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MONETARY POLICY RULES IN SOME TRANSITION ECONOMIES

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Abstract

In this paper we examine the question of whither monetary rules or ad hoc monetary policies were followed during the early stages of transition and in response to the global financial crisis. We study Eastern European countries and thee CIS countries. We find that during the early of transition, both developed economies and economies in transition used the monetary base, as well as the interest rate, as the main tools for monetary policy. However, in response to the global crises, priority was given to the main objective such as containing inflation and supporting economic growth. Monetary authorities had the additional possible choice of alternative objectives, such as stabilization of nominal exchange rate and real effective exchange rate, or increase in reserves. It was found that countries mostly retained priorities of monetary policy and some of them gave a greater importance to the alternative objectives.

Keywords: Monetary Policy Rule, Interest Rate, Exchange Rate, Expectation, Econometric Model, Instrument, Transition Economies

1. Introduction

The recent global financial and economic crisis affected the economies of both developed and developing countries including countries with transition economies. Over the past two and a half decades in the countries of EE (Eastern Europe) and CIS (Commonwealth of Independent States) approaches to monetary policy were informed, naturally, by the prevailing current economic conditions. The main goal of monetary authorities of any country is to regulate financial flows so as to keep inflation at a level consistent with sustainable economic growth and high employment.

An important question in the theory of monetary policy is whether the central bank should follow predetermined (set) rules or to follow an adaptive control path in response to changes in economic conditions i.e. adopt a discretionary monetary policy. It has been observed, for instance, that if discretionary policy, rather than set rules to respond macroeconomic shocks then high inflation persists longer (Kydland and Prescott, 1977; Barro and Gordon, 1983). It turns out that central banks of developed countries were indeed able to adhere to set rules that define their responses to various macroeconomic shocks. For the U.S. economy a well-known formula has been offered, according to which the short-term nominal interest rate depends on the real interest rate and the current value of deviations of inflation rate and output from their target values (Taylor, 1993).

With appropriate modifications to the Taylor rule, similar studies for central banks of other countries were carried out. Specifically in the right hand side of formula, lags of the

interest rate were added, the current rate of inflation was replaced by its expected level, the potential output was replaced with a lag of actual output, and other target variables were added.

Many studies were devoted to the question whether central banks of emerging economies adhere to certain monetary policy rules, or they act according to circumstances. It turned out that there are differences in the behavior of central banks in developed and developing countries. The central banks of developing countries and countries with transition economies prefer to use the monetary base as a tool of monetary policy rather the interest rate. In the paper of McCallum (1993) a model in which the monetary base as an instrumental variable was proposed. Some authors have replaced the interest rate with the exchange rate. In the paper of Ball (1998) weighted average interest rates and exchange rates were used as tools.

Significant contribution to the empirical methodology to identify and analyze the objectives of monetary policy was made by Clarida *et al.* (1997). In their approach the base interest rate is considered as the main instrument, which values are defined depending on expected deviations of macroeconomic indicators from their target values. The model determines the response rule of a monetary policy instrument to deviations of expected inflation rates, economic activity, and real exchange rate from their target values.

In the article of Vdovichenko and Voronina (2006) that has a study on data of Russia for the period of 1999-2003 the exchange rate together with the inflation and the output were included in the right side of the equation. It was noted that under formed circumstances refinancing mechanism would not work, and the monetary base would serve as a monetary policy tool. The article concluded that the monetary policy of the Bank of Russia in the post-crisis period was not discretionary. Along with the indicators of inflation and GDP the central bank of Russia took into account the behavior of the exchange rate, which, according to the authors, is contrary to official statements about the priority of inflation fighting.

In the paper of Esanov *et al.* (2004) for the period 1993-2002 it was shown that the simple rule of Taylor (1993), under which the monetary policy instrument is a short-term interest rate as well as its variations, poorly describes policy of the Central Bank of Russia. As it turned out the rule under which the monetary aggregate is selected as a tool is better suited for existing Russian data (McCallum, 1993). Based on regressions it was concluded that during 1993-2002 the Bank of Russia has used monetary aggregates as the main tool of monetary policy. If before the year 1995 the Bank of Russia was concerned about high rates of inflation, since 1995 its main goal was stabilization of the exchange rate.

In the article of Ghatak and Moore (2011) it is argued that the use of interest rate as a tool may fail, because there are both political and economic risks associated. According to the authors monetary aggregates such as the monetary base could be the best tool of monetary policy in the countries with transition economies. However, in the countries of EE and CIS the use of the monetary base to impact on inflation, GDP growth, and exchange rate, which took place at the initial stage of transition to the market economy, later time was changed to the use of the interest rate as the main instrument for achieving ultimate goals of monetary policy.

In the study for Russia on monthly data for the period 1999 – 2007 it was revealed that the central bank used various milestones such as interest rates as well as money supply and balances of commercial banks at the Bank of Russia (Drobyshevski *et al*. 2008).

An empirical study on the availability of monetary policy rules was conducted in Kazakhstan. It was revealed that at different stages the National Bank of Kazakhstan followed certain rules of monetary policy. Prior to 2000 it mainly used the monetary base as an instrument of monetary policy, and during the period of 2000-2006 it influenced on the processes in the economy mainly through short-term interest rate (Mukhamediyev, 2007).

Not always stated objectives of the monetary authorities coincide with actual goals that they pursue . This was revealed by an empirical analysis of the impact of monetary policy on real output in 12 countries with transition economies in the period of 1992-2002 (Drobyshevski *et al.* 2003). This conclusion was also confirmed in the article of Vasicek (2009), which examined the logic of monetary policy in 12 new EU countries. Based on the evaluation of extended Taylor rule it was found that the monetary authorities of these countries have

conducted such a monetary policy, which was not always consistent with the stated official monetary policy.

In particular this can be explained by the fact that at central banks which have switched to floating exchange rate regime the “fear of navigation” (“fear of floating”) may emerge whereas by declaring inflation targeting they are nevertheless react legibly on fluctuations in the exchange course in regulating interest rates. The study for a number of Central and Eastern European countries have shown that for Poland the most rigorous results of pure inflation targeting took place, and at the same time it confirmed the presence of exchange rate targeting for Slovenia and to some extent for Romania also (Frommel, 2006).

In the paper of Mohanty and Klau (2004) the results of a study on 13 developing countries with a market economy in Eastern Europe, Asia, Latin America, and Africa, including Hungary, Poland and the Czech Republic are presented. The main conclusion was that, although most central banks kept the focus on maintaining price stability, they systematically changed interest rates in response to shocks to inflation and exchange rate.

In this paper we investigate how the recent financial and economic crisis has affected the monetary policy rules in the countries with transition economies. Countries of Eastern Europe (Czech Republic, Hungary, Poland) and CIS (Russia, Kazakhstan, Ukraine) were included in the empirical study.

Paper is organized as following. Research methodology and the model are discussed in section 2. Section 3 describes statistical data used, as well as provides information on testing for stationarity. Section 4 reveals the main results obtained in this work. The last section 5 concludes.

2. Econometric Model

Monetary policy is one of the government key tools to regulate economy. Therefore, the general objectives of government macroeconomic policies such as providing low inflation, sustainable economic growth, and high employment are also the goals of monetary policy of central bank. Since a central bank cannot control the behavior of target variables, in order to achieve the target goals intermediate objectives on which the central bank can influence are selected. These include the rate of interbank loans, the exchange rate, and the monetary base. Values of intermediate goals should be set such that to maintain the required levels of final target variables. For controlling interim targets the central bank can use open market operations, changes of reserve requirements, interest rate, interest rates on deposits and other instruments.

The main instrument of monetary policy for most central banks in developed countries is a short term interest rate. Usually this is a rate of interbank loans. Although in the early 1990s transition economies could use other tools, such as the monetary base, however, then the interest rate became the main tool of monetary policy. A central bank can influence it by acting on availability of funds of commercial banks, interventions on foreign exchange market, operations with securities on the open market, changing interest rates on bank deposits at the central bank, as well as the refinancing rate. Following the methodology of Clarida (1997) the equation for the target value i_t^* of the interest rate i_t could be written as following:

$$i_t^* = \alpha + \beta[E_t(\pi_{t+n} \mid \Omega_t) - \pi^*] + \gamma[E_t(y_t \mid \Omega_t) - y_t^*] + \delta[E_t(z_t \mid \Omega_t) - z_t^*], \qquad (1)$$

Here π_{t+n} - the rate of inflation in the period $t+n$, π^* - the target value of the rate of inflation, y_t - the real output, and y_t^* - its target value, Ω_t - the information set - information available to the central bank, E_t - the operator of expectations at the time t, z_t^* - the target value of alternative target variable z_t. A term α represents the desired value of the instrument i_t^*, provided that the inflation, output and alternative target variable reached their desired levels.

It is assumed that the coefficients have the "right" sign in front, corresponding to the direction of changes of interest rate by the monetary authorities to reduce the gap between the expected value and the target value of targeted variable. So the sign should be "+" in front of the coefficients of inflation and output. This means that under rising of prices, the central bank tightens monetary policy by increasing the interest rate of interbank loans, which should slow the growth of prices; whereas, the reduction in GDP growth leads to softening of monetary policy and reducing of the rate of interbank loans. For the nominal exchange rate the coefficient should be positive, and for the real effective exchange rate and foreign reserves coefficients should be negative.

As central banks seek to avoid abrupt changes in interest rates, for modeling the behavior of the actual interest rate a partial correction mechanism is used, in which the parameter ρ reflects the inertia of interest rate movements and determines the degree of smoothing of interest rate dynamics:

$$i_t = (1-\rho)i_t^* + \rho i_{t-1} + \nu_t \tag{2}$$

Parameter ρ determines the degree of inertia of the instrument i_t and ν_t - random disturbance. Value ρ for the developed countries such as USA, Germany, Japan, UK, France, Italy, was approximately equal to 0.9 - 0.95, indicating a high inertia of the interest rate dynamics.

Substituting i_t^* from equation (1) into equation (2), we obtain equations for the rule of monetary policy of the central bank, taking into account the alternative goal:

$$i_t = (1-\rho)\alpha + (1-\rho)\beta\pi_{t+n} + (1-\rho)\gamma y_t + (1-\rho)\delta z_t + \rho i_{t-1} + \eta_t, \tag{3}$$

where

$$\eta_t = (1-\rho)[\beta(E_t(\pi_{t+n} \mid \Omega_t) - \pi_{t+n}) + \gamma(E_t(y_t \mid \Omega_t) - y_t) + \\ + \delta(E_t(z_t \mid \Omega_t) - z_t)] + \nu_t.$$

Equation 3 can be rewritten for the average values of the relevant variables:

$$\bar{i}_t = (1-\rho)\alpha + (1-\rho)\beta\bar{\pi}_{t+n} + (1-\rho)\gamma\bar{y}_t + (1-\rho)\delta\bar{z}_t + \rho\bar{i}_{t-1}. \tag{4}$$

Subtracting equation (4) from equation (3) we obtain the equation

$$\tilde{i}_t = (1-\rho)\beta\tilde{\pi}_{t+n} + (1-\rho)\gamma\tilde{y}_t + (1-\rho)\delta\tilde{z}_t + \rho\tilde{i}_{t-1} + \eta_t. \tag{5}$$

in deviations from the mean values: $\tilde{i}_t = i_t - \bar{i}_t$, $\tilde{\pi}_t = \pi_t - \bar{\pi}_t$, $\tilde{y}_t = y_t - \bar{y}_t$, $\tilde{z}_t = z_t - \bar{z}_t$.

Estimation of the parameters of equation (5) can be achieved by using the generalized method of moments (GMM). It does not require a normal distribution of the dependent variable; obtained estimations are consistent even when residues have conditional heteroskedasticity. At the same time it should be noted that GMM estimations are asymptotically efficient, i.e. are effective on large samples.

The estimation results for the generalized method of moments will not be adequate, if no error specification condition is satisfied. To verify this condition the value of **J**-*statistic* is used, which is asymptotically distributed as χ^2 with a number of degrees of freedom equal to the difference between the number of instrumental variables and the number of estimated parameters.

Also for estimation using the generalized method of moments, stationarity of used variables is required.

3. Data

The calculations are based on quarterly data, mainly of the International Financial Statistics of the International Monetary Fund (IMF) <www.imf.org>, and the National Bank of Kazakhstan (NBRK) <www.nationalbank.kz> from January, 1995 to December, 2012. Trend values were obtained using the Hodrick-Prescott filter.

Through irh, rcpih, lgdph, erh, rerh and resh deviations from trend values of the rate of interbank loans, the rate of inflation, the logarithm of GDP, the exchange rate, the real effective exchange rate, and the foreign reserves are marked, respectively. In the notation of variables consoles cz, hu, kz, pl, ru, and ua variables referring to countries Czech Republic, Hungary, Kazakhstan, Poland, Russia and Ukraine are indicated, respectively. For example, plirh denotes the deviation from trend value of the interbank lending rates in Poland.

In order to detect changes of monetary policy over time the rules of monetary policy were assessed at two time intervals: the first interval - from the first quarter of 1999 to the fourth quarter of 2007 and the second interval – from the first quarter of 2005 to the fourth quarter of 2012. The fact that these intervals overlap a bit is not important as statistical conclusions are based on averaging the values. All data were subjected to testing on stationarity. Table 1 and Table 2 show the results of checking by ADF test on the hypothesis of a unit root.

Table 1. Dickey-Fuller statistics for the interval 1997q1-2005q4

Prefix	irh	rcpih	lgdph	erh	rerh	resh
cz	-2.43*	-4.80**	-2.62**	-2.48*	-3.84**	-2.67**
	(.016)	(.000)	(.010)	(.014)	(.000)	(.008)
hu	-4.86**	-3.85**	-2.52*	-1.65^{+}	-3.60**	-2.57*
	(.000)	(.000)	(.013)	(.093	(.001)	(.011)
kz	-5.48**	-4.06**	-2.37*	-2.61**	-4.52**	-1.48
	(.000)	(.000)	(.019)	(.010)	(.000)	(.126)
pl	-3.79**	-3.54**	-1.94*	-3.02**	-2.42*	-2.70**
	(.000)	(.000)	(.050)	(.003)	(.017)	(.008)
ru	-2.54*	-4.85**	-2.94**	-3.03**	-4.07**	-4.38**
	(.012)	(.000)	(.004)	(.003)	(.000)	(.000)
ua	-7.55**	-5.80**	-1.35	-.98	-2.65**	-1.55
	(.000)	(.000)	(.159)	(.286)	(.009)	(.114)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

Table 2. Dickey-Fuller statistics for the interval 2003q1-2012q4

Prefix	irh	rcpih	lgdph	erh	rerh	resh
cz	-2.60*	-3.65**	-3.21**	-4.01**	-4.02**	-3.88**
	(.011)	(.001)	(.002)	(.000)	(.000)	(.000)
hu	-1.96*	-8.26**	-1.80^{+}	-4.54**	-5.43**	-1.95*
	(.049)	(.000)	(.069)	(.000)	(.000)	(.050)
kz	-4.70**	-5.06**	-1.97*	-2.97**	-3.96**	-3.15**
	(.000)	(.000)	(.048)	(.004)	(.000)	(.002)
pl	-1.93*	-3.57**	-2.38*	-5.00**	-3.95**	-4.48**
	(.050)	(.001)	(.018)	(.000)	(.000)	(.000)
ru	-3.95**	-3.78**	-3.52**	-3.45**	-3.78**	-2.75**
	(.000)	(.000)	(.001)	(.001)	(.000)	(.007)
ua	-2.84**	-6.37**	-4.16**	-2.74**	-3.43**	-3.91**
	(.006)	(.000)	(.000)	(.008)	(.001)	(.000)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

As could be noticed for all variables on each interval the hypothesis of a unit root presence is rejected mainly at a1-percent level and a 5-percent level of significance, except for the two variables of Hungary, for which the hypothesis is rejected only at a 10-percent level of significance.

4. Empirical Results

For each instrument of monetary policy the basic equation of the form (5) without the term of alternative target variable was initially estimated. Then the equation with an alternative target variable was estimated. Calculations were performed for two time intervals: the first – from the first quarter of 1999 to the fourth quarter of 2007, and the second – from the first quarter of 2005 to the fourth quarter of 2012. Results of the econometric estimation using the generalized method of moments (GMM) are presented on Tables 3-14.

In the first column names of explanatory variables are provided. In the second column (a) the estimated coefficients of the main equation with the dependent lag variable - the rate of interbank loans, rate of inflation and economic growth. And in the third, fourth and fifth columns (b) - (d) the coefficients of the alternative target variables: the exchange rate of the national currency against the U.S. dollar, the real effective exchange rate and the foreign reserves, respectively are also shown. In parentheses next to coefficients their standard errors are given. The last line contains the values of J-statistics in parentheses, and appropriate p-values are shown. Columns in which all estimated coefficients are statistically significant, and the specifications are not rejected at least at a 90-percent level are in bold.

a) Czech Republic

On the first time interval only main regression without alternative target variables was significant (Table 3). Monetary authorities relied on the expected rate of inflation and output with one quarter ahead. Their coefficients are positive. This means that in response to changes in inflation and output changes of interest rate occurred in the right direction. Expected increase in the rate of inflation contributed to tightening of monetary policy and rising of interest rates. And the expected decline in GDP growth led to a decrease in interest rates. And there is no reason to assume that the central bank reacted to changes of alternative target variables of the exchange rate, the real effective exchange rate and the international reserves.

Table 3. Dependent variable czirh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
czirh(-1)	**.914** (.021)**	1.125** (.016)	.919** (.036)	1.001** (.027)
czrcph(+1)	**.070** (.018)**	.054** (.017)	.061** (.015)	.059** (.017)
czlgdph(+1)	**1.552** (.306)**	.077 (.324)	1.330** (.284)	.071 (.339)
czerh		.077** (.005)		
czrerh			.0045 (.0057)	
czresh				-2.3E-05** (7.7E-06)
J-statistics	**7.33 (.92)**	8.84 (.97)	7.92 (.95)	6.90 (.91)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

On the second interval the regression without major alternative target variables and the regression with the alternative target variable of the real effective exchange rate are statistically significant (Table 4). However unlike from the first time interval monetary authorities relied on expected values of these two variables ahead by two quarters. For both of these regressions coefficients before inflation and economic growth are positive. This means that the central bank of the country changed interest rates in the right direction by restraining growth of prices and supporting business activity.

For the regression with an alternative target variable of the real effective exchange rate the coefficient czrerh is significant. However, the sign of this coefficient is positive, i.e. it is "wrong". This means that in response to a real appreciation of the national currency monetary policy was tightened, leading to higher rates of interbank loans.

Table 4. Dependent variable czirh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	(d)
czirh(-1)	**.834** (.024)**	.831** (.057)	**.813** (.015)**	1.066** (.051)
czrcph(+2)	**.046** (.006)**	-.009 (.014)	**.032** (.007)**	.129** (.016)
czlgdph(+2)	**.781** (.108)**	.663** (.176)	**1.296** (.099)**	2.254** (.183)
czerh		-.039** (.005)		
czrerh			**.012** (.001)**	
czresh				6.5E-06 (3.8E-06)
J-statistics	**6.57 (.95)**	7.15 (.97)	**7.36 (.98)**	6.18 (.96)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

For both time intervals the coefficient before the lag of interest rate takes a value of about 0.8 - 0.9 indicating a fairly high interest rate of inertia.

b) Hungary

From Table 5, it follows that for the first time interval the main regression and the regression with the target variable of exchange rate and the real effective exchange rate are statistically significant, whereas the regression with an alternative target variable of the international reserves is insignificant. To changes of expectations of the inflation variables and GDP growth the monetary authorities reacted ahead in one quarter.

In all three regressions the sign before inflation is positive, i.e. the central bank changed interest rates in the right direction increasing it in response to higher prices. But the sign of the coefficients before the GDP growth variable is negative. The central bank was acting in the direction of increasing interest rates while reducing GDP. Also a positive coefficient before the real effective exchange rate variable indicates that the monetary authorities have not sought to stabilize it. Therefore, the main goal on the first time interval was controlling inflation.

Table 5. Dependent variable huirh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
huirh(-1)	**.864** (.051)**	**.838** (.042)**	**.822** (.033)**	.514** (.053)
hurcph(+1)	**.163** (.051)**	**.122** (.008)**	**.143** (.049)**	.096 (.081)
hulgdph(+1)	**-2.339* (.916)**	**-3.245** (.715)**	**-2.142** (.571)**	-.316 (1.046)
huerh		**-.0047^{+} (.003)**		
hurerh			**.026* (.013)**	
huresh				7.3E-06 (3.3E-05)
J-statistics	**7.37 (.92)**	**7.05 (.97)**	**6.65 (.98)**	8.57 (.93)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

On the second time interval the main regression and regression with an alternative target variable of the real effective exchange rate are statistically significant (Table 6). In contrast to the first time interval the coefficients before inflation variable are negative, and the coefficients of GDP growth variable are positive. Moreover, the expectations of inflation rate ahead in two quarters and the current value of GDP growth are considered. Consequently, on the second time interval the monetary authorities of the country focused on the support of business and were not concerned about the rise of prices. In the regression with an alternative target variable hurerh the coefficient is negative. Hence, the central bank acted in the right direction seeking to prevent excessive appreciation of the real exchange rate.

Table 6. Dependent variable huirh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	(d)
huirh(-1)	**.893** (.025)**	1.124** (.034)	**.940** (.016)**	1.114** (.033)
hurcph(+2)	**-.513** (.075)**	-.005 (.052)	**-.272** (.034)**	.072* (.027)
hulgdph	**8.658** (1.109)**	3.701** (.782)	**2.773** (.324)**	-.059 (.614)
huerh		.005** (.002)		
hurerh			**-.013* (.005)**	
huresh				-1.6E-04** (6.9E-06)
J-statistics	**6.93 (.91)**	6.46 (.95)	**7.86 (.93)**	6.74 (.96)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

c) Poland

At the first time interval the main equations (a) with no alternative target variables were statistically significant (Table 7). In all these equations the coefficients at variables of the expected values of inflation and GDP growth rates ahead for one quarter are positive. Hence, the monetary authorities of the country responded in the right direction to changes of these target variables. However, the coefficients of alternative target variables of nominal and real effective exchange rates and foreign exchange reserves are insignificant.

Table 7. Dependent variable plirh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
plirh(-1)	**.942** (.024)**	.913** (.013)	.923** (.022)	.920** (.015)
plrcph	**1. 034** (.048)**	1.004** (.019)	.999** (.023)	.973** (.031)
pllgdph(+1)	**8.580** (.778)**	7.817** (.534)	8.879** (.553)	7.984** (.626)
plerh		.365 (.266)		
plrerh			-.005 (.005)	
plresh				-2.4E-05 (1.5E-05)
J-statistics	**7.58 (.91)**	8.57 (.95)	8.58 (.98)	8.77 (.98)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

The main equation (a) is also statistically significant for the second time period (Table 8). Only the expected value of inflation variable was used ahead for two quarters, and the GDP variable - for one quarter. As for the first time interval the coefficients of inflation and economic growth variables have "correct" positive signs, i.e. changes of interest rates occurred in the right direction to limit the rise of prices and to support business activity. And note that in contrast to the first time interval the equation for the variable of international reserves is statistically significant, but its coefficient is positive, which was not assumed in the model specification. Consequently, the monetary authorities reacted in the right direction in response to fluctuations of inflation and economic growth variables, and variations of alternative target variables had no significant effect on their decisions.

Table 8. Dependent variable plirh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	**(d)**
plirh(-1)	**.787** (.022)**	.842** (.016)	.650** (.025)	**.975** (.011)**
plrcph(+2)	**.264** (.030)**	.044** (.013)	.054+ (.031)	**.165** (.022)**
pllgdph(+1)	**1.536** (.305)**	.007 (.274)	-.250 (.674)	**1.216** (.340)**
plerh		-1.169** (.034)		
plrerh			.076** (.002)	
plresh				**4.1E-05** (2.3E-06)**
J-statistics	**7.34 (.92)**	7.55 (.98)	7.14 (.95)	**7.41 (.96)**

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

d) Russia

According to Table 9 for the first time period the main equation (a) as well as the equations with an alternative target variable of nominal exchange rate (b) and the real effective exchange rate (c) are statistically significant. They use expected values of the inflation variable ahead for two quarters and current values of economic growth. The sign of inflation variable is negative, i.e. actions of the monetary authorities do not contribute to limiting price increases. The coefficient before the GDP variable is positive, which means that in response to its fluctuations the interest rate reacted towards stimulating economic growth. In the equations (b) and (c) the signs of coefficients are negative at the nominal exchange rate variable and are positive at the real effective exchange rate variable, which is inconsistent with the assumptions incorporated in the model specification.

Table 9. Dependent variable ruirh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
ruirh(-1)	**.807** (.050)**	**.663** (.038)**	**.615** (.017)**	.560** (.024)
rurcph(+2)	**-.331* (.148)**	**-.547** (.084)**	**-.723** (.110)**	-.539** (.082)
rulgdph	**18.14** (3.514)**	**18.81** (1.960)**	**17.18** (3.132)**	16.53** (1.838)
ruerh		**-.159** (.021)**		
rurerh			**.574** (.012)**	
ruresh				2.1E-06 (2.8E-06)
J-statistics	**5.56 (.96)**	**6.10 (.96)**	**7.54 (.98)**	7.74 (.98)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

On the second time period goals pursued by the monetary authorities of the country have changed (Table 10). The basic regression (a) and the regressions with an alternative target variable of the nominal exchange rate (b) and foreign exchange reserves (d) are statistically significant. Here, unlike the first time interval the sign of the expected inflation variable ahead in two quarters is positive, i.e. in response to its fluctuations the interest rate changed in the right direction, but the coefficient of the economic growth variable is negative so the interest rate changes did not occur in the directions of supporting the growth of GDP. At the same time the coefficient of the nominal exchange rate variable is positive, and the coefficient of foreign exchange reserves variable is negative, which means that the interest rate has reacted to their changes in the right direction.

Table 10. Dependent variable ruirh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	(d)
ruirh(-1)	**.799** (.069)**	**.531** (.038)**	.649** (.068)	**.578** (.031)**
rurcph(+2)	**.516** (.101)**	**.713** (.076)**	.627** (.081)	**.531** (.058)**
rulgdph(+1)	**-6.575** (1.724)**	**-9.146** (1.819)**	-8.694** (1.831)	**-4.144** (1.258)**
ruerh		**.107** (.033)**		
rurerh			-.028 (.026)	
ruresh				**-2.7E-06* (1.1E-06)**
J-statistics	**6.77 (.91)**	**6.69 (.97)**	6.76 (.92)	**6.18 (.96)**

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

e) Kazakhstan

On the first time interval (Table 11) the basic regression (a) and the regressions with alternative variables of the nominal exchange rate (b) and the foreign exchange reserves (d) are statistically significant. The interest rate kzirh changed in the "right" direction in response to fluctuations in the expected rate of inflation ahead in one quarter, its coefficient is positive, and in the "wrong" direction to the current value of economic growth since its coefficient is negative. Also the interest rate variable changed in the opposite direction to stabilizing the nominal

exchange rate. However, the coefficient of the foreign exchange reserves variable is negative, and the interest rate influenced them in the right direction. Apparently, this reflects the existed interest of monetary authorities to build the foreign reserves on the first time interval.

Table 11. Dependent variable kzirh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
kzirh(-1)	**.964** (.055)**	**.976** (.059)**	.150** (.056)	**.970** (.055)**
kzrcph(+1)	**.261** (.044)**	**.472** (.072)**	.167** (.038)	**.094** (.022)**
kzlgdph	**-4.707** (.527)**	**-5.276** (.462)**	-3.359** (.443)	**-3.404** (.259)**
kzerh		**-.044** (.007)**		
kzrerh			-.005 (.009)	
kzresh				**-4.8E-05** (1.7E-05)**
J-statistics	**7.49 (.96)**	**8.73 (.97)**	8.11 (.97)	**8.61 (.97)**

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

All regressions were statistically significant for the second time interval (Table 12). As well as inflation variable enters the equation with positive coefficients and the economic growth variable with negative coefficients during the first time interval. Whereas the expected value of the rate of inflation is taken ahead in two quarters, and the expected value of the economic growth variable - ahead in one period. Nevertheless, the coefficients of the alternative target variables of the nominal exchange rate, real effective exchange rate and foreign reserves have signs opposite to those assumed in the model specification. Therefore, the main objective of the monetary authorities at this time interval was curbing inflation, and the rest target variables were not given significant meaning.

Table 12. Dependent variable kzirh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	(d)
kzirh(-1)	**.333** (.042)**	**.401** (.029)**	**.268** (.034)**	**.384** (.032)**
kzrcph(+2)	**.223** (.056)**	**.080** (.020)**	**.189** (.028)**	**.059* (.028)**
kzlgdph(+1)	**-2.673** (.398)**	**-1.559** (.207)**	**-3.150** (.446)**	**-2.573** (.377)**
kzerh		**-.037** (.005)**		
kzrerh			**.014* (.005)**	
kzresh				**5.4E-05** (1.1E-05)**
J-statistics	**6.53 (.95)**	**6.94 (.98)**	**7.54 (.99)**	**7.01 (.99)**

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

f) Ukraine

For the first time interval as can be seen on Table 13 the main regression (a) and the regression with an alternative target variable of the nominal exchange rate (b) are statistically significant. The coefficient of the expected value of the inflation variable ahead in two quarters is positive. This means that the interest rate reacted to changes of this variable in the right direction. Increase in interest rates reduced the availability of money and helped to restrain rising of prices. A coefficient of economic growth variable is negative, i.e. responses of the interest rate to fluctuations of GDP have not contributed to its growth. In regression (b) the coefficient of the nominal exchange rate is positive. On weakening of the national currency monetary authorities responded by an increase of interest rates and created conditions for its strengthening.

Table 13. Dependent variable uairh, estimation interval 1999q1-2007q4

Equation	(a)	(b)	(c)	(d)
uairh(-1)	**.889** (.008)**	**.819** (.020)**	.926** (.007)	.938** (.019)
uarcph(+2)	**.217** (.035)**	**.172** (.049)**	.024 (.019)	-.111** (.029)
ualgdph(+1)	**-2.632** (.708)**	**-2.571* (1.049)**	-1.532** (.346)	-.540 (1.005)
uaerh		**.485* (.180)**		
uarerh			.047** (.010)	
uaresh				1.8E-04** (3.2E-05)
J-statistics	**6.53 (.92)**	**6.91 (.91)**	7.73 (.90)	6.88 (.91)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

From the data in Table 14 it follows that on the second time interval the main regression (a) and the regressions with alternative variable of the nominal exchange rate (b) and the real effective exchange rate (c) are statistically significant. They use the expected values of the inflation and economic growth variables ahead in one quarter. Coefficients of these variables are positive; on the expected rise of inflation interest rate would increase, and on the expected decline of GDP the interest rate would decrease. But the coefficient of the nominal exchange rate is negative, and the coefficient of the real effective exchange rate is positive, i.e. the interest rate did not react in the direction of stabilizing these alternative variables in response to their fluctuations.

Table 14. Dependent variable uairh, estimation interval 2005q1-2012q4

Equation	(a)	(b)	(c)	(d)
uairh(-1)	**.903** (.026)**	**.986** (.018)**	**.970** (.004)**	.982** (.008)
uarcph(+1)	**.077^{+} (.040)**	**.196** (.026)**	**.136** (.015)**	-.040 (.045)
ualgdph(+1)	**1.107* (.528)**	**1.066** (.344)**	**2.090** (.465)**	-.446 (.670)
uaerh		**-.302** (.062)**		
uarerh			**.041** (.008)**	
uaresh				-1.2E-04** (2.1E-05)
J-statistics	**7.44 (.92)**	**7.60 (.96)**	**7.39 (.98)**	6.09 (.97)

Notes: ** - significance at a 1-percent level, * - significance at a 5-percent level, + - significance at a 10-percent level. In parentheses are the corresponding values of p-value.

5. Discussion

The results of calculations are summarized in Table 15. The changes in monetary policy in six countries of Eastern Europe and CIS on the time interval up to the global financial and economic crisis and on the time interval, which includes the crisis could be noticed.

Table 15. Target variables' influence on the interest rate

	First time period 1999q1-2007q4					Second time period 2005q1-2012q4				
	rcph	lgdph	erh	rerh	resh	rcph	lgdph	erh	rerh	resh
Czech Republic	**+**	+	…	…	…	+	+	…	+	+
Hungary	+	-	-	+	…	-	+	…	-	…
Poland	+	+	…	+	+	+	+	…	-	-
Russia	-	+	-	+	…	+	-	+	…	-
Kazakhstan	+	-	-	…	-	+	-	-	+	+
Ukraine	+	-	+	…	…	+	+	-	+	…

Notes: "+" - The coefficient at the corresponding variable is positive, "-" - the coefficient at the corresponding variable is negative, "..." - coefficient or regression in general is not statistically significant. The signs that match to the interest rate responses in the right direction are in bold.

To illustrate the results obtained following graphs of variables with appropriate prefixes are presented: CPI inflation rate (inf), GDP growth (rgdp), calculated relative to the corresponding quarter of the previous year, as well as the nominal exchange rate (er), real

effective exchange rate (rer) and foreign exchange reserves (res). Also smoothed Hodrick-Prescott filter graphs, which are denoted by the addition of a closure "_hp" to the names of variables are shown.

According to the signs of coefficients it could be recognized that the monetary authorities of the Czech Republic carried out inflation targeting policy and stimulated economic growth at both time intervals. This policy has brought positive results. The rate of inflation declined at the first interval and kept low at the second time interval (Figure 1). GDP growth rates rose at the first interval, and apparently under the influence of the global financial and economic crisis declined significantly at the second interval (Figure 2). Monetary authorities changed interest rates in the right direction in the effort to prevent the economic downturn. Only for the variable of real effective exchange rate the coefficient was statistically significant at the second time interval. But the monetary authorities did not change the interest rate in the right direction in response to fluctuations of this variable.

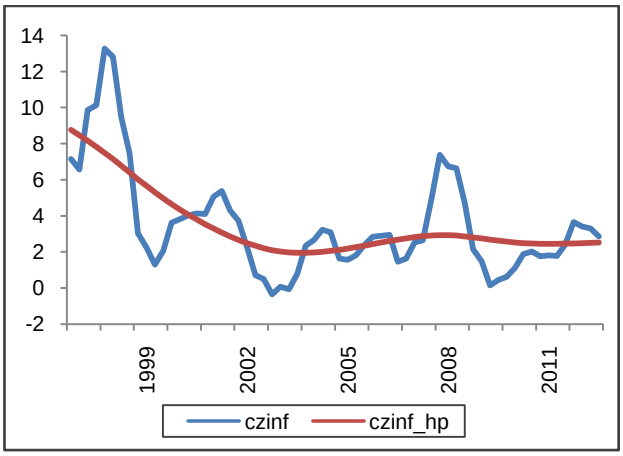

Figure 1. Inflation in Czech Republic

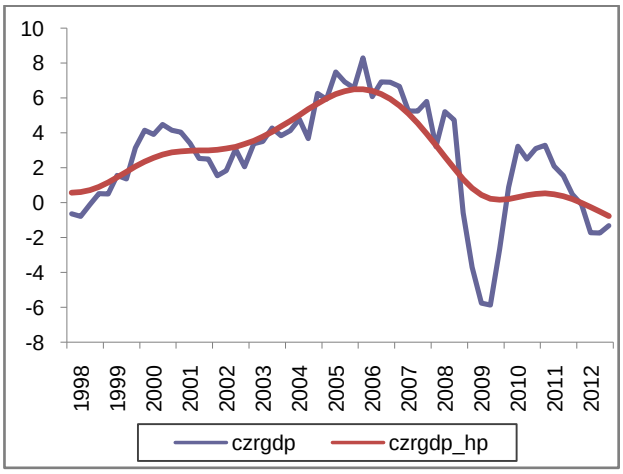

Figure 2. GDP growth rates in Czech Republic

Hungary's monetary policy appears ambiguous. At the first time interval the main goal was to reduce inflation, and this goal was achieved (Figure 3). GDP growth remained stable at about 4 percent. And in response to fluctuations of GDP the interest rate responded correctly (Figure 4).

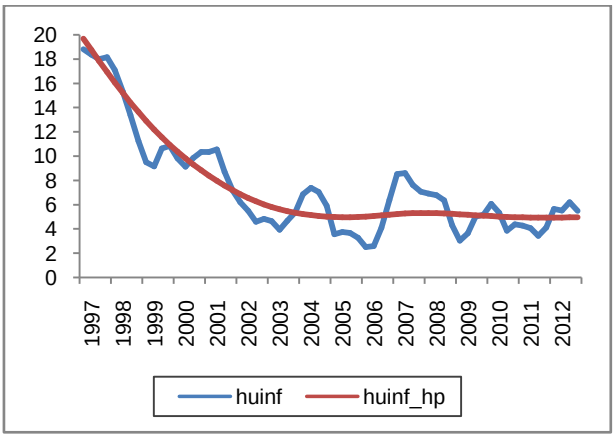

Figure 3. Inflation in Hungary

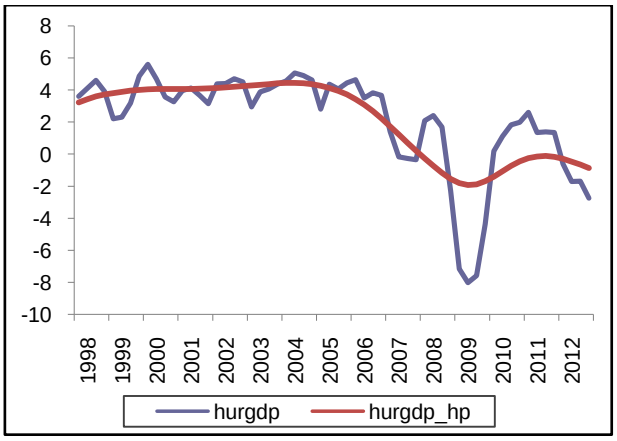

Figure 4. GDP growth rates in Hungary

On the contrary at the second time interval under the global financial and economic crisis at moderate rates of inflation the main goal was apparently to support economic growth and stabilization of the real effective exchange rate. The interest rate changed in the direction opposite to curbing of rising prices. Real appreciation of the national currency, which occurred at the first interval, forced the monetary authorities to pay attention to this indicator. Changes of interest rates in the right direction resulted in a stabilization of the real effective exchange rate at the second period (Figure 5).

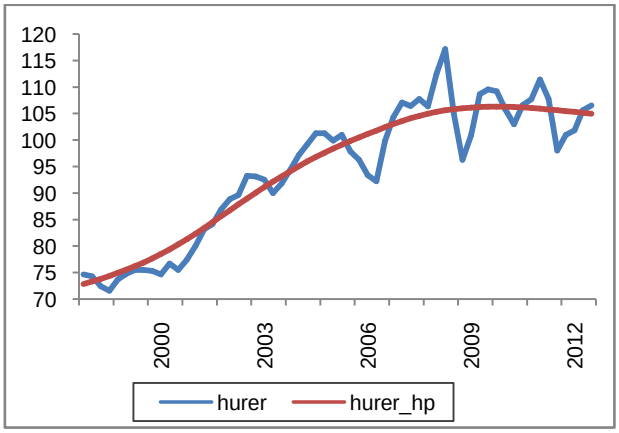

Figure 5. Real effective exchange rate in Hungary

Of all viewed countries here the monetary policy in Poland was found to be the most consistent. At both time intervals changes of interest rates occurred in the right directions, contributing to curbing of inflation and GDP growth. At the first interval inflation rates has dropped considerably (Figure 6). And decline of GDP growth rates was overcome (Figure 7).

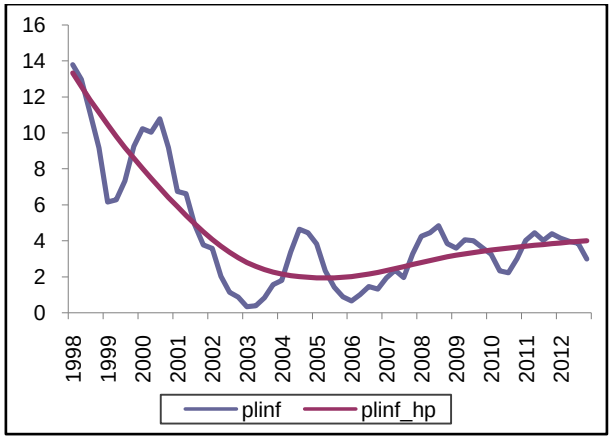

Figure 6. Inflation in Poland

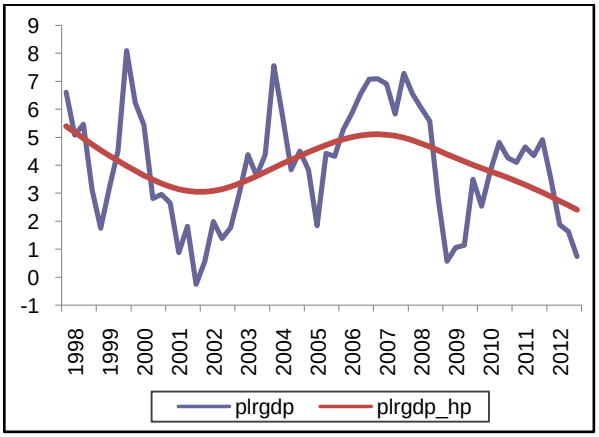

Figure7. GDP growth rates in Poland

At the second time interval the global financial and economic crisis influenced the economy. Inflation rates increased, and economic growth rates reduced. But, it can be assumed that due to the conducted monetary policy these changes were not so great. The coefficient at the variable of international reserves was statistically significant. However, focusing on the dynamics of inflation and GDP, the monetary authorities did not act in the direction to support the international reserves.

In Russia as well as in Hungary with the passage of time goals altered for which the interest rate reacted in right directions. At the first time interval the interest rate responded correctly to fluctuations of GDP and improperly to changes of inflation and real effective exchange rates (Figures 8-11). Indeed, this corresponds to the view that during 2000-2008 the Russia's central bank sought to target the real exchange rate, thus regularly violated its inflation target (Sinyakov, 2013).

At the second time interval, on the contrary, the monetary authorities have been paying main attention to curbing rising prices, and the interest rate responded appropriately to changes of inflation rates, nominal exchange rates and international reserves, but responded improperly to fluctuations of GDP. During the global financial crisis the GDP growth dropped markedly.

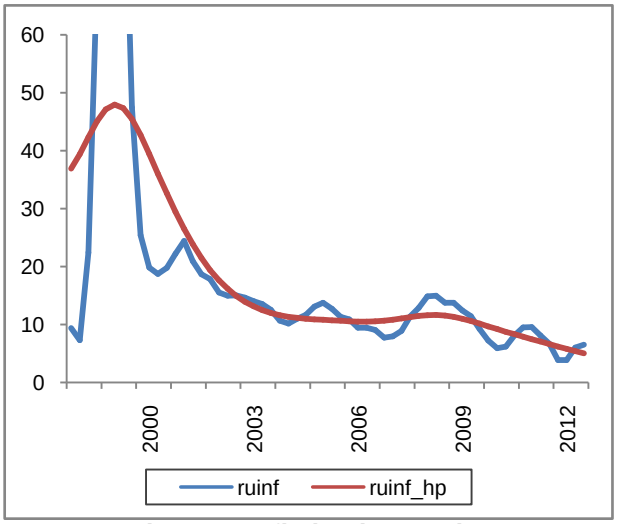

Figure 8. Inflation in Russia

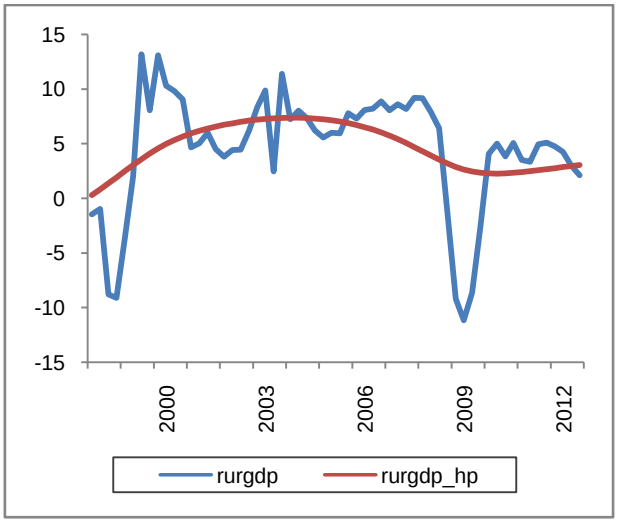

Figure 9. GDP growth rates in Russia

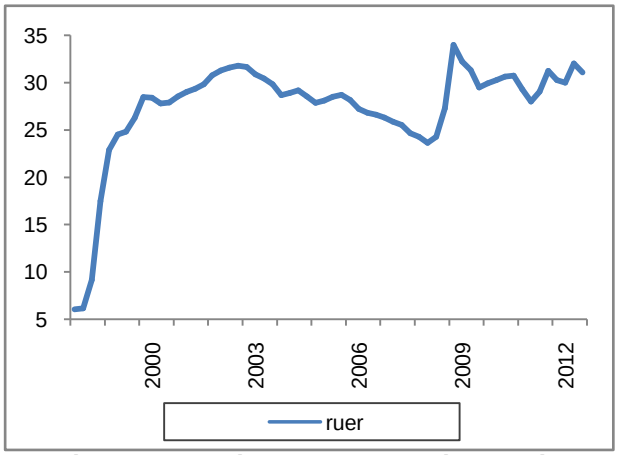

Figure 10. Exchange rate USD in Russia

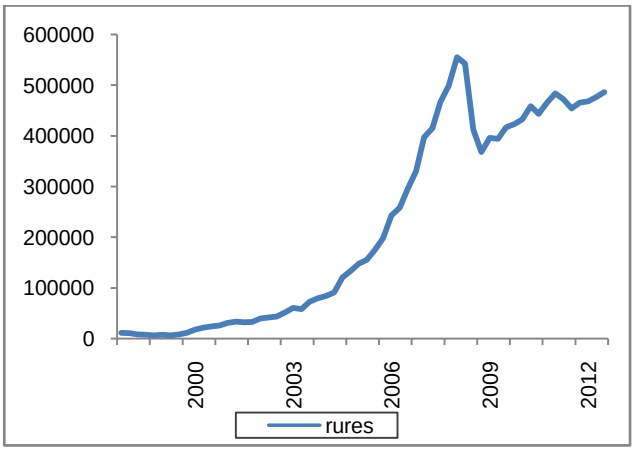

Figure 11. International reserves in Russia

Monetary authorities of Kazakhstan at both time intervals had policies directed mainly to curbing inflation (Figure 12). GDP growth rates at the first time interval were high, about 10 percent in annual terms (Figure 13). This is primarily explained by the oil production in Kazakhstan and its demand on the global market. Therefore, monetary authorities were not concerned about supporting economic growth. Significant emphasis was placed on increasing international reserves at the first time interval, as the interest rate reacted in the right directions in response to their changes (Figure14).

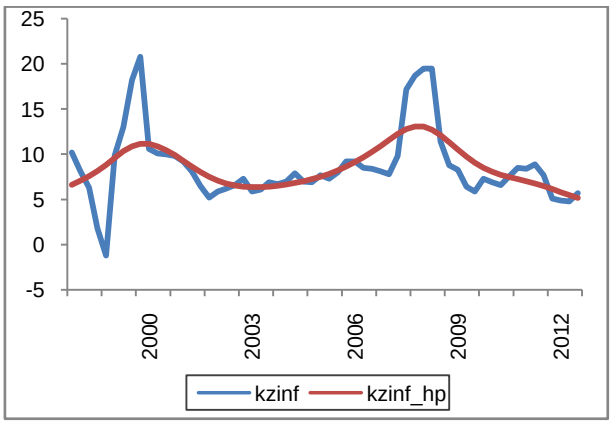

Figure 12. Inflation in Kazakhstan

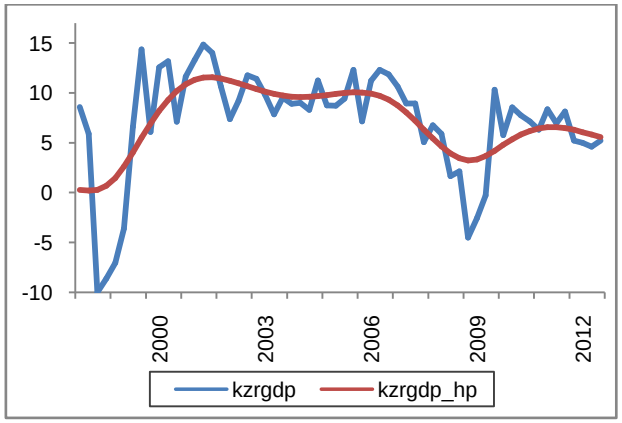

Figure 13. GDP growth rates in Kazakhstan

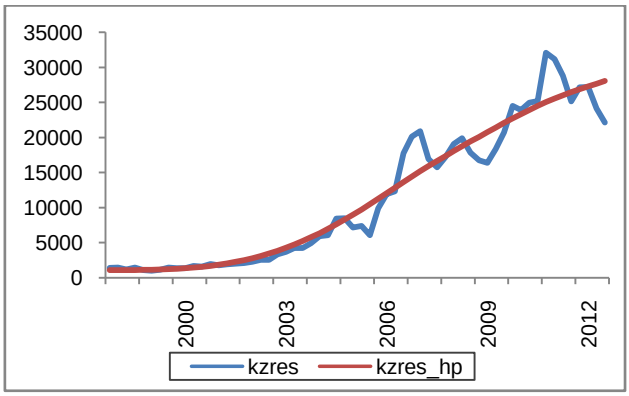

Figure 14. International reserves in Kazakhstan

Whereas, at the second time interval, the interest rates reacted improperly to changes of international reserves. This can be explained by the fact that significant international reserves were already accumulated, and their constant influx was provided through the sale of the oil abroad. For the rest of goals the interest rate replied in opposite directions to those assumed in the model specification.

In Ukraine the monetary authorities at both time intervals influenced on the interest rate toward curbing of rising prices (Figure 15). At the first interval the interest rate changed incorrectly with respect to changes of GDP (Figure 16). However, considerable attention was paid to stabilization of the exchange rate of the national currency - hryvnia (Figure 17).

And at the second interval the interest rate reacted correctly to support the growth of GDP and reacted incorrectly to fluctuations of the nominal and real effective exchange rates.

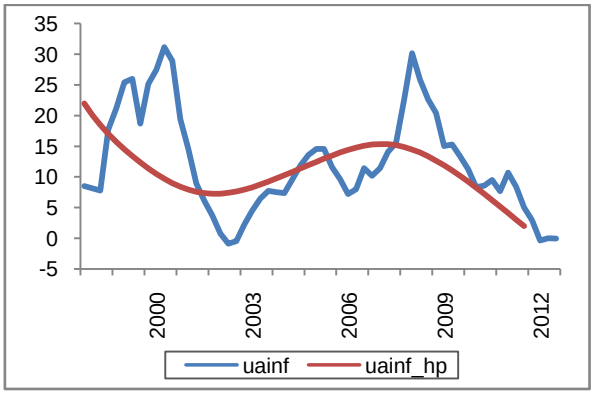

Figure 15. Inflation in Ukraine

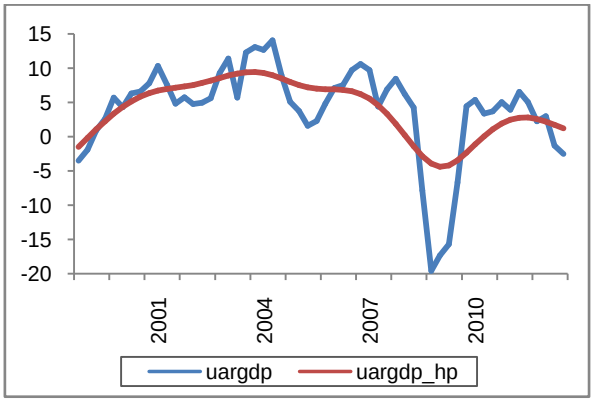

Figure 16. GDP growth rates in Ukraine

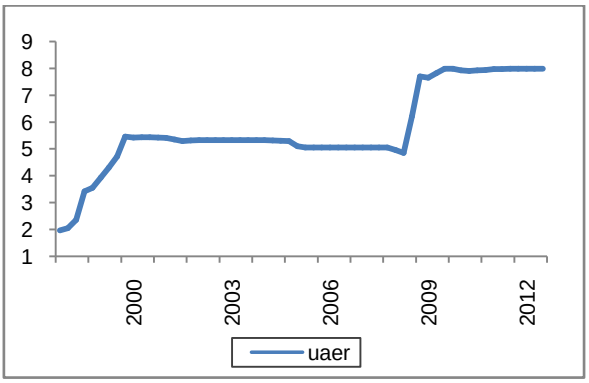

Figure 17. Exchange rate USD in Ukraine

6. Conclusion

Thus, in the considered countries of Eastern Europe and CIS certain rules of monetary policy took place. Dynamics of interest rates was formed primarily due to changes in inflation and / or growth of GDP. Interest rate had a fairly high inertia. The evolution of monetary policy rules reflect changes in monetary policy priorities of each country during the world financial and economic crisis. Central banks of several countries have not only maintained their key objectives on containment of rising prices and supporting economic growth, but also highlighted the importance of alternative objectives of nominal and real exchange rates and foreign exchange reserves by correctly responding to their changes. Apparently, this reflects the desire of these banks to provide greater stability of the economy to external shocks during the global world turmoil.

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