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«**MONETARY POLICY RULES ACROSS INFLATION-TARGETING COUNTRIES**»

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Коржик Таїсія Миколаївна

Керівник: Фарина О.І.
канд. економ. наук, PhD

Рецензент**:** Цапін А.О.
PhD, заступник начальника відділу досліджень Департаменту монетарної політики та економічного аналізу, Національний банк України

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Секретар ЕК _____Донкоглова Н.А.

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Abstract

This paper attempts to examine monetary policy rules for inflation targeting countries. This is done by looking at a particular simple Taylor rule and its modifications. The basic idea is to derive a simple rule to: guide central banks, explain their activities more clearly, and reduce uncertainty. For this purpose, we analyzed the classical Taylor rule, the Taylor rule with modified coefficients, and the rule with the addition of the exchange rate to it for five inflation targeting countries (New Zealand, Canada, Poland, Georgia, and Chile), as well as the effectiveness of using such simple rules under stressful conditions for the economy.

Keywords: monetary policy rules, Taylor's rule, inflation-targeters country

INTRUDUCTION

This research paper is devoted to the analysis of monetary policy rules in countries with inflation targeting, and the derivation of an optimal rule that describes the response of central banks. The low inflation rates recently achieved in the developed world are very often seen as the result of policy rules adopted by independent central banks. Although there are still proponents of monetary policy discretion who argue that a country's complex economic system cannot be described by any rule and that it must include many components that are difficult to describe numerically, even with such assertions a rule can be a good basis for decision-making, albeit with adjustments by the central bank. Currently, there are many monetary policy rules, such as: Friedman's rule, McCallum's rule, Taylor's rule, the monetary conditions index, and other less popular ones. Many of them partly describe the response of countries' Central Banks, some, like the banker's statement, have been in use for some time. This research paper takes the main components of classical monetary policy rules and tries to find commonalities in the work of central banks of inflation targeting countries.

The purpose of this study is to evaluate the application of monetary policy rules in inflation targeting countries, to derive a rule to describe the response of central banks and to evaluate their operating conditions.

To implement this goal are the following tasks:

- The study of economic literature on the topic of research;
- formulation of the main concepts related to the topic of the study;
- Analysis of the application of the rules in different countries and under different conditions;
- Assessment of the rules of monetary policy.

The object of the study is the rules of monetary policy. Accordingly, the subject of the thesis is the influence of various economic factors of the countries on their application and modification. The information base of the study is the data of the World Bank, as well as monographs, scientific papers of domestic and foreign scientists on the use of monetary policy rules and their variations, as well as Internet resources.

This paper complements the well-known theoretical and practical positions in the use of Taylor's rule in inflation targeting countries. To begin with, the paper reviewed the literature on inflation targeting and monetary policy rules, as well as examples of the use of monetary policy rules in the United States and inflation targeting countries. Then the optimal rules were derived, the basis of which is the Taylor rule. This was followed by graphically illustrated results for the five inflation targeting countries (New Zealand, Canada, Poland, Georgia, and Chile) and the possibility of using the rules under stressful economic conditions. At the end of the paper, we summarized the results of the models built and recommendations for the use of monetary policy rules.

LITERATURE REVIEW

1.1 Monetary policy and inflation targeting

Monetary policy of the state is a set of measures taken by the Central Bank of the country by influencing the state of credit and money circulation. These measures serve as a way of regulating business activity, creating favorable economic conditions for citizens' living and doing business, strengthening the national currency rate, maintaining stability in the country and sustainability of the state balance of payments. This policy is implemented through a variety of instruments, including adjusting interest rates, buying or selling government securities, and changing the amount of money circulating in the economy. The central bank or a similar regulatory organization is responsible for formulating these policies [1].

Monetary policy instruments:

1) Adjusting the interest rate. The central bank can influence interest rates by changing the discount rate. The discount rate is the interest rate charged by the central bank to banks for short-term loans. For example, if the central bank increases the discount rate, the cost of borrowing for banks increases. Subsequently, banks will increase the interest rate they charge their customers. Thus, the cost of borrowing in the economy will increase and the money supply will decrease.
2) Transactions on the open market. The central bank can buy or sell securities issued by the government to influence the money supply.
3) Change the requirements for the reserve. Central banks usually set a minimum amount of reserves to be held by a commercial bank. By changing the required amount, the central bank can affect the money supply in the

economy. If monetary authorities increase the required amount of reserves, commercial banks will find that less money is available to lend to their customers, and thus the money supply decreases.

One common regime of monetary policy is inflation targeting. «The essence of inflation targeting is that a central bank publicly announces quantitative targets for inflation and commits to achieve these targets over the medium-term horizon». Because of the medium-term focus of inflation targeting, policymakers do not need to feel compelled to do everything possible to meet the targets on a periodic basis. Some countries have chosen inflation targets with symmetrical ranges around the middle, while others have defined only a target rate or inflation ceiling. Most countries set their inflation targets in the low single digits.

The main advantage of inflation targeting is that it combines elements of both "rules" and "discretion" in monetary policy. This "limited discretion" framework combines two distinct elements: a precise numerical inflation target in the medium term and a response to economic shocks in the short term [2].

In order to properly and successfully achieve its goal of inflation targeting, a central bank must possess three important characteristics - independence, credibility, and transparency [1]. If central banks are not independent, monetary policy may be influenced by short-term political interests that may be incompatible with inflationary goals. In some cases, inflation targets may be inconsistent with other macroeconomic conditions and that is why confidence in the dental bank and its actions are so important. A central bank that is not transparent in its decisions may eventually lose credibility.

The first country to adopt inflation targeting was New Zealand in 1990. The only central banks that stopped inflation once they started are Spain, Finland, and the Slovak Republic - in each case after they adopted the euro as their domestic currency. The Czech Republic (1997), Poland (1998), Hungary (2001) and Armenia (2006) adopted

inflation targeting as they transitioned from centrally planned to market economies. Several emerging market economies adopted inflation targeting after the 1997 crisis, which forced several countries to abandon fixed exchange rate pegs. There are also several central banks in more developed countries, including the European Central Bank and the U.S. Federal Reserve, which have adopted many of the basic elements of inflation targeting, but do not officially call themselves inflation targeters.

As of the end of 2021, there are 55 countries around the world with an inflation targeting regime.

The classification of inflation targeting regimes can be found in the scientific literature, dividing them into: initial, classical, the highest. The main criteria allowing to distinguish between targeting regimes include: the degree of confidence in the national banking system, transparency of monetary policy, sustainability of macroeconomic parameters, development and sustainability of political institutions, flexibility of response of the financial and monetary system to changes in monetary policy instruments. The group of countries with a high inflation targeting regime includes the following countries: Japan, Switzerland, Singapore and others. Countries with a classical regime of inflation targeting include many countries in Central Europe, South African countries, Peru and others. Countries with an initial (low) inflation targeting regime include Eastern European countries, Slovakia, Uruguay, Russia and others. The compliance with these criteria in these countries is at a lower level, the probability of economic shocks and fluctuations is high [3, p.35-40].

Inflation targeting is thought to have several advantages, namely:

1) lead to greater independence for central banks;
2) reduce inflation by making monetary policy more credible;
3) reduce uncertainty about expected inflation rates;
4) improve communication between policymakers and the public by making monetary policy more transparent [4] so many countries have moved to it.

Under this concept, however, lower inflation can be achieved at the cost of lower output and higher unemployment than under other monetary regimes.

Conducting monetary policy according to simple rules that help achieve policy objectives, such as inflation targeting, has become a crucial issue for price and macroeconomic stability, especially in developing economies, as it increases the transparency and credibility of the monetary authority [5].

1.2 Monetary policy rules

Scholars and policymakers have long argued about whether central banks should follow predetermined, fixed rules or should have discretion in monetary policy. Proponents of using rules argue that a simple monetary policy rule is incompatible with the complexity of a country's economy. A good monetary policy rule defines an action plan that a central bank cannot ignore, while discretion allows central bankers to react - and often overreact - to economic performance as they see fit. A concrete plan gives confidence to the market that the central bank will not sacrifice long-term stability for short-term gains.

There are many definitions of monetary policy rules, both general, treating rules as a systematic process of making certain decisions based on current and past information, and using it in a consistent and predictable way, and more technical, that it is a certain formula, such as the Friedman's rule, which determines the way monetary policy instruments are applied.

«The K-Percent Rule was a proposal by economist Milton Friedman that the central bank should increase the money supply by a constant percentage every year» [6]. That is, he proposes to set the growth rate of the money supply equal to the rate of economic growth every year. Friedman's rule describes the following formula:

$$\Delta m_t = const, \quad (1.1)$$

where Δm_t - *the nominal growth rate of the money supply at a specific point in time (t).*

The problem with the rule is its inability to adapt to sudden fluctuations in the economy, as with many monetary policy rules, especially to changes in the demand for money. The result can be sharp "shocks" to income, employment, and the market.

The McCallum Rule is a monetary policy rule developed by economist Bennett T. McCallum at the end of the 20th century. «The McCallum Rule (1.2) uses a formula to set an operating target level for the monetary base in the next quarter based on the recent average velocity of money, current nominal Gross Domestic Product (GDP), and desired nominal GDP» [6].

$$\Delta m_t = y^* - v_t + p^*, \quad (1.2)$$

where Δm_t – *the nominal growth rate of the money supply at time t;*
y^* – *ten-year change in the average growth rate of real GDP;*
v_t – *four-year change in the growth rate of the money supply;*
p^* – *inflation target.*

One disadvantage of this rule is that although it looks at changes in several variables, the user still needs to have more information and decide what to do with it. Another disadvantage is that focusing on inflation can sometimes destabilize the economy, for example in a negative supply shock. The rule explains how the Federal Reserve must manipulate the supply of money to keep economic growth sustainable over the long term.

The McCallum rule is often contrasted with another Taylor rule. Taylor's rule is primarily concerned with the federal funds rate, while McCallum's rule describes the monetary base relationship.

The Taylor rule is one of the most famous rules of monetary policy. It was designed to provide "guidance" on how a central bank, such as the Federal Reserve, should set short-term interest rates as economic conditions change to meet both its short-term goal of stabilizing the economy and its long-term goal of inflation. Here's the formula:

$$r = p + 0{,}5y + 0{,}5(y - 2) + 2, \quad (1.3)$$

where r - *the Federal funds rate;*

p - *the rate of inflation;*

y - *the percent deviation of real GDP from a target (according to Taylor's calculations for the period from 1984-1992, it was 2.2%).*

To adequately understand the Taylor rule, the following explanation is needed: The policy rule in the equation (1.3) assumes that the federal funds rate rises if inflation rises above the 2% target, or if real GDP becomes above the "trend" value of GDP [7, c.202]. That is, this Taylor rule takes into account, first, the growth of GDP above the average value, which means overheating of the economy, and second, the accelerated rate of inflation in these conditions. The equation was built based on econometric research and therefore reflected the trends typical for a certain period of economic development.

But the author shuts down the mechanical use of rigid policy rules. Taylor identifies two methods for the practical use of his rule. The first is to use it as one of the tools to support central bank decisions on monetary regulation. For example, members of the U.S.

Federal Open Market Committee could use this rule when making appropriate decisions (primarily related to the regulation of interest rates) along with taking into account other indicators: forecasts obtained as a result of mathematical models, leading indicators, changes in the yield curve, etc. Second, Taylor advises taking into account the fundamental relationships identified through policy rule-making as basic principles of monetary policy formation and implementation. These principles include central bank rate hikes when inflationary pressures increase, and rate cuts when recession is more likely than higher inflation. The magnitude of the response of monetary policy to gaps in real GDP and inflation (the coefficients of formula (1.4)) depends on the level of sensitivity of aggregate demand to interest rates [8, p.26].

Understanding the limitations of this formula, in later works John Taylor gives the rule in a more general form:

$$r = \pi + gy + h(\pi + \pi^*) + r^f, \qquad (1.4)$$

where $r -$ *short-term interest rate;*

π - *retrospective inflation rate;*

$y -$ *percentage revelation of real GDP from the trend;*

$g, h, r^f, \pi^* -$ *constants.*

The modified formula of Taylor's rule (1.4) "can describe monetary policy in different historical periods in which different policy regimes were applied" [9, p.323]. When monetary policy implementation regimes change, coefficients (constants) (a, b) must be changed. The modified formula of Taylor's rule (1.4) "can describe monetary policy in different historical periods in which different policy regimes were applied" [9,

p.323]. When monetary policy implementation regimes change, coefficients (constants) (a, b) must be changed.

The Taylor rule recommends that the central bank should raise the interest rate when inflation or GDP is high, above potential, to cool the economy and to bring GDP or inflation to target levels. Conversely, when inflation and GDP are low, the interest rate should be lowered. Consequently, the purpose of the Taylor rule is to consider potential interest rate targets given the country's inflation and GDP.

Taylor's rule is the most famous rule of monetary policy and has the following advantages: it minimizes cyclical fluctuations in economics, simplicity in the formula, ease of testing in practice, it reflects all available economic information. The disadvantages that this rule has:

- ambiguous recommendations if inflation and GDP growth move in opposite directions;

- cannot cause sudden shocks or reversals in the economy, if necessary;

- during periods of (stagflation) stagnant economic growth and high inflation, Taylor's rule provides little guidance to users because equation conditions tend to exclude each other (according to the classical rule).

In his papers (with co-authors) [10, 11], Columbia University professor Richard H. Clarida justifies a slightly different form of monetary rule (formula (1.5)):

$$r = \pi^* + gy_t + h(\pi_t + \pi^*) + r^f, \quad (1.5)$$

where $r -$ *short-term interest rate;*

$\pi^* -$ *the long-term equilibrium level of inflation;*

$y -$ *percentage revelation of real GDP from the trend;*

r^f *−long-term equilibrium real interest rate;*

g, h *− constants.*

There are two fundamental features of this rule. First, formula (1.7) uses the equilibrium inflation rate (π^*) as an independent summand, not the lagged re-inflation (π). The second peculiarity is that π^* and r^f are calculated for a long term period; y_t and π_t are recalculated on a periodic basis (e.g., quarterly, as in Taylor's class rule).

This rule has been used by researchers to retrospectively analyze the monetary history of the United States and to analyze the monetary policies of other advanced market economies (Italy, France, and the United Kingdom). The authors pay special attention to the study of the actual values of constants g and h over different time intervals, and investigate the causes of deviations of the actual rates from the rates calculated according to the monetary rule.

Edward Nelson evaluated the application of the Taylor rule to various monetary regimes in Great Britain over the period from June 1972 (the introduction of the floating pound sterling exchange rate) to May 1997. (The Bank of England's operational independence from the Bank of England in May 1997. (the Bank of England gaining operational independence) [12]. During this period, monetary policy in Britain went through several monetary regimes: from the early 1970s income policy as an anti-inflationary tool; targeting of the M3 (cash in circulation outside depository corporations, transferable deposits in national currency, transferable deposits in foreign currency and other deposits and securities other than shares) aggregate from the late 1970s to the early 1980s; exchange rate management in the late 1980s, which reached its peak during the country's membership in the Eurozone from 1990 to 1992; and from October 1992 the introduction of an inflation targeting regime. Nelson applied two modifications of the Taylor rule (with smoothing) based on retrospective and forecast inflation data.

The Taylor rule is now widely known and taken into account in the development and implementation of monetary policy by most central banks in developed countries. In countries that develop Taylor:

1) the possible use of monetary aggregates as an alternative to interest rates;

2) the inexpediency of mechanical adherence to the monetary rule;

3) the need for inflation targeting regime;

4) the feasibility of increasing coefficients (which determine the response rate of monetary policy instruments);

5) the need to introduce the exchange rate indicator into the rule (for small open economies) [13, p. 32].

Consequently, the concept of "monetary rules", as well as any economic concept based on taking into account certain stable relationships between macroeconomic parameters to solve current economic problems, has a number of shortcomings. These shortcomings are mainly due to the unstable nature of socio-economic relations and little predictable, at the macroeconomic level, behavior of economic agents. However, two key theses in support of monetary rules offset most of the above drawbacks. First, all developers of monetary rules, in particular John Taylor, warn against their mechanical use and emphasize the advisability of their use along with other tools (expert judgment, modeling, etc.) to support the decisions of monetary authorities. Second, there is currently no theoretically sound and empirically confirmed alternative to monetary rules.

Taylor's rule is the basis for the creation of many other rules and is both the most common and the most varied rule.

1.3 The Taylor rule and other monetary policy rules for the United States

The primary Taylor rule was invented specifically for U.S. politics. The Federal Reserve is the primary authority on U.S. monetary policy and is mandated by Congress to pursue two objectives:

1) stable prices;

2) maximum sustainable output and employment.

Although Taylor's rule is the best known, the United States of America uses a number of other rules in its monetary policy.

Table 1.1 - Monetary policy rules adapted for the U.S.

Name of the rule	The formula for the U.S. rule
Taylor rule	$R_t^T = r_t^{LR} + \pi_t + 0{,}5(\pi_t - \pi^*) + 0{,}5(y_t - y_t^P)$
Balanced-approach rule	$R_t^{BA} = r_t^{LR} + \pi_t + 0{,}5(\pi_t - \pi^*) + (y_t - y_t^P)$
Inertial rule	$R_t^I = 0{,}85R_{t-1} + 0{,}15[r_t^{LR} + \pi_t + 0{,}5(\pi_t - \pi^*) + (y_t - y_t^P)]$
ELB-adjusted rule	$R_t^{Eadj} = maximum\{R_t^{BA} - Z_t, ELB\}$
First-difference rule	$R_t^{FD} = R_{t-1} + 0{,}1(\pi_t - \pi^*) + 0{,}1(y_t - y_{t-4})$

where *ELB - constant corresponding to the effective lower bound for the federal funds rate;*

$R_t^T, R_t^{BA}, R_t^I, R_t^{Eadj}, R_t^{FD}$ *- represent the values of the nominal federal funds rate prescribed by the Taylor, balanced-approach, inertial, ELB-adjusted, first-difference rules, respectively;*

R_t *- denotes the actual federal funds rate for quarter t;*

r_t^{LR} *- the level of the neutral inflation-adjusted federal funds rate in the longer run that, on average, is expected to be consistent with sustaining inflation at 2 percent and output at its full resource utilization level;*

π_t *- the four-quarter price inflation for quarter t;*

π^* *- the inflation objective, set at 2 percent;*

y_t *- the log of real gross domestic product (GDP) in quarter t;*

y_t^P *- the log of real potential GDP in quarter t;*

Z_t *- the cumulative sum of past deviations of the federal funds rate from the prescriptions of the balanced-approach rule when that rule prescribes setting the federal funds rate below zero.*

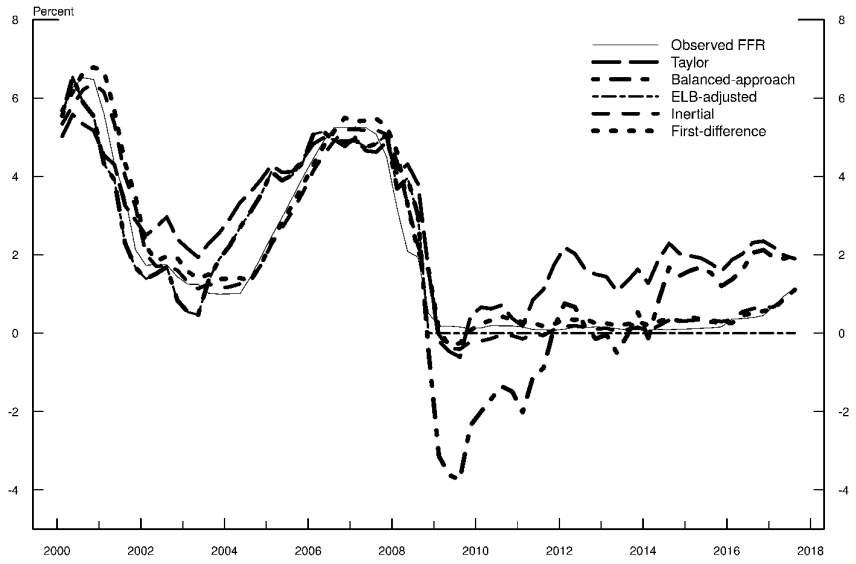
All of the rules in the table prescribe a policy rate level that is related to the deviation of inflation from the central bank's goal of 2% in the United States. The first four rules also respond to the percentage difference between the current value of real GDP and

potential GDP. These rules differ in the extent to which the prescribed policy rate responds to inflation and the resource utilization gap. The fourth rule recognizes the existence of an effective lower bound for the policy rate (central banks consider ELB to be close to zero). The third as well as the fifth rules differ from the other rules in that they relate the current policy prescription to the level of the rate in the previous period. The balanced approach rule is similar to the Taylor rule, except that the coefficient of the resource utilization gap is twice as large as in the Taylor rule, and thus gives more importance to the stabilization of this gap than the Taylor rule. This feature becomes very important in situations where there is a conflict between stabilizing inflation and stabilizing the output gap.

In deciding how to conduct monetary policy, the Federal Open Market Committee (FOMC) regularly relies on the prescriptions of several monetary policy rules along with other information relevant to the economy and economic outlook [14]. However, the U.S. economy is very complex, and monetary policy rules by their very nature do not reflect this complexity and so the FOMC examines a great deal of information to assess how realized and expected economic conditions change relative to inflation and employment goals.

Let us also consider a graphical representation of monetary policy rules from Table 1.1 for the United States from 2000 to 2018 (Figure 1.1)

Figure 1.1 – Prescriptions of Simple Rules for the Federal Funds Rate



Source: [15], [16], [17].

Figure 1.1 also shows that all of the rules called for a significant reduction in the federal funds rate in 2008, when the U.S. economy deteriorated significantly during the global financial crisis, and all but the ELB-adjusted rule called for policy rate values below ELB in 2009.

“Significant discrepancies between the actual federal funds rate and the prescriptions of the Taylor rule and the Balanced Approach rule suggest that economic outcomes would probably have been significantly different if monetary policy had followed one of these rules. To address such questions, economists use models of the U.S. economy designed to estimate the effects of alternative monetary policy. However, these models are invariably simplifications of reality, and there is no agreed-upon "best" model representing the U.S. economy” [18].

1.4 The use of monetary policy rules in inflation targeting countries

New Zealand was the first country to establish a formal inflation targeting regime in 1990, followed by Canada (1991), Great Britain (1992), Australia and Sweden (in 1993) and many other countries. Currently, 41 countries adhere to this regime. Inflation targeting regimes usually set price stability as the primary objective, and also set a clear numerical inflation target and define a period during which any deviation of inflation from the target must be eliminated. The inflation target is sometimes set as a point (a specific target) and sometimes as a range. Also a time period is set for returning to the target level of inflation after a deviation from it, it may or may not be clearly expressed, usually it is from eighteen months to two years [19].

In its theoretical approach to inflation targeting, monetary authorities must choose a nominal interest rate that minimizes this loss function in the structural model of the economy. This nominal interest rate is based on the central bank's optimal response function. In this context, monetary policy under an inflation targeting regime must consider three things: central bankers' preferences, the structural model of the Union economy, and monetary policy decision-making [20]. The inflation targeting regime is characterized by a dual nature: on the one hand the central bank has full freedom to choose instruments of monetary regulation and mechanisms of their implementation, and on the

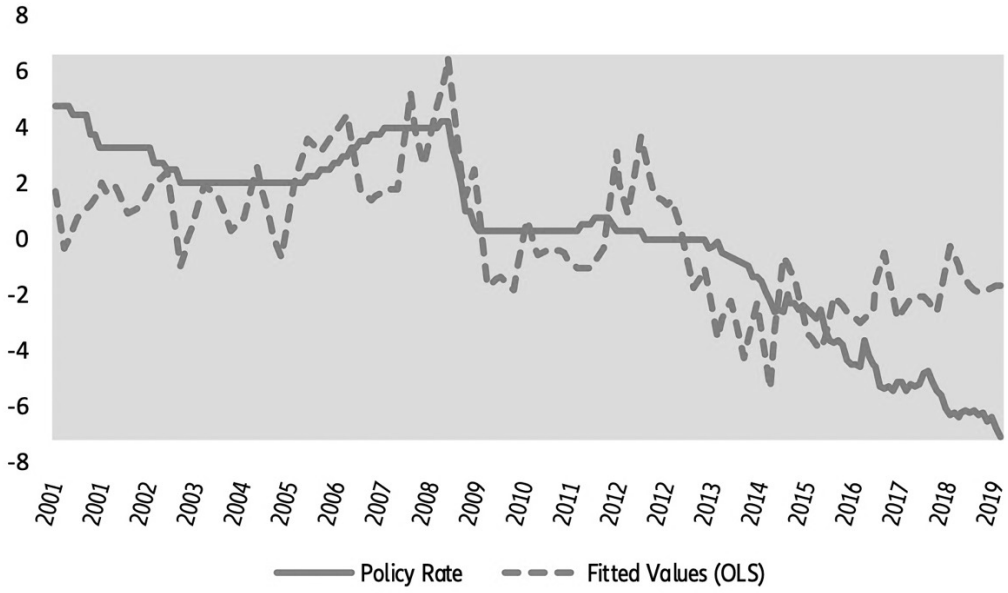
other hand, it is limited by a rigid procedure of setting goals and responsibility to the society.

Monetary policy rules corresponding to inflation targeting can be divided into two broad classes of rules: instrument rules and targeting rules. «An explicit instrument rule expresses the monetary policy instrument as an ex- plicit function of available information. We examine both optimal unrestricted instrument rules (a tradition that goes back at least to Taylor 1979; recent con- tributions include Blake and Westaway 1996) as well as optimal simple or re- stricted instrument rules, which involve only a few parameters or arguments (e.g., current inflation and output as in Taylor's 1993rule)» [21, p.204]. But no central bank, inflation targeting or not, adhering only to a rule (unrestricted or simple) uses more information than that on which simple rules are based, and no central bank would voluntarily restrict itself to mechanically react in a pre-described way to new information. The role of unrestricted or simple instrument rules is to provide a baseline and comparison with the policy actually being pursued. By explicit instrument rule we mean that the monetary policy instrument is expressed as an explicit function of available information, e.g.: McCallum (1988) and Taylor (1993). By a targeting rule we imply that the central bank is instructed to minimize the loss function that increases depending on the deviation between the target variable and the target level for that variable, i.e. the implicit instrument rule.

For the last twenty years, the European Central Bank has been responsible for setting a single monetary policy for the Eurozone, most of whose countries are pursuing tradeable inflation. The central bank's goal has been defined as an inflation rate below, but close to 2% in the medium term. Moreover, the European Central Bank should, without prejudice to its objective and price stability, support the general economic policy of the European Union in order to help achieve goals such as sustainable growth and high employment.

Using a variant of the Taylor rule, which suggests that the course of monetary policy can be explained by a constant plus a weighted sum of the deviation of inflation from the target and the GDP gap. Figure 1.2 provides the approximated values and residuals of the MNA regression of the indicator on constant, inflation, and the output gap.

Figure 1.2 – OLS -Actual and Fitted Values



Source: [22]

Therefore, the standard Taylor rule provides a fairly accurate description of the monetary policy of the European Central Bank. But as of 2016, it cannot reflect a sharp decline in the shadow rate, since the Taylor rule assumes only small negative values. So the inflation and output gap considerations are useful for explaining the monetary policy stance of the European Central Bank, but over the past 20 years, the rule's performance has struggled to explain adaptive policy.

METHODS AND MATERIALS

2.1 Analytical framework

This paper takes as its starting point an assumption made by Taylor in 1993 - a simple monetary policy rule can guide monetary policy. This rule has shown a high characterization of the behavior of the Federal Reserve System since the mid-1980s. According to the rule, the central bank responds to fluctuations in inflation and the output gap toward target levels [9]. A rule of the same kind was found by Stewart in 1996 as expressing the exact behavior of the central bank of Great Britain [23]. Further research on the characterization of monetary policy by means of Taylor-type rules was carried out by Clarida et al. (using future-oriented rules) [24], Christiano and Gust (in a restricted model) [25], Weymark (to characterize monetary policy in six countries) [26]. Taylor-type rules have been compared with other rules in studies by Ball [27], de Brouwer and O'Regan (on the use of the rule in Australia) [28] and Debelle.

Many authors, including John Taylor, Lawrence Ball, and Bennett McCallum, have offered theoretical and practical arguments for choosing particular rules. Briefly, Taylor's monetary rule states: the nominal short-term interest rate depends on the real interest rate, on the rate of inflation as measured by the GDP deflator, on the difference between the rate of inflation and the inflation rate targeted by the central bank, and on the difference between real GDP and potential estimated or GDP. Taylor's general rule for inflation-targeting countries is as follows:

$$R_t - R_{normal} = 1.5 * (\Pi_t - \Pi_{target}) + 0.5 \left(\frac{Y_t - Y_{potential}}{Y_{potential}}\right), \quad (2.1)$$

where R_t – *the interest rate at time t;*

R_{normal} – *natural or normal interest rate level;*

Π_t – *the inflation rate at time t;*

Π_{target} – *inflation target;*

Y_t – *GDP of the country at time t;*

$Y_{potential}$ – *potential GDP level.*

To calculate the natural or normal interest rate level:

$$R_t = \mathrm{c}(1) + 1.5 * \left(\Pi_t - \Pi_{target}\right) + 0.5\left(\frac{Y_t - Y_{potential}}{Y_{potential}}\right) + \epsilon_t \qquad (2.2)$$

where $\mathrm{c}(1)$ – *constants for different countries.*

Let us try to estimate the monetary rule that best describes the actual interest rate data for inflation-targeting countries. To do this, we will also use Equation 2.2 itself, but estimate the coefficients before inflation and GDP as well. The equation will look as follows:

$$R_t = \mathrm{c}(1) + \mathrm{c}(2) * \left(\Pi_t - \Pi_{target}\right) + \mathrm{c}(3)\left(\frac{Y_t - Y_{potential}}{Y_{potential}}\right) + \epsilon_t, \qquad (2.3)$$

where $\mathrm{c}(2), \mathrm{c}(3)$ - *coefficients (slopes of the function).*

Let's modernize the classical Taylor rule by making an interest rate lag, because the calculated interest rate can be used only in the next period, as well as add the exchange rate, which is also an important indicator of the economy. We obtain the following equation:

$$R_{t-1} = \mathrm{c}(1) + \mathrm{c}(2) * \left(\Pi_t - \Pi_{target}\right) + \mathrm{c}(3)\left(\frac{Y_t - Y_{potential}}{Y_{potential}}\right) + \mathrm{c}(4)X_t + \epsilon_t, \qquad (2.4)$$

where R_{t-1} – *interest rate lag in one period;*

c(4) - coefficients (slopes of the function;

X_t *– annual change in the exchange rate (unit of national currency per U.S. dollar).*

Let's compare the 1990-2021 data with the actual data. Once we have the results of the 1990-2019 equations, let's build a forecast for 2022 (having the country banks' forecasts) and compare it with the actually applied rate. Thus, we will evaluate which rule diverges the most from the actually applied rate for the period, and which rule can be used to get the most accurate interest rate forecast for the future period.

2.2 Data description

Characteristics of the information base for the models:

- Increase in the country's GDP. A Hodrick-Prescott filter in the Eviews package was used to fit the time series to draw conclusions about long-term trends in the data, and then the percentage deviation of actual GDP from the pre-filtered GDP was determined. Annual percent real GDP growth rates from 1990 to 2019.
- Inflation targets (target) - the central bank's goal to achieve some specific level of inflation. Monthly inflation targets of countries in percentages from 1990 to 2019.
- Inflation rate. To properly estimate the inflation rate, apply a moving average to determine the trend and smooth out fluctuations. Monthly inflation targets of countries in percentages from 1990 to 2019.
- Short-term nominal rate. Annual readings in percentages from 1990 to 2019.
- Change in the exchange rate. Data was taken from the annual national unit of the country for the U.S. dollar from 1990 to 2019.

The data for the models were taken from the World Bank [29], BIS [30], and International Financial Statistics [31] websites.

RESULTS

3.1 Model results

Inflation targeting has been a popular choice of monetary policy regime since the early 1990s, followed by more than 20 countries, including at least 13 emerging markets. IT gained popularity following the successful implementation of this regime in developed countries, including New Zealand, Canada, and others. Countries have adopted inflation targeting under a variety of circumstances, ranging from a well-planned transition from another political regime (New Zealand, Canada) to addressing the currency crisis [32] Countries such as: Poland, Georgia.

Two developed countries (Canada and New Zealand), two countries that are developing (Poland and Georgia) and a country with low development (Chile) were chosen to build the model. These countries were chosen not only because they are countries with different degrees of development, but also because they adopted inflation targeting at different times, some of the first countries, others not so long ago, as well as of these countries have an export-oriented strategy, others do not.

Let's build models for countries that have long adopted the inflation targeting regime and those that are just getting acquainted with it, and see if it is possible to predict the future interest rate of the country on the basis of the rules.

New Zealand has the longest history of inflation targeting. The policy was announced on March 4, 1989 and implemented on February 1, 1990. Moreover, New Zealand has the most clearly defined target and policy framework to achieve it. In New Zealand, the targeting target currently ranges from 0 to 3 percent and is the broadest of all the ranges of inflation targeting regimes. The inflation target from 1990 to 2019 has only been changed by 1%.

If we compare New Zealand's actual interest rate for 1990-2021 with the ones we calculated earlier (see Figure 3.1), we can conclude that the model calculated by the

classical Taylor rule describes the actual one the least, while the other two are very similar to it.

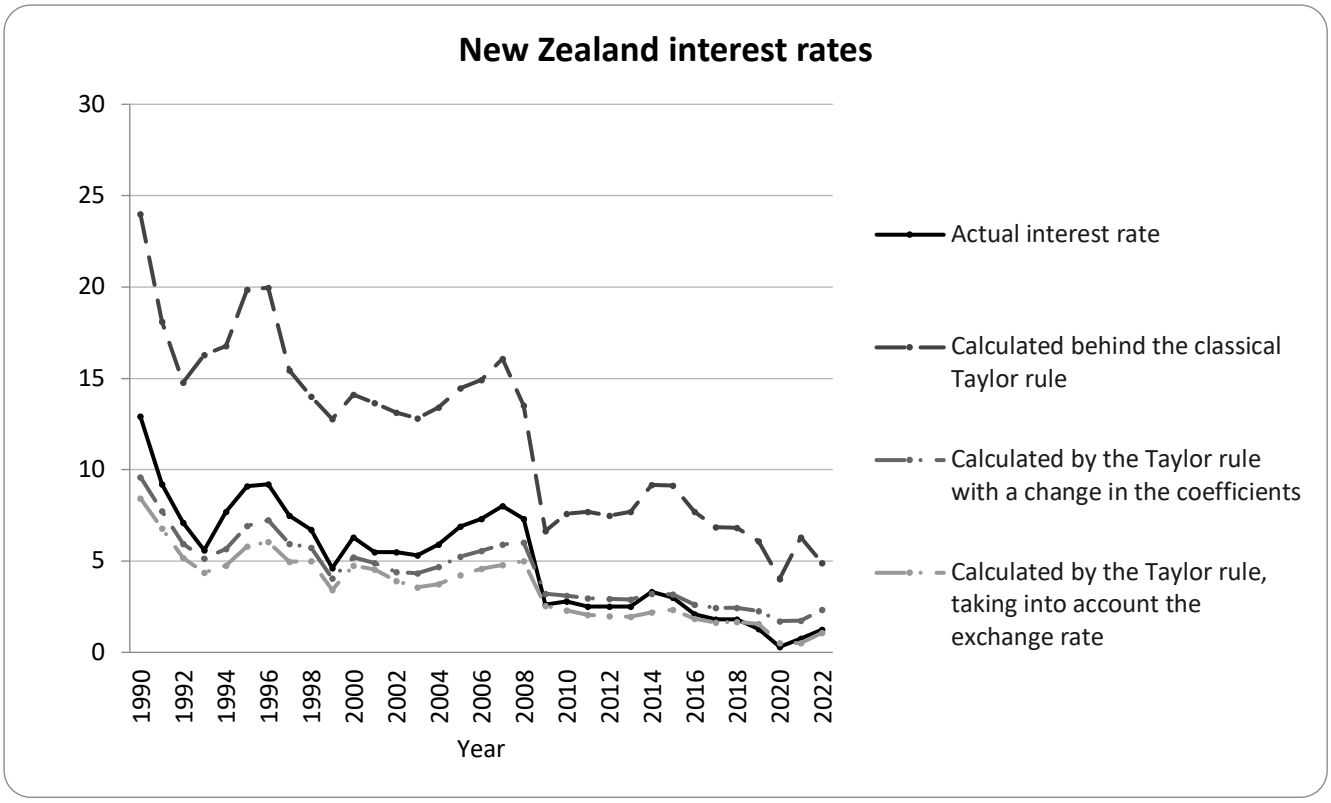


Fig. 3.1 - Comparison of actual and calculated interest rates under the Taylor rule in New Zealand

Sources: Author's calculations based on data (see appendix A)

For the last fifteen years, the actual rate has been very similar to that calculated behind the Taylor rule with the addition of the exchange rate and modified coefficients. The projected value for New Zealand in 2022 is also very similar to that calculated by this rule.

In Canada, inflation was a serious problem in the late 1970s and throughout the 1980s. Annual inflation reached more than 12 percent in 1981. The government and the Bank of Canada sought to bring inflation down gradually. After trying several different approaches, they decided in 1991 to reach the inflation target of 2 percent. The goal was to reach that target by the end of 1995. The Bank of Canada successfully reduced inflation to 2 percent and then repeated its success. With a focus on inflation, price growth in Canada averaged about 2 percent for three decades. This has led to low and stable borrowing rates for consumers and businesses. The tool they use is the interest rate policy,

also known as the target overnight rate. This is the interest rate that the major banks accept for overnight borrowing from each other [33].

The interest rate calculated by the Taylor rule with the addition of the exchange rate for Canada, as in the case of New Zealand, most accurately describes the actual interest rate (see Figure 3.2).

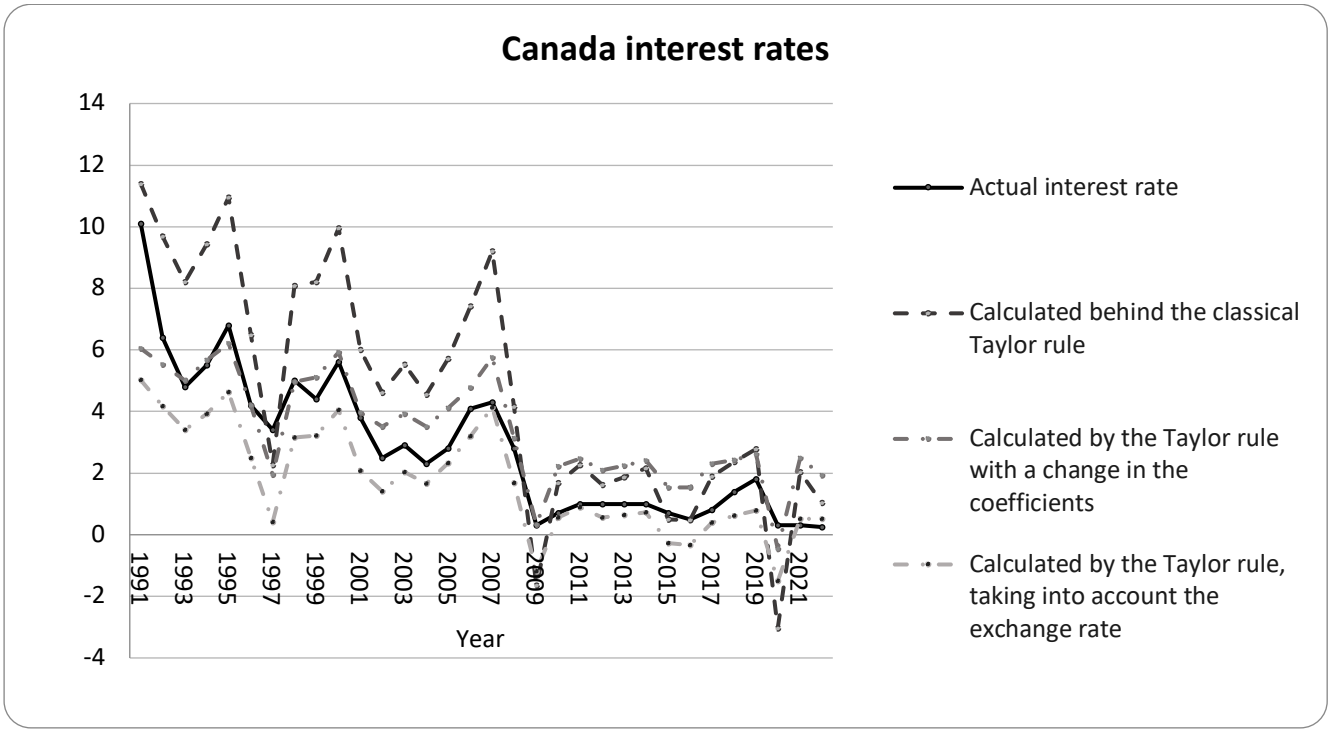


Fig. 3.2 - Comparison of actual and calculated interest rates under the Taylor rule in Canada

Sources: Author's calculations based on data (see appendix B)

The value of the actual rate for 2022 most closely resembles the classic Taylor rule.

The main objective of the National Bank of Poland is to maintain price stability, and an inflation target has been used since 1999. Since 2004, when Poland joined the European Union, the goal has been an annual inflation target of 2.5% with a tolerance range of plus or minus one percentage point [34].

In Poland, the actual interest rates are very similar to the rates calculated by the Taylor rule with changes in the coefficients (see Figure 3.3), but the need to raise the interest rate in 2022 showed two other rules, eating the classic and with the addition of the exchange rate.

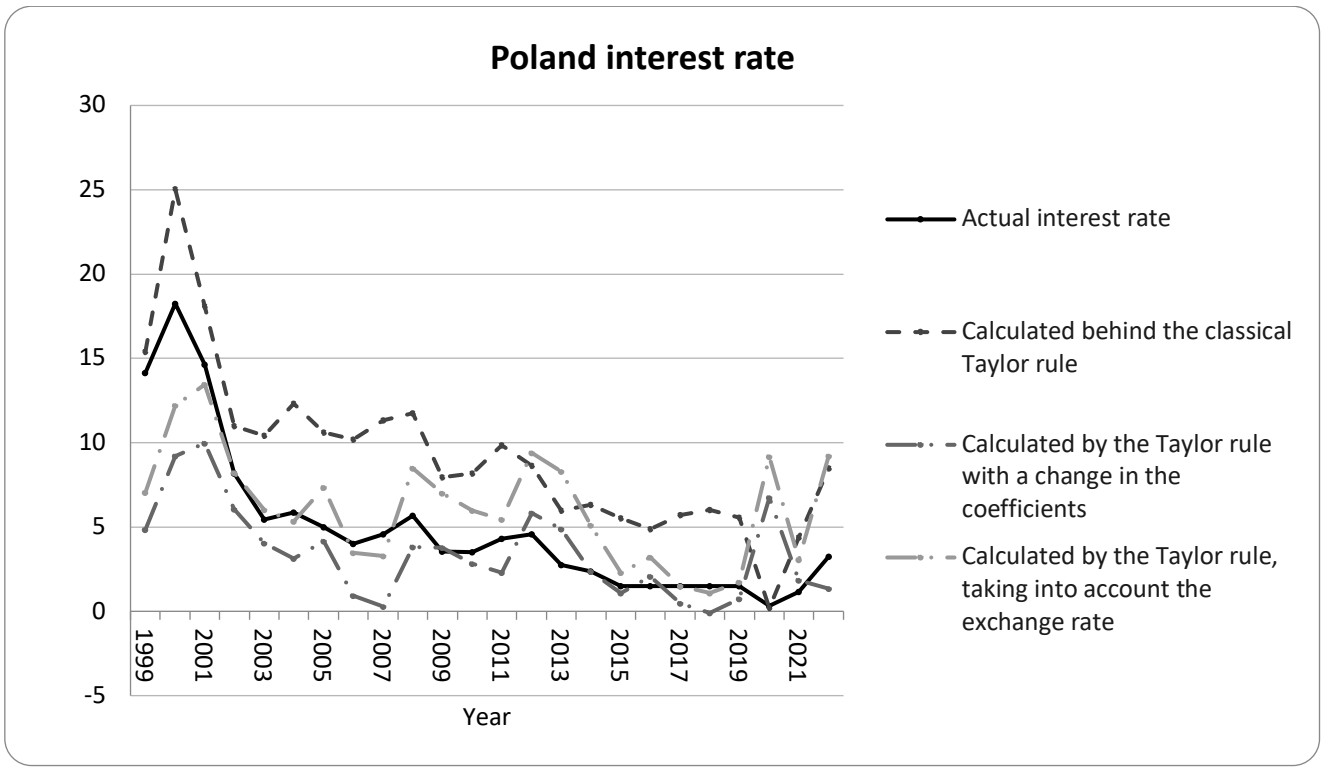


Fig. 3.3 - Comparison of actual and calculated interest rates under the Taylor rule in Poland

Sources: Author's calculations based on data (see appendix C)

Also in Poland, in comparison with the foreseeable two developed countries, there is no such proximity to the values of the rules.

Monetary policy of the National Bank of Georgia has been implemented through the inflation targeting regime since 2009. At the initial stage, the National Bank introduced liquidity management tools to improve the efficiency of financial sector liquidity management. Subsequently, this strengthened the monetary policy transmission mechanism. Over time, the inflation targeting regime has become more forward-looking.

As you can see from figure 3.4, Georgia adheres to the fact that its actual interest rate is without sharp fluctuations, the closest model built is the model according to Taylor rule with the change of coefficients, but we can still assume that the National Bank of Georgia does not use the rule as often and focuses more on maintaining stability or a smooth increase in the interest rate, which can also be seen for the year 2022.

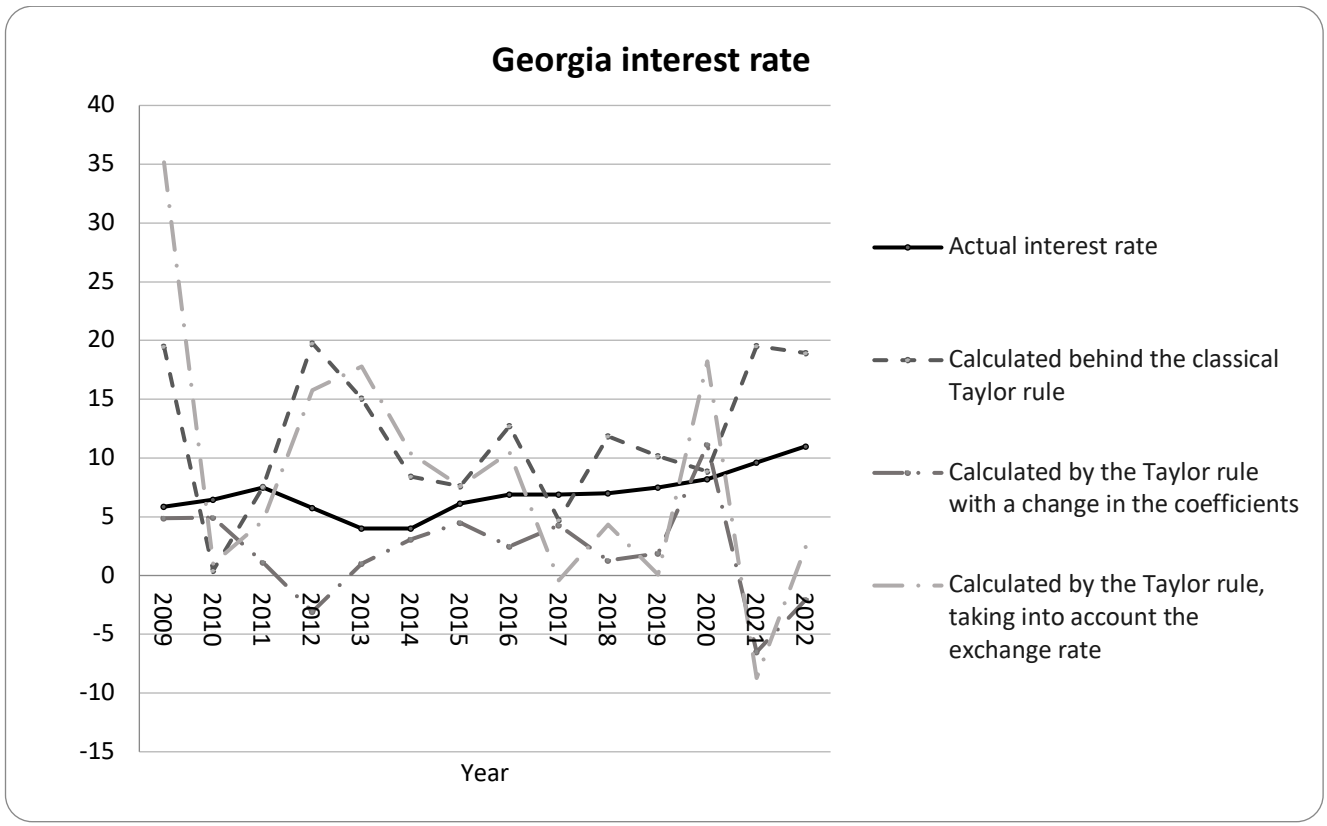


Fig. 3.4 - Comparison of actual and calculated interest rates under the Taylor rule in Georgia

Sources: Author's calculations based on data (see appendix D)

That is, in countries that are developing a large relationship between the actual interest rate and the Taylor rule is not observed because of the small period of adoption of inflation targeting.

The Central Bank of Chile began partially applying inflation targeting in September 1990, when it announced its annual inflation target for 1991, although an official definition of this monetary regime did not appear until 1997. The bank's goal in terms of inflation targeting is to keep annual CPI inflation within one percentage point plus or minus 3% of the target most of the time. The goal of the Central Bank of Chile is to take care of currency stability and the normal functioning of the domestic and foreign payment systems.

For Chile, as for Canada and New Zealand, two rules most accurately expressed the actual interest rate: The Taylor rule with modified coefficients and the Taylor rule with the exchange rate (see Figure 3.5). The rises and falls of the actual interest rate correspond almost entirely to the rises and falls of the rates over the rules, but the actual rate has a

smaller amplitude, which is logical, because sharp changes can lead to negative consequences in the economy.

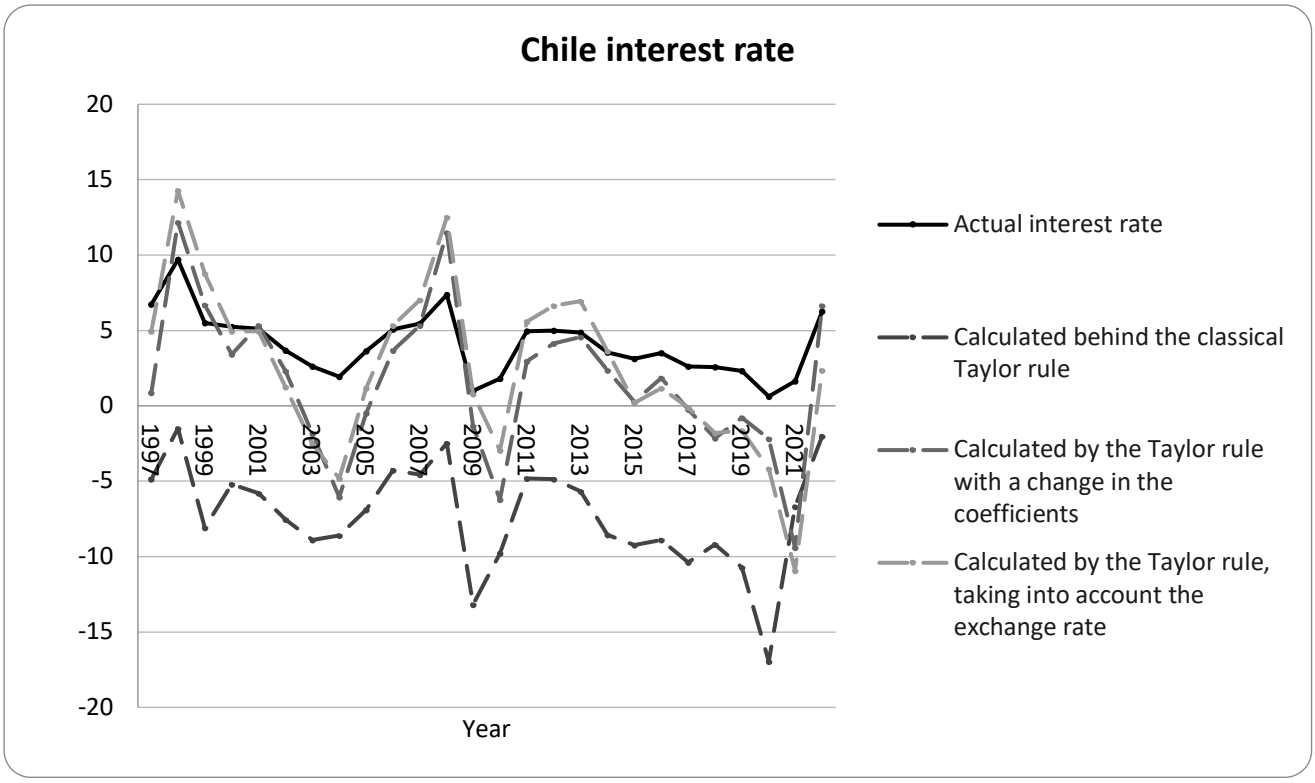


Fig. 3.5 - Comparison of actual and calculated interest rates under the Taylor rule in Chile

Sources: Author's calculations based on data (see appendix E)

A sharp rise in the interest rate in 2022 was foreseen by all the rules, especially the exchange rate rule.

Consequently, the greatest pattern between line-by-line rules and the actual interest rate is observed in countries that have long adopted inflation targeting. The closest to the actual interest rate were the Taylor models, taking into account the interest rate, as well as the change in coefficients for a particular country. The forecasting of the actual interest rate based on the model did not show perfect results, from which we can conclude that the external environment and unforeseen conditions strongly affect the economy (such as a crown crisis or war).

The coefficient of determination for the models of 5 countries (see Fig. 3.6), among which two are developed countries (New Zealand and Canada), developing countries (Poland, Georgia) and countries with low development (Chile), for the calculated models

confirm the preliminary conclusions and show that the Taylor rule model with lag and annual exchange rate changes is the most supportive for the actual interest rate.

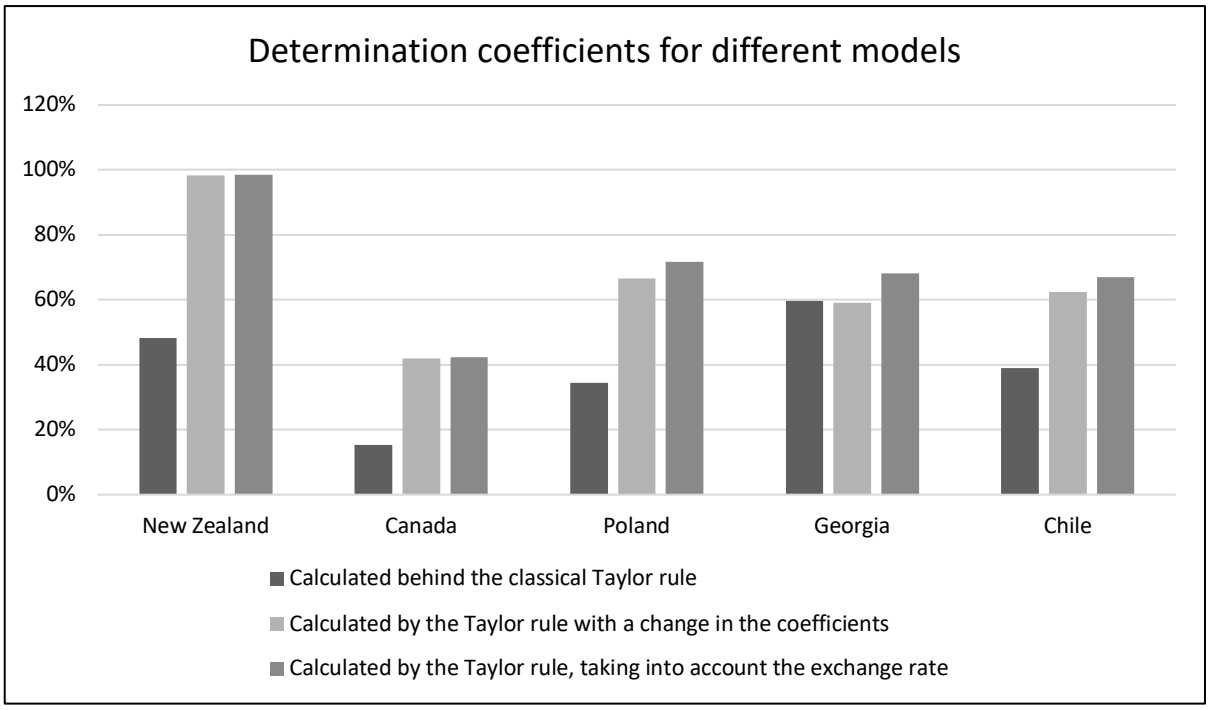


Fig. 3.6 - Determination coefficients for calculated models

Sources: Author's calculations based on data (see appendix F)

3.2 The use of monetary policy rules under stressful conditions for the economy

Modern policy rules, such as the Taylor rule (1993a), were created to end severe price and output volatility during the Great Inflation of the late 1960s and 1970s. But the problem of developing rational rules to maintain monetary stability or achieve other policy goals began long before that.

Major historical events provided economists with an ideal environment in which to write and develop new rules of conduct for monetary policy. In fact, it was simultaneously with the emergence of nation-states, the universal introduction of paper money, and its gradual dematerialization that the economic consequences of alternative monetary rules yielded their first results, both analytically and practically. The recurrent crisis that struck Britain's economy after the Napoleonic Wars also provided new grounds for a discussion of the objectives and instruments of monetary policy. Moreover, it was after World War I that economists began to reconsider monetary stability and monetary management as one of the most important factors contributing to economic cycles and growth [35]. That

is, the major shifts and discoveries in the study of monetary policy were made under stressful conditions.

In an article by Tanya Molodtsova and David Papell that enlightens the effect of the Taylor rule during a financial crisis. The authors found that the Fed and ECB interest rates before 2008 could be described, though certainly not accurately, by the Taylor rule, and when the federal funds rate reached the zero lower bound at the end of 2008, it was assumed that the Taylor rule was no longer relevant for assessing Fed policy, they refuted that assumption, as the Taylor rule's prescribed interest rate became a key element in the 2009 and 2010 debates over how much quantitative stimulus the Fed should provide, and becomes an element in the debate over when the Fed should start raising interest rates. Similarly, it was assumed that once the federal funds rate reached the zero lower bound in late 2008 and when the ECB policy rate reached the zero lower bound in late 2009, the Taylor rules would no longer be useful for predicting exchange rates.

They built models and proved that Taylor's rules proved successful in describing interest rate setting at the Fed and other central banks. Once policy rates reached the zero lower bound in the U.S. in late 2008 and in the eurozone in late 2009, Taylor rules became prescriptive rather than descriptive, and measures of financial conditions played an important role in prescribing Taylor rules during the financial crisis [36].

Taylor, the author of the rule himself, in his book Going Off Track: How Government Actions and Interventions Caused, Prolonged, and Worsened the Financial Crisis, makes a compelling case that the Fed's deviation of monetary policy from the Taylor rule was the greatest since the 1970s, before the housing boom. Although the Fed's deviation occurred because of fear of deflation, it can be cited as the root cause of the housing boom, which inevitably led to the housing crash and if the Fed had followed the Taylor rule, the "counterfactual" housing input rate would have been far below the actual rate, which in turn led to a gradual rise in overall prices, as the average consumer price index was 3.2%, 60% above the target .

There is much debate about the use of rules during stressful situations for the economy, like the 2008 crisis: on the one hand, some economists question the legitimacy of the Taylor rule and its usefulness before and during the financial crisis, while on the

other hand, economists like Taylor argue that the Fed's deviation level was the only cause of the housing crisis, although other global factors may have played a role in the crisis [37]. Obviously, deviations from Fed rules also occurred before the 2008 financial crisis, as well as in other past periods, since strict adherence to any adopted monetary policy rule reduces the flexibility and speed of adjustment.

To summarize, there is ample evidence that simple rules influenced actual monetary policy in the 1980s and 1990s, but deviations sometimes occur, both before the global financial crisis, during the Coronavirus crisis, and during the war. Nevertheless, interest in simple rules in central banks has continued for many of the reasons noted above. But the debate continues, and more progress is still needed, especially in international monetary policy, as well as empirical, theoretical, and historical experience.

3.3 Recommendations for the use of monetary policy rules

John Taylor in his article «Simple monetary rules: many strengths and few weaknesses» suggests a number of advantages for central banks in using simple monetary rules as his: has clearer explanations, less short-term political pressure (less subject to political pressure than complex or discretionary policies), reduced uncertainty (clearly describing future policy actions), evaluation of central bank actions, accountability and a useful historical benchmark [38].

The debate and negotiation of monetary policy rules has not subsided since the 1990s. Monetary policy rules are popular among many economists and policymakers, including the Fed, because these rules, when applied, help provide insight into future monetary policy, which in turn is important for households and businesses making investment and consumption decisions. Much of the Fed's communications, both within the Fed and to the public, already include the use of policy rules as guidance, for example, as an input to discussions at each Federal Open Market Committee meeting, staff economists prepare and distribute a briefing paper to the FOMC known as a Tealbook. Publicly released Tealbooks include policy rate recommendations from a set of monetary policy rules [39].

The central bank must be responsible and transparent in its work on the monetary rule, and what determines policy will clearly justify its actions. A policy rule should not be considered irrevocable or immutable, but policymakers necessarily act within the constraints imposed by the current state of knowledge, and they cannot be blamed for outcomes that could not have been avoided given that knowledge, such as the 2008 crisis. One advantage of monetary policy rules is that there is a historical record that can be analyzed, and from that analysis we can gain insight into why past policy actions have not led to the desired outcomes. And also the knowledge gained from this analysis should be incorporated into a formula for future policy rules, and before that, it should be studied and discussed in detail. If the analysis shows that the rule can be improved, the change should be announced in advance and the reason for it explained. It is also the most reliable method of communicating the accumulated knowledge about the effectiveness of a country's monetary policy.

Conclusions

Monetary policy of the state serves as a way to regulate business activity, create favorable economic conditions for citizens' living and doing business, strengthen the national currency exchange rate, maintain stability in the country and sustainability of the state balance of payments. Its instruments of influence are interest rate regulation, open market operations and changes in reserve requirements. One of the regimes of monetary policy is inflation targeting, which consists in the fact that the central bank publicly announces quantitative inflation targets and commits to achieve these targets over the medium-term horizon. The main advantage of this regime is that it combines elements of both "rules" and "discretion" in monetary policy.

One of the most famous rules of monetary policy is the Taylor rule, which was originally created for the Federal Reserve and later adapted for other Central Banks. It was designed to provide "guidance" on how a central bank should set short-term interest rates as economic conditions change to meet both the short-term goal of stabilizing the economy and the long-term goal of inflation. The rule has the following advantages: minimizes cyclical fluctuations in the economy, simplicity in the formula, ease of testing in practice, reflects all available economic information.

On the basis of this rule, models were built: behind the classical Taylor rule, behind the rule with modified coefficients, and behind the rule, which includes the exchange rate. Models were built for five countries and the following results were obtained: first, the model with the included exchange rate most accurately describes the economy of the studied countries; second, forecasts based on models are not accurate enough due to many factors that affect the economy. Based on these studies, it is impossible to say exactly how the rules behave during unstable situations because researchers on the subject have said just the opposite, to follow them precisely in such conditions, some claim that following them is harmful. To summarize, more progress is still needed, especially in international monetary policy, as well as empirical, theoretical and historical experience.

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Appendix A

Table A.1 - Comparison of actual and calculated interest rates under the Taylor rule in New Zealand

Year	Actual interest rate	Calculated behind the classical Taylor rule	Calculated by the Taylor rule with a change in the coefficients	Calculated by the Taylor rule, taking into account the exchange rate
1990	12,9	23,99	9,60	8,43
1991	9,2	18,12	7,74	6,80
1992	7,1	14,77	5,93	5,19
1993	5,6	16,29	5,14	4,36
1994	7,7	16,76	5,65	4,74
1995	9,1	19,87	6,91	5,79
1996	9,2	19,96	7,23	6,05
1997	7,5	15,42	5,94	4,95
1998	6,70	13,99	5,72	5,00
1999	4,60	12,76	4,05	3,41
2000	6,30	14,11	5,22	4,74
2001	5,50	13,66	4,90	4,55
2002	5,50	13,14	4,40	3,92
2003	5,30	12,82	4,33	3,57
2004	5,90	13,41	4,68	3,75
2005	6,90	14,47	5,25	4,23
2006	7,30	14,90	5,54	4,59
2007	8,00	16,05	5,90	4,78
2008	7,30	13,50	6,00	4,99
2009	2,60	6,64	3,20	2,54
2010	2,80	7,59	3,12	2,29
2011	2,50	7,70	2,96	2,04
2012	2,50	7,48	2,93	2,00
2013	2,50	7,68	2,90	1,95
2014	3,30	9,18	3,20	2,20
2015	3,00	9,12	3,18	2,34
2016	2,10	7,70	2,62	1,83
2017	1,80	6,85	2,44	1,65
2018	1,80	6,80	2,44	1,68
2019	1,30	6,09	2,25	1,56
2020	0,3	4,03	1,72	0,51

continued table - A.1

2021	0,75	6,30	1,74	0,51
2022	1,25	4,90	2,32	1,07

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.

Appendix B

Table B.1 - Comparison of actual and calculated interest rates under the Taylor rule in Canada

Year	Actual interest rate	Calculated behind the classical Taylor rule	Calculated by the Taylor rule with a change in the coefficients	Calculated by the Taylor rule, taking into account the exchange rate
1991	10,10	11,40	6,04	5,02
1992	6,40	9,68	5,52	4,17
1993	4,80	8,21	5,01	3,41
1994	5,50	9,44	5,68	3,93
1995	6,80	10,95	6,20	4,63
1996	4,20	6,49	4,19	2,50
1997	3,40	2,26	1,96	0,41
1998	5,00	8,09	4,97	3,15
1999	4,40	8,22	5,11	3,22
2000	5,60	9,95	5,93	4,06
2001	3,80	6,01	3,97	2,08
2002	2,50	4,61	3,50	1,41
2003	2,90	5,52	3,93	2,03
2004	2,30	4,54	3,51	1,66
2005	2,80	5,72	4,10	2,32
2006	4,10	7,41	4,78	3,20
2007	4,30	9,20	5,75	4,14
2008	2,80	4,16	3,13	1,69
2009	0,30	-1,64	0,34	-1,18
2010	0,70	1,67	2,21	0,57
2011	1,00	2,27	2,47	0,89
2012	1,00	1,62	2,09	0,56
2013	1,00	1,87	2,24	0,65
2014	1,00	2,17	2,41	0,72
2015	0,70	0,51	1,53	-0,27
2016	0,50	0,47	1,54	-0,33
2017	0,80	1,88	2,31	0,39
2018	1,40	2,37	2,43	0,62
2019	1,80	2,79	2,61	0,78
2020	0,30	-3,03	-0,45	-1,50
2021	0,30	2,03	2,49	0,52

continued table - B.1

2022	0,25	1,04	1,92	0,51

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.

Appendix C

Table C.1 - Comparison of actual and calculated interest rates under the Taylor rule in Poland

Year	Actual interest rate	Calculated behind the classical Taylor rule	Calculated by the Taylor rule with a change in the coefficients	Calculated by the Taylor rule, taking into account the exchange rate
1999	14,13	15,41	4,85	7,05
2000	18,25	25,02	9,20	12,19
2001	14,63	18,08	9,97	13,45
2002	8,19	11,00	6,04	8,23
2003	5,44	10,40	4,04	6,00
2004	5,88	12,31	3,14	5,33
2005	5,00	10,62	4,14	7,34
2006	4,00	10,20	0,94	3,47
2007	4,56	11,33	0,27	3,27
2008	5,69	11,75	3,82	8,49
2009	3,56	7,96	3,78	7,01
2010	3,50	8,16	2,82	5,99
2011	4,31	9,83	2,28	5,44
2012	4,56	8,62	5,81	9,38
2013	2,75	5,98	4,88	8,29
2014	2,38	6,32	2,36	5,09
2015	1,50	5,53	1,09	2,30
2016	1,50	4,86	2,07	3,21
2017	1,50	5,71	0,47	1,49
2018	1,50	6,01	-0,10	1,09
2019	1,50	5,56	0,75	1,74
2020	0,33	0,20	6,74	9,15
2021	1,17	4,36	1,85	3,07
2022	3,25	8,48	1,34	9,21

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.

Appendix D

Table D.1 - Comparison of actual and calculated interest rates under the Taylor rule in Georgia

Year	Actual interest rate	Calculated behind the classical Taylor rule	Calculated by the Taylor rule with a change in the coefficients	Calculated by the Taylor rule, taking into account the exchange rate
2009	5,88	19,46	4,87	35,15
2010	6,44	0,43	4,92	0,99
2011	7,5	7,52	1,10	4,66
2012	5,75	19,77	-3,10	15,75
2013	4	15,08	0,98	17,77
2014	4	8,40	3,07	10,40
2015	6,13	7,59	4,49	7,59
2016	6,88	12,72	2,48	10,51
2017	6,88	4,69	4,27	-0,38
2018	7	11,86	1,28	4,31
2019	7,5	10,17	1,89	0,11
2020	8,19	8,84	11,13	18,24
2021	9,63	19,55	-6,51	-8,72
2022	11	18,90	-2,05	2,47

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.

Appendix E

Table E.1 - Comparison of actual and calculated interest rates under the Taylor rule in Chile

Year	Actual interest rate	Calculated behind the classical Taylor rule	Calculated by the Taylor rule with a change in the coefficients	Calculated by the Taylor rule, taking into account the exchange rate
1997	6,75	-4,85	0,86	4,93
1998	9,7	-1,50	12,18	14,27
1999	5,5	-8,07	6,70	8,78
2000	5,25	-5,22	3,40	4,96
2001	5,125	-5,81	5,35	4,95
2002	3,6875	-7,54	2,31	1,25
2003	2,625	-8,88	-1,85	-2,51
2004	1,9375	-8,58	-6,07	-4,82
2005	3,625	-6,90	-0,47	1,15
2006	5,0625	-4,28	3,67	5,32
2007	5,4375	-4,55	5,33	7,01
2008	7,375	-2,50	11,48	12,50
2009	1,00	-13,17	-1,33	0,78
2010	1,8125	-9,78	-6,23	-2,97
2011	4,9375	-4,82	2,93	5,59
2012	5	-4,85	4,13	6,63
2013	4,875	-5,65	4,58	6,93
2014	3,5625	-8,56	2,34	3,63
2015	3,125	-9,22	0,29	0,19
2016	3,5	-8,90	1,85	1,16
2017	2,625	-10,36	-0,23	-0,10
2018	2,5625	-9,20	-2,16	-1,80
2019	2,3125	-10,73	-0,77	-1,62
2020	0,625	-16,96	-2,17	-4,18
2021	1,625	-6,71	-9,41	-10,91
2022	6,25	-2,02	6,66	2,36

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.

Appendix F

Table F.1 - Determination coefficients for calculated models

	New Zealand	Canada	Poland	Georgia	Chile
Calculated behind the classical Taylor rule	48,25%	15,24%	34,48%	59,70%	38,95%
Calculated by the Taylor rule with a change in the coefficients	98,26%	41,89%	66,66%	59,00%	62,46%
Calculated by the Taylor rule, taking into account the exchange rate	98,61%	42,30%	71,73%	68,20%	66,90%

Sources: compiled by the authors on the basis of data [29, 30, 31] and their own calculations.