

## Evaluation of Pass-Through Effect of the Exchange Rate to Inflation

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**Abstract** Monetary policy has a significant impact on economic growth. Exchange rate changes have a strong effect on relative prices of goods and services. The importance of the influence of the exchange rate on inflation can't be overstated and that is causes the monetary authorities to monitor the behavior of both nominal and real exchange rates to take an active interest in determining the behavior of the exchange rate. One of the key dilemmas of modern monetary policy is the issue of currency regulation. The performed analysis will show whether there is a correlation between exchange rate and inflation and will also identify the extent of this dependence in both developed and developing countries.

**Keywords** Monetary policy– Inflation- Exchange rate – Central banks

**JEL classification** E31 - E52

The choice of the exchange rate regime has a significant impact on the trade of goods and services, capital flows, inflation, balance of payments and other macroeconomic indicators. That is why the choice of the appropriate exchange rate regime is the main instrument of monetary policy in maintaining economic growth and stability. However, there is no consensus on how to choose a suitable exchange rate regime, and there is no single regime that would fit all countries. The characteristics of a particular country, the preferences of national governments, the institutional environment and trust can have influence on the choice of the exchange rate regime. The most important factors are the size and openness of countries to trade and financial flows, the degree of economic and financial development, trade and production structure.

Exchange-rate regimes can be roughly divided into three categories: fixed, flexible and intermediate. Until the 1970s, most countries adhered to a fixed exchange rate regime known as Bretton Woods system. Due to this system, countries used to fix their exchange rates against the US dollar, and the dollar was fixed against gold. All participating currencies were implicitly tied to gold. This system has existed for 25 years (1946-1971), but it still remains the preferred mode in many countries. The basic motivation for keeping exchange rates is the

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belief that a stable exchange rate can facilitate trade and investment flows between countries by reducing fluctuations in relative prices and by reducing uncertainty. Since 1971 the economy of many countries is moving towards flexible exchange rate regimes where the currency value is determined by market.

Taking into account the influence of exchange rate regimes on economic activity, the selection of the appropriate mode should be based on the pros and cons of each option regimes and basic economic fundamentals. Each of these modes has advantages and disadvantages. Floating regimes are more appropriate for developed countries, while intermediate regimes are the best options for developing countries with open economies and a developed financial sector. In the case of less integrated countries in the world economy and the lack of monetary independence, the soft modes of binding are preferable. Hard modes of binding, as a rule, is an option for countries with high inflation and a low confidence level.

In international practice, countries use either fixed or floating exchange rates. Until 1973 almost 75% of all countries used fixed exchange rates, since 1973. – floating exchange rates. The fixed exchange rate is established by the government or the Central Bank of the country. The course is governed by the instruments of currency regulation, however, the ratio of market fluctuations between the national currency and the foreign currency does not change. Basically small countries with open economies that depend on exports, pass to the fixed exchange rate. Thus, they provide a stability of export and import prices, which makes the development of foreign trade more predictable. A fixed rate is preferable for those countries which are at the same level of development and implement trade among themselves. This system was popular until the Bretton Woods monetary system. It promotes commerce and stimulates the inflow of capital increases the financial credibility of monetary policy.

Despite the advantages, a fixed exchange rate has the following disadvantages:

- due to the fact that the policy is strongly related to monetary interventions, the Central Bank should either buy the domestic currency to lock exchange rates, which will reduce the lending of commercial banks, and leads to economic decline as a result, or to buy foreign currency, thereby increase the need to issue the national currency, which, in its turn, leads to a growth of the inflation rate and economic recession.
- if the export market has suffered losses, and the country has gold reserves in sufficient quantity to maintain a fixed exchange rate, it won't be able to withstand economic shocks. In this case, domestic prices fall, production stops and the number of unemployed people increases;
- the government practically does not manipulate the exchange rate (the possibility of manipulation reduces);
- "the risk of exchange rate in trade reduces, since transactions conducted in one currency is favorable for a large trade partner;
- the fluctuation of one currency determines the fluctuation of domestic currency against all functional"<sup>1</sup>.

The floating exchange rate is formed on the basis of supply and demand, and only in the case when it is necessary, is corrected by the state. This mode is effectively used, if the production country is not in high correlation with the outside world. A floating exchange rate reduces inflation by the accurate prediction of money demand, which should exceed or be equal to the proposal from the Central Bank. But as many factors are unforeseeable and unpredictable, it is rarely possible to predict demand accurately. A floating exchange rate supports the competitiveness and adapts to external economic shocks. If the foreign exchange market works effectively, then speculators

<sup>1</sup> Madiyarova D. M. (1999), «Strategy of foreign economic activity», Almaty

won't be able to capitalize on the profits of the Central Bank.

The disadvantages of a floating exchange rate include the following cases:

- “if the foreign exchange market is characterized by low capacity, a few large transactions can undermine the existing situation;
- conditions of uncertainty reduce the attractiveness of the market to foreign investors and trading partners by the conditions of uncertainty under the current regime;
- the threat of government manipulation undermines the confidence of market participants.
- in the presence of large speculative capital flows, the exchange rate largely constrains monetary independence.”

The transition to a floating rate regime can be effective in the presence of a developed financial market, its integration with the world system, the interchangeability of domestic and foreign monetary assets and development degree of financial intermediation. Despite these requirements, many underdeveloped countries have switched to this system. The consequence was that the appearance of a mixed exchange rate, which has combined elements of fixed and floating exchange rates. It is possible to include all the pros and cons of floating and fixed exchange rates that will occur with less force and it is easier to handle.

Examples of mixed exchange rate are:

- Creeping binding. A corridor for the exchange rate is set and when you change certain parameters (the difference between the growth rate of the national economy and partner countries inflation, the difference between expected and actual inflation rates in partner countries) is adjusted. The containment of the exchange rate within a certain corridor restricts currency regulation.
- A fixed exchange rate with horizontal binding. The exchange rate may fluctuate within  $\pm 1\%$  from a fixed exchange rate
- A fixed exchange rate with creeping the horizon. The rate fluctuates within  $\pm 1\%$  from a fixed exchange rate with periodic adjustments of the exchange rate. The difference between the minimum and maximum exchange rate should not exceed 2%. The value of the fixed exchange rate is adjusted periodically, depending on changes to the pre-defined indicators. Sloping corridor may have trailing or leading character as possible in the event of creeping of the anchor. Commitment of maintaining the exchange rate within the band imposes constraints on monetary policy. Exchange rate flexibility depends on the width of the currency band. The oscillations range can be symmetrical relative to the Central parity or gradually widen from time”.
- Managed floating exchange rate with no pre-established horizon of the exchange rate. No corridors are established. Monetary authorities try to control the fluctuations of the exchange rate near long-term trend. To adjust the exchange rate, such factors as balance of payments, foreign exchange reserves, the level of development of neighboring countries are used.

The exchange rate allows you to calculate the volume of international investments in the national currency and the price of foreign trade. It also improves the competitiveness of countries and reflects the direction of change of the balance of payments of the country. However, taking into account the fact that the exchange rate is the monetary measure, first of all it informs the market about the existing measures of monetary policy.

Regarding the choice of exchange rate regime over the past 40 years economists have developed various theories. In early literature, based on the work on optimal currency areas by Mundell (1961), McKinnon (1963), and Kenen (1969), the foundations associated with abilities to cope with the shocks of demand and the effectiveness of monetary policy to manage aggregate

demand are emphasized. Subsequent authors, according to William Poole (1970) wrote about the analysis of monetary policy instruments aimed at the type and source of the dominant shocks faced by the economy. Drawing on the work of Barro and Gordon's (1983) reliability of monetary policy, the 1980s has developed the idea that the binding of the exchange rate can contribute to the credibility of a policy of low inflation, foreign Central Bank (Francesco Giavazzi & Giovannini Alberto (1989) Fratianni and von Hagen (1991)). More recent literature, finally, notes that the currency crises of the 1990s (Mexico, Southeast Asia, Russia, Brazil and Argentina) include the combination of some forms of fixed exchange rates with high capital mobility. This suggests that countries that are in contact with large flows of capital, must avoid unstable exchange rate regimes and for this there are two solutions: a very rigid binding of currencies (such as currency Board or dollarization) or a flexible mode<sup>2</sup>.

The collapse of the Bretton Woods system in the early 1970s paved the way for a more diversified choice of exchange rate regimes and facilitated the analysis of the necessity of choosing one or another mode in the empirical literature. Early empirical literature also considers the foundations and approaches then gives some recommendations regarding the choice of modes (Heller (1978) and Dreyer (1978)). More recent studies introduced considerations of optimal macroeconomic stabilization, adding power to various types of shocks (Melvin (1985) and Savvide (1990, 1993)). These authors consider that the presence of fixed nominal shocks increases the likelihood that the anchor currency, while real shocks reduce it. Empirical studies of the 1990s considering the impact of political and institutional variables on the choice of mode and coming to the conclusion that political instability increases the likelihood of the introduction of flexible exchange rate regimes (Edwards (1996) and Berger and others (2000)).

Member countries of the International Monetary Fund (IMF) report their exchange-rate regimes which in turn annually publishes these data. Until 1999 these countries have announced one of three possible modes: hard binding (pegged arrangements), flexible binding (flexible arrangements), and freely floating regime (free float). This rough classification was refined in 1999, responding to an observation about a significant degree of variation in the official descriptions of policies, classified as "bound" or "more flexible". Regarding the classification of exchange rate regimes, the IMF (1999) allows to divide them into eight different categories ranging from the adoption of foreign currency as legal tender and ending the regime of free floating.

There are three groups of factors influencing the choice of exchange rate regime of a country: economic base, variables related to macroeconomic stabilization and the variables associated with the risk of currency crises. The work of Mundell (1961), McKinnon (1963) indicates the degree of economic openness as important fundamentals. They argue that small and open economies are more likely to adopt fixed exchange-rate regimes than large and relatively closed economy<sup>3</sup>. In addition, the country is likely to adopt a fixed exchange rate regime if its trade is heavily concentrated in a particular currency area. Furthermore, Kenen (1969) shows that countries with very concentrated production structures are more likely to adopt flexible exchange rates than countries with highly diversified production, as exchange rate fluctuations,

2 Eichengreen, Barry, (1994), *International Monetary Arrangements for the 21st Century* (Washington DC: Brookings Institution); Obstfeld, Maurice, and Kenneth Rogoff, (1995), „The Mirage of Fixed Exchange Rates,“ *Journal of Economic Perspectives*, Vol. 9, No. 4, pp.73.; and Fischer, Stanley, (2001), „Exchange Rate Regimes: Is the Bipolar View Correct?“ IMF.

3 McKinnon, Ronald (1963), „Optimum Currency Areas,“ *American Economic Review* 53 (September): 717-725; Mundell, Robert, (1961), „A Theory of Optimal Currency Areas,“ *American Economic Review* 51 (September): 657-665.

practically equivalent to the change in relative product prices, and therefore more useful to combat demand shocks<sup>4</sup>. The last consideration is the development of the financial sector of the country. Countries with relatively underdeveloped financial sector often choose the regimes of fixed exchange rate, as they lack the market instruments to conduct domestic open market operations and they need to protect their fledgling banking industry in the presence of significant fluctuations in the exchange rate. Thus, low financial development increases the probability of adopting fixed exchange rate regimes. Henderson (1979), McKinnon (1981), and Boyer (1978) argue that fixed exchange rates work best from the point of view of the absence of stability, that is, the presence of monetary shocks occurring in the economy, while flexible rates perform better in the presence of real shocks<sup>5</sup>. After Barro and Gordon (1983), many authors have argued that countries whose monetary authorities suffer from low credibility of the Central Bank, can increase Central Bank credibility by adopting a fixed exchange rate regime with a more stable currency (Fратиани and Von Hagen (1992), Francesco Giavazzi&Giovannini Alberto (1989), and Daniel &Melitz)<sup>6</sup>. This opinion is important in the transition from a socialist economy to a market economy, when price liberalization and the elimination of the monetary overhang leads to high inflation.

Originally for macroeconomic stabilization, a fixed exchange rate can provide a nominal anchor for domestic prices in a situation where there are no reliable monetary policy institutions. Even for transition countries that started transition with more moderate inflation, “Washington consensus” in the early 1990s decided that the exchange rate is the appropriate nominal anchor provided that fiscal policy is sustainable (Begg (1998) and Bruno (1991, 1993))<sup>7</sup>.

In recent years the General trend full or large capital mobility has shifted attention on the implications of capital movements on the basis of the choice of exchange rate regimes. The regimes of fixed exchange rate combined with a high degree of capital mobility is exposed to speculative attacks as a result of policy inconsistencies (Krugman (1979), Salant and Henderson (1978)), or lead to expectations that arise in the context of multiple equilibria (Obstfeld (1996))<sup>8</sup>. The point is that countries should avoid unstable combinations of capital mobility and rigidity of exchange rates. Important factors that reduce the risk of speculative attacks are the availability of foreign exchange reserves to protect a fixed exchange rate, and the coherence of macroeconomic policies. The sustainability of public finances is a key factor in this regard.

There are many factors that affect the exchange rate of the country and which can have both positive and negative impacts on economic growth of the country.

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4 Kenen, Peter B.(1969), „The Theory of Optimum Currency Areas: An Eclectic View,“ in Robert Mundell and Alexander Swoboda, eds., *Monetary Problems of the International Economy* (Chicago: University of Chicago Press).

5 Boyer R., (1978), „Optimal Foreign Exchange Market Intervention,“ *Journal of Political Economy*: 1045; Henderson D., (1979), „Financial Policies in Open Economies,“ *American Economic Review* 69(2); McKinnon, R., (1981), „The Exchange Rate and Macroeconomic Policy: Changing Postwar Perceptions,“ *Journal of Economic Literature* 19(2): 531.

6 Melitz, Jacques, (1988), „Monetary Discipline and Cooperation in the ERM: A Synthesis,“ in F. Giavazzi, S. Micossi, and M. Miller eds., *The European Monetary System* (Cambridge: Cambridge University Press).

7 Begg, David, 1998, „Disinflation in Central and Eastern Europe: The Experience to Date,“ in Carlo Cottarelli and GyörgySzapary eds., *Moderate Inflation: The Experience of the Transition Economies* (Washington DC: IMF).

8 Obstfeld, Maurice, 1996, „Models of Currency Crises with Self-fulfilling Features,“ *European Economic Review* 40 (April): 1037

The main ones should be noted:

- the inflation rate.
- the payments balance.
- the difference in interest rates on the attracted capital in different countries.
- the degree of trust to the country in the global society.
- competitive product.
- national income of the country.
- higher domestic prices.
- increase interest rates to attract foreign capital.
- the degree of development of the securities market.

### **Pass-Through Effect of the Exchange Rate**

Traditional Economics considers that the purpose of devaluation is to make imports more expensive and exports cheaper, and that if the devaluation was effective, domestic prices should remain unchanged. The situation, when the devaluation of the national currency affects the domestic prices and relations with any other country, such a measure will undoubtedly be compounded, as each subsequent devaluation will not create your own price spiral, while the initial effect is neutralized. However, in this case, the domestic production does not increase sufficiently to meet the additional demand caused by the devaluation.

Oyejide said that the devaluation of the exchange rate often leads to increased costs in local currency of imported inputs (raw materials and intermediate goods capital use) and end-products through cost inflation. He noted that non-traded goods cannot be imported, because the excess demand will increase prices in the domestic market in the short term<sup>9</sup>.

Omotor considered the impact of the price change exchange rate in Nigeria using annual data in the period 1970-2003. The evidence suggests that exchange rate policy plays a significant role in determining inflation in Nigeria<sup>10</sup>. Other studies that have similar findings - Odedokun, Odusola and Akinlo, Nnanna, and Zhang Lu. Having considered the available evidence, we were able to install the main impact of exchange rate on inflation in the country, although there are other variables such as money supply, government expenditure and others.

It is important that prior to adaptation mechanisms of the market system, the main objective of monetary policy impact on exchange rates, which could affect real economic variables in the economy and reduce inflation. Consequently, the policy of progressive appreciation was conducted for the period of the oil boom that occurred in the same period. The sudden transition to a market economy provoked the practice of using the floating exchange rate, especially among Western countries<sup>11</sup>. The international Monetary Fund approved the selection of a floating exchange rate regime. Therefore it was made part of the policy of restructuring the external debt<sup>12</sup>. In addition, Japan, the USA and other countries of Western Europe used it to solve the problem of overcapacity and to achieve equilibrium of the balance of payments<sup>13</sup>.

9 Oyejide T.A.,(1989). Thoughts on Stability of Nigeria's Exchange Rate. The Nigerian Banker, September –December.

10 Omotor G.D., (2008). Exchange Rate Reform and its Inflationary Consequences: The Case of Nigeria. *Economski Pregled*, 59 (11): 688-716

11 Bannerjee A.D., Mestre R, (1998). Error Correction Mechanism Tests for Co integration in Single Equation Framework. *Journal of Time Series Analysis*, 19: 207–283

12 Canetti E., Greene J., (1991). Monetary Growth and Exchange Rate Depreciations as Causes of Inflation in African Countries: An Empirical Analysis. Mimeo, IMF, Washington.

13 Shanks M., (1973). "The Quest for Growth. London & Basingstoke: The Macmillan Press Ltd.

To link the exchange rate and price dynamics serve as other indicators. These are the so-called real exchange rate, real effective exchange rate and exchange rate on purchasing power parity (PPP). The real exchange rate characterizes a change in the price level in one country compared with the price level of another, measured using the nominal exchange rate. Inflation is objectively one of the fatal characteristics of a capitalist economy. It can be more or less, take the form of a depressed or open, but it is present in the economy of all countries for many decades.

Over the past twenty years there has been a decline in the number of countries using fixed exchange rate as a formal anchor for monetary policy. In 1979, 68% of member countries of the IMF have used a fixed exchange rate policy, while the number in 1997 had dropped to 36%. Including in countries with limited floating exchange rate, the corresponding figures dropped from 76% to 44% (IMF, 1999). However, the official regimes only tell part of the story. The actual conduct of monetary policy is subject to change without reflect changes in the organization of monetary policy. Taken into account the number of countries de facto applying the fixed exchange rate as an anchor for its monetary policy, it appears that fixed exchange rates in one form or another remained an important anchor of monetary policy of countries in the world.

Almost 60% of countries have adopted a fixed regime policy, while fixed exchange rate is used as the formal objectives of monetary policy in only 45% of them<sup>14</sup>. However, the number of countries using a fixed exchange rate, fell. In 1991, 76% had a fixed exchange rate as their main instrument of monetary policy, but the figure had fallen to 60 per cent (IMF, 1999 and International Financial Statistics, August 1999).

According to Goldberg and Knetter (1997) the effect of the exchange rate is defined as “the degree of sensitivity of the price of import goods on a one per cent change in national exchange rate is called the effect of exchange rate transfer to prices”.

However, the change in the price of imported goods to some extent also influences production and consumer prices. For this reason, in this work the influence of carry-over effect of the exchange rate is considered in a broader sense, as the changes in consumer prices can be linked to previous changes in the nominal exchange rate.

### **Inflation and Pass-through Effect of the Exchange Rate**

To assess the impact of the devaluation on domestic prices, we use the technique of VAR analysis, proposed by McCarthy in 2000. Existing studies usually use a single equation in the evaluation of the effect of the exchange rate to explain the reaction of the index of domestic prices to exchange rate changes (for example, Olivei (2002); Campa and Goldberg (2005); Campa, Goldberg and González-Mínguez (2005); and Otani, Shiratsuka and Shiota (2005)). The effect of the exchange rate implies a causal direction from exchange rate to domestic variables, which may be most pronounced in the period of the currency crisis. However, the inverse causal relationship of domestic prices to the exchange rate cannot be ignored. For example, as suggested by a standard monetary model, an increase in domestic prices most likely leads to the depreciation of the exchange rate.

It is more appropriate to use a model in which the exchange rate and domestic price inflation are treated as endogenous variables. In addition, domestic macroeconomic variables are likely to affect the exchange rate, especially in the floating exchange rate regime. The VAR approach is useful to ensure the endogenous interactions between the exchange rate and other macroeconomic variables, including domestic prices. McCarthy (2000), Hahn (2003) and Faruqee (2006) used a vector autoregression (VAR) to evaluate the effect of the exchange rate in developed countries,

<sup>14</sup> Thórarinn G. Pétursson(2000)“Exchange rate or inflation targeting in monetary policy”, Monetary Bulletin

especially in the Eurozone. Ito and Sato (2006) also applied the VAR analysis to evaluate the effect of exchange rate in East Asian countries, while Belaish (2003) used a VAR for Brazil, Leigh and Rossi (2002) for Turkey.

Following the methodology of Ito and Sato (2006), we use the VAR model with 7 variables

$$X_t = (\Delta \text{oil}_t, \Delta \text{gap}_t, \Delta m_t, \Delta \text{neer}_t, \Delta \text{imp}_t, \Delta \text{ppi}_t, \Delta \text{cpi}_t)'$$

where

$\text{oil}_t$  - the natural logarithm of oil prices,

$\text{gap}_t$  - the gap between actual and potential output,

$m_t$  - the natural logarithm of the money supply (monetary base or M1)

$\text{neer}_t$  - the nominal effective exchange rate,

$\text{imp}_t$  - the import price index,

$\text{ppi}_t$  - the producer price index,

$\text{cpi}_t$  - the consumer price index

$\Delta$  - the operator of first difference

World oil price is an average of the three indices of spot prices: Texas, Brent and Dubai Crude expressed in US dollars. The gap between actual and potential output, is calculated by applying the HP filter to estimate a strong trend in the index of industrial production. All data except the nominal effective exchange rate, are calculated from the seasonally adjusted using the method CensusX-12. The main objective of this study is to assess the impact of the exchange rate and other macroeconomic shocks on domestic prices, as well as other possible interactions between them. To generate the structural shocks, we use the decomposition of Kholetskova matrix  $\Omega$ , the variance-covariance matrix with the VAR remains. The relation between the residues of VAR ( $u_t$ ) and structural deviations ( $\varepsilon_t$ ) can be written as follows:

$$\begin{pmatrix} u_t^{oil} \\ u_t^{gap} \\ u_t^m \\ u_t^{neer} \\ u_t^{imp} \\ u_t^{ppi} \\ u_t^{cpi} \end{pmatrix} = \begin{pmatrix} S_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ S_{21} & S_{22} & 0 & 0 & 0 & 0 & 0 \\ S_{31} & S_{32} & S_{33} & 0 & 0 & 0 & 0 \\ S_{41} & S_{42} & S_{43} & S_{44} & 0 & 0 & 0 \\ S_{51} & S_{52} & S_{53} & S_{54} & S_{55} & 0 & 0 \\ S_{61} & S_{62} & S_{63} & S_{64} & S_{65} & S_{66} & 0 \\ S_{71} & S_{72} & S_{73} & S_{74} & S_{75} & S_{76} & S_{77} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{oil} \\ \varepsilon_t^{gap} \\ \varepsilon_t^m \\ \varepsilon_t^{neer} \\ \varepsilon_t^{imp} \\ \varepsilon_t^{ppi} \\ \varepsilon_t^{cpi} \end{pmatrix}$$

$\varepsilon_t^{oil}$  - shock in oil prices (supply shocks);

$\varepsilon_t^{gap}$  - the shock to the GDP gap (the demand shock);

$\varepsilon_t^m$  - the monetary shock;

$\varepsilon_t^{neer}$  - the shock of the nominal effective exchange rate;

$\varepsilon_t^{cpi}$ ,  $\varepsilon_t^{imp}$ ,  $\varepsilon_t^{ppi}$  - price shocks.

The structural model is identified because the  $k^* (k - 1) / 2$  restrictions on the matrix  $S$  as zero restrictions where  $k$  denotes the number of endogenous variables. The result is a lower triangular matrix  $S$  implies that some structural shocks do not have a simultaneous effect on some endogenous variables.



### ***Some features of the model and assessment methodology***

- First, the order of endogenous variables must be defined carefully to identify structural shocks. The change in oil prices is included to identify the supply shock and is at the beginning of the VAR model. In the remains of the prices for oil it is hardly affected simultaneously by any other shocks except the supply shock (oil prices), while the supply shock is likely to affect all the other variables in the system simultaneously. The shock of the production gap ranks second in the ordering of the VAR model. The shocks of supply and demand that affect the production gap is expected, mostly predefined. There are lags from the exchange rate, monetary policy and price changes in discontinuities of GDP. Thus, it seems reasonable that the gap in production simultaneously is affected only by the oil price shock and the production gap.
- Money supply, i.e. monetary base or M1, included in the VAR to account for the influence of monetary policy in response to large scale or rate of devaluation. Money supply is ranked third in the ordering of the VAR model before NEER and price variables have the following sequence: the price index for imported goods, because they are the first affected by shocks; followed by the producer price index, which are the second point of impact; and in the end the impact of shocks is displayed on the applicants of the consumer price index.

The literature that studies the effect of the transfer of course, usually raises domestic prices in the lower part of the VAR, so that the variable "price" at the same time is influenced by all other shocks while the price shock has simultaneous impacts on other variables. However, it is not clear whether it would be appropriate to put the money indicator before the indicator of the nominal effective exchange rate. Kim and Roubini (2000), Kim and Ying (2007) propose to place the course in the lower part of the VAR. Indeed, while the exchange rate is considered as a promising asset, it is reasonable to assume that the exchange rate tends to respond pretty quickly and simultaneously to macroeconomic shocks.

As noted above, however, in most studies investigating the effect of the exchange rate, domestic prices are the last in the VAR model. Accordingly, the money supply stands in front of NEER according to Kim and Roubini (2000), but internal prices, in contrast of course, are in the lower part in accordance with the literature that studies the effect of the transfer of course.

### **Empirical results and conclusions**

Obtained as a result of the analysis based on the selected and the above methodology are presented in Annex 1. This shows the infusion of several key macroeconomic indicators in the selected price indexes. In addition, it also considers the mutual influence among the main indicators of price changes.

For determining the levels of dependency and importance in the table are presented the values of the influence coefficients, the values of the probability (to establish the significance of the indicator), and also the separate values of R square for each regression equation are presented to show how this equation is correct the relationship of the selected regressors and the dependent variable.

For all used time series test was performed Dickey-fuller test for unit root to check the stationarity of time series and their integration.

As a result of analysis we obtained the following results:

- The model describes the influence of the macroeconomic indicators used in the formation of prices in the more developed countries where market factors dominate pricing. This

result is clearly visible, if we consider the values  $R^2$ : for example, in the USA, the UK, Switzerland, Germany, etc. the indicator  $R^2 \geq 0.70$ . With regard to developing countries, such as Brazil, Russia, China, India, etc., this ratio varies from 0.5 to 0.7. However, in the countries in transition the value of  $R^2$  ranges from 0.01 to 0.04 (0.06 in some cases). The lowest result for this indicator was registered in Armenia, which is the basis for the assumption that the formation of prices in the country occurs under the influence of non-market mechanisms.

- Checking the reliability of our model for each country under consideration, let us consider the following two indicators which are worth paying attention to, there are the influence coefficient of each of the chosen indicators on dependent variables and the probability values to establish the significance of the obtained coefficients. Examining the data from the table we can conclude that in developed countries the level of consumer prices affect oil prices or import prices or prices, which in its turn also depend on oil prices (USA, UK, Canada, Singapore, Switzerland, etc.). In developing countries a more significant impact is the index of the nominal effective exchange rate, and in countries which are oil exporters the factor of world prices for oil also affects (Russia, Turkey, Mexico, etc.). Finally, in the case of countries with economies in transition (despite the low indicator  $R^2$ ) the indicators of money supply has major influence (M1) and to some extent nominal real exchange rate (Armenia, Georgia, Moldova, etc.).

Taking into account the results obtained by us after conducting regression analysis of VAR, we can draw conclusions about the extent to which the relationship between exchange rate changes and inflation in countries applying a specific exchange rate regime. In countries with economies in transition, including Armenia (in spite of the low rate  $R^2$ ) indicators of money supply provide a great influence on the formation of prices (M1), and, to some extent, the nominal and real exchange rates. In particular, it should be noted that this situation is typical for countries inclined to use fixed exchange rate.

## References

- Bannerjee AD, Mestre R (1998) Error Correction Mechanism Tests for Co integration in Single Equation Framework. *Journal of Time Series Analysis*, 19: 207–283
- Begg D (1998) Disinflation in Central and Eastern Europe: The Experience to Date, in Carlo Cottarelli and GyörgySzapary eds, *Moderate Inflation: The Experience of the Transition Economies* (Washington DC: IMF).
- Canetti E, Greene J (1991) Monetary Growth and Exchange Rate Depreciations as Causes of Inflation in African Countries: An Empirical Analysis. Mimeo, IMF, Washington.
- Eichengreen B (1994) *International Monetary Arrangements for the 21st Century* (Washington DC: Brookings Institution)
- Fischer S (2001) *Exchange Rate Regimes: Is the Bipolar View Correct?* IMF.
- Madiyarova DM (1999) *Strategy of foreign economic activity*. Almaty
- McKinnon R (1963) Optimum Currency Areas, *American Economic Review* 53 (September): 717-725
- Obstfeld M, Rogoff K (1995) The Mirage of Fixed Exchange Rates. *Journal of Economic Perspectives*, Vol. 9 (4): 4, pp.73.
- Obstfeld M (1996) Models of Currency Crises with Self-fulfilling Features. *European Economic Review* 40 (April): 1037

Oyejide TA (1989) Thoughts on Stability of Nigeria's Exchange Rate. The Nigerian Banker, September–December.

Omotor GD (2008) Exchange Rate Reform and its Inflationary Consequences: The Case of Nigeria. *Economicski Pregled*, 59 (11): 688-716

Shanks M (1973) *The Quest for Growth*. London & Basingstoke The Macmillan Press Ltd.

Pétursson TG (2000) Exchange rate or inflation targeting in monetary policy, *Monetary Bulletin*.

## APPENDIX 1 – The relationship of the exchange rate and inflation

		Oil price	Output gap	MI (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Armenia</b>									
2007Q2- 2015Q4	Import price	0.094387 (0.4078)	0.119853 (0.3502)	-0.178803 (0.5314)	-0.235142 (0.3951)	1	0.211209 (0.3971)	-0.180184 (0.8392)	0.040707
	PPI	0.042514 (0.3553)	0.0570720 (0.3553)	-0.208056 (0.0863)	-0.393463 (0.0006)	0.038636 (0.3971)	1	0.258591 (0.4955)	0.165213
	CPI	-0.008912 (0.5164)	0.008912 (0.7479)	0.04975 (0.0462)	0.067868 (0.4630)	-0.000261 (0.8392)	-0.020479 (0.4955)	1	0.063204
<b>Australia</b>									
2004Q2- 2015Q4	Import price	-0.061292 (0.0063)	0.003145 (0.9938)	-0.303642 (0.0664)	-0.22188 (0.4822)	1	4.064.614 (0.0000)	-0.944914 (0.3030)	0.767551
	PPI	0.002241 (0.6196)	0.050146 (0.5159)	0.056467 (0.0747)	0.00363 (0.9522)	0.148744 (0.0000)	1	0.558154 (0.0006)	0.77636
	CPI	0.011642 (0.0041)	-0.06806 (0.3514)	-0.05533 (0.8572)	0.041122 (0.4731)	-0.031158 (0.3030)	-0.031158 (0.0006)	1	0.57705
<b>Canada</b>									
2005Q3- 2015Q4	Import price	0.214758 (0.0002)	0.121795 (0.7191)	-0.143205 (0.7929)	0.139942 (0.6679)	1	1.104.063 (0.2790)	212.856 (0.2434)	0.802164
	PPI	0.000242 (0.9828)	0.023894 (0.6882)	0.040017 (0.6762)	-0.267648 (0.0000)	0.034139 (0.2790)	1	1.125.404 (0.0001)	0.850104
	CPI	0.00451 (0.4699)	0.026826 (0.4175)	-0.023549 (0.6596)	0.084658 (0.0049)	0.020498 (0.2434)	0.350483 (0.0001)	1	0.775172

		Oil price	Output gap	MI (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Georgia</b>									
2008Q2- 2015Q4	Import price	0.133412 (0.2490)	0.143991 (0.7383)	0.695491 (0.0470)	0.643268 (0.2052)	1	0.053975 (0.9459)	1.247.926 (0.1750)	0.6518
	PPI	0.050109 (0.1230)	0.354911 (0.0009)	-0.102841 (0.3198)	0.110514 (0.3198)	0.004368 (0.9459)	1	0.483461 (0.0591)	0.659245
	CPI	0.019046 (0.4983)	-0.07079 (0.4923)	-0.087796 (0.3147)	0.018124 (0.8843)	0.072091 (0.1750)	0.345138 (0.0591)	1	0.456128
<b>Germany</b>									
2004Q2- 2015Q4	Import price	0.010363 (0.5200)	0.021281 (0.7768)	0.016911 (0.8376)	-0.151301 (0.0176)	1	109.922 (0.0000)	-0.120104 (0.8617)	0.911149
	PPI	0.025653 (0.0189)	0.085459 (0.0990)	-0.04902 (0.3957)	-0.015055 (0.7464)	0.960859 (0.4548)	1	0.542981 (0.0000)	0.934743
	CPI	0.0959 (0.0107)	0.069779 (0.0000)	0.007771 (0.6985)	-0.012273 (0.4449)	0.043265 (0.8617)	-0.07113 (0.8617)	1	0.772763
<b>Japan</b>									
2004Q2- 2015Q4	Import price	0.252877 (0.0002)	121.048 (0.0084)	1.276.511 (0.3202)	0.535754 (0.0218)	1	2.734.149 (0.0715)	-2.798104 (0.1152)	0.582621
	PPI	0.009733 (0.2277)	0.029946 (0.5646)	-0.061443 (0.6599)	-0.104707 (0.0000)	0.031966 (0.0715)	1	0.434499 (0.0210)	0.720418
	CPI	0.006077 (0.3827)	0.006876 (0.0293)	0.883807 (0.3635)	0.034019 (0.1241)	-0.024122 (0.1152)	0.32038 (0.0210)	1	0.346055
<b>Russia</b>									
2004Q2- 2015Q4	Import price	-0.015496 (0.8884)	-0.060153 (-8518)	-0.344395 (-0.1233)	-0.605666 (0.1060)	1	10.323.525 (0.2136)	1.240.243 (0.0097)	0.343487
	PPI	0.082905 (0.0000)	-0.055022 (0.3906)	-0.012182 (0.7886)	-0.250727 (0.0003)	0.041303 (0.2136)	1	1.728.336 (0.0790)	0.640201
	CPI	-0.04393 (0.2286)	0.018636 (0.0765)	0.009666 (0.1974)	-0.019273 (0.1241)	0.013828 (0.0097)	0.048166 (0.0790)	1	0.518845
<b>Singapore</b>									
2004Q2- 2015Q4	Import price	0.264300 (0.0161)	0.478075 (0.1315)	-0.136606 (0.6215)	1.448.164 (0.1135)	1	0.104115 (0.3765)	0.083371 (0.0430)	0.716429
	PPI	0.254147 (0.0000)	-0.262566 (0.1841)	-0.053164 (0.7572)	-0.816062 (0.1525)	0.104115 (0.3756)	1	1.658.494 (0.0430)	0.763368
	CPI	-0.021584 (0.1729)	0.152321 (0.0001)	0.023212 (0.5462)	0.193792 (0.1288)	-0.019831 (0.4526)	0.083371 (0.0430)	1	0.521697

		Oil price	Output gap	M1 (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Switzerland</b>									
2004Q2-	Import price	0.009858 (0.2572)	-0.102693 (0.2850)	-0.137267 (0.0002)	-0.008805 (0.8331)	1	1.101.765 (0.0001)	0.557096 (0.2066)	0.856221
	2015Q4	PPI	-0.005607 (0.2256)	0.116354 (0.0190)	0.019881 (0.3552)	-0.010395 (0.6399)	0.312301 (0.0001)	1	0.412392 (0.0651)
		CPI	0.009357 (0.0038)	0.038825 (0.3006)	0.009882 (0.5320)	0.003164 (0.8461)	0.081804 (0.2066)	0.221589 (0.0651)	1
<b>UK</b>									
2004Q2-	Import price	0.105029 (0.0000)	0.137182 (0.2103)	0.125022 (0.1525)	-0.133343 (0.2489)	1	0.956865 (0.1061)	0.328678 (0.0000)	0.889047
	2015Q4	PPI	0.006837 (0.5950)	0.094760 (0.0964)	0.028107 (0.5447)	-0.092557 (0.1245)	0.263511 (0.0013)	1	-1.135113 (0.1061)
		CPI	-0.000895 (0.8765)	-0.024786 (0.3368)	-0.041877 (0.0380)	-0.006757 (0.8050)	-0.062451 (0.1061)	0.328678 (0.0000)	1
<b>USA</b>									
2004Q2-	Import price	0.072408 (0.0063)	-0.370187 (0.2465)	-0.087599 (0.2455)	-0.129173 (0.1820)	1	1.093.825 (0.0017)	0.765970 (0.2765)	0.956663
	2015Q4	PPI	-0.001940 (0.8773)	-0.060865 (0.6747)	0.045896 (0.1752)	0.042771 (0.3293)	0.221850 (0.0017)	1	1.188.928 (0.0000)
		CPI	0.002921 -6576	0.193711 (0.0076)	-0.011806 (0.5108)	0.010628 (0.6460)	0.042828 (0.2765)	0.327764 (0.0000)	1
<b>Lithuania</b>									
2006Q2-	Import price	0.338733 (0.0036)	1.667.310 (0.0355)	0.118862 (0.6728)	10.043.236 (0.4165)	1	1.022.114 (0.3099)	-1.343953 (0.3984)	0.771365
	2015Q4	PPI	-0.066181 (0.0022)	0.400996 (0.0055)	0.036381 (0.4897)	-0.230652 (0.3186)	0.035989 (0.3099)	1	1.175.669 (0.0000)
		CPI	-0.025043 (0.0847)	-0.196067 (0.0379)	0.005702 (0.8650)	0.202083 (0.1647)	-0.019040 (0.3984)	0.473045 (0.0000)	1
<b>Turkey</b>									
2007Q2-	Import price	0.299404 (0.0006)	0.710988 (0.0310)	1.050.835 (0.0068)	0.892763 (0.0023)	1	0.916326 (0.2551)	-1.131532 (0.2299)	0.817664
	2015Q4	PPI	0.033878 (0.1278)	0.067859 (0.3958)	-0.079255 (0.4114)	-0.222662 (0.0010)	0.050196 (0.2551)	1	0.809091 (0.0012)
		CPI	0.01456 (0.9266)	-0.08483 (0.8795)	-0.024316 (0.7184)	0.055225 (0.2815)	-0.029981 (0.3299)	0.391345 (0.0012)	1

		Oil price	Output gap	MI (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Slovenia</b>									
2007Q2-	Import price	0.396103	-0.127117	0.281583	1.437.817	1	3.656.458	-2.665408	0.825802
		(0.0000)	(0.7003)	(0.5477)	(0.1613)		(0.0037)	(0.1180)	
2015Q4	PPI	-0.030024	0.081426	0.009768	-0.259480	0.082397	1	0.673717	0.604386
		(0.0321)	(0.0310)	(0.8899)	(0.1035)	(0.0037)	(0.0054)		
	CPI	0.030221	-0.025765	-0.105365	-0.027911	-0.037044	0.415511	1	0.61841
		(0.0044)	(0.5067)	(0.0476)	(0.8282)	(0.1180)	(0.0054)		
<b>Slovak Republic</b>									
2007Q2-	Import price	0.342503	-0.107558	-0.293560	0.362943	1	1.921.197	-4.003157	0.763306
		(0.0000)	(0.7285)	(0.2780)	(0.5940)		(0.0434)	(0.1769)	
2015Q4	PPI	-0.024523	0.081223	0.246645	0.024614	0.024614	1	2.248.896	0.94468
		(0.1724)	(0.1998)	(0.0000)	(0.8622)	(0.0434)	(0.0000)		
	CPI	0.009713	0.027466	-0.067590	-0.054647	-0.018647	0.242663	1	0.791281
		(0.0967)	(0.1864)	(0.0000)	(0.2340)	(0.1769)	(0.0000)		
<b>Moldova</b>									
2007Q2-	Import price	0.268212	-0.889986	1.087.721	1.889.870	1	2.554.816	-0.167677	0.627904
		(0.1674)	(0.3634)	(0.19134)	(0.1732)		(0.1175)	(0.9252)	
2015Q4	PPI	-0.03466	0.036483	0.043261	-0.313703	0.069595	1	0.654732	0.784372
		(0.7536)	(0.8241)	(0.7615)	(0.1704)	(0.1175)	(0.0122)		
	CPI	-0.015335	0.131465	0.064737	-0.013993	-0.04201	0.602103	1	0.653298
		(0.6160)	(0.3973)	(0.6348)	(0.9510)	(0.9252)	(0.0122)		
<b>Mexico</b>									
2004Q2-	Import price	0.024433	0.154188	-0.199304	0.150097	1	0.815033	-0.758311	0.793107
		(0.0417)	(0.0177)	(0.0920)	(0.0012)		(0.0000)	(0.0365)	
2015Q4	PPI	0.005162	-0.015076	0.200545	-0.157005	0.579570	1	0.879679	0.681878
		(0.6196)	(0.7796)	(0.0425)	(0.0000)	(0.0000)	(0.0030)		
	CPI	-0.007523	-0.000139	-0.130062	0.040739	-0.152748	0.249185	1	0.334906
		(0.1691)	(0.9361)	(0.0121)	(0.0624)	(0.0365)	(0.0030)		
<b>Latvia</b>									
2005Q2-	Import price	-0.001779	0.206196	0.036638	-0.808440	1	0.280106	0.318433	0.665265
		(0.9073)	(0.1637)	(0.5883)	(0.0049)		(0.1917)	(0.2020)	
2015Q4	PPI	-0.006288	0.149629	0.103256	-0.431213	0.214482	1	0.734319	0.737664
		(0.6378)	(0.2507)	(0.0735)	(0.1014)	(0.1917)	(0.0002)		
	CPI	0.008217	-0.058718	-0.110530	0.598436	0.180488	0.543560	1	0.613743
		(0.4729)	(0.6038)	(0.0235)	(0.0058)	(0.2020)	(0.0002)		

		Oil price	O u t p u t gap	M1 (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Kazakhstan</b>									
2004Q2-	Import price	0.062182 (0.0084)	-0.045297 (0.5990)	-0.011296 (0.5454)	-0.115876 (0.1202)	1	-0.092317 (0.0547)	0.172881 (0.1269)	0.428576
	2015Q4								
2015Q4	PPI	0.377257 (0.0000)	-0.383714 (0.2668)	0.003639 (0.9618)	-0.608648 (0.0402)	-1.514697 (0.0547)	1	0.670918 (0.1444)	0.745016
	CPI	0.024682 (0.5740)	0.107710 (0.4718)	0.033823 (0.2950)	0.184033 (0.1584)	0.524580 (0.1269)	0.124084 (0.1444)	1	0.236699
<b>India</b>									
2007Q3-	Import price	0.145050 (0.2011)	1.919.140 (0.0668)	-0.726146 (0.4296)	0.817419 (0.0784)	1	2.449.073 (0.1658)	0.734855 (0.6285)	0.622122
	2015Q4								
2015Q4	PPI	0.027653 (0.0310)	0.171561 (0.1671)	-0.079164 (0.4613)	-0.131848 (0.0118)	0.033389 (0.1658)	1	0.513023 (0.0034)	0.745802
	CPI	-0.08270 (0.5745)	-0.358867 (0.0049)	0.042719 (0.7180)	0.039350 (0.5203)	0.013016 (0.6285)	0.616202 (0.0034)	1	0.51812
<b>Finland</b>									
2004Q2-	Import price	0.370306 (0.0000)	-0.370547 (0.4581)	-1.062738 (0.0635)	0.0837012 (0.1720)	1	-1.570192 (0.2033)	4.342.985 (0.1126)	0.734894
	2015Q4								
2015Q4	PPI	0.004865 (0.6544)	0.063278 (0.3448)	0.0485898 (0.5396)	-0.041593 (0.6177)	-0.028382 (0.2033)	1	0.645068 (0.0784)	0.321601
	CPI	0.001589 (0.7444)	0.063278 (0.0000)	0.005467 (0.8779)	-0.045390 (0.2201)	0.015761 (0.1126)	0.129510 (0.0784)	1	0.695456
<b>China</b>									
2004Q2-	Import price	0.008856 (0.2685)	0.017893 (0.8063)	-0.081635 (0.0235)	0.063237 (0.1457)	1	0.013846 (0.6997)	0.555628 (0.0008)	0.581551
	2015Q4								
2015Q4	PPI	0.066708 (0.0702)	0.573423 (0.0860)	0.087269 (0.6164)	-0.007282 (0.9718)	0.302019 (0.6997)	1	0.261841 (0.7536)	0.422184
	CPI	0.011222 (0.1325)	0.184509 (0.0044)	0.045045 (0.1938)	-0.015305 (0.7115)	0.489730 (0.0008)	0.010582 (0.7536)	1	0.692488
<b>Chile</b>									
2006Q2-	Import price	0.284967 (0.0002)	0.871590 (0.1341)	1.387.600 (0.0046)	0.651668 (0.0489)	1	1.040.848 (0.0231)	1.523.382 (0.2795)	0.781109
	2015Q4								
2015Q4	PPI	-0.017844 (0.5975)	-0.130087 (0.5804)	-0.100873 (0.6289)	-0.393281 (0.0016)	0.1264348 (0.0231)	1	1.027.277 (0.0609)	0.692523
	CPI	-0.004205 (0.7124)	0.141448 (0.0668)	-0.022647 (0.7478)	-0.057533 (0.2034)	0.027329 (0.2795)	0.116714 (0.0609)	1	0.638534

		Oil price	Output gap	MI (Money base)	NEER	Import price	PPI	CPI	R <sup>2</sup>
<b>Brazil</b>									
<b>2008Q2-</b>	Import price	0.140916	1.592.166	0.584938	0.140847		1.653.798	3.598.997	
		(0.3591)	(0.2680)	(0.4944)	(0.6990)	1	(0.2140)	(0.5610)	0.720737
<b>2015Q4</b>	PPI	0.002926	0.672386	0.071605	-0.047909	0.046008	1	-2.999505	
		(0.4234)	(0.0019)	(0.6170)	(0.4276)	(0.2140)		(0.0009)	0.609943
	CPI	0.002926	0.152825	-0.020946	-0.000572	0.004773	-0.143000	1	0.606603
		(0.6037)	(0.0010)	(0.5017)	(0.9657)	(0.5610)	(0.0009)		