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# MONETARY POLICY IN POLAND – HOW THE FINANCIAL CRISIS CHANGED THE CENTRAL BANK'S PREFERENCES

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**Abstract**

The aim of the study is to analyze the preferences of the Polish central bank concerning inflation and output gap stabilization and verification, and whether these preferences changed after the beginning of the global financial crisis. For this purpose Taylor rules are estimated by the means of GMM (linear Taylor rule) and LS with breakpoints (nonlinear Taylor rule) estimation methods. We find that the smoothing parameter decreased, the weight of the output gap increased and the weight of inflation decreased after the outburst of the crisis. Moreover, we calculate ex-post interest rate simulations to compare the actual interest rates set by the NBP with a hypothetical situation of no change in the central bank's preferences. The results suggest that the interest rates set by the NBP were significantly lower in comparison with the no-change scenario, in particular in the first quarters after the beginning of the crisis.

**JEL classification:** E52, E58, C54
**Keywords:** monetary policy, linear and nonlinear Taylor rule, interest rates simulations, financial crisis

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## Introduction

The primary goal of monetary policy in Poland is the maintenance of price stability. To achieve this goal the Narodowy Bank Polski (National Bank of Poland) adopted in 1998 an inflation targeting framework. Under the IT regime, the main commitment of the central bank is to meet a publicly announced numerical inflation target, which serves the economy as a nominal anchor. Therefore, the IT regime requires inflation to be a primary concern of the central bank in order for the conducted monetary policy to be credible.

Inflation targeting had become a very popular framework in central banking before the outburst of the global financial crisis. After the beginning of the crisis many researchers suggested that the strategy had failed (e.g. Leijonhufwud, 2008; Giavazzi & Giovannini, 2010), and was unable to prevent growing financial imbalances. On the other hand, pronounced advocates of inflation targeting (Svensson, 2010; Woodford, 2012) argued that it can still be a useful tool in challenging the problems caused by the crisis. Nevertheless, it seems that many central banks pursuing inflation targeting at that time changed their inclination in monetary policy towards real economy and financial markets stabilization.

The aim of the paper is to analyze the preferences of the Polish central bank, concerning inflation and output gap stabilization and verification, and whether these preferences changed after the beginning of the global financial crisis. For this purpose, we estimate several specifications of a Taylor rule for monetary policy in Poland and use the estimates for calculation of ex-post interest rate path simulations to compare the actual interest rate with the scenario of no change in the central bank's preferences. This allows us to answer the question as to whether the monetary policy in Poland was more adaptive or tighter after the beginning of the crisis in comparison with the situation of no change in monetary policy rule parameters.

After the famous paper of Taylor (1993) monetary policy rules became very popular in analyses. According to this rule the central bank should respond to deviations of inflation from its target and deviations of output from its potential value. Since then the formulation of the Taylor rule has been subject to many modifications. One of most important from the point of view of inflation targeting as a forward-looking framework was the idea that it should include forecasted rather than current values of macroeconomic variables (Clarida et al. 1998, 2000; Batini & Haldane, 1999). Taylor rules for Poland have been estimated in several studies, usually among other countries from the region (e.g. María-Dolores, 2005; Frömmel & Schobert 2006; Mohanty & Klau, 2004; Vašíček, 2010; Arlt & Mangel, 2014). The conclusions on the central bank behavior presented in these studies are very different which suggests that the results are very sensitive on the specification of the Taylor rule. All of the results confirm a high degree of interest rate smoothing, but the relative weights of inflation and output gap vary across the studies.

More recently, some studies suggest the existence of a nonlinear Taylor rule in Poland. Vašíček (2012) estimates Taylor rules for the Czech Republic, Hungary and Poland, applying a threshold model. He finds evidence for asymmetric behavior of Polish monetary policy over the business cycle. Sznajderska (2014), also using the threshold model, concludes that the NBP reacts more strongly to inflation when it is relatively high. Mackiewicz-Łyziak (2015) estimates Markov-switching monetary policy rules in the Czech Republic, Hungary and Poland and finds that monetary policy in Poland switched between active and passive monetary policy regimes.

The rest of the paper is organized as follows: the next section describes the data and methodology applied; the third section presents results of the estimations and simulations. Finally, the last section offers some conclusions.

## Data and methodology

### Data

To estimate the Taylor rule for Poland we use quarterly data from 1998 q1 to 2014 q2. Although it comes at cost of a shorter time series, the quarterly data have the advantage of being less noisy than monthly data. Moreover, as argues Vašíček (2012) in the context of estimating Taylor rules, some variables, such as inflation or interest rates, are characterized by high persistency at monthly frequency, so quarterly data may be preferable in estimating the weights the central banks attach to inflation and output gap developments.

As a short-term nominal interest rate, we use the

quarterly average of the main policy interest rate in Poland – the reference rate of the Narodowy Bank Polski (NBP). A frequent approach in empirical studies on monetary policy rules is adoption of short-term money market interest rates as a proxy for the central bank policy interest rate. However, the money markets rates are also influenced by factors other than monetary policy, so, as Arlt and Mangel (2014) argue, if one wants to model the reactions of the central bank, and not the money markets, one should use the interest rate set by the central bank as the dependent variable.

Inflation is measured as percentage change in CPI in the same period of the previous year. As a measure of the output gap we use the difference of the logarithm of real GDP and its trend obtained by an HP filter.

Inflation expectations are expressed as inflation expectations of commercial bank analysts formed for 12 months ahead of the Reuters survey. As the survey is conducted monthly, we use a quarterly average of the monthly data.

Inflation gap is calculated as the difference between future inflation or expected inflation and the inflation target set for the horizon consistent with the applied forward-looking inflation measure. As at an initial stage of inflation targeting in Poland, inflation targets were set for the end of a given year, to obtain quarterly data, the targets were extrapolated. If the targets were set in term of a band, the central value of the band was used.

Two variables that may potentially affect the interest rate setting behavior of central banks in a small open economy are the foreign interest rate and exchange rate. As a foreign interest rate we use the main policy interest rate set by the European Central Bank (measured as the quarterly average). The exchange rate is expressed as the deviation of the logarithm of the real effective exchange rate from the trend obtained by the HP filter.

## Taylor rule specification

Poland was an inflation targeting country during the entire sample period. Inflation targeting is a forward-looking framework, with central banks trying to achieve their numerical inflation targets over the medium term. Therefore, we estimate a forward-looking Taylor rule, where the central bank's interest rates are explained by the forward-looking variable describing future inflation developments, as opposed to backward-looking Taylor rules, where it is assumed that the central banks respond to currently observed inflation behavior. Inflation targeting central banks usually publish their inflation forecasts, for transparency reasons and in order to guide inflation expectations of the private sector. Therefore, it seems that the most proper way to estimate the monetary policy reaction function in this case is to consider the reaction of the central bank to its own inflation forecast. However, in the case of Poland the NBP started to publish its projection as late as in 2004. For this reason, we proxy the inflation forecast by two variables: future inflation and inflation expectations of commercial bank analysts.

Adopting future inflation as a forward-looking component in a Taylor rule is a common approach in empirical literature. But this approach assumes that the monetary authorities have perfect foresight. Another problem, as argued by Arlt and Mangel (2014), is that the current actions of the central banks (current interest rate changes) influence the future inflation rate. So, if the monetary authorities predict that the inflation rate will rise in the future and raise interest rates, the actual future inflation rate may be lower than predicted.

The second variable used as a proxy for inflation forecasting are inflation expectations formed by financial analysts. Inflation expectations from a Reuters survey are an important factor analyzed by the NBP while conducting monetary policy, as reflected in inflation reports. On the other hand financial analysts are the group of private agents that are more strongly interested in the central bank publications, so the central bank forecasts should have the most visible impact on the expectations of this group of agents.

An important issue from the point of view of Taylor rule estimation for Poland is the treatment of inflation targets by monetary authorities. Inflation targeting has been adopted in Poland as a measure of disinflation. Inflation targets were initially set for the end of a given year and were gradually lowered to bring inflation expectations and inflation down. Therefore, it seems that the proper way of taking into account the time-varying inflation targets is to include the inflation gap (difference between future/expected inflation and inflation target) in the Taylor rule, rather than inflation alone. On the other hand the NBP quite often adopted an "opportunistic approach" to disinflation, not correcting the downward deviations of inflation from inflation targets, because the true, long-term inflation target was lower. In this

case estimation of a Taylor rule with inflation gap would give misleading results. For this reason, we estimate two specifications of the Taylor rule: with inflation and inflation gap as explanatory variables.

Output gap always enters the equation as a one-lag value. Following Judd and Rudebusch (1998), all the specifications of the Taylor rule assume interest rate smoothing, that is the estimated interest rate equation includes a lagged interest rate term. Interest rate smoothing may on the one hand reflect the unwillingness of the central bank to undermine the confidence of the public in the central bank by sudden policy reversals (Williams, 1999), on the other hand, it may reflect the uncertainty of the central bank on the true state of the economy.

To summarize, the estimated Taylor rules are of the following form:

$$i_t = \alpha + \beta_1 i_{t-1} + \beta_2 \pi_{t+k} + \beta_3 y_{t-1} + \varepsilon_t, \quad (1)$$

$$i_t = \alpha + \beta_1 i_{t-1} + \beta_2 (\pi_{t+k} - \pi^*_{t+k}) + \beta_3 y_{t-1} + \varepsilon_t, \quad (2)$$

where:

$i_t$ = the nominal interest rate set by the central bank,

$\pi_{t+k}$ = may be actual future inflation k quarters ahead or expected inflation for k quarters ahead,

$\pi^*_{t+k}$ = inflation target for k quarters ahead,

$y_{t-1}$ = output gap,

$\varepsilon_t$ = error term.

## Estimation methods

At the first stage of the study we estimate a linear Taylor rule, assuming that all the coefficients are constant, on the sample ending in the third quarter of 2008. We use a Generalized Method of Moments (GMM), which allows us to deal with the possible problem with endogeneity, arising from inclusion in the estimated equation a forward-looking term. Two lags of each explanatory variables are used as instruments. Moreover, monetary policy in Poland, being a small open economy, may be affected by monetary policy conducted by some major central bank. Similarly, the exchange rate, as a variable affecting inflation, may influence the interest rates set by NBP. For this reason, we use ECB interest rate and real effective exchange rate as additional instruments. The estimations were obtained with the Newey-West covariance estimator, allowing for heteroscedasticity and autocorrelation (HAC weighting matrix).

For the Taylor rules estimated with future inflation rate or future inflation gap, we use information criteria (Akaike and Schwarz) to determine the number of leads. In each case the results indicated the forecasting horizon of two quarters.

The second stage is estimation of a non-linear Taylor rule, where we assume that the coefficients in the Taylor rule are not constant, but may change over time. The central bank preferences may not be stable over time but may be subject to changes. However, as we are mainly interested in the change in monetary policy preference after the beginning of the global financial crisis, we take a different approach from previous studies on non-linear Taylor rules in Poland (described in the introduction) and apply least squares with a breakpoint estimation method, with the breakpoint determined in fourth quarter of 2008. As the period from adoption of inflation targeting in Poland to the outburst of the global financial crisis was diversified, we set another breakpoint to the first quarter of 2004. This is the date when NBP switched to a continuous inflation target of 2,5% +/- 1p.p. We choose this date as a breakpoint for two reasons. Firstly, adoption of a constant inflation target suggests that the NBP determined that the disinflation process had ended, which might change the behavior of the central bank. The other reason is technical: the switch to a continuous inflation target eliminates the problem of calculation of quarterly inflation targets from changing yearly inflation targets, which might disturb the results. [1]

Similarly, as in the case of GMM estimation, for the determination of the forecasting horizon Akaike and Schwarz information criteria were used and the estimations were obtained with the Newey-West covariance matrix.

Finally, we use estimated coefficients (in the case of GMM estimation calculated on the sample 1998q1:2008q3[2], in the case of LS with breakpoint from period 2004q1:2008q3) to produce the ex-post interest rates simulations. The comparison of the actual interest rates with the simulations allows us to infer how the change in the central bank's preferences affected interest rates in the period from 2008q4.

1 These breakpoints are consistent with estimates of regime switches in Mackiewicz-Łyziak (2015). A higher number of breakpoints would be difficult considering the relatively short sample period.
2 The estimation results calculated on the entire sample period are presented in the Appendix.

## Results

### Estimation results

The presented below GMM estimates suggest that the results strongly depend on the choice of the forward-looking inflation variable. The general conclusions that may be drawn on the basis of all regressions suggest that NBP rather strongly smoothed the interest rate path and it responded to both inflation/inflation gap and output gap developments.

On the basis of these results one cannot state what was the relative weight of inflation vs. output gap in the monetary policy rule. However, only one estimation of the Taylor rule (with future inflation gap as explanatory variable) suggests a higher weight of inflation. The conclusion that in Poland the output gap played a more important role is consistent with other studies. The estimation results for the last specification of the Taylor rule – with expected inflation gap – we treat as unrealistic. The results might be disturbed by the fact that in the period under consideration at this forecasting horizon (4 quarters ahead) the inflation targets might not yet have been known.

However, another reason why the results obtained for a linear Taylor rule might not reflect the true preferences of the central bank is the fact that the preferences might change over time. In Table 2 estimates of the Taylor rule are presented obtained by the means of the LS with breakpoints.

The results presented above seem more robust than the GMM estimates, in particular as far as the first period is concerned. According to all the specifications of the Taylor rule the weight of the output gap was significantly higher than the weight of inflation, regardless of the inflation measure (in the specification with the expected inflation gap the coefficient on inflation gap is again negative, this might be for the reasons explained above). In the second period (2004q1:2008q3) an increase in the smoothing parameter may be observed. Taylor rules with future inflation and future inflation gap indicate that the weights of inflation and output gap were similar.[3] On the contrary, the rules with expected inflation and expected inflation gap indicate that inflation was the primary concern of NBP and the output gap proved to be statistically insignificant. The difference between the Taylor rule specifications may be a result of the fact that in the case of longer forecasting horizons (4 quarters in the case of expected inflation) the information content in output gap about future inflation developments may be less significant than in the case of shorter forecasting horizons.

Finally, in the last period, after the outburst of the global financial crisis, a significant drop in the smoothing parameter is visible, as monetary policy switched to a more active regime, with increase in significance of the output gap. Again, there are differences between the rules with future inflation and expected inflation. Future

3 In the second and third period estimated coefficients are the same for rules with inflation and inflation gap, because the inflation target is constant. The only difference in the results concerns constants.

**Table 1: GMM estimates of Taylor rule for Poland (1998q1:2008q3)**

| Coeff. | Taylor rule specification | | | |
|---|---|---|---|---|
| | Future inflation | Future inflation gap | Expected inflation | Expected inflation gap |
| const. | 0,004 | 0,003 | 0,005 | 0.005* |
| | (0.002) | (0.002) | (0.004) | (0.002) |
| i(-1) | 0.84*** | 0.95*** | 0.76*** | 0.92*** |
| | (0.03) | (0.02) | (0.05) | (0.02) |
| π | 0.23*** | 0.37*** | 0.38* | -0.71*** |
| | (0.04) | (0.05) | (0.21) | (0.12) |
| y(-1) | 0.25* | 0.18* | 0.41*** | 0.56*** |
| | (0.13) | (0.10) | (0.14) | (0.08) |
| $R^2$ | 0,98 | 0,98 | 0,98 | 0,98 |
| Prob(J-stat) | 0,37 | 0,17 | 0,29 | 0,42 |

*Source: Own calculations. Standard errors in parenthesis; *, **, *** denote statistical significance at 10%, 5% and 1% level, respectively; Prob(J-stat) denotes p-value of the Sargan test for overidentification*

**Table 2: LS with breakpoints estimates of the Taylor rule for Poland (1998q1:2014q2)**

| Coeff. | Taylor rule specification | | | |
|---|---|---|---|---|
| | Future inflation | Future inflation gap | Expected inflation | Expected inflation gap |
| | 1998q2:2003q4 | | | |
| const. | 0.02*** | 0.02*** | 0.03*** | 0.02** |
| | (0.004) | (0.004) | (0.005) | (0.08) |
| i(-1) | 0.71*** | 0.81*** | 0.54*** | 0.81*** |
| | (0.03) | (0.03) | (0.07) | (0.06) |
| π | 0.21*** | 0.29*** | 0.51*** | -0,37 |
| | (0.04) | (0.05) | (0.14) | (0.29) |
| y(-1) | 0.85*** | 0.73*** | 1.10*** | 0.94*** |
| | (0.10) | (0.10) | (0.09) | (0.18) |
| | 2004q1:2008q3 | | | |
| const. | -0,002 | 0,001 | -0.01* | 0.01*** |
| | (0.004) | (0.003) | (0.008) | (0.002) |
| i(-1) | 0.97*** | 0.97*** | 0.82*** | 0.82*** |
| | (0.08) | (0.08) | (0.05) | (0.05) |
| π | 0.14** | 0.14** | 0.92*** | 0.92*** |
| | (0.06) | (0.06) | (0.30) | (0.30) |
| y(-1) | 0.12*** | 0.12*** | -0,1 | -0,1 |
| | (0.05) | (0.05) | (0.10) | (0.10) |
| | 2008q4:2013q4/2014q2 | | | |
| const. | 0.02** | 0.02*** | -0,002 | 0.01*** |
| | (0.008) | (0.006) | (0.004) | (0.003) |
| i(-1) | 0.46*** | 0.46*** | 0.58*** | 0.58*** |
| | (0.15) | (0.15) | (0.07) | (0.07) |
| π | -0,0003 | -0,0003 | 0.69*** | 0.69*** |
| | (0.08) | (0.08) | (0.20) | (0.20) |
| y(-1) | 0.49*** | 0.49*** | 0.23*** | 0.23*** |
| | (0.14) | (0.14) | (0.07) | (0.07) |
| $R^2$ | 0,99 | 0,99 | 0,99 | 0,99 |
| AIC | -7,85 | -7,95 | -7,76 | -7,45 |
| Schwarz | -7,44 | -7,54 | -7,36 | -7,05 |

Source: Own calculations. Standard errors in parenthesis; *, **, *** denote statistical significance at 10%, 5% and 1% level, respectively

inflation seems to be insignificant, with the central bank paying attention only to the output gap. Expected inflation is significant and its weight is higher than the weight of the output gap.

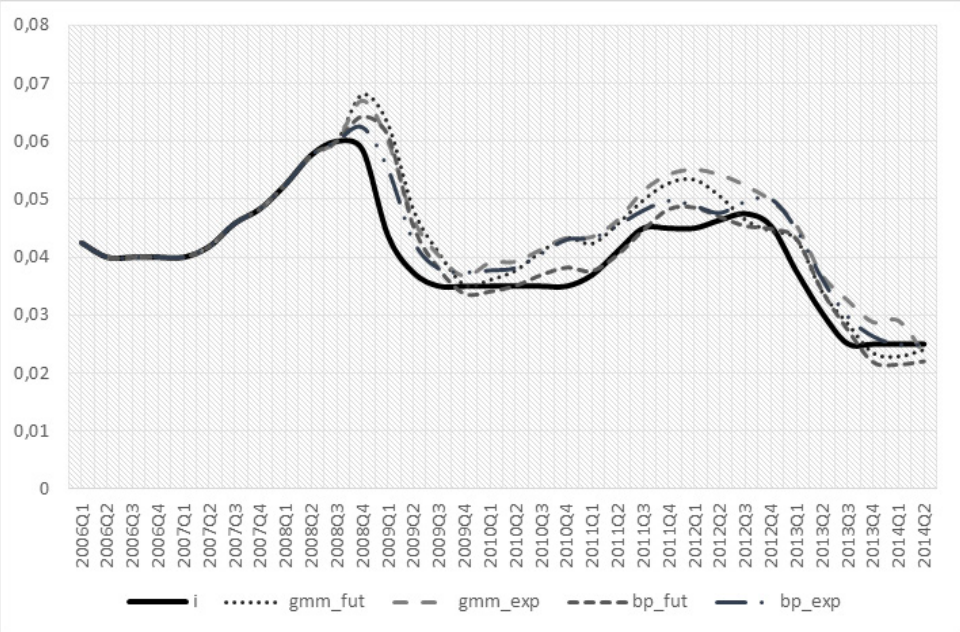
All the presented results, despite differences in the estimated coefficients, show significant change in the reaction function of the NBP after the beginning of the global financial crisis. The responsiveness to inflation decreased while to the output gap increased. The coefficient on the past interest rate declined, which indicates less smoothing. Below we present ex-post simulations of the interest rates, calculated with the assumption of no change in the central bank's preferences.

## Simulations

The estimation results presented above were used to produce ex-post simulations of the interest rate path,

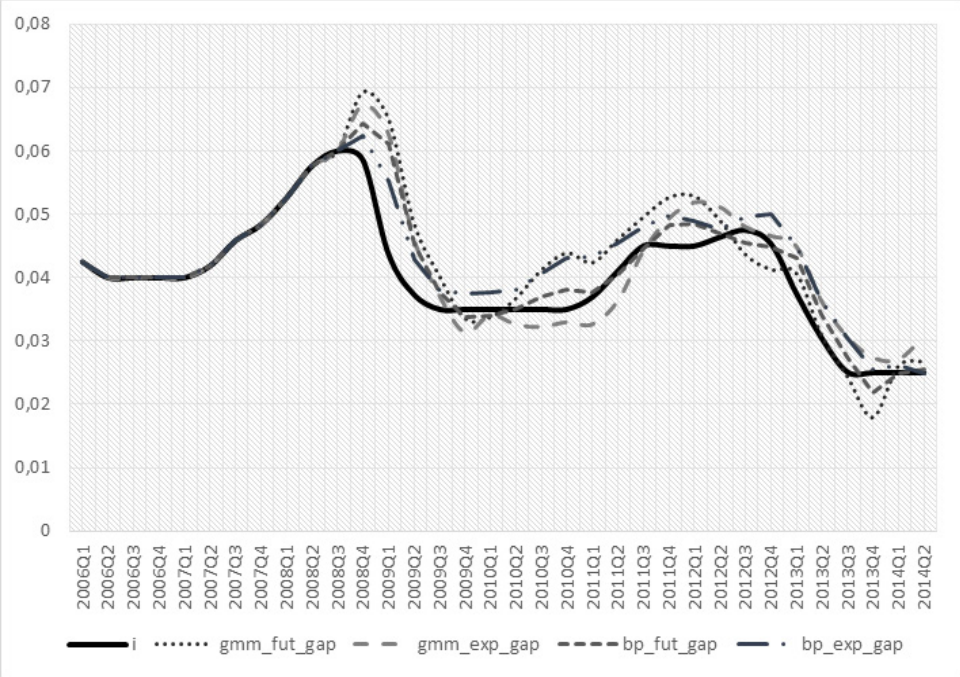
assuming no change in preferences of the monetary authorities in Poland. Comparing the calculated interest rate path with the actual interest rates set by the NBP will allow us to answer the question of whether the monetary policy in Poland was more adaptive or more restrictive after the beginning of the global financial crisis, than it

**Figure 1: Actual interest rates and simulated interest rate path (Taylor rules with inflation)**




Source: NBP data and own calculations

**Figure 2: Actual interest rates and simulated interest rate path (Taylor rules with inflation gap)**




*Source: NBP data and own calculations*

**Table 3: Descriptive statistics of the differences between the ex-post simulations and actual interest rates (in p.p.)**

| | Max | Min | Min(abs) | Average | Average(abs) |
|---|---|---|---|---|---|
| GMM_fut | 1,92 | -0,21 | 0,02 | 0,46 | 0,49 |
| GMM_exp | 1,62 | -0,16 | 0,16 | 0,64 | 0,64 |
| BP_fut | 1,72 | -0,35 | 0,01 | 0,19 | 0,31 |
| BP_exp | 1,15 | -0,01 | 0,01 | 0,41 | 0,42 |
| GMM_fut_gap | 2,13 | -0,71 | 0,04 | 0,38 | 0,51 |
| GMM_exp_gap | 1,89 | -0,47 | 0,05 | 0,28 | 0,45 |
| BP_fut_gap | 1,72 | -0,31 | 0 | 0,22 | 0,29 |
| BP_exp_gap | 1,15 | -0,01 | 0,01 | 0,42 | 0,42 |

Source: Own calculations. Min(abs) denotes minimum of the absolute values of the differences, average(abs) denotes average of the absolute values of the differences

would be, had the central bank not changed its reaction to the inflation and output gap developments. Figures 1. and 2 present actual and conditional interest rate paths (Figure 1. presents interest rates calculated with the use of Taylor rules with future or expected inflation, Figure 2. – with future or expected inflation gap).

The results of the simulation show that in the first quarters after the start of the global financial crisis monetary policy in Poland was looser than it would be consistent with monetary policy without a change in preferences. These results are consistent with the findings of Vašíček (2012), who proved that the NBP reacted by lowering interest rates in the face of financial stress. The average deviation of the actual interest rates from the calculated interest rates during the entire period amounted to about 0.4 p.p. The highest differences appeared for the first quarter of 2009 for all simulations (interest rates calculated with the use of all Taylor rule specifications), with the largest deviation equal to 2.1 p.p., calculated with the use of the Taylor rule with future inflation gap. At the end of the sample the opposite may be stated, namely the monetary policy proved to be tighter than it would be, if the central bank acted in the same way than before the global financial crisis. The largest difference amounts to -0.7 p.p. in the case of a Taylor rule with future inflation gap estimated by GMM. Table 3 offers a summary of the differences between actual interest rate and ex-post simulations.

## Conclusions

In this study we verify whether the preferences of the Polish central bank concerning inflation and output gap stabilization changed after the beginning of the global financial crisis and how large was the impact of this change on the interest rates set by the NBP. For this purpose, we estimate monetary policy rules for the period before the crisis and calculate ex-post interest rates consistent with these estimates. For robustness purposes, we use several measures to express inflation in the Taylor rule: future inflation, future inflation gap, expected inflation and expected inflation gap. The comparison of the actual rate path with calculated interest rates shows the scale of change in the interest rate setting behavior of the NBP.

Our results show that the preferences of the NBP changed significantly after the outburst of the global financial crisis. The weight attached by the NBP to the output gap developments increased while the weight of inflation dropped. Interest rate simulations performed on the basis of all specifications of the Taylor rule indicate that in the first quarters the actual interest rates were about 2 p.p. lower than they would be if the central bank had not changed preferences. It is worth noting that at this time inflation was rather high and exceeded the higher band of inflation target.

At the end of the sample period some of the simulations indicated that the interest rates should be lower. In this period inflation dropped significantly, as a result of very low prices of oil and food in world markets and overall economic slowdown. At the end of 2014 the Polish economy experienced even deflation. Many postulated at this time lowering interest rates, but NBP kept interest rates unchanged. Analysis of the NBP behavior in the environment of low interest rates and very low inflation could be an interesting field for further research.

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## Appendix

**Table A.1: GMM estimates of Taylor rule for Poland (1998q1:2014q2)**

| Coeff. | Taylor rule specification | | | |
|---|---|---|---|---|
| | Future inflation | Future inflation gap | Expected inflation | Expected inflation gap |
| const. | -9.02E-05 | 0,001 | -0,005 | 0.003** |
| | (0.001) | (0.001) | (0.004) | (0.001) |
| i(-1) | 0.86*** | 0.96*** | 0.80*** | 0.93*** |
| | (0.03) | (0.02) | (0.04) | (0.02) |
| π | 0.22*** | 0.34*** | 0.50** | -0.51*** |
| | (0.04) | (0.06) | (0.20) | (0.16) |
| y(-1) | 0.15** | 0,06 | 0.14* | 0.46*** |
| | (0.07) | (0.07) | (0.07) | (0.08) |
| R2 | 0,98 | 0,98 | 0,98 | 0,98 |
| Prob(J-stat) | 0,16 | 0,28 | 0,13 | 0,2 |

*Source: Own calculations. Standard errors in parenthesis; *, **, *** denote statistical significance at 10%, 5% and 1% level, respectively; Prob(J-stat) denotes p-value of the Sargan test for overidentification*