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TAYLOR-TYPE RULES IN POLAND: A HISTORICAL ANALYSIS OF MONETARY POLICY

Abstract. This paper examines a history of the Polish monetary policy using the framework proposed by John B. Taylor. The "Taylor rule" describes an optimal monetary policy in a closed economy, where interest rates depend on deviation of real output from potential output and on deviation of rate of inflation from the target rate of inflation. The paper is organized as follows. At the beginning we briefly summarize different views of "Taylor rule", a methodology of the monetary policy rules for closed and open economies and main problems in "Taylor rule" calculations. Then we focus on methods of calculation Taylor-type reaction functions for Poland over the period from 1999 to 2003. The results of the calculation and historical evaluation of monetary policy in Poland will conclude the paper.

Keywords: monetary molicy, central banks policies, Poland.
JEL Classification: E52, E58, G1.

1. INTRODUCTION

Which rules should central banks follow? Which monetary policy is optimal? These questions are still open. There are different rules among central banks. Currently the most popular is inflation targeting (e.g. Janecki 2002). John B. Taylor (1997) argues that the monetary policy rule in which the interest rate policy instrument adjusts to both inflation and real GDP works better than policy in which there is no instrument reaction to real GDP. A basic proposal of "Taylor rule" has become a tool for evaluating monetary policy for a closed economy.[1] Using this simple rule for monetary policy, economists have estimated deviations of inflation and output from their optimum. Taylor recommended a modification of the typical policy rule for economies with more developed financial markets.[2] According to

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[1] Svensson (1997) and Ball (1997) extend the model for an open economy.

[2] Taylor (1993) proposal fits the Federal Reserve policy during 1987–1992.

the policy rule, central bank rate is adjusted to changes in inflation rate and output (GDP growth). "Taylor rule" could represent a guideline for the central bank to follow when taking monetary policy decisions.

The paper proceeds as follows. Section 2 presents the theory of "Taylor rule" and economists' view on the Taylor proposal together with a framework for measuring potential output and output gaps. Section 3 covers the method of "Taylor rule" calculations for Poland, the method based on Taylor (1993) proposal. Section 4 presents results of "Taylor rule" in Poland. This paper provides historical analyzes of monetary policy in Poland using "Taylor rule" as a point of reference.

2. MONETARY POLICY DESIGN: "TAYLOR RULE"

2.1. The Concept of "Taylor Rule"

"Taylor rule" captures the key factors affecting inflation: inflation gap, output gap and the equilibrium real interest rate (equation 1).

$$r = \pi + gy + h(\pi - \pi^*) + r^f, \tag{1}$$

where:

r – the short-term interest rate ("Taylor rate");

r^f – the central bank estimate of the equilibrium real rate of interest;

y – the output gap, the per cent deviation of real GDP from a target and $y = 100 \cdot \frac{Y - Y^*}{Y^*}$;

Y – the real GDP;

Y^* – potential output (trend real GDP), in %;

g – output gap coefficient;

π – the inflation rate (quarterly average in %);

π^* – the central bank target inflation rate;

$\pi - \pi^*$ – inflation gap;

h – inflation gap coefficient, the amount by which central bank raises the *ex post* real interest rate.

The constants are g, h, π^* and r^f (g and h are non-negative). Note also that $1 + h$ is the slope coefficient on inflation and $r^g - h\pi^*$ is an intercept term. Taylor (1993) suggested the values for parameters: $g = 0.5$, $h = 0.5$, $\pi^* = 2.0$, $r^f = 2.0$. The problem of parameters value is widely discussed among economists. "Taylor rule" says that central bank rate rises if inflation rate increases above target of 2% or if real GDP rises above trend GDP.

According to Taylor assumptions, if inflation rate and real GDP are on target, then the central bank interest rate would equal 4% (2% in real terms). Brayton et al. (1997) for example suggest that g should be closer to 1 or just below 1, but still there is no consensus about a size of the coefficients of "Taylor rule". Ball (1997) derives the optimal coefficients on y and π in a closed economy. He proposed 1.13 for output and 0.82 for inflation. Armour et al. (2002) confirms that the output gap coefficient (g) should equal 0.5.

"Taylor rule" in terms of the European Central Bank (ECB) monetary policy provides information that common monetary policy for different economies in euro-zone can be profitable for some countries and should generate looses for other economies. ECB interest rates are the same for all European Monetary Union (EMU) countries, but we can differentiate in EMU zone three different countries according to money price. We know, that using "Taylor rules", such countries like Greece, Ireland, Spain should have much higher interest rate: 6.6% in Ireland, 6.2% in Greece, 3.8% in Spain (Bielecki 2003). Taylor rates and ECB rates are similar for other countries like Portugal, the Netherlands, and Finland. According to "Taylor rule" the ECB rate is too high for some countries. In this group we have France ("Taylor rate" is 1%) and Germany (0.25%) (Bielecki 2003). Taking these aspects into consideration, we can conclude that there are some beneficiaries like Great Britain. Interest rate setup by the Bank of England is higher than ECB rate and close to "Taylor rate", independency of the Bank of England is close related to higher GDP growth. This view gives support for the use of the "Taylor rule" for monetary policy especially in the context of monetary policy in EU zone. Anyway, "Taylor rule" should not be used automatically, or mechanically, because of supply shocks and market expectations at financial markets (Taylor 1993).

The core version of "Taylor rule" does not consider an exchange rate. It is because the exchange rate plays a small role in the formulation of US monetary policy (Taylor 1997). The analyzes based on simple "Taylor rule" assume a closed economy. Svensson (1997) and Ball (1997) derive an open-economy extension to "Taylor rule" by adding the exchange rate. Ball (1997) adds a weighted average of interest rate and exchange rate (the monetary Conditions Index – MCI) and the lagged exchange rate. The MCI is used as the policy instrument in Canada, New Zealand, Norway, Sweden (Gerlach and Smets 1996), to an overall stance of monetary policy.[3] We should notice that there is disagreement between economists about whether monetary authorities should react to the exchange rate when setting interest rate. Taylor (1998) reports other, not solved, problems. There are

[3] Central banks in Canada and New Zealand use MCI as operational targets.

disagreements about whether monetary policy should respond to the lagged interest rate or whether it should include a measure of expected future inflation, rather than actual observed values.

2.2. A Framework for Measuring Potential Output and Output Gaps

"Taylor rule" includes a monetary policy reaction function y, which requires knowledge of the potential GDP. The level of potential output and the output gap are major uncertainty in a calculus. The most problematic is the measurement of the potential output and output gap. The output gap is the difference between the economy's actual output and the level of production it can achieve with existing labor, capital, and technology without putting sustained upward pressure on inflation. The common definition of output gap is a difference between actual and potential output (equation 2).

$$y = 100 \cdot \frac{Y - Y^*}{Y^*}. \tag{2}$$

The output gap is positive when actual output exceeds the economy's potential (potential GDP) and negative when actual GDP growth is below a potential output growth. Excess demand is referred to positive output gap and excess supply is referred to a negative output gap. We treat output gap in the monetary rule as an indicator of future inflation. The output gap should help to distinguish between demand shocks and price-level shocks. The problem of the output gap estimation refers to calculation the potential GDP, which is non-observable directly. There is a need for additional assumptions to choose estimation methods for output gaps. There are several ways to define the concept of computation methods for potential output and output gaps. Concepts based on trend, production function and univariate or multivariate filters approaches. We follow in this paper the Hodrick-Prescott methodology. The Hodrick-Prescott filter is computed as (cf. *Technical Note...* 1995):

$$Min \sum_{t=1}^{T} (\ln Y_t - \ln Y_t^*)^2, \tag{3}$$

subject to:

$$\sum_{t=2}^{T-1} [(\ln Y_{t+1}^* - \ln Y_t^*) - (\ln Y_t^* - \ln Y_{t-1}^*)]^2 \leqslant e, \tag{4}$$

where:

Y_t – actual GDP at constant market prices;
Y_t^* – trend GDP at constant market prices;
e – small number arbitrarily chosen.

The specification of the Hodrick – Prescott filter can be rewritten as:

(5)

$$Min\left[\sum_{t=1}^{T}(\ln Y_t - \ln Y_t^*)^2 + \lambda \cdot \sum_{t=2}^{T-1}[(\ln Y_{t+1}^* - \ln Y_t^*) - (\ln Y_t^* - \ln Y_{t-1}^*)]^2\right] \leqslant e,$$

where λ – Lagrange multiplier.

The choice of the value for the Lagrange multiplier λ determines the length of the weighted moving average, trend smoothing and trade-off between the smoothing and fit of trend output to actual output. A lower value of the Lagrange multiplier produces trend output closer to actual output. It means that higher λ generates the smoother trend output, which poorer follows actual output. The sensitivity test on the value of the Lagrange multiplier of the Hodrick-Prescott filter for EU-15, provides information that small changes in the value of the Lagrange multiplier do not significantly modify the trend for the GDP series (cf. *Technical note...* 1995).

The OECD and the International Monetary Fund (IMF) use a Cobb-Douglas production function (Cotis et al. 2003). In this situation potential output is defined as the level of real GDP attainable with full employment of all production factors and sustainable over medium term at a stable rate of inflation. With this approach, trend factor productivity, capital input and full employment labor input are determined separately and plugged into the production function to obtain potential output estimates. The Directorate-General for Economic and Financial Affairs of the European Commission (DG II) adopted the Hodrick–Prescott trend estimation method for the detrending of time series. The OECD methodology for estimation potential output and output is based on a Cobb-Douglas production function (described in Giorno et al. 1995). This approach is hybrid because it relies on economic relationships (to estimate the Non-Accelerating-Inflation Rate of Unemployment – NAIRU) and univariate filters (HP filter) to calculate trend participation rates, trend hours worked and trend total factor productivity. A methodology used by the EU Commission for estimation of potential output is similar to that of the OECD. The EU Commission uses also a Cobb-Douglas production function with exogenous trend (Denis et al.

2002), but EU Commission uses the Non-Accelerating Wage Rate of Unemployment (NAWRU) approach (without worked hours).[4] The IMF approach is based on a production function method, with assumptions that vary across countries. It means that IMF chooses for each country the method, that fits the country situation best. The methods cover the split time trend and the HP filter, the band pass filter and the production function (IMF 2002). The ECB has not published any estimates of potential output for the euro area. The ECB uses trend measures of various macroeconomic series derived by an HP filter in its calculation of cyclically adjusted budget balances (Bouthevillain et al. 2001).

3. CALCULATION OF "TAYLOR RULE": THE CASE OF POLAND

This section presents methodology of calculation interest rate using "Taylor rule" for Poland ("Taylor rate"). The calculations are based on the formula presented in Taylor (1993) with parameters: $g = 0,5$, and $h = 0,5$:

$$r = \pi + 0,5 \cdot y + 0,5 \cdot (\pi - \pi^*) + r^f. \tag{6}$$

The empirical analysis of "Taylor rule" presented in this section is based on data from Central Statistical Office (GDP) and National Bank of Poland (interest rates). The sample period covers the years 1995–2003. The estimation of output gap is based on the methodology suggested by the European Commission (DG II) presented in Section 2 of this paper. In case of two-digit inflation in Poland (till Q1, 2000), we could not follow "Taylor rule" for real equilibrium interest rate (r^f) on 2% level. Because of that, the real three-month WIBOR rate is assumed as the real equilibrium interest in the Polish case.

An important factor, in case of calculation "Taylor rule", is availability of data in a particular day of Monetary Policy Council (MPC) meeting. Let us assume that MPC should take a decision in last decade of December. We know inflation rate from November and its forecast and GDP growth for Q4. Real reference rates and inflation targets are known. Calculations are based on first inflation rate estimation and GDP growth, which we could verify after some months. This time lag could provide errors.

[4] In estimation, OECD and EU Commission use the Kalman filter.

4. MONETARY POLICY VS. "TAYLOR RULE" IN POLAND

There are several sources in the Polish law, where there are rules of activity of the central bank in Poland (NBP). These are "The Constitution of the Republic of Poland" (1997),[5] "Act on the National Bank of Poland" (1997)[6] and *Medium-Term Strategy for Monetary Policy* (1998).[7] The Monetary Policy Council (MPC) determines monetary policy[8] guidelines for each year. The goal of monetary policy in Poland in the period 1998–2003 was to reduce the inflation rate and to attain price stability in the long perspective.

The main central bank's policy instruments are: interest rates, required reserves ratios, open market operations. The MPC strategy is based on direct inflation targeting. In September 1998 the MPC adopted a *Medium Term Strategy in Monetary Policy 1999–2003*, which aimed to lower inflation rate below 4% by the end of 2003. In February 2003 MPC adopted *Monetary Policy Strategy after 2003*, which is aimed at stabilising inflation at a low level. The inflation target is a constant rate of 2.5% +/–1.0 pp. Until 1998, the NBP had two official interest rates: the rediscount rate and the lombard rate. Since 1998, the predominantly influential rate has become the reference rate – the minimum rate at which the NBP, is willing to sell NBP bills and set a floor for the yield on NBP bills – the main securities

[5] Article 227.1: "The central bank of the State shall be the National Bank of Poland. It shall have the exclusive right to issue money as well as to formulate and implement monetary policy. The National Bank of Poland shall be responsible for the value of Polish currency".

[6] Article 3.1: "The basic objective of NBP activity shall be to maintain price stability, and it shall at the same time act in support of Government economic policies, insofar as this does not constrain pursuit of the basic objective of the NBP".

[7] "The ultimate goal of the central bank monetary policy will continue to be the process of reducing inflation, and consequently, over time, to ensure price stability. Achieving this objective will provide a solid foundation for sustained economic growth. Considering the ongoing transformation of the Polish economy into a mature market economy, the additional goal of the central bank is to support the institutional development of modern financial markets

The strategic goal of Poland is to integrate our economy with EU, and at a later time, with EMU. To accomplish this goal, the Polish economy will have to meet several macro-economic convergence criteria over the next few years. Some of them represent a serious challenge to monetary policy. The monetary convergence criteria relate to price, exchange rate and long-term interest rates stability. The price stability criterion implies that Poland will have to reduce inflation to the level not exceeding 3–4% annually in a relatively short time. Under the exchange rate criterion, a country aspiring to join the monetary union will have to be a part of the European Exchange Rate Mechanism (ERM2) for at least two years. Within this system, the Zloty will have to be pegged to the Euro. The market rate of the Zloty will be allowed to fluctuate around the fixed parity rate, probably within a plus-minus 15% band".

[8] Exchange rate policies are established by the Council of Ministers after consultation with the MPC, the NBP has sole authority to implement exchange rate and monetary policy.

used in the NBPs open market operations to manage market liquidity. The lombard rate sets an upper limit on interbank market interest rates. In December 2001, the NBP introduced a new official rate for deposit standing facilities. Together with the lombard rate it determines the band within which the overnight money market rate can fluctuate.

The deposit rate constitutes a floor on fluctuations in overnight rates. The rediscount rate is the rate at which the NBP accepts bills of exchange from commercial banks extending the rediscount credit of such bills. The rediscount rate is not widely used.

It is obvious that policy mix in Poland is far from optimal. MPC stressed that Poland has a non-optimal mix of fiscal and monetary policy, that means "a tight monetary policy in reaction to a loose fiscal policy, which results in an increase in the cost of reducing inflation, in the form of lower GDP growth than would be possible with optimum policy mix" (*Monetary Policy Guidelines...* 2001). According to MPC monetary policy is determined by the level of restrictiveness. The problems in achieving annual inflation rate (over- and under shooting) are results mainly of the "supply shocks", situation in public finance and not optimal interest rates policy. According to MPC: "Achieving the inflation target for 2001, in the context of the medium term policy, may require tightening of monetary policy stance" (*Monetary Policy Guidelines...* 2001). Between 1998 and 2001 we have experienced a slowdown of the Polish economy. Since autumn 1999 MPC adopted a restrictive monetary policy (cf. Figure 1). In 2000, despite very tight monetary conditions, the GDP growth remained at average 4%, but in 2001 a real GDP growth reached 1% (cf. Figure 2). This slowdown was caused by internal and external factors just to mention global recession, especially in major EU markets, and was also partially caused by tight monetary policy. As early as from the Q1, 2002 the Polish economy is recovering forcefully. We can observe a significant relaxation in monetary policy from the second half of 2001. The question about the path of this relaxation and the level of contraction in terms of output growth is open. GDP increased by 1.4% in 2002 and by 3.7% in 2003. It is estimated that in 2004 the GDP will grow in real terms by 5%. Of course, one of the most significant factors determining the effectiveness of monetary policy in Poland is the finance of public sector – the size of the current account deficit and the public sector budget deficit. The slowdown of the Polish economy (especially between 2000 and 2001) together with problems in achieving annual inflation targets leads to a conclusion that the level of central bank interest rates was not at the proper level.

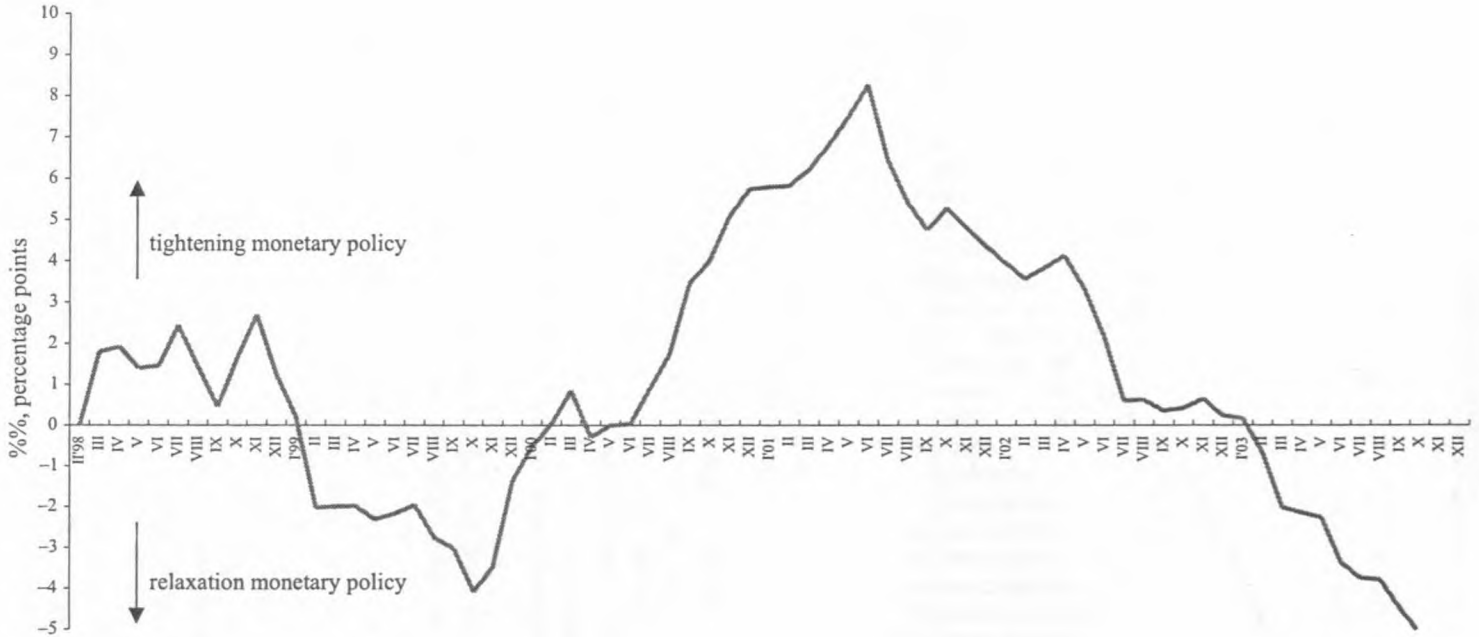

Fig. 1. MCI in 1995–2003 (base period: February 1998 = 0). Sources: own calculations based on GUS and NBP data

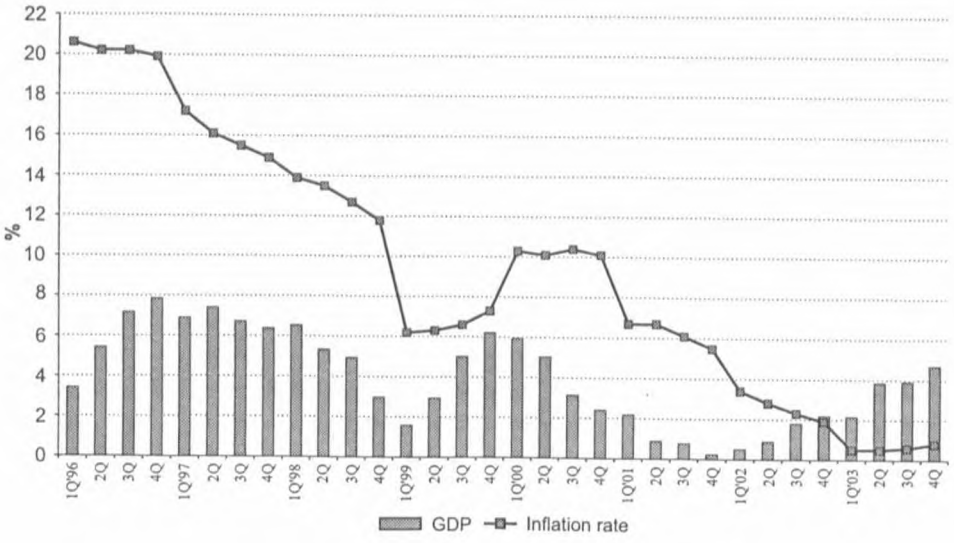

Fig. 2. GDP growth and inflation (1996–2003).
Sources: GUS and NBP data

Interest rate calculated according to "Taylor rule" was below a „corridor" set by lombard rate and rediscount rate in 1999 and from Q1, 2001 to Q4, 2003. The interest rate policy in 2001 was over-restrictive. According to "Taylor rule", central bank interest rates could be lower especially in the period of recession from the Q1, 2001 till Q1, 2003. The "Taylor rate" was below rediscount and lombard rate in that period (cf. Figure 3 and Table 1).

Assuming that for the Q4 in terms of average inflation rate from the past year we will take inflation forecast for the quarters (2% in terms of 0.8%), the "Taylor rate" increases from 3.2% to 5%, but still will be below rediscount interest rate from Q4, 2003. The changes appear in case of changes to inflation target. Let us assume that NBP have inflation target around 2%, in that case "Taylor rate" will increase from 3.2% to 3.7%. The change in output gap (from – 1% to 0%) brings a small increase in "Taylor rate", to 3.7%. We have an interesting situation in 2004. Instead of higher inflation rate, inflation target, "Taylor rate" is between lombard and rediscount rate. Based on assumptions for Q1, 2004: inflation rate 2.5%, interest rate at the level of Q4, 2003 and – 0.75 for output gap, "Taylor rate" increases by 0.4–0.5 pp. Assuming that MPC wants to keep the spread between central bank interest rate and "Taylor rate", there is a high probability of the tightening monetary policy in Q2, 2004.

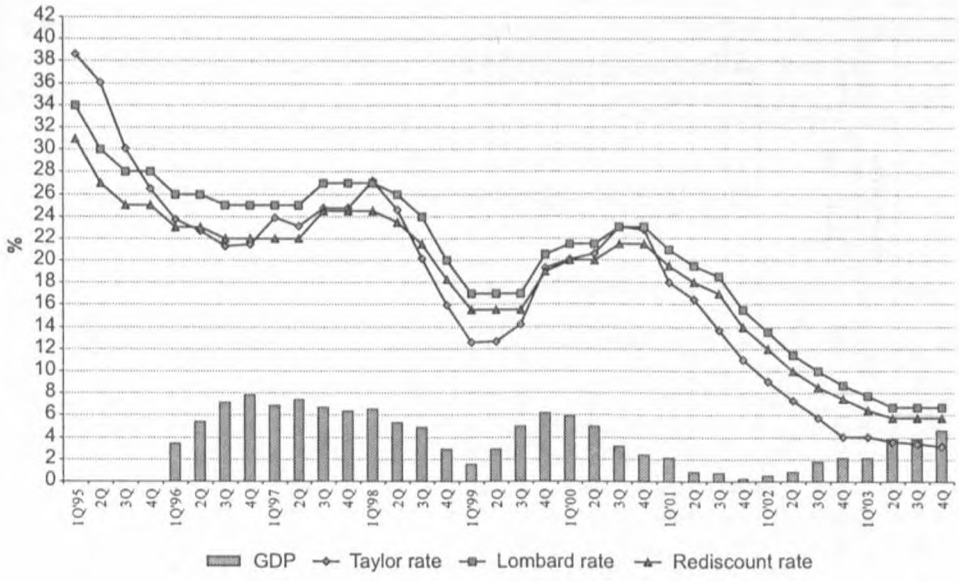

Fig. 3. Interest rates according to "Taylor rule" vs. central bank interest rates. Sources: own calculations based on GUS and NBP data

5. CONCLUSIONS

There is no single answer to a question: which rules should central banks follow or which monetary policy is optimal. According to the Polish law NBP should focus not only on price stability (inflation targeting) but also should provide foundations for a sustained economic growth. The "Taylor rule" covers these two aspects. It should be stressed that, officially no central bank would set interest rates just only on the basis of "Taylor rule". Of course, monetary authorities use many more indicators and information about the future path of inflation, output growth. We presented one variant of "Taylor rule" calculations. The results can be summarized with three major conclusions. First of all, monetary policy from the "Taylor rule" point of view was not optimal especially in the period 2001–2003. The scale of interest rate reductions in Q4, 2001 was in accordance with "Taylor rule", but the policy was too contractory in the following quarters. Secondly, monetary authorities can assume the difference between official interest rates and interest calculated on the basis of "Taylor rule". The "Taylor rate" could be treated as a recommended rate. Thirdly,

Table 1. Results of calculation "Taylor rate" for Poland

Period	GDP seasonal adjusted (PLN mln)	Potential GDP (mln PLN)	Output gap	Inflation rate (end of period)	Inflation target	Inflation gap	Equilibrium rate (3-months WIBOR rate)	Taylor rate
	(1)	(2)	(3) = 100 · [(1)–(2)]/(2)	(4)	(5)	(6) = (4)–(5)	(7)	(8)
1Q'99	92 358.0	93 094.2	–0.79	6.2	7.2	–1.0	7.08	12.4
2Q	94 206.6	93 976.7	0.24	6.3	7.2	–0.9	6.45	12.4
3Q	96 308.3	94 829.4	1.56	6.6	7.2	–0.6	6.18	13.3
4Q	97 523.3	95 651.4	1.96	7.3	7.2	0.1	8.09	16.4
1Q'00	97 892.4	96 442.9	1.50	10.3	6.1	4.2	6.85	20.0
2Q	99 030.1	97 205.4	1.88	10.1	6.1	4.0	7.71	20.7
3Q	99 246.2	97 941.1	1.33	10.4	6.1	4.3	8.94	22.2
4Q	99 873.7	98 653.4	1.24	10.1	6.1	4.0	11.27	24.0
1Q'01	100 069.5	99 346.6	0.73	6.7	7.0	–0.3	11.05	18.0
2Q	99 983.0	100 025.7	–0.04	6.7	7.0	–0.3	9.87	16.4
3Q	99 951.9	100 696.1	–0.74	6.1	7.0	–0.9	10.00	15.3
4Q	100 062.3	101 363.3	–1.28	5.5	7.0	–1.5	9.31	13.4
1Q'02	100 564.2	102 032.2	–1.44	3.4	5.0	–1.6	7.00	8.9
2Q	100 918.2	102 706.9	–1.74	2.8	5.0	–2.2	7.46	8.3
3Q	101 683.2	103 390.7	–1.65	2.3	5.0	–2.7	7.15	7.3
4Q	102 303.6	104 085.7	–1.71	1.9	5.0	–3.1	6.03	5.5
1Q'03	102 788.7	104 792.9	–1.91	0.5	3.0	–2.5	5.80	4.1
2Q	104 749.1	105 512.3	–0.72	0.5	3.0	–2.5	5.08	4.0
3Q	105 816.4	106 242.5	–0.40	0.6	3.0	–2.4	4.36	3.6
4Q	106 836.3	106 981.8	–0.14	0.8	3.0	–2.2	4.36	4.0

Sources: own calculations based on GUS and NBP data.

the results of "Taylor rule" calculations for the Polish case should be one of instruments in defining future monetary policy. The "Taylor rule" should be treated also as a tool for evaluating monetary policy. According to Taylor (1997) it could be helpful in creating of a more complex monetary policy rule.

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RYS HISTORYCZNY POLITYKI PIENIĘŻNEJ W POLSCE: REGUŁA TAYLORA

(Streszczenie)

W artykule omówiono zagadnienie dotyczące prowadzenia w Polsce polityki pieniężnej przy wykorzystaniu metodologii, którą zaproponował John B. Taylor. Funkcja, znana powszechnie pod nazwą „reguły Taylora", opisuje optymalną politykę pieniężną, prowadzoną w gospodarce zamkniętej, gdzie stopy procentowe ustalane przez władze monetarne zależą od kształtowania się odchylenia realnego produktu krajowego brutto od produktu potencjalnego oraz odchylenia stopy inflacji od wyznaczonego celu inflacyjnego. Toteż najpierw podsumowano różne podejścia do koncepcji Taylora oraz zaprezentowano różne problemy dotyczące obliczeń „reguły Taylora". Następnie przedstawiono metodologię zastosowaną do obliczenia „stopy Taylora" dla polskiej gospodarki dla okresu 1999–2004. Wyniki obliczeń oraz ocenę prowadzonej przez bank centralny polityki pieniężnej w Polsce zawarto w końcowej części artykułu.