.0138	0.0994
7	0.1244	0.1387	0.0877	0.1031	0.4128	0.0162	0.1167
8	0.1233	0.1574	0.0847	0.1045	0.3924	0.0254	0.1120
9	0.1199	0.1603	0.0844	0.1062	0.3857	0.0260	0.1172
10	0.1211	0.1617	0.0851	0.1058	0.3836	0.0259	0.1166
11	0.1194	0.1612	0.0863	0.1041	0.3774	0.0269	0.1243
12	0.1212	0.1641	0.0849	0.1037	0.3699	0.0260	0.1294
13	0.1211	0.1669	0.0854	0.1027	0.3675	0.0274	0.1293
14	0.1199	0.1655	0.0844	0.1015	0.3632	0.0267	0.1340
15	0.1207	0.1675	0.0842	0.1039	0.3587	0.0255	0.1324
16	0.1205	0.1656	0.0859	0.1039	0.3538	0.0250	0.1380
17	0.1202	0.1703	0.0852	0.1031	0.3507	0.0248	0.1385
18	0.1249	0.1692	0.0844	0.1039	0.3477	0.0241	0.1374
19	0.1241	0.1675	0.0835	0.1041	0.3440	0.0235	0.1436
20	0.1232	0.1686	0.0856	0.1035	0.3422	0.0234	0.1438
21	0.1235	0.1684	0.0857	0.1031	0.3408	0.0230	0.1449
22	0.1239	0.1695	0.0851	0.1038	0.3383	0.0226	0.1453
23	0.1234	0.1697	0.0851	0.1036	0.3371	0.0224	0.1471
24	0.1232	0.1706	0.0857	0.1031	0.3363	0.0225	0.1468
25	0.1252	0.1702	0.0854	0.1032	0.3354	0.0222	0.1464
26	0.1248	0.1689	0.0853	0.1025	0.3331	0.0219	0.1512
27	0.1243	0.1726	0.0849	0.1022	0.3315	0.0218	0.1505
28	0.1243	0.1723	0.0848	0.1020	0.3315	0.0221	0.1503
29	0.1240	0.1723	0.0844	0.1018	0.3303	0.0217	0.1525

30	0.1236	0.1730	0.0847	0.1016	0.3296	0.0216	0.1529
31	0.1233	0.1739	0.0844	0.1013	0.3286	0.0215	0.1534
32	0.1236	0.1741	0.0842	0.1014	0.3282	0.0217	0.1534
33	0.1230	0.1736	0.0842	0.1009	0.3270	0.0214	0.1560
34	0.1226	0.1755	0.0840	0.1011	0.3262	0.0212	0.1555
35	0.1227	0.1753	0.0842	0.1010	0.3260	0.0212	0.1554
36	0.1223	0.1752	0.0841	0.1007	0.3253	0.0212	0.1570

Source: Author's Calculations

Table 6. Variance Decomposition of Consumer Prices

Forecast Horizon	**Oil Prices**	**GDP**	**Exchange rate**	**Import Prices**	**Producer Prices**	**Consumer Prices**	**Interest Rate**
1	0.0248	0.0255	0.3383	0.0029	0.0154	0.5930	0
2	0.1010	0.0551	0.3542	0.0025	0.0167	0.5166	0.0441
3	0.0148	0.0770	0.2979	0.0055	0.0225	0.4434	0.1387
4	0.0197	0.0956	0.2790	0.0124	0.0586	0.3965	0.1378
5	0.0281	0.1280	0.2627	0.0108	0.0565	0.3984	0.1151
6	0.0220	0.1496	0.2549	0.0118	0.0461	0.3903	0.1250
7	0.0198	0.1621	0.2243	0.0174	0.0651	0.3492	0.1618
8	0.0310	0.1545	0.2196	0.0165	0.0974	0.3226	0.1579
9	0.0345	0.1529	0.2130	0.0159	0.1062	0.3238	0.1534
10	0.0311	0.1740	0.2005	0.0195	0.1000	0.3183	0.1563
11	0.0320	0.1914	0.1849	0.0240	0.1124	0.2879	0.1671
12	0.0373	0.1824	0.1855	0.0241	0.1316	0.2771	0.1617
13	0.0368	0.1812	0.1826	0.0262	0.1361	0.2749	0.1618
14	0.0349	0.2009	0.1715	0.0350	0.1281	0.2674	0.1618
15	0.0334	0.2112	0.1648	0.0409	0.1338	0.2550	0.1606
16	0.0338	0..2062	0.1655	0.0414	0.1442	0.2509	0.1576
17	0.0337	0.2044	0.1632	0.0454	0.1456	0.2486	0.1587
18	0.0339	0.2247	0.1558	0.0550	0.1370	0.2413	0.1519
19	0.0332	0.2284	0.1521	0.0610	0.1399	0.2355	0.1495
20	0.0326	0.2257	0.1513	0.0630	0.1436	0.2347	0.1487
21	0.0355	0.2245	0.1493	0.0702	0.1417	0.2309	0.1477
22	0.0397	0.2340	0.1471	0.0783	0.1340	0.2269	0.1397
23	0.0405	0.2324	0.1458	0.0826	0.1351	0.2248	0.1385
24	0.0405	0.2304	0.1450	0.0847	0.1353	0.2259	0.1380
25	0.0438	0.2303	0.1432	0.0915	0.1329	0.2221	0.1359
26	0.0464	0.2307	0.1456	0.0960	0.1283	0.2197	0.1329
27	0.0478	0.2290	0.1447	0.0992	0.1279	0.2184	0.1326
28	0.0493	0.2259	0.1437	0.1023	0.1265	0.2212	0.1309
29	0.0522	0.2233	0.1430	0.1065	0.1245	0.2173	0.1327
30	0.0549	0.2194	0.1472	0.1083	0.1224	0.2161	0.1314
31	0.0571	0.2178	0.1462	0.1106	0.1216	0.2153	0.1310
32	0.0583	0.2154	0.1453	0.1128	0.1202	0.2174	0.1303
33	0.0596	0.2125	0.1456	0.1140	0.1193	0.2145	0.1341
34	0.0620	0.2096	0.1489	0.1150	0.1191	0.2126	0.1325
35	0.0646	0.2082	0.1478	0.1171	0.1183	0.2121	0.1315

36	0.0654	0.2068	0.1465	0.1172	0.1172	0.2127	0.1334

Source: Author's Calculations

Table 7. LM Test for residual autocorrelation

Lag	chi2	df	Prob>chi2
1	38.8101	49	0.85134
2	55.5725	49	0.24101

H0: no autocorrelation at lag order

Source: Author's Calculations

Table 8. Jarque Bera test for normality

Equation	chi2	df	Prob > chi2
D1OIL	16.542	2	0.00026
D1GDP	18.480	2	0.00010
D1REER	10.543	2	0.00514
D1IMP	0.983	2	0.61182
D1PPI	30.425	2	0.00000
D1CPI	1.232	2	0.54022
D1REPO	0.325	2	0.85001
ALL	78.528	14	0.00000***

Source: Author's Calculations

Figure 4. Test for stability