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INTERACTION BETWEEN REAL AND MONETARY SECTORS OF THE ECONOMY IN TERMS OF ECONOMIC INSTABILITY

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Abstract

This paper is a continuation of an article dedicated to the analysis of monetary policy shocks in the context of the interest rate channel operation in the Republic of Moldova during 2001-2012. This work represents the elaboration of the error correction model, which includes the relationship between the base rate and monetary aggregate M3 and inflation. The analysis, based on interaction and equilibration between the indicators in the real and monetary sector – is relevant in the current conditions of economic instability. As international practice of advanced economies show, there is strong correlation between the level of development of the (monetary) financial sector and economic growth, which is associated with such phenomena as: economic cyclicity, inflation. The present paper proposes the analysis of some transmission effects of monetary shocks, in the context of interaction mechanism of real and monetary sector of the economy. The main analysis and conclusions are based on the implementation of correlation tests, granger causality tests, analysis of variance decomposition of forecast and error correction model.

Keywords: Economic instability**,** Aggregate demand, Transmission monetary effects, Potential GDP, Impulse – response, Vector error correction, Forecast error variance decomposition
JEL Classification: E31, P24, C32

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Introduction

Moldova, like many countries in transition has faced strong inflationary phenomenon that remained at double-digit levels for 17 years. Period of 2003q3-2008q3 has recorded a strong inflationary trend, which was supported by the depreciation of the national currency against the currencies of major trading partners and as a result the average rate of inflation for this period was about 13 percent. According to the international practice of the advanced economies, there is a strong correlation between the level of development of the financial sector (monetary) and economic growth that is associated with such phenomena as the – economic cyclicity, unemployment and inflation. The financial crisis has caused economic instability and has proofed that understanding the interaction between monetary and real sector of economy is more profound and complicated. Balanced budget, modest inflation, monetary policy and its objectives are the main elements and determinants of economic stability in the short and long.

In the case of Moldova, the adoption of a new program - Monetary Policy Strategy of the National Bank of Moldova for 2010-2012[1] showed positive effects, so that during three years the inflation rate has fallen to single-digit values (September 2012 - September 2013 inflation constituted 3.9 percent). According to this strategy since 2010, the NBM started implementing the monetary policy regime - inflation targeting. Considering the monetary authority instruments available in the context of Moldova's economic realities, and the experience of other central banks, inflation targeting enables more efficient primary objective of the NBM - ensuring and maintaining price stability - stipulated by the Law on National Bank of Moldova[2]. Managed by central banks monetary policy (for RM NBM) has achieved its objectives through monetary transmission channels, giving crucial role to the interest rate in steering markets: monetary, credit and currency. Generally, the NBM base rate changes lead to changes in interest rates on loans and deposits in the economy and the exchange rate of the national currency. Monetary transmission mechanism appears as a change in monetary conditions and influences the demand for goods and services, aiming mainly – at ensuring and maintaining price stability.

[1] To ensure and maintain price stability, the Bank sets inflation target - measured by the consumer price index published monthly by the National Bureau of Statistics (NBS) - at 5.0 percent for 2010 with a possible deviation of ± 1.0 percentage points. In the period 2011 - 2012 NBM ensure inflation rate in mid-single digit

[2] http://www.bnm.md/md/history

The objective of this work is to estimate the economic-econometric relations between the *base rate*, as the main instrument of monetary policy in Moldova; *monetary aggregate - M3*[3], *inflation* level and also some Taylor rule elements that appear like equilibrium conditions in the economy, where monetary policy instruments are presented as a function of forward-looking variables[4].

1. Survey methodology

Some of the earliest and most successful empirical works in the field meant to substantiate the quantitative logic of economic transmission were works[5]of B. Bernanke, M. M. Gertler, F. Mishkin, J. Taylor. Traditionally, the diagnosis of the monetary effects on the real sector is performed by VAR and VECM models developed by Sims (1980) to estimate the presence of short and long -term connections, based on economic logic of connections between factors. In developing the performed estimations were used monthly series converted into quarterly data; the period taken into consideration was the first quarter of 2001 – the third quarter of 2013. The data series used were fixed based, first quarter of 2000[6], based on series of monthly statistical bulletins of the National Bureau of Statistics and the National Bank of Moldova. Quarterly data used in the model are therefore affected by the seasonality phenomenon and possibly the non-stationary one, which required the use of some tests in order to check the series, staring with the Dickey, Hasza and Fuller stationary tests (1984), modified by Osborn et alter (1988) and Franses (1991). Initially were analyzed and estimated five macroeconomic variables: GDP, potential GDP, inflation, monetary aggregate M3, the base rate of the National Bank. The VECM model and the forecast variance decomposition were also constructed based on inflation, M3 aggregate and the base rate. The model assumes the presence of statistical interaction between the real and monetary sectors (the influence of monetary factors on the real sector indicators). The traditional approach over transmission processes of monetary effects is based on the transmission effects of based rate shocks in the short-term on the monetary sector – the real sector of economy. The

[3] M3 choice for estimates is substantiated by investigating the ability of the indicator, which signed risks to price stability over the medium to long term because of the components included in M3

[4] The rule of "anticipation" as a response of interest rates to inflation and GDP deviation

[5] Bernanke Ben S., Gertler Mark (1995). *Inside the black box: the credit channel of monetary policy transmission*. National Bureau of Economic Research. Cambridge

[6] fixed the base rate start with I quarter 2001

classical scheme of the monetary transmission effects can be presented as follows: $i_{basa} \uparrow \Rightarrow i_{market} \uparrow \Rightarrow MM \downarrow \Rightarrow D \downarrow \Rightarrow I_{NFL} \downarrow$

where i_{basa}– the base rate of central bank, i_{market} - the rate of market, *MM* – money supply, *D* (output) – aggregate demand, I_{nfl} – inflation.

The present work analyzes the interaction between indicators of real and monetary sector, therefore investigation begins with the analysis of Taylor rule, because their practical and theoretical aspects are used to control inflation, which tends to accelerate with constant increase in prices of oil, gas, increasing the volume of consumer loans. It is worth mentioning that the study of the transmission mechanisms through the interest rate channel in the Republic of Moldova, taking into account the specific transitional instabil economy, is current and relevant, important because it allows drawing conclusions about the effectiveness of monetary policy and developing different scenarios of macroeconomic indicators depending on the decisions taken by the National Bank.

The explanation of all monetary rules conceptualize the central bank adjusting a short-term nominal interest rate in linear response to the deviation of inflation from target level and to the deviation of the real output from some target level. Monetary policy rules which react to corrent values of inflation and output deviation could easily induse equilibrum[7]. Bank signals to market participants about restricting or loosening monetary policy, which affects short-term interest rates and the environment, thus, influencing inflation by economy demand. Therefore the response to monetary policy shocks is analyzed firstly, in terms of influence on inflation. Raising rates is causing "higher prices" of money, reduced demand for loans, "tightening" monetary dimensions that lead to currency appreciation. The simple form of Taylor rule: $i_t baza = i_t + \pi_t + 0.5(y_t - y_t^*) + 0.5(\pi_t - \pi^*)$ (1)

where : $i_t baza$ - the base rate;

i_t - real interest rate;

π - average inflation rate for the last four quarters;

y - real GDP;

[7] Verejan O., Crasovschi A. (2012). *Politica Monetară si cursul de schimb. Analiza statistică – cazul Republicii Moldova*. Academie de Studii Economice din Moldova.

y^* - real GDP trend.

The rule describes the situation when the time t coincides with the target inflation (refernce) monetary authorities, and GDP is produced in its potential. Otherwise, start by gap coefficients plays inflation and GDP gap. This also is "Taylor principle", which indicates that the central bank employs more aggressive on inflation and aggregate demand. Gap inflation is included in the Taylor rule out of simple economic reasons. If inflation in an abstract country for some time has been, for example, 5%, then the loan rate can not be less than 5%, as otherwise the creditor has losses. In fact, permanent inflation fluctuations occur with its long-term target. Therefore is needed to correct this fluctuation rate with certain weight.

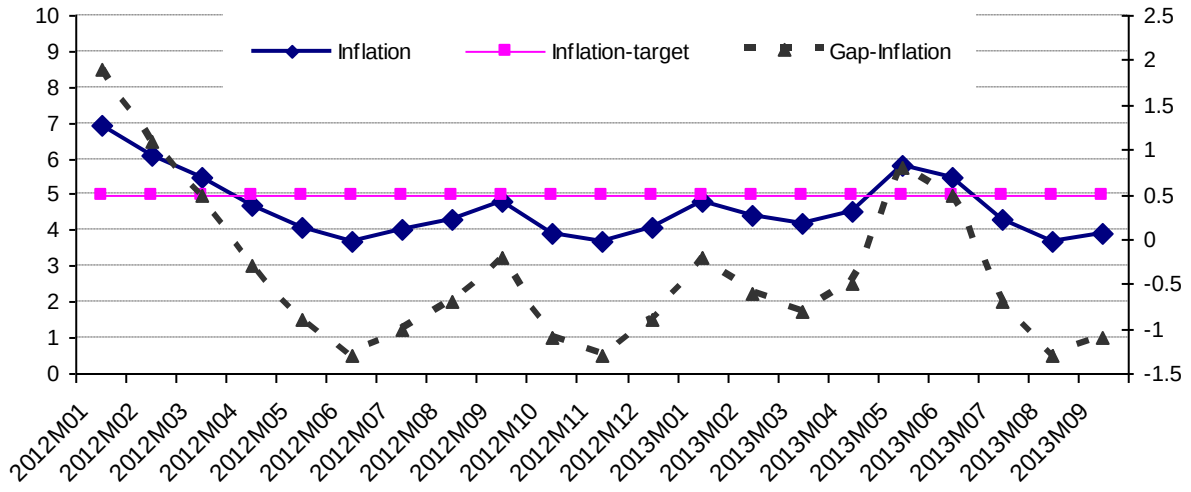

Fig. 1 Inflation and target - Inflation

Source: BNM, BNS, author's calculations

Gap GDP enters in the Taylor rule out of 2 reasons[8]: it is an indicator of future inflation and allows dividing the price shock (supply shock) and demand-side shock. In the present work, potential GDP was estimated by the Hodrick-Prescott filter[9]. It is not a theoretical method, statistical, which extracts a smooth component time series like GDP, "penalizing" frequencies from occurring fluctuations like "business cycles". The filter is parameterized (parameter λ, for which Prescott suggests the value of

[8] Estimated GDP – gap is shown on the image

[9] Hodrick R.J and E.C.Prescott (1980). *Post-war U.S. business cycles: An empirical investigation.* Carnegie – Mellon University

$$x_t^{trend} = \min_t \left\{ \sum_{t-1}^{T} (y_t - \nu_t)^2 + \lambda \sum_{t-2}^{T-1} [(\nu_{t+1} - \nu_t) - (\nu_t - \nu_{t-1})]^2 \right\}$$
$$x_t^{cycle} = x_t - x_t^{trend} \qquad (2)$$

where $x_t = \log(y_t)$, in this case y_t is real GDP

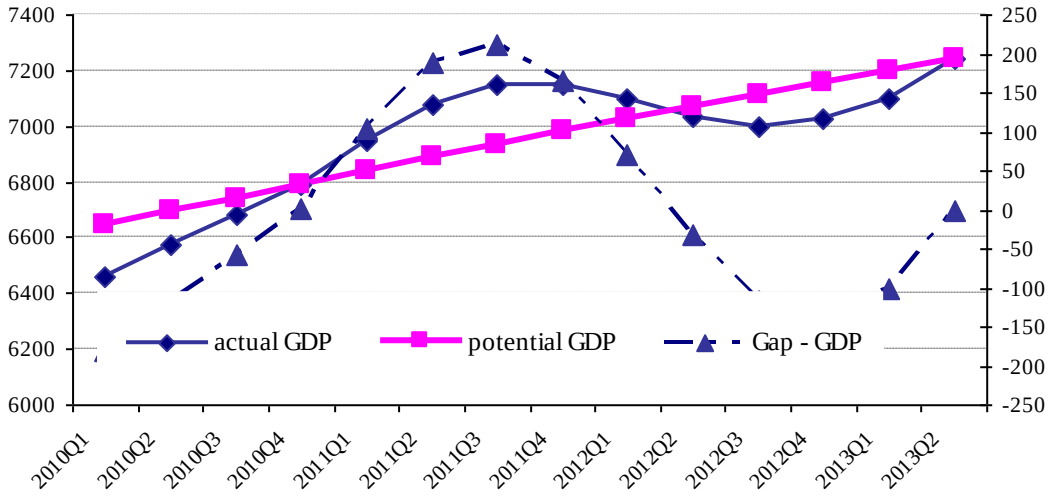

Fig. 2 Estimation of potential GDP by Hodrick-Prescott Filter (LAMDA = 1600)

Source: BNM, BNS, author's calculations

The analysis of actual GDP and potential GDP shows that the last quarter is greater than potential GDP as actual GDP, indicating the absence of inflationary pressures from the demand for those last monetary policy decision taken by the Council of Administration was diminishing base rate up to 3.5 percent.

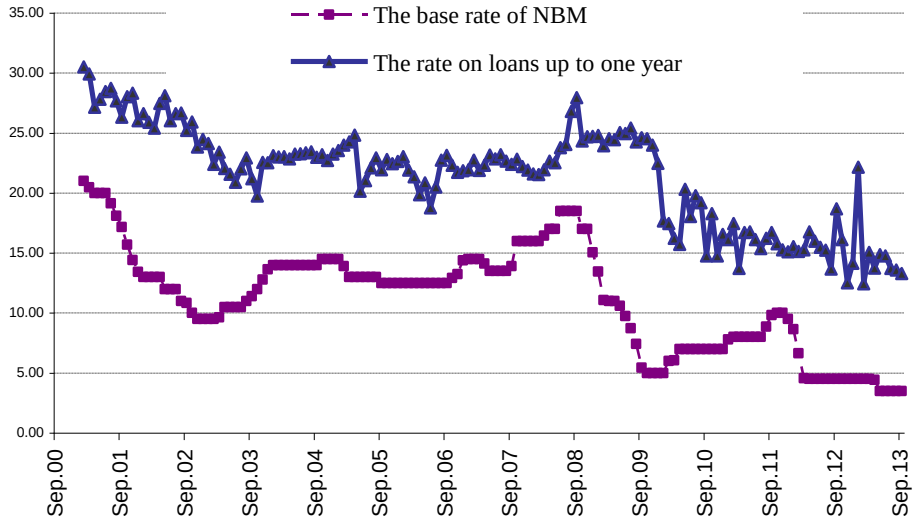

Fig 3. The base rate of NBM and the rate on loans up to one year

Source: BNM, BNS, author's calculations

2. Econometric estimations

Diagnosis of interaction between real and monetary sector was made by correlation matrix, Granger Causality test, Johanson cointegration test that allowed construction of VEC model for predicting of short and long-term time VECM to estimate the presence of short and long-term. In developing the performed estimation was used quarterly data converted to monthly series, the period considered was the first quarter 2001 - second quarter 2013. Data sets used were fixed base, first quarter 200010, based on series of monthly statistical bulletins of the National Bureau of Statistics and the National Bank of Moldova. Quarterly data used in the model are therefore affected by the phenomenon - the seasonality and possibly nonstationary, which required the use of tests to check the series since stationarity tests Dickey, Hasza and Fuller (1984), modified by Osborn et alter (1988) and Franses (1991). The steps in developing the model were:

- analysis of descriptive elements of variables;
- stationarity test series;
- testing the influence of variables through Granger causality test;
- construction of equations (VECM);
- tests, presentation of results and their interpretation.

[10] fixed the base rate start with I quarter 2001

Data

Quarterly and monthly data for analysis and estimation was taken from the electronic database of the National Bureau of Statistics of the Republic of Moldova, the National Bank of Moldova for the period January 2001 - September 2013.

Table 1. The correlation coefficients between the variables

	GDP_SA	GDP_POT_SA	M3_SA	CPI_SA	RATA_BASA
GDP_SA	1	0.9	0.9	0.9	-0.5
GDP_POT_SA	0.9	1	0.9	0.9	-0.6
M3_SA	0.9	0.9	1	0.9	-0.5
CPI_SA	0.9	0.9	0.9	1	-0.5
RATA_BASA	-0.5	-0.6	-0.5	-0.5	1

Source: BNM, BNS, author's calculations

The table reveals that the correlation between variables is strong and the signs of the coefficients reflect the logical connection between the factors: domestic demand growth (GDP growth) causes increased demand for money, and therefore, of inflation, which leads to increased the base rate, which in turn affects the economic activity growth (aggregate demand) – followed by reduction of demand inflationary processes.

Table 2. Stationary test Dickey - Fuller

Variable	ADF - (level)	ADF - (first diferences)	
RATA_BASA	-2.42	-3.96	
M3_SA	-2.28	-3.22	
CPI_SA	-1.51	-4.37	
GDP_SA	-1.98	-7.30	
GDP_POT_SA filter Hodrick-Prescott.	- 3.07	- 2.82	
Test critical value	**1%**	**5%**	**10%**
	-3.56	**-2.91**	**-2.59**

Source: BNM, BNS, author's calculations

Table 3. Granger causality test

Null Hypothesis:	Obs	F-Statistic	Prob.
L_M3_SA does not Granger Cause L_CPI_SA	10	5.56530	0.0504
L_CPI_SA does not Granger Cause L_M3_SA		0.06516	0.8059
L_GDP_POT_SA does not Granger Cause L_CPI_SA	7	3.47077	0.1359
L_CPI_SA does not Granger Cause L_GDP_POT_SA		0.74046	0.4380
L_GDP_SA does not Granger Cause L_CPI_SA	7	1.86935	0.2433
L_CPI_SA does not Granger Cause L_GDP_SA		0.29810	0.6141
L_R_BASA does not Granger Cause L_CPI_SA	10	10.6016	0.0139
L_CPI_SA does not Granger Cause L_R_BASA		3.20141	0.1167
L_GDP_POT_SA does not Granger Cause L_M3_SA	7	0.17039	0.7009
L_M3_SA does not Granger Cause L_GDP_POT_SA		14.2023	0.0196
L_GDP_SA does not Granger Cause L_M3_SA	7	0.91407	0.3932
L_M3_SA does not Granger Cause L_GDP_SA		0.61993	0.4751
L_R_BASA does not Granger Cause L_M3_SA	10	25.6368	0.0015
L_M3_SA does not Granger Cause L_R_BASA		0.99434	0.3519
L_GDP_SA does not Granger Cause L_GDP_POT_SA	7	8.85452	0.0409
L_GDP_POT_SA does not Granger Cause L_GDP_SA		0.82692	0.4146
L_R_BASA does not Granger Cause L_GDP_POT_SA	7	3.51634	0.1340
L_GDP_POT_SA does not Granger Cause L_R_BASA		3.02737	0.1568
L_R_BASA does not Granger Cause L_GDP_SA	7	3.23609	0.1464
L_GDP_SA does not Granger Cause L_R_BASA		3.47807	0.1356

Source: BNM, BNS, author's calculations

The analysis of the relationship between variables is appropriate and does not contradict with economic logic. Base rate affect money supply that in turn affect inflation. For some variables Granger causality test revealed mutual causality. In order to illustrate quantitatively the existence of these effects of influence between the variables, were built the VAR and VECM models with different lags making IRF calculations by Cholesky method.

Since all variables are integrated of order I, we applied the cointegration Iohansan test, which showed that the 1% significance test (Trace) and 5 % - significance test (Maximum eigenvalue) of variables base rate, monetary aggregate M3 and inflation there is a cointegration relationship. Iohansen positive test result allows us to build a VECM. Long term elasticity coefficients of the cointegration relationship and error correction coefficients are presented below:

Table 4. Long-term elasticities, normalized against inflation and error correction parameters

Variabils	The coefficient of elasticity	The coefficient of corrective
L_CPI_SA	**1**	**- 0.61**
L_M3_SA	**-0.42**	- 0.85
L_RATA_BASA	**0.01**	-92.4

Source: BNM, BNS, author's calculations

The adjustment coefficient is negative and according to the significative, nonzero t test, the VECM model helps to maintain long-term equilibrium inflation. The cointegration relationship indicates that in long-term the prices respond positively to increased aggregate M3 and negative to base rate. Error correction coefficients describe the speed of adjustment of the endogenous variables in long-term equilibrium, thus, in the given case, the time necessary to reduce the gap between the current level of inflation and the steady state (deleted by shock) is about 1.5 quarters.

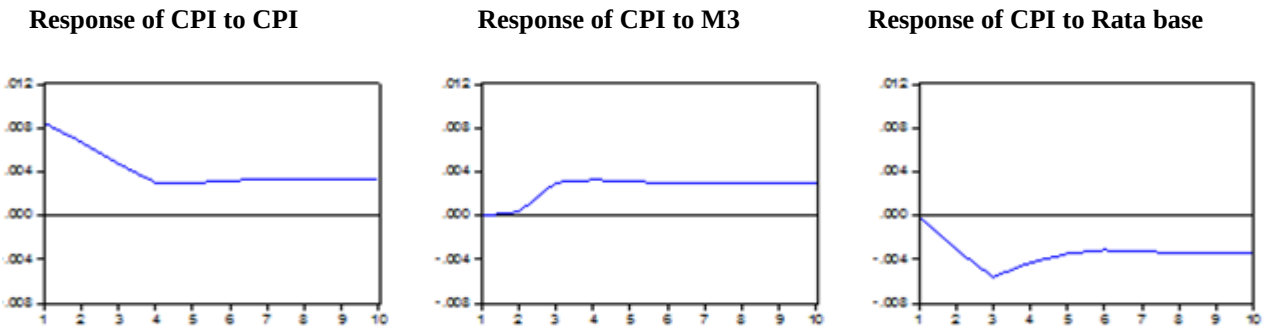

Fig 4. Shock response function in a standard deviation. Deviation after Choleski [11]

Source: BNM, BNS, author's calculations

From the Choleski impulse response function we can note that inflation, is best described by itself, beginning with the first period, the autoregression effect attenuates during the fourth

[11] Picture shows values - answers forecasted inflation in standard deviation residues M3 and base rate

quarter. The maximum shock from monetary aggregate M3 on inflation is reached during quarters IV - VI, which does not contradict the classical theories about the medium and long term links between inflation and monetary factors. The shock influence on the inflation rate is negatively affecting it in the first quarter, which is logical and allows us to conclude that the National Bank of Moldova can influence inflation in the short term.

Table 5. Forecast error variance decomposition %

	Horizon (quarters)	CPI	M3	Base rate
Inflation	1	100.00	0.0	0.00
	2	92.43	0.09	7.46
	3	79.65	4.89	21.45
	4	65.34	8.72	25.92
	5	60.98	11.56	27.45
	6	58.49	13.34	28.15
	7	56.43	14.70	28.86
	8	54.58	15.85	23.56
	9	52.97	16.84	30.17
	10	51.61	17.70	30.68

Source: BNM, BNS, author's calculations

The analysis of variance decomposition of forecast errors showed significant contribution of the monetary aggregate and the base rate in explaining the inflation variation. During the first period the inflation autoregression describes very well its behavior, further description of other factors of inflation dispersion begins in the second quarter. The influence of base rate better describes the behavior of inflation; this can be explained by the fact that the base rate is a short-term instrument, but its influence increase throughout the forecast period. The strongest influence begins in the fourth quarter, but peaks at the end of the interval.

Conclusions

Taking into consideration the inability to obtain significant statistical estimates of the influence on macroeconomic variables (based on the classical representation of the transmission mechanism of monetary policy) due to the heterogeneity of processes, as well as the lack of historical long data series through the VECM model, only three factors were

estimated. Using the VECM concepts to analyze the determination of the monetary effects associated with certain difficulties caused by changes in the monetary policy regime, the behavior of economic agents and external factors. However, from the analyzed variables are presented long-term connections, which influence the short-term relationships, thus, confirming the initial hypothesis about the presence of the link between the real and monetary sectors.

The analysis based on interaction, the balance between the real and monetary sector indicators is both relevant and topical under the current economic instability conditions. According to the results obtained through the VECM model, the adjustment speed of inflation (speed of response) is about 2 quarters, this indicator is quite good, it shows the cumulative influence of the M3 and the basic rate, the last shows the reaction of the monetary authority on the changes the base rate of inflation. The obtained coefficients in the analysis are statistically significant, for example between inflation and monetary aggregate were found strong long-term links; the base rate also demonstrated statistically significant results in relation to inflation, which proves that the relationship between variables is due and effect, it should be noted that in the future it can maintain and will reach a positive value (this is seen in the response function to a standard deviation shock after Choleski), this can be interpreted as monetary policy decisions (the base rate) have a forecasting – adaptive character, i.e. the base rate is adjusted depending on the current level of inflation. In this case this means that the monetary authorities can not only focus on maintaining stable levels of inflation, but also to try to optimize the cyclical fluctuations of output in achieving the inflation target.

Forecast error variance decomposition allows to make conclusions that inflation in Moldova, at present, is a monetary phenomenon, because the effect of shock transmission from the base rate is more significant towards the response to inflation shock in the monetary aggregate, but its influence grew during the periods, i.e. the major part of the variation in inflation in the constructed model was explained by the base rate. In this case we can talk about "cost-push inflation" caused by monopoly or high level of sensitivity of the economy to external and internal shocks, based on economic dependence on natural resources and energy. However, the overall results reflect general trends in relations between the analyzed variables, and due to the emergence of historical data and improvement of practical aspects of building econometric models in the future will arise the possibility to analyze more detailed the effects of transmission of monetary policy shocks not only on inflation but also on the rest of macroeconomic indicators that are of particular interest for proper understanding and decision-making that lead to growth and stability in the future.

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