Economics and Management
ISSN: 2367-7600; 1312-594X
Volume: XV, Issue: 2, Year: 2018, pp. 100-110

МОДИФИЦИРАНЕ НА ПРАВИЛОТО НА ТЕЙЛЪР ЗА БАНКИТЕ НА УЗБЕКИСТАН НА ОСНОВАТА НА ПРЕКРАТЯВАНЕ НА РЕЖИМА

Сардор Садиков

THE MODIFIED TAYLOR RULE FOR BANK OF UZBEKISTAN ON THE BASIS OF MODE SWITCHING

Sardor Sadykov [1]

Received: 1.10.2018, Accepted: 30.10.2018

Abstract

Uzbekistan and foreign studies prove that the policy of central banks can be described by one or another version of the Taylor Rule. The Taylor Rule is a rule of a monetary policy, which defines how the interest rate changes in case of a change in GDP and inflation indicators. In particular, it states that for each percent of inflation growth a central bank has to increase the nominal interest rate by more than one percentage point. This aspect is often called the Taylor principle. We made an empirical assessment of the efficiency of the Central Bank of Uzbekistan policy and built an econometric model based on the nonlinear least square method. We used the data on inflation rate and GDP size from the official site of the Department of statistics of Uzbekistan, and the inflation data from annual reports of the Central Bank of Uzbekistan on principal direction of the unified State monetary policy. We calculated the GDP gap as a difference between the quarterly GDP value and its trend generated with the help of the Hodrick–Prescott filter. The results of the developed model enabled to conclude that all indicators turned out to be significant. According to the original Taylor's work, the coefficient of inflation gap is 1.5, and the coefficient of GDP gap is 0.5. In our case, the coefficient of inflation gap was lower and made 1.13, and the coefficient of GDP gap – 0.4. On the basis of our calculations (the Chow test and evaluation of two econometric models for two sub-samplings: during pre-crisis and post-crisis periods), we found out that it is economy during crisis periods. We believe it is necessary to develop the Taylor Rule, which the Bank of Central Bank of Uzbekistan can use in inflation targeting based on crisis situations.

Keywords: *Taylor's model, monetary policy, inflation targeting*
JEL Codes: *(C36, D84, E31, E52.)*

[1] Student of the Master's programms in Applied Economics, National Research University „Higher School of Economics", e-mail s.sadykov@edu.hse.ru

The article notes that foreign studies prove that the policy of Central banks can be described by one or another version of Taylor's rule.

Taylor's rule is a monetary policy rule that determines how much interest rate changes if GDP and inflation change. In particular, it States that for each percent of inflation growth, the Central Bank must raise the nominal interest rate by more than one percentage point. This aspect is often referred to as the Taylor principle.

The empirical evaluation of the efficiency of the policy of the Central Bank of Uzbekistan was carried out and the econometric model was built. The nonlinear least squares method was used as a methodology. Data on the level of inflation, as well as the value of GDP were taken from the official Website of the Bureau of statistics of Uzbekistan, inflation data – from the annual reports of the Central Bank of Uzbekistan on the main directions of the unified state monetary policy. The GDP gap was calculated as the difference between the quarterly GDP value and its trend generated by the Hodrick-Prescott filter.

According to the results of the constructed model, it is concluded that all the indicators were significant. According to Taylor's original work, the inflation gap ratio is 1.5, and the GDP gap is 0.5. In the case under consideration, the inflation gap ratio was lower at 1.13, and the GDP gap was 0.4.

As a result of calculations (based on the Chow test and the evaluation of two econometric models for two subsamples: in the pre-crisis and post-crisis periods), it was found that the standard Taylor's rule for the economy of Uzbekistan is certainly applied to crisis periods.

The idea of developing such Taylor's rule, which the Central Bank of Uzbekistan will be able to use when targeting inflation considering crisis situations, is put forward.

Over the past two decades, there have been significant changes in the monetary policies of developing countries. Special attention of the Central banks of the majority of States is focused on achieving stability of the main macroeconomic indicators-inflation, production volumes, real and nominal exchange rate of the national currency, which ultimately leads to positive results:

- improving the living standards of the population;
- increasing monetization of the economy;
- maintaining long-term economic growth.

In accordance with the main directions of the unified state monetary policy, the main objectives of the Central Bank of Uzbekistan are to reduce inflation or maintain inflation at a level that ensures sustainable economic growth, as well as increasing the investment attractiveness of the country. To do this, the Central Bank of Uzbekistan needs to solve a number of problems:

- to ensure the stability of the Uzbek Summ

- gradually narrow the interest rate corridor to reduce the volatility of the monetary market rates, etc.
- The following set of tools is used:
- interest rates on operations of the Central Bank of Uzbekistan
- mandatory reserve ratios (reserve requirements) of the Central Bank of Uzbekistan;
- secured loans of the Central Bank of Uzbekistan;
- direct REPO operations of the Central Bank of Uzbekistan;
- currency swap transactions of the Central Bank of Uzbekistan;
- Deposit operations of the Central Bank of Uzbekistan;
- operations with securities of the Central Bank of Uzbekistan;
- Central Bank of Uzbekistan operations on buying / selling securities on the open market;
- loans of the Central Bank of Uzbekistan without collateral.

There is currently no consensus on how to achieve these goals. The following questions remain debatable:

✓ whether active intervention of the state power in the market is required or the best way of regulation-the neutral attitude to the events in economy;

✓ whether monetary policy becomes more effective in forecasting and determining the normative values of macroeconomic indicators.

Despite numerous studies in the field of monetary policy, some aspects of Uzbekistan's economy have not been sufficiently studied. This encourages modern analysts to develop mathematical models that can be used to study the behavior of time series and predict the financial stability of the country. It is also important to choose an adequate method of analysis and the accuracy of the estimates of the functional dependence parameters. Thus, monetary policy can be described through the function of several variables.

Many foreign studies show that Central Bank policies can be described by some version of Taylor's rule. Note that Taylor's rule is a rule of monetary policy that determines how much the interest rate changes in the case of changes in GDP and inflation. In particular, the rule States that for each percent of inflation growth, the Central Bank must raise the nominal interest rate by more than one percentage point. This aspect is often referred to as the Taylor principle.

The main types of Taylor's rule are based either on matching data or on a set of forecasts or on accurate information available to Central banks at the time of the decision (so-called real-time data). Various modifications of the classical Taylor rule are studied in detail in a number of papers (7, 8, 10, 11, 14). In addition to the Taylor rule, there are other methods of describing and modeling the monetary policy of a country. For example, the McCallum rule (McCallum,2000), which is based on the analysis of the monetary base, is quite popular. The main difference between the rules of McCallum and Taylor is

the choice of the Central Bank's response to changes in macroeconomic conditions. The Taylor rule, which uses the nominal interest rate as a tool, is widely used in the evaluation of monetary policy because of its simplicity. However, the McCallum rule, which uses the growth rate of the monetary base as an instrument, played a significant role in the formulation of monetary policy until the 1990s [1].

The original McCallum rule can be expressed as follows:

$\Delta b_t = \Delta x^* - \Delta \gamma_t + 0.5(\Delta x^* + \Delta x_{t-1}) + \mu_t$ (1)

where Δb_t - is the rate of change of the monetary base in percent per year;

Δx^* - planned level of change in nominal GDP in percent per year;

$\Delta \gamma_t$ - rate of change in base speed as a percentage per year, average for the previous 4 years;

Δx^* - the level of change in nominal GDP as a percentage per year.

For this rule, the planned value of nominal GDP growth is calculated as the sum of the planned level of inflation and the long-term average growth rate of real GDP.

Some researchers attempt to explain inflation in Russia using monetary aggregates. For example, Pesonen, Korhonen (Pesonen & Korhonen, 1998, pp.59-72) etc. Dabrowski (Dobrowski et al., 2002) Usanov et al. (13) using the test of causality according to Granger is shown on the example of Russia, at least in the short term (up to 7 months.) Granger causality is directed only from prices to monetary aggregates, and not Vice versa. Score (9) argues that the Taylor rule-based interest rate ineffective. He emphasizes that monetary policy affects the economy through the exchange rate, as well as through interest rate channels. Ball builds a simple model based on the is curve of the open economy, the Phillips curve, and the relationship between interest rate and exchange rate. In addition, ball suggests that in a small open economy, the Central Bank should use a weighted average interest rate and exchange rate as an instrument. However, this type of hybrid rule did not become popular among researchers due to inaccuracies in determining weights[2].

We will analyze the monetary policy of the Central Bank of Uzbekistan in 1998-2018 using the Taylor standard rule. Following the instructions on the empirical evaluation of the rules of monetary policy, we use the following equation of the interest rate dynamics:

$$i_t = p_t i_{t-1} + (1 - p_t) i^*$$

where i_t – is the nominal interest rate;

i^* - the target interest rate.

[1] For example, for the Central Bank of Germany.

[2] Ball rules are hybrid rules where the monetary conditions index (MCI) applies. The MCI is an indicator of the monetary policy environment, looking at the impact of the exchange rate on inflation.

Suppose that the target interest rate depends on the expected inflation and the gap between GDP and lag in one period. This type of structure may be optimal in a model where the real interest rate affects aggregate demand with a lag in one period (with a delay in one period) and where aggregate demand affects inflation with the same lag (17).

Thus, this equation has the following form:

$$i* = i^{\wedge} + \rho_{\pi}(\pi_t + \pi^T) + \rho_y(y_t + y^T)$$

where $i^{\wedge} -$ is the equilibrium nominal interest rate, which is a constant;

p - ratio for variables';

$(\pi_t + \pi^T)$ - inflation gap, the difference between the current inflation rate and the inflation benchmark;

$(y_t + y^T)$ - the GDP gap, the difference between actual GDP and potential GDP.

The combination of formulas (1) and (2) gives the empirical model the following form:

$$i_t = p_t i_{t-1} + (1 - p_t)\left[i^{\wedge} + \rho_{\pi}(\pi_t + \pi^T) + \rho_y(y_t + y^T)\right] + \varepsilon_t$$

$\varepsilon_t -$ the random error of the model.

Data on the nominal interest rate (refinancing rate) were taken from the website of the Central Bank of Uzbekistan , data on the level of inflation, as well as the level of GDP – from the Uzstat website, data on the inflation target – from the annual reports "Main directions of the unified state monetary policy" of the Central Bank of Uzbekistan, the GDP Gap was calculated as the difference between the quarterly value of GDP and its trend generated by the Hodrik-Prescott filter. Graphs of indicators included in the Taylor rule are shown in Fig. 1-3.

Thus, the econometric model is constructed using the nonlinear least squares method, as well as using quarterly data for 1996-2016 (Table 1).

According to the results of the estimated model, it can be concluded that all the indicators were significant. According to Taylor's original work, the inflation gap ratio is 1.5, and the GDP gap is 0.5. In this case, the rate of inflation gap is lower and is 1.15, with a gap in GDP-0.3.

Figure. 1. Dynamics of the refinancing rate in Uzbekistan in 1996-2016, %

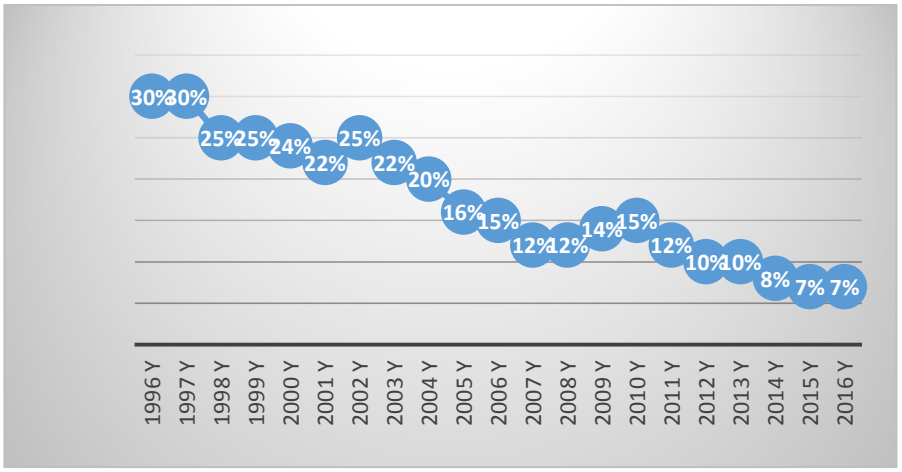


Figure. 2. Dynamics of inflation gap in Uzbekistan in 1996-2016, %

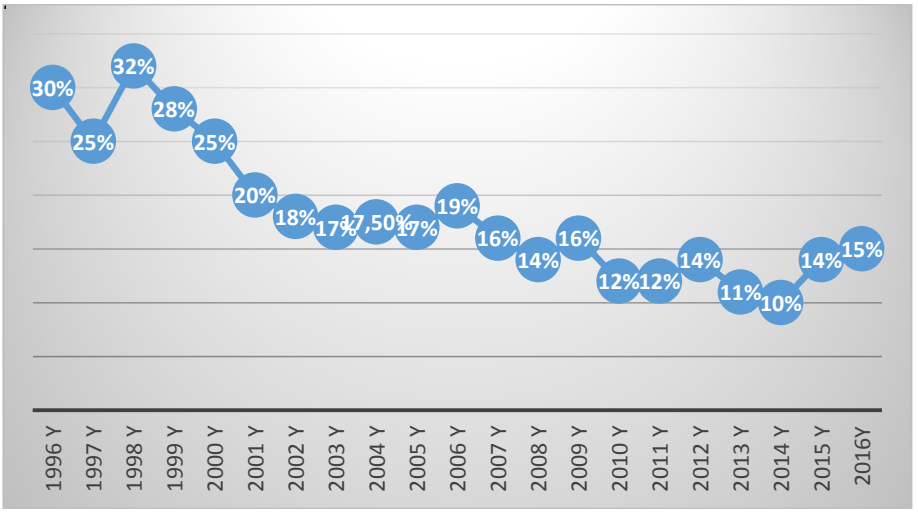
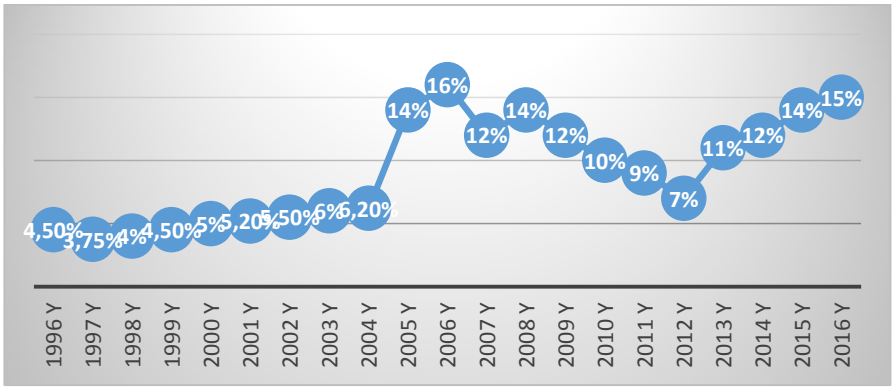


Figure 3. The dynamics of the gap of GDP in Uzbekistan in 1996-2016



In addition, it was found that the coefficient of smoothing the dynamics of the interest rate p_i is significant and plays an important role in the formation of monetary policy. For example, in the resulting model it is equal to 0.75. This means that the current interest rates are highly dependent on their previous value, the interest rates are very slowly adjusted against the target interest rates. The adequacy of the model is confirmed by a small standard error. ($\sqrt{S^2} = 0.75$), this indicates a good approximation of the results obtained in the simulation to the actual, and a high coefficient of determination, (R^2 =0.75), this suggests a close connection between the target interest rate and the selected instruments that affect its change.

However, it was decided to check whether the Central Bank's policies differ from one time to another, whether the Central Bank is focusing on inflation targeting, GDP targeting, or its policies remain unchanged during the period under review. To test this hypothesis, the Chow structural change test was applied. This test tests the hypothesis that the model parameters remain the same in different time periods and it is necessary to build a General model for the whole sample (according to the alternative hypothesis, the samples are considered to be heterogeneous and it is necessary to build two different models for samples).

*Table no.1. Evaluation of the Taylor standard rule**

Indicator	Coefficient	Std. Error	t-Statistic	Prob.
p_i	0,828710	0,050114	12,56339	0,0000
p_π	1,105444	0,128350	5,207376	0,0000
p_y	0,358530	0,154948	1,544564	0,0392
i*	0,683775	1,334911	0,408808	0,5549
R-squared	0,958681	Mean dependent var		10,50000
Adjusted R-	0,955045	S.D. dependent var		4,208738

squared				
S.E. of regression	0,759255	Akaike info criterion		2,452928
Sum squared resid	20,29332	Schwarz criterion		2,616760
Log likelihood	–45,73795	Hannan-Quinn criter		2,513344
Durbin-Watson stat	1,544605	-	-	-

$$i_t = p_t i_{t-1} + (1 - p_t)\left[\hat{i} + \rho_\pi(\pi_t + \pi^T) + \rho_y(y_t + y^T)\right]$$

Therefore, after the Chow test, two econometric models were also evaluated for two subsamples: for 1996-2008 (pre-crisis period), for 1996-2007 (post-crisis period). According to the results of the evaluation of the Taylor rule in the years 1996-2007 (table. 2) there was a significant difference in the value of the coefficient at the gap of GDP: it was equal to 1.15, not 0.4, as it was with the full sample.

However, the presence of a higher ratio in the GDP gap does not necessarily imply the Central Bank of Uzbekistan's desire to stabilize the GDP gap (GDP targeting), since the parameters of the Taylor rule reflect from a conceptual point of view not only the preferences of the Central Bank in a particular policy, but also the structural determinants of the transmission mechanism of monetary policy.

The increased attention to inflation targeting until mid-2016 is evidenced by the fact that the level of inflation in this period has significantly decreased compared to the previous two years. Growth in consumer prices amounted to 18.6% in 2001 and 15.1% in 2007 compared to 6.5% in 2017 reduce the level of inflation in the 2001-2017 years was achieved due to the following factors:

- carrying out a balanced budget and monetary policy corresponding to the adaptive possibilities of economic development (state budgets in the 2001-2007 years, was executed with a surplus);
- improvement of financial discipline;
- reduction of non-payment and barter.

The reduction of inflation was also facilitated by the implementation of a balanced tariff policy in the sphere of natural monopolies, the improvement of the price regulation process in 2001-2005.it Should be noted that the slowdown in inflation occurred in the conditions of growing solvent demand of the population.

*Table no. 2. Evaluation of the Taylor rule in 2001-2007**

Indicator	Coefficient	Std. Error	t-Statistic	Prob.
p_i	0,831710	0,030114	12,56339	0,0000
p_π	1,205444	0,044350	5,207376	0,0000

p_y	0,218530	0,054950	1,544564	0,0392
i*	0,583766	1,434922	-0,208814	0,5549
R-squared	0,958675	Mean dependent var		10,50000
Adjusted R-squared	1,155045	S.D. dependent var		4,208738
S.E. of regression	-0,859255	Akaike info criterion		2,452928
Sum squared resid	15,29332	Schwarz criterion		2,616760
Log likelihood	–45,73795	Hannan-Quinn criter		2,513344
Durbin-Watson stat	1,544605	-	-	-

$$i_t = \left[\hat{i} + \rho_\pi(\pi_t + \pi^T) + \rho_y(y_t + y^T)\right]$$

From mid-2002 to mid 2003 there was growth in GDP, industrial production and fixed capital investment. Capital expenditures in 2003 increased almost 4 times compared to 2002, the Revival of the investment activity also contributed to the growth of the industry. In 2003, GDP growth of 7.3% was accompanied by growth of capital investments and industrial production (12.5 and 7%, respectively). Most Uzbekistan economists and politicians believe that investment, rather than a favorable foreign economic environment, was the main reason for growth in 2003. The authorities ' attention to reducing the GDP gap (GDP targeting) in 2002-2007 is confirmed by consistently high GDP growth rates. According Uzstate, the average annual growth rate of GDP in Uzbekistan during this period was 7.5%.

*Table no. 2. Evaluation of the Taylor rule in 2008-2017**

Indicator	Coefficient	Std. Error	t-Statistic	Prob.
p_i	0,31710	0,030114	14,56339	0,0000
p_π	1,205444	0,044350	5,207376	0,0000
p_y	0,218530	0,054950	1,544564	0,0392
i*	0,583766	1,434922	-0,208814	0,5549
R-squared	0,958675	Mean dependent var		10,50000
Adjusted R-squared	1,155045	S.D. dependent var		4,408738
S.E. of regression	-0,859255	Akaike info criterion		2,252928
Sum squared resid	15,29332	Schwarz criterion		2,216760
Log likelihood	–45,73795	Hannan-Quinn criter		2,413344
Durbin-Watson stat	1,544605	-	-	-

$$i_t = p_t i_{t-1} + (1 - p_t)\left[i^{\wedge} + \rho_\pi(\pi_t + \pi^T) + \rho_y(y_t + y^T)\right]$$

This period is characterized by the global economic crisis of 2008-2009. the Peculiarity of the situation that has developed in the country is that the main negative trends that have determined the depth and severity of the crisis, were the result of developments in the world economy. However, despite the officially announced priority of the Central Bank of Uzbekistan on anti-inflation policy, the main efforts were aimed at smoothing the fluctuations in GDP, which is confirmed by the results of the evaluation of the Taylor rule in this period (the insignificance of the coefficient in the inflation gap). These results are also confirmed in the article. In addition, the insignificance of the coefficient of monetary policy smoothing indicates a lack of inertia in setting interest rates, i.e. the Central Bank of Uzbekistan when deciding on interest rates to a small extent, the management was the value of the rate in the previous period. Therefore, based on the results obtained, it can be concluded that the use of the standard Taylor rule for different periods of economic development of Uzbekistan is incorrect. The reform, the task is to develop a Taylor rule that the Central Bank of Uzbekistan will be able to apply when targeting inflation in view of crisis situations.

REFERENCES

Aizenman, J., Hutchison M. Inflation Targeting and Real Exchange Rates in Emerging Markets. *World Development*, Elsevier, 2010, vol. 39, pp. 712–724.

Aoki, K. On the optimal monetary policy response to noisy indicators. *Journal of Monetary Economics*, 2003, vol. 50, pp. 501–523.

Ball, L. Policy rules for open economies. *Working paper*, 1998, no. 6760, NBER, Cambridge.

Clarida, R., Gali, J., Gertler, M. Monetary policy rules and macroeconomic stability: Evidence and some theory. *Q.J. Econ,* 2000, no. 155, pp. 147–180 (and *NBER WP* 6442).

Cuche Nicolas A. Monetary policy with forwardlooking rules: The Swiss case. Swiss National Bank WP 00.10, Study Center Gerzensee, 2000.

Dabrowski, M., Paczynski, W., Rawdanowicz L. Inflation and monetary policy in Russia: Transition experience and future recommendations. *Case Studies and Analyses*, 2002, no. 241, Warsaw.

Esanov, A., Merkl, Ch. Monetary Policy Rules for Russia. *BOFIT Discussion Papers*, 2004, vol. 11.

Evans, C. Real-Time Taylor Rules and the Federal Funds Future Market. Federal Reserve Bank of Chicago. *Economic Perspectives*, 1998, vol. 2, pp. 44–55.

Fedorova, E.A., Lysenkova, A.V. Kak vliyayut instrumenty denezhno-kreditnoi politiki na dostizhenie tselei TSB RF [How monetary policy tools influence the achievement of objectives of the Central Bank of the Russian Federation]. *Voprosy Economiki*, 2013, no. 9, pp. 106–118.

Fedorova, E.A., Lysenkova, A.V. Modelirovanie pravila Teilora dlya denezhno-kreditnoi politiki Banka Rossii: empiricheskii analiz [Modeling the Taylor Rule for the monetary policy of the Bank of Russia: an empirical analysis]. *Finansy i kredit = Finance and credit*, 2013, no. 37, pp. 10–17.

McCallum, B. Alternative monetary policy rules: A comparison with historical settings for the United States, the United Kingdom and Japan. *Working Paper*, 2000, no. 7725, NBER, Cambridge.

Moiseev, S. Inflyatsionnoe targetirovanie: mezhdunarodnyi opyt i rossiiskie perspektivy [Inflation targeting: international experience and Russian prospects]. *Voprosy Economiki*, 2000, no. 9, pp. 88–105.

Moiseev, S.R. Pravila denezhno-kreditnoi politiki [Rules of monetary policy]. *Finansy i kredit = Finance and credit*, 2002, no. 16, pp. 37–46.

Pesonen, H., Korhonen, I. The short and variable lags of Russian monetary policy. *Review of Economies in Transition*, 1998, no. 4, pp. 59–72.

Plushchevskaya, Yu. O sostoyatel'nosti teoreticheskogo fundamenta targetirovaniya inflyatsii i novokeinsianskikh modelei obshchego ravnovesiya [On validity of the theoretical base of inflation targeting and new-Keynesian general equilibrium models]. *Voprosy Economiki*, 2012, no. 5, pp. 22–36.

Qin, T., Enders, W. In-sample and out-of-sample properties of linear and nonlinear Taylor rules. *Journal of Macroeconomics*, 2008, no. 30, pp. 428–443.

Shagas, N.L., Tumanova, E.A. *Makroekonomika. Elementy prodvinutogo podkhoda: uchebnik* [Macroeconomics. Elements of an advanced approach: a textbook]. Moscow, INFRA-M Publ., 2004, 400 p.

Svensson, L.E.O. Inflation forecast targeting: implementing and monitoring inflation targets. *European Economic Review*, 1997, no. 41, pp. 1111–1146.

Taylor, J.B. Discretion versus policy rules in practice. *Carnegie – Rochester Conference Series on Public Policy*, 1993, no. 39, pp. 195–214.

Vdovichenko, A.G., Voronina, V.G. Monetary policy rules and their application in Russia. *Research in International Business and Finance*, 2006, no. 20, pp. 145–162.

Wolters, M. Estimating monetary policy reaction functions using quantile regressions. *Journal of Macroeconomics*, 2012, vol. 34, pp. 342–361.

Zheng, T., Wang, X. Estimating forward-looking rules for China's Monetary Policy: A regime-switching perspective. *China Economic Review*, 2012, vol. 23, pp. 47–59.