
**PREDICTING KEY INTEREST RATES: A REGULATORY
FRAMEWORK FOR MANAGING INFLATION**

**PREVENÇÃO DAS PRINCIPAIS TAXAS DE JUROS: UM QUADRO
REGULATÓRIO PARA ADMINISTRAR A INFLAÇÃO**

**PREDICCIÓN DE LAS TASAS DE INTERÉS CLAVE: UN MARCO
REGULATORIO PARA LA GESTIÓN DE LA INFLACIÓN**

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ABSTRACT

Objective: The purpose of this study is to develop a toolkit that allows you to effectively predict the decision of the Central Bank to change the key rate.

Methods: Using the methods of correlation analysis and multiple linear regression, a model has been built that shows that there is a close relationship between the key rate and inflation, the volume of currency in circulation, and inflation expectations of the population.

Result: The results of the study are consistent with the findings presented in previous works, indicating that inflation is the main factor in making decisions about raising and/or lowering the key rate.

Conclusion: The findings of the study suggest that a more thorough analysis of additional factors is necessary, which will allow for the development of a qualitative forecast of economic growth and outline ways to stabilize prices. As a result of the analysis, an equation is obtained that can be used to predict the level of the key rate when certain macroeconomic indicators change.

Keywords: Interest rates; Monetary policy; Inflation; Regulation; Inflation expectations.

RESUMO

Objetivo: O objetivo deste estudo é desenvolver um kit de ferramentas que permita prever com eficácia a decisão do Banco Central de alterar a taxa básica de juros.

Métodos: Utilizando os métodos de análise de correlação e regressão linear múltipla, foi construído um modelo que mostra que existe uma estreita relação entre a taxa básica de juros e a inflação, o volume de moeda em circulação e as expectativas de inflação da população.

Resultado: Os resultados do estudo são consistentes com os achados apresentados em trabalhos anteriores, indicando que a inflação é o principal fator na tomada de decisões sobre aumento e/ou redução da taxa básica de juros.

Conclusão: Os resultados do estudo sugerem que é necessária uma análise mais aprofundada de fatores adicionais, o que permitirá o desenvolvimento de uma previsão qualitativa do crescimento econômico e delineará maneiras de estabilizar os preços. Como resultado da análise, obtém-se uma equação que pode ser usada para prever o nível da taxa básica quando certos indicadores macroeconômicos mudam.

Palavras-chave: Taxas de juros; Política monetária; Inflação; Regulamento; Expectativas de inflação.



RESUMEN

Objetivo: El propósito de este estudio es desarrollar un juego de herramientas que le permita predecir de manera efectiva la decisión del Banco Central de cambiar la tasa clave.

Métodos: Utilizando los métodos de análisis de correlación y regresión lineal múltiple, se ha construido un modelo que muestra que existe una estrecha relación entre la tasa clave y la inflación, el volumen de moneda en circulación y las expectativas de inflación de la población.

Resultado: Los resultados del estudio son consistentes con los hallazgos presentados en trabajos previos, indicando que la inflación es el principal factor en la toma de decisiones de subida y/o baja de la tasa de referencia.

Conclusión: Los hallazgos del estudio sugieren que es necesario un análisis más profundo de factores adicionales, lo que permitirá desarrollar un pronóstico cualitativo del crecimiento económico y delinear formas de estabilizar los precios. Como resultado del análisis se obtiene una ecuación que puede ser utilizada para predecir el nivel de la tasa clave cuando cambian ciertos indicadores macroeconómicos.

Palabras clave: Tasas de interés; La política monetaria; Inflación; Regulación; Expectativas de inflación.

1 INTRODUCTION

The economies of many countries are actively recovering and, according to forecasts, due to a further revival of domestic and external demand, economic growth will continue (International Monetary Fund, 2021).

At the same time, the rise in prices on world commodity markets, the weakening of national currencies in most transition economies led to an increase in inflation, which largely depends on favorable loan terms for all sectors of the economy (Manuylenko & Shebzukhova, 2021). Moreover, savings accumulated by the population during lockdowns and a surge in consumer demand after the relaxation of restrictions related to COVID significantly contributed to the rise in prices (Zhilenko et al., 2021).



In response to increased inflationary pressures, central banks are adjusting their monetary policy and making decisions to change the key interest rate depending on inflationary prospects and economic growth.

The central banks of some countries with low inflation and low growth rates are using instruments of quantitative easing of monetary policy. For example, the central banks of Denmark, Switzerland, Sweden, and Japan have cut key rates to zero and below. The banks' decision to set negative interest rates, coupled with other policy measures, is an efficient tool for stimulating economic growth and higher inflation, however, leads to increased pressure on banks' profits.

The central banks of some countries, which have identified the achievement and maintenance of price stability and low inflation as the main goals of their monetary policy, will actively raise key rates in 2021. This policy is implemented by the central banks of the Czech Republic, South Korea, Chile, Mexico, Brazil, the Russian Federation, etc. It should be noted that Russia has one of the highest rates and during 2021 it has been raised several times.

Establishing the optimal level of the key rate is one of the urgent tasks facing the Central Bank to achieve stable inflation and moderate interest rates on loans. This will allow monetary policy to provide strong support to the economy before the recovery is complete (Lochan et al., 2021).

As a rule, decisions on changing the key rate are made based on the forecast of inflation and economic growth. Considering that many other factors influence decision-making on the key rate, the study of the nature and extent of such influence determines the relevance of our research.

Currently, there is a wide range of theoretical and empirical literature on the impact of monetary policy pursued by the Central Bank on the growth of the country's economy.

Much of the research is devoted to analyzing the relationship between monetary and fiscal policies (Alves et al., 2019; Kamps et al., 2017; Miftahu, 2019; Moreira & Zambon Monte, 2021; Silva & Vilela, 2017), the impact of monetary policy



of the Central Bank on economic growth and financial stability of the country (Akalpler & Duhok, 2018; Hassen & Hamdi, 2020; Lee & Werner, 2018; Smets, 2014).

Currently, there are various monetary instruments available and various ways of influencing the economy. According to classical economic theory, central banks use key rates to shape monetary policy (Partachi & Mija, 2015). The central bank's function of changing interest rates is used as an additional instrument of government intervention. The problems of the Bank of Russia in the field of decision-making based on a macroeconomic forecast and the application of the key rate were studied in a joint study by A. Tsakaev and Z. Saidov (2021). The authors formulated recommendations regarding the application of the world practice of accounting for the real neutral interest rate when the Central Bank decides on the level of the key rate.

Studies show that the interest rate plays several roles in the economy, and these roles are closely related.

First, decisions to change the interest rate are made to ensure price stability and low inflation. Research results (Gashchyshyn et al., 2020; Monsalve-Cobis et al., 2017; Özen et al., 2020) show that interest rate indirectly affects inflation through domestic demand for goods and the exchange rate. The central bank usually raises the interest rate when inflation is forecast to exceed the inflation target (Neri & Ropele, 2019).

The relationship between the Central Bank's interest rate and inflation has been tested by numerous researchers in different regions and over different periods. I. Polyakova, having studied the relationship between the key rate and inflation, concludes that the key rate is "tied" to the inflation index. However, according to the author, one should not "blindly" drive up the key rate for price increases, since sometimes the inflation rate is "overinflated" and is largely determined by the psychology of producers of goods and services and not by real market processes (Polyakova, 2021).

E. Kilchi (2018), using the Fourier approach, analyzed the connection between central bank interest rates and inflation. The findings confirmed the data of similar studies previously conducted by E. Goole, and A. Ekinchi (2006), S. Guris, B. Guris,



and T. Un (2016), and others on the presence of a causal relationship between the central bank interest rate and the consumer price index.

D. Paun, S. Manta, and S. Mihaela (2013) using the econometric theory of multiple regression applied a new statistical approach to estimate inflation over time in terms of money supply and interest rates. The results confirmed the findings of many previous empirical studies showing that decisions on interest rate setting can be influenced by inflationary effects and an increase in the money supply.

Second, the Central Bank's interest rates affect the cost of borrowing. With an increase in the key rate, interest payments on loans increase, disposable income decreases, and, therefore, the growth of consumer spending is limited (Yuzvovich et al., 2020). Lower interest rates stimulate borrowing, discourage household savings, and increase the liquidity of the banking sector (Bhunja, 2016).

At the same time, other empirical studies (Ampudia & Heuvel, 2018; Ballach & Kobi, 2019; Borio & Gambacorta, 2017; Eggertsson et al., 2019; Kylie & Roberts, 2017) find that low interest rates can negatively affect the profitability of the lending business of banks and can encourage them to take risks.

Therefore, the problems of using the interest rate as one of the main instruments of the state's monetary policy and its relationship with macroeconomic indicators of economic development are comprehensively explored in the academic literature. At the same time, studies on the influence of numerous other factors, such as the amount of cash in circulation, inflation expectations of the population, etc., on making decisions on raising/lowering the key rate are extremely scarce.

This study hypothesizes that the inflation rate, the amount of cash in circulation, and the change in inflation expectations of the population are closely related to the level of the key rate and have a significant impact on the Central Bank's decision-making to change it.



2 METHODOLOGY

This study is aimed at evaluating regression parameters, testing hypotheses about the statistical significance of the selected factors; verifying the adequacy of the presented model. To build a research model, a statistical observation was carried out to collect the data necessary to build a multiple linear regression and correlation model, which make it possible to assess the influence of various factors on the key rate of the Central Bank and make a decision on its change. The source of information is the statistical databases of the Central Bank of the Russian Federation.

The multiple linear regression model is as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + u \quad (1)$$

Where $\beta_1, \beta_2 \dots \beta_k$ are model parameters and u is a random value.

The coefficients $\beta_1, \beta_2 \dots \beta_k$ for each variable $X_1, X_2 \dots X_k$ show the degree of influence of a separate variable on the indicator Y , provided that the influence on Y of the remaining variables remains unchanged.

The resulting indicator (Y) is the level of the Central Bank's key rate, which is formed under the influence of other factors.

The correlation coefficient reflects the degree of dependence between these factors. Using the linear correlation function, an assessment of the influence of factors ($X_1, X_2, X_3 \dots, X_n$) on each other and the studied indicator Y is carried out.

Three factors were selected as variables:

X_1 is inflation rate, %;

X_2 is the index of the output of goods and services by basic types of economic activity;

X_3 is the changes in inflation expectations of the population, %. This indicator is the median value of expected inflation, which is calculated according to the data of a standardized survey of the population conducted by the Central Bank on a representative all-Russian sample in the "face-to-face" mode (LLC "inFOM", 2021).



X4 is the volume of cash in the economy's circulation, billion rubles;

X5 is the volume of loans provided by banks to legal entities and sole proprietors;

X6 is the exchange rate of the national currency to the US dollar.

The statement that the key rate (y) does not depend on the selected factors is accepted as a null hypothesis, i.e. $\beta = 0$.

An alternative hypothesis is $\beta \neq 0$, i.e. the selected factors influence the key bank rate (Y).

Therefore: H_0 is the hypothesis that there is no relationship between the key rate of the Central Bank and the inflation rate in the country:

$H_0: \beta=0$

$H_1: \beta \neq 0$

Assessment of the influence of factors ($X_1, X_2, X_3 \dots, X_n$) on each other and on the studied indicator Y was carried out in Excel using the linear correlation function.

To test the significance of multivariable correlation and statistical hypotheses, the Fisher test (F) is used, the empirical value of which is calculated by the formula:

$$F_{emp} = \frac{R^2_{xy1} - R^2_{xy2}}{R^2_{xy1} - R^2_{xy2}} \quad (2)$$

The obtained F_{emp} index is compared with the critical value (F_{crit}), the value of which is calculated using the FINV function at the accepted significance level $\alpha = 0.05$, $k_1 =$ the number of parameters for variables in the multiple regression equation (n), $k_2 = m - 2$, where m is the number of observations.

If $F_{emp} \geq F_{crit}$, the null hypothesis about the random nature of the estimated factors is rejected, and the multiple regression equation is considered statistically significant and reliable.

If $F_{emp} < F_{crit}$, then the null hypothesis is not rejected and the statistical insignificance and unreliability of the model are recognized.

At the final stage, a forecast of the Central Bank's key rate is created, taking into account the influencing factors for making further decisions on changing it. To



obtain the predicted value of the key rate (Y), we substitute the predicted indicators of factor traits X1, X2 ... Xn into the resulting multiple regression equation.

3 RESULTS

The initial data for building a model and confirming the statistical hypothesis are presented in Table 1.

Table 1. Initial data for creating A statistical model for the dependence of the central bank's key rate on variable factors

Number of observations (Months)-n	Y	X1	X2	X3	X4	X5	X6
January	4.25	5.19	73.3	10.5	12,476.5	4,515.0	74.39
February	4.25	5.67	102	9.9	12,483.6	5,450.0	74.32
March	4.25	5.79	109.9	10.1	12,553.9	6,974.0	74.40
April	4.5	5.53	88.4	11.9	12,714.8	7,685.0	76.14
May	5	6.02	97.9	11.3	12,806.1	6,120.0	74.00
June	5	6.5	108.3	11.9	12,769.4	7,363.0	72.62
July	5.5	6.46	102.7	13.4	12,862.6	8,269.0	73.89
August	6.5	6.68	101.8	12.5	12,954	8,154.0	73.58
September	6.5	7.4	103.7	12.3	13,028.3	8,087.0	72.93

The resulting matrix of paired coefficients made it possible to assess the multicollinearity of the selected factors and make a decision to include them in the regression model (Table 2).



Table 2. Matrix of pair correlation coefficients

Factors	Key rate of the Central Bank	Inflation level	Index of the output of goods and services by basic types of economic activity	Changing inflation expectations	Cash in circulation, billion rubles	The volume of loans provided to legal entities and sole proprietors, billion rubles	Ruble to US dollar exchange rate
Key rate of the Central Bank	1.000						
Inflation level	0.902	1.000					
Index of the output of goods and services by basic types of economic activity	0.333	0.608	1.000				
Changing inflation expectations	0.749	0.662	0.178	1.000			
Cash in circulation, billion rubles	0.933	0.889	0.377	0.849	1.000		
The volume of loans provided to legal entities and sole proprietor	0.697	0.733	0.572	0.803	0.806	1.000	



s, billion rubles							
Ruble to US dollar exchange rate	-0.570	-0.734	-0.509	-0.276	-0.471	-0.213	1.000

Analyzing the data obtained, it can be noted that the inflation rate (0.902), the amount of cash in circulation (0.933), and the change in inflation expectations of the population (0.749) have the most significant impact on the key rate level. Moreover, there is a close correlation between the inflation rate (X1) and the amount of cash in circulation (X4), as well as between the amount of cash in circulation (X4) and changes in inflation expectations of the population (X5).

Thus, a regression model that includes all selected factors will be multicollinear. The procedure of step-by-step selection of the most informative variables made it possible to facilitate the interpretation of the parameters of this model.

The results of the regression statistics are presented in Table 3.

Table 3. Regression statistics of step-by-step selection of variables

Regression statistics	X1	X2	X3	X4	X5	X6
Multiple correlation coefficient R	0.902	0.333	0.749	0.933	0.697	0.570
R squared	0.814	0.111	0.560	0.871	0.486	0.325
Adjusted R squared	0.788	-0.016	0.498	0.852	0.413	0.229
Standard error	0.419	0.917	0.645	0.350	0.697	0.799
F-statistic of the Fisher test	30.712	0.872	8.922	47.113	6.629	3.372
Significance of F	0.001	0.382	0.020	0.0002	0.037	0.109

The results show that out of the six selected variables, two stand out: the volume of cash in circulation (X4) and the inflation rate (X1), which have the highest determination coefficients with the dependent variable Y, 0.871 and 0.814, respectively. The adjusted coefficients of determination of regression (adjusted R-squared) for these variables also have the highest values and are 0.788 for X1 and 0.852 for X4.

The significance of F for X1, X3, X4, and X5 is below the accepted level ($\alpha = 0.05$), which allows rejecting the null hypothesis with a 95% probability. That is, the



relationship between these variables has been proven, and these factors have a strong influence on the Central Bank's decisions on determining the key rate.

For variables X2, X6, the correlation coefficient is statistically insignificant. That is, these factors have an insignificant or indirect impact on decision-making on the key rate. Since the relationship between these variables has not been proven, a null hypothesis is accepted, and these factors are excluded from the regression model.

Regression statistics of the generalized linear model are presented in Table 4.

Table 4. Regression statistics of generalized linear model

Indicators	Value
Multiple correlation coefficient R	0.952
R squared	0.907
Adjusted R squared	0.814
Standard error	0.392
Observations	9
F	9.755
Significance of F	0.024

The indicators of regression statistics allow us to conclude that the quality of the constructed model is quite high. The coefficient of determination is 0.907, which indicates a very high degree of dependence. The empirical value for Fisher's test is 9.755. The critical value of the Fisher criterion (FFcr) for $\alpha = 0.05$, $k_1 = 4$, $k_2 = 7$ was 4.12. Since $9.755 > 4.12$, it can be argued that the equation is statistically significant and the model is of high quality.

To make a decision on the feasibility of changing the level of the key rate, a regression equation was created, which goes as follows:

$$Y = 0.5144 \cdot x_1 + 0.0408 \cdot x_2 + 0.0032 \cdot x_3 - 0.0001 \cdot x_4 + 38.1365$$

Using this equation, a forecast was made for changes in the key rate of the Central Bank until the end of 2021 (Table 5).

Table 5. Forecast of changes in the central bank key rate over three months

Months	FORECAST Y	Forecast of changes in variables			
		X1	X3	X4	X5
October	7.5	7.8	11.6	13,114.0	7,988.0
November	8.0	8.3	11.1	13,196.9	7,897.0
December	8.5	8.7	10.5	13,279.7	7,806.0



As the data in Table 5 show, due to the increase in the forecast inflation rate, a further increase in the key rate is a reasonable and rational decision on the part of the Central Bank of the Russian Federation.

4 DISCUSSIONS

The results of the study are consistent with the findings presented in the works by M.T. Kylie and J.M. Roberts (2017), D. Paun, S. Manta, and S. Mihaela (2013) about the fact that inflation is the main factor in making decisions about raising and/or lowering the key rate.

It should be noted that inflation forecasts by professional analysts have increased significantly. Thus, according to polls by Bloomberg, Reuters, and Interfax, analysts' forecasts for the end of 2021 were in the range of 6.4-6.6% (Bank of Russia, 2021a). Moreover, according to the forecast by the Bank of Russia, the inflation rate will stay in the range of 7.4-7.9% until the end of 2021.

At the same time, the actual inflation rate exceeds the forecast, and we agree with the experts that an additional rise in inflation is quite possible due to a low agricultural yield and an increase in the cost of food production.

A significant excess of the actual inflation rate over the target value may mean that with this approach, the key rate will not be reduced in the near future and may reach 8.5% by the end of the year.

It should be noted that the decision of the Central Bank to raise the key rate caused extensive discussions in the expert community. Part of the expert community believes that in the global realities of rising prices for raw materials and inflation expectations, the tightening of monetary policy by the Central Bank is fully justified.

The results of the study confirm the opinion of the Central Bank analysts, who believe that due to the rise in the cost of loans and the imposed macroprudential measures in the next six months, there will be "noticeable tightening of lending conditions for mortgages and consumer loans expected by banks" (Bank of Russia,



2021b). We believe that in the context of accelerating inflation and rising inflation expectations, tightening the monetary policy of the Central Bank is a rational and effective solution. This will increase the attraction of bank deposits for the population and balance the growth of lending (Izvestiya, 2021).

At the same time, as a rule, regulators consider not only the trend of consumer price growth but also the expectation of this growth.

Meanwhile, lowering the inflation rate through raising the key rate remains a controversial issue. Many experts conclude that the increase in the key rate will not lead to a decrease in inflation but will negatively impact economic growth.

According to the Higher School of Financial Management expert M. Kogan, in the current economic environment, it is impossible to achieve this through an increase in the cost of money and, having decided to further increase the key rate, the Central Bank will achieve the opposite effect, exacerbating the rise in prices for goods (Petrova, 2021).

G. Ostapkovich expresses doubts about the correctness of regulation by raising the key rate since inflation in Russia is cost-push rather than demand-pull (Lola & Ostapkovich, 2021). A further increase in the key rate will lead to a decrease in business activity and aggravate the conditions for doing business: loans will rise in price, the aggregate demand for goods will decrease.

We partially support A. Osin's opinion that the decision to raise the key rate creates constant fears of a shortage of liquidity and an increase in the cost of credit resources in the market (Aleksandrova, 2021).

A controversial issue at the moment is the nature of the impact of increasing the key rate on the national currency rate, the assessment of bank losses from the realization of the interest rate risk associated with the rapid growth of the key rate.

Some experts believe that the increase in the key rate will have a positive effect on the exchange rate of the national currency. At the same time, many experts argue that the impact of the key rate on the ruble exchange rate will be moderately positive and short-term. We tend to agree with this expert opinion since the findings showed that the two factors correlate at a medium level, and the significance of F exceeds 0.05,



which does not allow one to reject the null hypothesis with a high degree of probability and the relationship of these factors needs more detailed research.

Moreover, further research is required into the nature of the influence of other external and internal uncertain factors such as the epidemiological situation in Russia and the world, the price environment of world raw materials, commodity, financial markets, and the growth of global inflation in general on decision-making in terms of changing the key rate.

6 CONCLUSIONS

The findings of the study confirm the hypothesis that the key rate is closely interconnected with the level of inflation, the volume of cash in circulation, and changes in inflation sentiment of the population, and these factors have a significant impact on the decision to change the key interest rate.

In addition to the inflation rate, numerous economic factors have a significant impact on decisions to change the key interest rate.

For four of the six considered variables (inflation rate, changes in inflation expectations of the population, the volume of cash in circulation, and the volume of loans provided to legal entities and sole proprietors), the null hypothesis was rejected, i.e. these factors are closely related to the key rate.

The results obtained and the results of the activities of the Central Bank in Russia in 2022 fully confirm in practice the fears we have identified that a sharp increase in the key rate will reduce business activity and worsen the conditions for doing business (for example, the mortgage market has decreased several times).

The results presented in this work make it possible to conclude that a more thorough analysis of additional factors is necessary, which will allow us to develop a qualitative forecast of economic growth and outline ways to stabilize prices.



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