CENTRAL BANK INTEREST RATES, INFLATION AND ECONOMIC GROWTH IN LIGHT OF INFLATION TARGETING STRATEGY IN POLAND

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This article aims to analyze the dependence of interest rates, inflation and GDP growth in Poland in the years 2000 - 2014. The author positively verified the hypothesis that despite significant changes in the financial markets caused by the economic slowdown 2001-2002 and 2008-2009 recent financial crises the relationship between interest rate, inflation, and economic growth remains significantly statistical and important for economic development. Although in the literature we come across the views that the approach to monetary policy based on short-term interest rate and one target (inflation) - as inflation targeting strategy also linked to the Taylor rule discussed in the article – it has been verified by the recent financial crisis. To achieve this objective the following research methods were used: a review of the scientific literature, statistical research methods and methods of graphical presentation of economic phenomena.

Keywords: Taylor rule, Interest rates, Monetary policy, Economic growth, IT strategy.

Introduction

The rationale for conducting the rule-based monetary policy was time inconsistency of monetary policy. In Poland since 1999, the central bank has used a strategy of direct inflation targeting (IT), which helps to stabilize inflation expectations, which in the long run is conducive to lower inflation. The central bank striving to an effective implementation of monetary policy strategy seeks to adjust the monetary policy instruments to changing macroeconomic conditions. In particular, the recent financial crisis had a significant impact on economic variables, which is also reflected in the size of variables related to the conducting of monetary policy and their impact on economic growth in Poland. This article aims to analyze the dependence of interest rates, inflation and GDP growth in Poland in the years 2000 - 2014. To achieve this objective the following research methods were used: a review of the scientific literature, statistical research methods and methods of graphical presentation of economic phenomena.

Literature Review

Time inconsistency of monetary policy presented by Kydland and Prescott (1977) and extended in the work of Barro, Gordon (1983) has become a prerequisite for monetary policy based on rules. Thus, the inflation targeting approach has been used in Poland since 1999, based on the rule, it helps to stabilize inflation expectations, which in the long run is conducive to lower inflation [Baranowski 2014, p.140].
Today, most central banks use strategies based on the instrument, which is short-term interest rate [Romer, 2001]. On the other hand, the modern rules of interest rates are inspired by the equation proposed by Taylor [1993].

The modified prototype and assumptions of the Taylor rule included in the general equilibrium models are the basis for modeling work within the framework of inflation targeting strategy. This rule describes how the central banks react to changing circumstances in the economy. The original version of the Taylor rule is a description of fluctuations in interest rates depending on inflation and the output gap. This rule is based on the paradigm of the self-economy back to equilibrium. According to the Taylor rule, interest rates should respond to deviations of inflation from the target and deviation of production from its target - the potential level. At a time when the rate of inflation or the volume of production exceeds the target level is a condition to raise interest rates. On the other hand, when the inflation rate is lower than the target level or volume of production is less than the size of the target (the potential level) then this is the foundation to lower interest rates [Begg, Vernasca, Fisher and Dornbusch 2014]. The original version of the Taylor rule is based on the classic example of an overt rule. This rule was the theoretical basis of the dispute between discretion and rules under the new Keynesian economics. Today is the basis for most of the modeling work that arise in commercial banks and complements models especially the DSGE (Dynamic Stochastic General Equilibrium Model), creating the possibility of these models to automatic return to equilibrium [Baranowski, 2008].

The original version of the Taylor rule:

\[ i_t = \Pi_t + \phi_1 (\Pi_t - \Pi^*) + \phi_2 x_t + r^* \] (1)

where: \( i_t \) - the nominal federal funds rate in period t, \( \Pi_t \) - the rate of inflation in period t (annual in %), \( \Pi^* \) - inflation target in period t (in %), \( x_t \) - GDP gap (demand) in period t (deviation of GDP from its potential level, in %), \( r^* \) - the real interest rate corresponding to the full employment (natural interest rate), \( \phi_1, \phi_2 \) - structural parameters.

After calibrating parameters the original Taylor rule was as follows:

\[ i_t = \Pi_t + 0.5(\Pi_t - 2) + 0.5x_t + 2 \] (2)

Taylor rule comparable to recent studies before and after calibrated:

\[ i_t = i_0 + \phi_1 (\Pi_t - \Pi^*) + \phi_2 x_t \] (3)

\[ i_t = 4 + 1.5(\Pi_t - \Pi^*) + 0.5x_t \] (4)

It should be noted, however, that in reality due to the delays of the statistical data is not observed the current inflation or the output gap. Hence, the decision of the central bank on the basis of official publications of statistics requires the lags in the model [Baranowski, 2014, p. 41].

A variant of the Taylor rule in terms of \textit{backward looking}

\[ i_t = i_0 + \phi_1 (\Pi_t - \Pi^*) + \phi_2 x_{t-1} \] (5)

where \( k, l \) - a row of time - lags - the deviation of inflation from target and the output gap.

On the other hand, an anticipatory variant of the Taylor rule should be based on ranks of the real-time type, but the problem is that there are deficiencies of data on central bank forecasts. In Poland, these data provide the inflation projection, however, it is prepared under the strong assumption that interest rates will not change [Baranowski 2014, p. 42].

A variant of the Taylor rule in terms of \textit{forward-looking}

\[ i_t = i_0 + \phi_1 E_r (\Pi_{t+m} - \Pi^*) + \phi_2 E_r (x_{t+m}) \] (6)

where: \( n, m \) - the time horizon of expectations: deviations from the inflation target and the output gap.


\( E_t \) - the operator of rational expectations, the conditional - in regard to the information available in period \( t \).

In the studies, among other things Woodford (2003) and Walsh (2010) another aspect of the dynamics of Taylor's equation was highlighted, namely the hypothesis of interest rate smoothing. According to this hypothesis, changes in interest rates are spread over time in such a way that individual changes are small.

\[
i_t = \rho i^*_{t-1} + (1 - \rho) + i_t^*\tag{7}
\]

\( i_t^* \) - the interest rate resulting from the Taylor rule
\( \rho \) - the parameter of adjustments (smoothing interest rates), the range (0,1).

The arguments for the use of the smoothing interest rates method, are among other things such as the following: uncertainty as to the error-free measurement of explanatory variables, e.g. natural rate of interest and the output gap; the desire to transmit a clear message to operators with regard to monetary policy or concerns about the perceptions of the competence of decision-making by the financial markets [Baranowski 2014, p.57].

The equation of the Taylor rule with smoothing interest rates, often used in the empirical analysis:

\[
i_t = i_0' + \rho i^*_{t-1} + \phi_i (\Pi_t - \Pi')^* + \phi_t' x_t \tag{8}
\]

As pointed out by Baranowski [2014, p. 57] the Taylor rule is a tool to describe the monetary policy. It facilitates the forecasting of interest rates as well as being an important element of theoretical or empirical models of the national economy. The effective implementation of the monetary policy strategy is based primarily on the proper adjustment of the central bank monetary policy instruments to changing macroeconomic conditions.

Baranowski (2011) notes that Polish monetary authorities strongly react to deviations of inflation from the target, i.e. with a permanent increase in inflation by 1 percentage point interest rates increase by 3 percentage points - in the case of the current central bank's reaction on inflation and the output gap (standard rule) - and by about 5 percentage points - in the case of the central bank's reaction to future inflation (forward-looking rule).

Siklos (1999) and Kuttner and Posen (2001) underlined a reduction in level and in persistence of inflation in countries that used inflation targeting strategy.

An important concept in economic growth is also understood as a process of enlarging from year to year economic values such as the size of the forces of production, manufacture, consumption of the national economy (Todaro, 1994). In the literature emphasizes that economic growth is one of the most important economic categories (Lucas, 2000; Romer, 2006). In the literature, there are many studies on the connection between inflation and economic growth. Barro (1995) showed the negative impact of inflation on economic growth and investment. Barro conducted a study on a group of over 100 countries during the period 1960-1990. In his opinion, increase in average inflation of 10 percentage points, leads to a decline in the growth rate of real GDP per capita of about 0.2 - 0.3 percentage points (Barro, 1995). Li (2006) conducted a study of the relationship between inflation and economic growth in 117 countries (including 90 developing countries) in the period 1961-2004. His analyzes show that there is a negative correlation between the inflation and economic growth.

The central bank responds to the level of inflation using the interest rates within the inflation targeting strategy, in turn, inflation is an important factor associated with economic growth.

**Methodology**

This article aims to analyze the dependence of interest rates, inflation and GDP growth in Poland in the years 2000 - 2014. To achieve this objective the following research methods were used: a review of the
scientific literature, statistical research methods and methods of graphical presentation of economic phenomena.

The study used the following variables: GDP at current prices million PLN [GDP_nom]; the nominal reference rate - end of the period, in% [REF_nom]; CPI - the consumer price index - the last month of the period - December of previous year = 100 [CPI].

The variables are presented in real values by using CPI (I1 = 2000 year = 100). The variables used in the regressions were checked for stationarity by using the ADF test (Dickey–Fuller test). In the case of [GDP_nom], a time series proved to be stationary only as the first difference of variable. In other cases (CPI, REF_nom) variables proved to be stationary at the levels.

Table 1 presents the results for the dependent variable REF_nom – NBP nominal reference rate and the independent variable - the price index - the CPI.

Table 1. The dependent variable (Y): REF_nom; independent variable (X) - CPI

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-Student</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>const</td>
<td>1,94319</td>
<td>1,23006</td>
<td>1,580</td>
<td>0,1382</td>
</tr>
<tr>
<td>CPI</td>
<td>1,40533</td>
<td>0,347719</td>
<td>4,042</td>
<td>0,0014 ***</td>
</tr>
</tbody>
</table>

Selected regression statistics and analysis of variance: used observation 2000-2014 (N = 15)

R-square 0,556832
F(1, 13) 16,33424  p-value for F test 0,001398

Source: own elaboration based on data from the Central Statistical Office and National Bank of Poland, using GRETL.

Analyzing the regression results in Table 1 it can be concluded that the reference rate to a large extent is linked to CPI inflation, which is consistent with economic theory and confirms the legitimacy of the use of interest rates as a tool of monetary policy in maintaining price stability.

Table 2 presents the results for the dependent variable of GDP (d_GDP_nom - as the first differences of nominal GDP) and the independent variable - the price index - the CPI.

Table 2. The dependent variable (Y): d_GDP_nom; independent variable (X) - CPI

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-Student</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>const</td>
<td>46319,0</td>
<td>11479,6</td>
<td>4,035</td>
<td>0,0017 ***</td>
</tr>
<tr>
<td>CPI</td>
<td>9916,43</td>
<td>3997,36</td>
<td>2,481</td>
<td>0,0289 **</td>
</tr>
</tbody>
</table>

Selected regression statistics and analysis of variance: used observation 2000-2014 (N = 14)

R-square 0,338992
F(1, 12) 6,154084  p-value for F test 0,028919

Source: own elaboration based on data from the Central Statistical Office and National Bank of Poland, using GRETL.

Table 3 presents the results for the dependent variable of GDP (d_GDP_real - as the first differences of real GDP) and the independent variable - the nominal reference rate lagged by 1 year (REF_nom_1).
Table 3. The dependent variable (Y): d_GDP_real; independent variable (X) - REF_nom_1

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t- Student</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>const</td>
<td>52273,7</td>
<td>8681,54</td>
<td>6,021</td>
<td>6,02e-05 ***</td>
</tr>
<tr>
<td>REF_nom_1</td>
<td>-3200,56</td>
<td>1175,25</td>
<td>-2,723</td>
<td>0,0185 **</td>
</tr>
</tbody>
</table>

Selected regression statistics and analysis of variance: used observation 2000-2014 (N = 14)

R-square 0,381963
F(1, 12) 7,416301
p-value for F test 0,018495

Source: own elaboration based on data from the Central Statistical Office and National Bank of Poland, using GRETL.

Based on the analysis it can be inferred that the variables associated with conducting monetary policy [REF_nom] and [CPI] have a significant impact on the size of GDP and macroeconomic variables associated with it (Table 2; Table 3).

Table 4 shows the results of the Pearson correlation coefficient between real GDP and nominal NBP reference rate without lagged variables and with lagged the reference rate by 1 year and 2 years.

Table 4. GDP and the nominal NBP reference rate in Poland in 2000 - 2014

<table>
<thead>
<tr>
<th>The correlation coefficient without time lag</th>
<th>GDP and the nominal NBP reference rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>The correlation coefficient without time lag</td>
<td>GDP_real and the nominal NBP reference rate</td>
</tr>
<tr>
<td>1-year lag</td>
<td>-0,72</td>
</tr>
<tr>
<td>2- year lag</td>
<td>-0,75</td>
</tr>
</tbody>
</table>

Source: own elaboration based on data from the Central Statistical Office and National Bank of Poland

Between the examined variables there is a significant negative correlation, which the strength increases with the delay of the reference rate of respectively by 1 year and 2 years.

Analyzing the data presented in Figure 1, regarding the dynamics of GDP, we can notice a significant decline in GDP during the economic slowdown in 2001-2002 (1.2% GDP in 2001 and 1.4% GDP in 2002) and during the recent financial crisis, especially in 2009 (1.6% GDP). It seems that as a result of the events that provoked the disturbances of the economy and the financial crisis - the crisis in public finances, GDP growth remained at a significantly low level (in the years 2012-2013 respectively 2% GDP and 1.6% GDP).

The Monetary Policy Council of NBP conducts monetary policy in accordance with the strategy of direct inflation targeting based on international experiences that demonstrate the effectiveness of this strategy to ensure price stability in the economy. The first intermediate target was set down for the period 1999-2003, except that in the years 1999-2001 annual targets were determined without specifying the center of the band of target inflation (Musielak-Linkowska, 2007). The annual targets were established pointwise with an acceptable fluctuation band since 2002. The long-term, continuous inflation target of 2.5% with a fluctuation band of +/- 1 percentage point has been admitted since 2004. It was decided to increase the time horizon of the objective of monetary policy, among other things, because the delayed
reaction of the economy to the actions of the central bank has increased (as predicted by the NBP) with decreasing inflation rates and the development of financial markets. It should be emphasized that monetary policy of NBP within the inflation targeting strategy responded flexibly to shocks in the Polish economy, both before and during the tensions related to the crisis in global markets, by adjusting the level of interest rates to the constantly changing macroeconomic conditions (Założenia polityki pieniężnej…, 2012).

By comparing the projected and the actual rate of CPI inflation, the anti-inflation policy in Poland was presented to illustrate the strategy of the central bank (Table 5). By analyzing the information contained in Table 5, it can be concluded that the achievement of the inflation rate corresponding to the planned value was not an easy task.

Table 5. Expected and actual CPI inflation in Poland in the years 1998 - 2014

<table>
<thead>
<tr>
<th>Year</th>
<th>The predetermined rate of inflation (in %)</th>
<th>The actual rate of inflation (in %)</th>
<th>Deviation (in percentage points)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>9.5</td>
<td>8.6</td>
<td>-0.9</td>
</tr>
<tr>
<td>1999</td>
<td>6.6 – 7.8</td>
<td>9.8</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The smallest deviation from the predetermined inflation, i.e. no larger than 1 percentage point, was reached in 1998, in the years 2003-2007, in 2009 and 2013. Despite these deviations, a monetary policy implemented during the years 1998 - 2014 has contributed significantly to the decline in inflation. Deviations up from the predetermined level took place in the years 1999 - 2000 (impact of external shocks, the financial turmoil) and after the Polish accession to the European Union in 2004, and then in the years 2007-2008, i.e. since the first symptoms of the global financial crisis (Sobol, 2008).

Kuttner, Posen (2012) and Wojtyna (2012) pointed out that the approach to monetary policy based on the short-term interest rate and the inflation target had been verified by the recent financial crisis (Kuttner, Posen 2012; Wojtyna, 2012). It should be noted that many economists contributed to this debate (including - Nelson (2009), Walsh (2009), Clarida (2010), Orphanides (2010), Svensson (2010), Issing (2011), and Mishkin (2011)).

The inflation targeting strategy in Poland was not proved to be wrong, but insufficient. It helps to effectively reduce fluctuations in inflation and production, however, it does not prevent by the formation of bubbles in asset markets, which suggests that macroeconomic stability does not guarantee financial stability.

**Conclusions**

In particular, the recent financial crisis had a significant impact on economic variables, which is also reflected in the size of variables related to the conducting of monetary policy and their impact on
economic growth in Poland. The author positively verified the hypothesis that despite significant changes in the financial markets caused by the economic slowdown 2001-2002 and 2008-2009 recent financial crisis the relationship between interest rate, inflation, and economic growth remain significantly statistical and important for economic development.

In Poland, the relationship between interest rate, inflation, and economic growth remain significantly statistical and important for economic growth. National Bank of Poland has a relevant impact on the real economy by monetary transmission mechanism. Although in the literature appear views that the approach to monetary policy based on instrument (short –term interest rate) and target (inflation) - as inflation targeting strategy also linked to the Taylor rule discussed in the article – it has been verified by the recent financial crisis.

References


