

CREDIBILITY AND TRANSPARENCY

Some evidence on inflation targeting in Poland

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Abstract

In this study we analyse the transparency and the credibility of the National Bank of Poland's monetary policy under the 1998-2004 inflation targeting regime on the basis of survey-based evidence. To verify monetary policy transparency we separately inspect the transparency of monetary policy frameworks and of monetary policy decisions. With respect to the former, we present some indicators as suggested in the literature and make cross-country comparisons, while with respect to the latter we analyse in detail the formation of interest rate expectations by commercial bank analysts. As far as monetary policy credibility is concerned, we focus our study on the way in which inflation expectations of consumers and commercial bank analysts are formed and how they are related to the NBP inflation target.

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Introduction

Central bank credibility means that the public believes that monetary authorities will do what they say [Blinder (1999)], which in the context of inflation targeting (IT) strategy may be verified by analysing the gap between inflation expectations of economic agents and the central bank inflation target or forecast. Theoretical literature and empirical evidence show that transparency is a prerequisite for establishing central bank credibility. Transparency is a multidimensional phenomenon, including not only the release of quantitatively and qualitatively adequate information by the central bank, but also its correct interpretation by the public. In this sense, transparency should make the private sector better able to predict monetary policy actions [Winkler (2000)].

In this study we test the transparency and the credibility of the National Bank of Poland's (NBP) monetary policy in the years 1998-2004, as conducted under inflation targeting regime. We use survey-based measures of inflation expectations of commercial bank analysts and consumers as well as survey data on commercial bank analysts' interest rate predictions. To verify monetary policy transparency we separately inspect its two dimensions, namely, the transparency of monetary policy frameworks and of monetary policy decisions. With respect to the former, we present some transparency indicators as suggested in the literature and make cross-country comparisons, while with respect to the latter we analyse in detail the formation of interest rate expectations by commercial bank analysts. As far as monetary policy credibility is concerned, we focus our study on the way in which inflation expectations of consumers and commercial bank analysts are formed and how they are related to the NBP inflation target.

This paper is organised as follows: Section 1 contains theoretical considerations on the relationship between central bank transparency and credibility, and presents in addition inflation targeters' experiences in building transparency and credibility. In Section 2 we briefly describe Polish experiences with the IT strategy as well as we test the transparency of the NBP monetary policy framework and the predictability of interest rate decisions. Section 3 verifies the credibility of the NBP inflation targets, focusing on inflation expectations formed by consumers and commercial bank analysts. The final section concludes the study.

1. Central bank credibility and transparency – theoretical aspects

1.1. *Credibility of monetary policy*

There is common agreement in the literature on monetary economics that private-sector inflation expectations constitute an important variable in the conduct of monetary policy.¹ Theoretical considerations suggest that if inflation expectations of economic agents remain high, the process of disinflation is longer and more costly in terms of output loss [Clarida, Galí and Gertler (1999)]. Therefore, the central bank that can manage expectations of the private sector should be able to conduct monetary policy more effectively. This kind of central bank is called credible. Thus, the concept of central bank credibility refers directly to the issue of private-sector inflation expectations. Blinder (1999) provides a very short – but in our view the most accurate – definition of credibility: “*a central bank is credible if people believe it will do what it says*”.² This definition is simple, yet consistent with intuition. It stresses the ability of central banks to manage the public’s inflation expectations.

Although the central bank’s credibility is relatively easy to define, it is difficult to measure. There is no commonly accepted and used indicator of monetary policy credibility. Most of the existing measures refer to a gap between policy targets and the public’s expectations.³ Below, we present several measures that are applied in the theoretical and empirical literature on monetary policy.

Cukierman and Meltzer (1986) define credibility as “*the absolute value of the difference between policymakers’ plans and the public’s beliefs about those plans*”.⁴ Their measure of credibility is based on the speed with which the public learns about changes in policymakers’ objectives. The higher the degree of “sluggishness” in the formation of private-sector expectations and the longer it takes for the public to recognize changes in the objectives of the monetary policymaker, the lower the credibility.

¹ This is reflected in a frequent adaptation of the expectations-augmented Phillips curve in theoretical models.

² See: Blinder (1999), p. 4.

³ Another approach to measuring central bank credibility is to analyse the reaction of the long end of the yield curve to changes in short-term interest rates by the central bank.

See: Taylor (1995), pp. 11-12 or Buttiglione, Del Giovane and Tristani (1997).

⁴ See: Cukierman and Meltzer (1986), p. 1108.

In line with the definition of credibility introduced by Cukierman and Meltzer (1986) and Blinder (1999), there are measures provided by Faust and Svensson (1998), Hutchison and Walsh (1998) and Cecchetti and Krause (2002), who measure credibility as the difference between inflation expectations of economic agents and the central bank's inflation target or forecast.⁵

Faust and Svensson (1998) analyse the credibility of a zero-inflation policy. They assume that the central bank announces a zero-inflation target for period t in the period $t-1$. The credibility of such policy (c) is expressed as a negative of the absolute value of private-sector inflation expectations π^e :

$$[1] \quad c_{t-1} = -|\pi_{t|t-1}^e|.$$

Hence, inflation expectations equal to zero mean perfect credibility. The lower the value of the measure, the lower is the credibility. However, it is implausible to assume that every central bank has an inflation target equal to zero. The measure [1] can be straightforwardly modified in order to allow for positive levels of the central bank's inflation target (π^{tar}):

$$[2] \quad c_{t-1} = -|\pi_{t|t-1}^e - \pi_t^{tar}|.$$

In the case of central banks that publish inflation forecasts, the inflation target may be replaced by the inflation forecast while calculating credibility indicators [Hutchison and Walsh (1998)].

The credibility measure [2] attaches the same weight to positive and negative deviations of expectations from the inflation target. On the contrary, Cecchetti and Krause (2002) construct an index of credibility (IC), in which negative deviations from the target do not imply a loss in credibility. The index has the following form:

⁵ The construction of credibility measures based on private-sector expectations usually entails the assumption that the central bank publishes its targets or forecasts. Since not every central bank reveals this information, the above-mentioned measures are not universal and cannot be applied to all central banks. However, they can be easily adapted to measure the credibility of monetary policy in inflation targeting countries, where the inflation target is clearly defined and publicly announced.

$$[3] \quad IC = \begin{cases} 1 & \text{if } \pi^e \leq \pi^{tar} \\ 1 - \frac{1}{0,2 - \pi^{tar}} (\pi^e - \pi^{tar}) & \text{if } \pi^{tar} < \pi^e < 20\% , \\ 0 & \text{if } \pi^e \geq 20\% \end{cases}$$

where π^e denotes the expected inflation and π^{tar} the inflation target. Higher credibility is reflected in higher values of the IC measure.

Another approach to measuring the central bank credibility based on inflation expectations is applied by Bomfim and Rudebusch (1997). In their study, credibility is proxied by the weight attached to inflation target in the formation of the private sector's long-term inflation expectations (λ):

$$[4] \quad \pi_t^e = \lambda \cdot \pi_t^{tar} + (1 - \lambda) \cdot \pi_{t-1},$$

where π denotes inflation, π^e the long-term inflation expectations and π^{tar} the inflation target. Hence, $\lambda = 1$ indicates perfect credibility, whereas $\lambda = 0$ means no credibility. The authors note that the parameter λ may be interpreted as a fraction of the society that expects the target will be attained. Its value may change in time.

The credibility of the central bank may be associated with its reputation, strong aversion to inflation or commitment.⁶ This approach is represented for example by Backus and Driffill (1985) and Rogoff (1985). Backus and Driffill (1985) measure the reputation of the central bank in terms of the public's probability that the central bank is "tough" and will choose a low inflation rate. The probability depends on central bank's actions in the former periods. Rogoff (1985) suggests that credibility can be established by appointing a conservative central bank's governor, who has a strong aversion to inflation. This approach to credibility is usually adopted in theoretical analyses, where reputation or pre-commitment allow for solving the time-inconsistency problem.⁷

⁶ For a discussion of the definitions of central bank credibility see Blinder (1999).

⁷ The time-inconsistency problem and the inflation bias as the potential outcome under discretion was originally analysed by Kydland and Prescott (1977) and Barro and Gordon (1983).

1.2. *How to define transparency?*

The growing number of publications on transparency has roots in the credibility problem as highlighted in monetary economics. If the central bank wants to make the public believe that it “*will do what it says*”, then first it has to announce what it intends to do, and second, it has to make it possible for the public to monitor its actions. Mahadeva and Sterne (2000) clearly point out that the transparency of a monetary policy regime comes primarily from the ability of market participants and the public to continuously observe and test the credibility of the target.⁸ Of course, transparency is a necessary but not a sufficient condition of the central bank credibility.

A simple definition of central bank transparency as the amount of information disclosed by the central bank to the private sector seems to us unsatisfactory. In this respect we share the view of Winkler (2000), who stresses the need for effective communication. He identifies four features of transparent monetary policy, namely: openness, clarity, common understanding, and honesty. Openness refers to the quantity and quality of information disclosed to the public. To fulfil the principle of clarity and common understanding, the presentation and interpretation of the central bank’s announcements must be easily understood and interpreted in the same way by all participants in the communication process. As far as the honesty requirement is concerned, the information released to the public must correspond to the interpretation of facts and to the internal analyses of the central bank [Winkler (2000), p. 8]. An important aspect in Winkler’s (2000) concept of transparency is that it includes not only the release of information by the central bank, but also a proper understanding of this information by the private sector. Thus, the central bank is transparent if the public correctly interprets the information disclosed by monetary authorities. In this sense, transparency should make the private sector better able to predict central bank’s actions and may be measured by examining market response to monetary policy surprises, for example, the reaction of short-term market interest rates to changes in the official interest rate.⁹

As stated above, transparency is a multidimensional phenomenon and it is difficult to provide one synthetic definition for it. Therefore, it is useful to deal with the concept by analysing its various aspects. Geraats (2001) distinguishes five aspects of the monetary policy transparency: political transparency (disclosure of monetary policy objectives and numerical targets), eco-

⁸ See: Mahadeva and Sterne [ed.] (2000), p. 73.

⁹ See Section 1.4 for a survey of empirical studies on transparency understood in such a way.

economic transparency (publication of economic data, forecasts, and macroeconomic models used by the central bank), procedural transparency (openness about the decision-making process, including the monetary policy strategy or rule and the release of minutes and voting records), policy transparency (announcements and explanations of central bank's decisions and its likely actions in the future) and operational transparency (information about implementation of monetary policy decisions and market interventions, as well as explanation of control errors) [Geraats (2001), p. 8]. A similar classification was introduced by Hahn (2002).¹⁰

In contrast to Winkler (2000), Geraats (2001) and Hahn (2002) focus on the disclosure practices of central banks without paying attention to its quality and proper (desired) interpretation by the public. They thus refer to the institutional transparency of the central bank. However, even transparency defined in such a way is difficult to measure. There are several indicators which attach numerical value to different types of information published by central banks.¹¹ One of the most popular indices in the literature was constructed by Eijffinger and Geraats (2002). Their index encompasses the five dimensions of transparency that Geraats (2001) distinguished. Nevertheless, these indices shall be viewed as tentative rather than precise measures of transparency. In Section 2 we present several indicators of transparency in detail.

1.3. Theoretical literature on transparency and credibility

We have so far defined the credibility and the transparency of monetary policy, but there still remains an open question: what is the relation between these two features? Theoretical considerations in this field are usually based on the time-inconsistency model of Barro and Gordon (1983) and the literature on monetary policy games.¹² Three assumptions play a central role in these models: first, the central bank (or other institution conducting monetary policy) possesses private information about its preferences on inflation and output and/or economic shocks; second, private-sector expectations are rational; and third, the central bank has the incentive to deviate from its inflation target in order to push output above its potential level. In this framework,

¹⁰ Hahn (2002) distinguishes three dimensions of transparency: goal transparency (openness about central bank's objectives), knowledge transparency (the release of economic data, models and forecasts by the central bank, consistent with economic transparency in Geraats, 2001), operational transparency (announcements of central bank's decisions and disclosure of voting records and minutes – procedural transparency in the terminology of Geraats, 2001).

¹¹ For example, Chortareas, Stasavage and Sterne (2002) construct an index of transparency based on inflation forecasts published by central banks, while Mahadeva and Sterne [ed.] (2000) produce a measure of policy explanation.

¹² For a discussion of a literature on monetary policy games see Canzoneri (1985).

transparency enables the public to infer the intentions of the central bank, so in response to any inflationary policy inflation expectations of the private sector rationally increase and the central bank's reputation falls. The rise in inflation expectations of the private sector imposes a cost for the central bank. Hence, with a high level of transparency, it may not be beneficial for the central bank to pursue an inflationary policy. In this sense, transparency is a mean to discipline monetary policy and enhance credibility. Below we present the most important conclusions from the literature on the relationship between transparency and credibility.

Cukierman and Meltzer (1986) present a model with uncertainty about central bank's preferences, which vary in time and are serially correlated. Furthermore, it is assumed that the central bank controls its instrument – money growth – imperfectly and that the degree of central bank's transparency is identified with the quality of its monetary control. The private sector observes the money supply and, on this basis, tries to infer the central bank's true intentions. However, the public faces uncertainty concerning both the goal and the instrument of monetary policy and thus it does not know whether the observed changes in the policy outcome are due to changes in the central bank's preferences or due to a control error. Maximum transparency (minimal feasible control error) would allow central bank's preferences to be more precisely inferred. Since monetary policy in this model can affect output only through inflationary surprises, it may be advantageous for the central bank not to adopt full transparency. On the other hand, transparency is related to the credibility of monetary policy, measured as the speed with which the public recognizes changes in the central bank's objectives. In this approach, the lower the transparency, the more slowly the private sector learns and the lower is the credibility of shifts to new policies. Thus, if transparency is low, a shift to a disinflationary policy is less credible and the disinflation process is longer and more costly. However, the authors show that the central bank with relatively unstable preferences may be inclined to be less transparent and therefore less credible.

The model of Cukierman and Meltzer (1986) was extended by Faust and Svensson (1998) who make a formal distinction between monetary control and transparency, assuming that a part of the control error can be observed by the private sector. In their analytical framework, the central bank has both inflation and employment targets. The inflation target is known to the public and equals zero, whereas the employment target is unobservable and time-varying. It is assumed that the central bank controls inflation imperfectly. The actual inflation consists of two components: central bank's intentions regarding inflation and the control error. Transparency is related to the

proportion of the control error revealed to the private sector. When the whole control error is revealed, the private sector can infer central bank's intentions regarding inflation and therefore the employment target. The authors find that increased transparency makes central bank reputation and private-sector inflation expectations more sensitive to monetary policy actions. Under high transparency, an inflationary policy would increase private-sector inflation expectations and thus would be more costly for the central bank. The solution of this model shows that high transparency leads to a reduced inflation bias and a lower variability of inflation and employment. However, it must be noted that under "extreme" transparency¹³, when central bank's preferences are directly observed by the private sector, the central bank's reputational effect disappears. This results in a higher inflation bias.

Jensen (2000) uses a two-period model with the New-Keynesian forward-looking Phillips curve, in which a higher degree of transparency about central bank preferences results in greater discipline in monetary policy-making and subsequently in improved credibility and lower inflation rates. Thus, transparency is beneficial, if the central bank lacks credibility. However, there is a trade-off between credibility and flexibility. Since transparency makes inflation expectations more sensitive to policy actions, a high degree of transparency may be disadvantageous when the economy is hit by a shock and needs a stabilizing monetary policy. Moreover, if the private sector is precisely aware of central bank's preferences, transparency does not have any effect in terms of increased credibility or lower inflation rate, but it still imposes a cost in terms of constrained flexibility in stabilizing the economy. The general conclusion is that it may be beneficial for low-credibility central banks to adopt a high degree of transparency, whereas for high-credibility central banks it may be costly.

Eijffinger, Hoeberichts and Schaling (2000) use a model similar to Cukierman and Meltzer (1986). They assume that there is uncertainty about the central bank's preferences over inflation and output and show that this uncertainty leads to higher inflation bias and inflation volatility. However, their results indicate that some degree of secrecy in monetary policy-making may be beneficial in terms of output stabilization, when the flexibility problem is large in relation to the credibility problem. Moreover, the smaller the credibility problem relative to the flexibility problem, the higher the optimal level of uncertainty about central bank's preferences. Therefore,

¹³ The authors distinguish three regimes of monetary policy: unobservable goal and intention, where both the employment target and the intention for inflation are not observed by the public; observable intention – the private sector observes the whole control error, which allows it to infer the central bank's intention regarding inflation and, in equilibrium, the employment target; and observable goal ("extreme" transparency) – the public perfectly knows the goals of the central bank.

the model explains why credible central banks need not be very transparent whereas low-credibility central banks should reduce uncertainty and be more open, similarly as in Jensen (2000).

Quite different conclusions are presented by Geraats (2001). In her two-period model, the central bank has private information about demand and supply shocks and there is uncertainty about the central bank's inflation target. Transparency is associated with the publication of central bank forecasts, which provide the public with information about economic shocks and allow it to infer central bank preferences. As in other models, greater transparency makes central bank reputation more sensitive to its actions. A non-transparent policy in the first period results in a higher inflation rate, because of the deterioration of monetary authorities' reputation. If the central bank does not publish its forecasts, the public suspects that it is "weak" and rationally expects higher inflation. Geraats (2001) argues that the monetary policy transparency may be beneficial for several reasons: it helps to build central bank reputation, reduces inflation bias, and allows a more flexible response to shocks in the economy. In respect of flexibility these findings are contrary to those obtained by Jensen (2000).

The concepts presented above differ from each other in many respects, including their definition of transparency. For example, there are no unequivocal findings about the effect of increased transparency on social welfare or the flexibility of monetary policy. The outcomes are highly model-specific. However, as we are primarily interested in the effects of transparency on the credibility of monetary policy and inflation bias, we can draw clear conclusions from the models. First, apart from the case of perfect transparency, in all the models a higher degree of transparency leads to a reduced inflation bias. Second, greater transparency leads to higher credibility. Therefore, we can consider transparency as a constraint on the discretionary behaviour of the central bank. It constitutes a way of mitigating the time-inconsistency problem and of establishing the credibility of a monetary policy without a binding commitment or a monetary rule. Another interpretation of the relationship between transparency and credibility involves the process of learning by the private sector. In the models presented above the credibility problem arises, because of the uncertainty of the private sector about central bank preferences. Even if the central bank announces an explicit inflation target, it may not be fully credible [Geraats (2001), Kozicki and Tinsley (2003)]. The private-sector agents try to infer the true preferences of the central bank from its actions and economic data and gradually update their expectations. Therefore, as King (1996) points out, transparency supports the learning process thanks to which pub-

lic's expectations adjust to the target more quickly. The role of transparency as a prerequisite for credibility, suggested by the above-described theoretical models, seems to be consistent with the intuitive definitions of these terms used in our study.

1.4. Transparency and credibility in the inflation targeting framework

In the past decade, several countries have adopted a new monetary policy framework – inflation targeting (IT). The first country that moved to the new regime was New Zealand (1990), followed by Chile (1991), Canada (1991), Israel (1992), the United Kingdom (1992), Sweden (1993) and Finland (1993). Since then a significant number of developed and emerging economies, including Poland (1998), have decided to adopt IT. Many of these countries experienced periods of inflation above their steady-state inflation rates.¹⁴ The inflation targeting framework was a mean to lower and stabilize inflation expectations and enhance the credibility of the disinflation policy.

Inflation targeting can be characterized as a forward-looking strategy, focused on inflation and inflation expectations of the private sector. The main features of the IT framework include a commitment to price stability as the long-term goal of monetary policy,¹⁵ the announcement of an explicit medium-term inflation target, specified as a point or a range; increased communication of the central bank with the public, including the explanation of policy objectives and actions; and the accountability of monetary policy-makers for meeting the target [Mishkin (2000)]. A significant advantage of this regime is that the inflation target is a clear, easily observable, and understandable objective of monetary policy. IT provides the private sector with a nominal anchor in the formation of its expectations and enables it to make predictions about central bank's future actions. Thus, IT reduces the uncertainty about future inflation rates [Bernanke and Mishkin (1997)]. However, in order to use the inflation target as a nominal anchor for the economy, the target must be credible. In this case, private-sector inflation expectations will approach the target, so it will be easier for the central bank to attain it. As a result, the process of disinflation will accelerate and be less costly in terms of output loss.

¹⁴ See for details: Corbo, Landerretche and Schmidt-Hebbel (2001) or Mishkin and Schmidt-Hebbel (2001).

¹⁵ Price stability is often understood as a low and stable inflation rate rather than a zero inflation rate.

In the IT framework, the central bank attempts to establish credibility through transparency.¹⁶ Announcements and explanations of policy goals and decisions make it easier for the public to verify the central bank's true intentions and to control whether its actions are consistent with the target. The central bank has substantial flexibility in the conduct of monetary policy, but it is accountable for achieving the medium-term target. Therefore, the IT regime is often described as "constrained discretion" [Bernanke and Mishkin (1997)]. This constraint is imposed by the central bank's high level of transparency and accountability, which helps to build up the credibility of the disinflation policy and to reduce the time-inconsistency problem.

There are several empirical studies investigating the effects of transparency in the IT framework. An important part of the surveys are event-studies measuring the magnitude of markets' responses to the central bank's announcements, which is in line with Winkler's (2000) concept of transparency. Other surveys examine the macroeconomic performance before and after the adoption of IT.

Muller and Zelmer (1999) show that after the Bank of Canada had adopted new measures to enhance transparency, market participants were able to anticipate monetary policy actions more accurately. As a result, the volatility of interest rates and exchange rates decreased. Thus, increased transparency is consistent with the improved efficiency of financial markets.

Haldane and Read (2000) examine the transparency and the credibility of the monetary policy in the UK by investigating movements at the short and long end of the yield curve at the time of policy announcements. Their empirical study shows a reduced response to monetary policy actions, in particular at the short end after increasing transparency in 1992. Clare and Courtenay (2001) obtain similar results, investigating the effects of interest rates and macroeconomic announcements on financial assets' prices in the UK before and after the Bank of England had gained operational independence. According to their study, under the new legislation the speed with which financial markets reacted to interest rate announcements increased while the size of the overall reaction seemed to fall. In the case of LIFFE contracts, the reaction to macroeconomic announcements decreased as well. Only exchange rate responses to macroeconomic announcements were stronger in the period after the central bank had gained independence.

¹⁶ The IT framework includes various communication practices of central banks, e.g. the publication of *Inflation Reports*. See also Section 2.

Coppel and Connolly (2003) analyse the impact of increased monetary policy transparency on financial markets in Australia since the late 1980s. The increase in transparency was associated with the introduction of announcements concerning changes in the target cash rate and the adoption of the IT regime. They find evidence that under IT the volatility of short-term interest rates decreased and the market response to central bank's announcements fell, which indicates improved ability of the markets to predict the changes in the policy rate.

Kuttner and Posen (1999) examine the effect of adopting IT in the United Kingdom, Canada, and New Zealand. Their study suggests that developed communication patterns of the central bank with the public contribute to lower inflation rates and enable more flexible reactions to supply shocks without affecting long-term inflation expectations, which may indicate the credibility of the new regime.

Corbo, Landerretche and Schmidt-Hebbel (2001) investigate the macroeconomic performance in a group of inflation targeting countries. They show that inflation targeters did not have much trouble attaining their targets. Moreover, the adoption of IT seems to lead to lower sacrifice ratios and lower output volatility. Finally, inflation forecasts were more accurate after the IT adoption. All these findings suggest that the monetary policy in these countries gained in credibility.

The empirical evidence suggests that transparency of the IT regime enables the private sector to better predict central bank actions. The speed of reaction to changes in monetary policy instruments typically increases. This indicates that communication practices under IT are effective. Moreover, several studies seem to confirm that a flexible reaction by the central bank to external shocks does not affect inflation expectations. This suggests increased credibility of the IT strategy.

2. Transparency of the inflation targeting strategy in Poland

2.1. *Inflation targets in Poland*

Until 1998, the National Bank of Poland conducted an “eclectic” strategy by combining elements of exchange rate targeting, inflation targeting, and money supply targeting with the aim of guaranteeing stability in the disinflation process. The intermediate target was to increase the money supply under conditions of crawling devaluation of the Polish zloty in relation to a basket of currencies, with limited fluctuations of the exchange rate within the permitted band. This strategy did not allow the two intermediate targets to be met in full, although initially, given the limited links between the Polish economy and the global financial market, it allowed inflation to be reduced smoothly, which constituted the main objective of the monetary authorities.

Starting from 1999, the NBP has been using a direct inflation targeting strategy. It should be noted that the announcement of the adoption of the IT strategy was first made in early June 1998 and in September 1998 a document entitled “*Medium-term strategy of monetary policy (1999-2003)*”, outlining the details of new policies, was released. Therefore 1998 is often treated as an interim year [Polański (2004), p. 9]. The decision to implement the inflation targeting strategy resulted from a growing integration of the Polish and the global economy and from the need of breaking through inflationary expectations, which were perceived as one of the main obstacles in the process of steadily reducing inflation.¹⁷

The Monetary Policy Council (MPC), a decision-making body, which in 1998 replaced the governor herself, set the medium-term inflation target at a level “below 4% at the end of 2003”. The MPC also declared targets for the end of each year – for any given year, the target was usually revealed to the public in the last quarter of the previous year. In communicating with the public, the relative importance of both types of inflation targets seemed to change in 1998-2003, with a gradual increase in the weight of the medium-term target [Kokoszcyński et al. (2005)]. The National Bank of Poland faced difficulties in meeting the inflation targets – all its short-term

¹⁷ A comprehensive description of the evolution of the NBP strategy, as well as of the features and outcomes of direct inflation targeting in Poland may be found in Jonas and Mishkin (2002), Kokoszcyński (2002), Polański (2004) and Kokoszcyński et al. (2005).

targets were missed, even those that were revised in the course of the year they had been set for (Table 1).

Table 1. Actual and targeted inflation rate, 1998-2003

	Inflation target	Actual inflation (realization)	Deviation of actual inflation from the target (in%) ⁽¹⁾
1998	9.5%	8.6%	- 9.5
1999	8.0-8.5% (changed in March to 6.6-7.8%)	9.8%	+15.3 (+25.6)
2000	5.4-6.8%	8.5%	+25.0
2001	6.0-8.0%	3.6%	-40.0
2002	5.0%±1pp (changed in June to 3.0%±1pp)	0.8%	-80.0 (-60.0)
2003	2-4%	1.7%	-15.0

⁽¹⁾ In the case of a range target the realization to target ratio is calculated with respect to the bound closer to the actual inflation.

Source: Kokoszcyński et al. (2005).

To obtain implicit monthly inflation targets on the basis of the annual targets set for the end of subsequent years in 1998-2003 and of the continuous target 2.5%±1pp as announced in February 2003, we calculate three measures: the official target for a given year, a smoothed series computed by a Hodrick-Prescott filter, and a monthly linear interpolation between end-year targets.¹⁸ Since the NBP inflation targets were usually set in the form of ranges, we compute monthly series of their central values as well as lower and upper bands. A comparison of continuous inflation target ranges and realizations of inflation confirms the poor performance of IT strategy in Poland. It occurs that in the analysed period the frequency of inflation being within the inflation target range was close to 10% (Figure 1, Figure 2, Figure 3).

¹⁸ Similar measures are suggested by Albagli and Schmidt-Hebbel (2004).

Figure 1. Official target for a given year and actual inflation

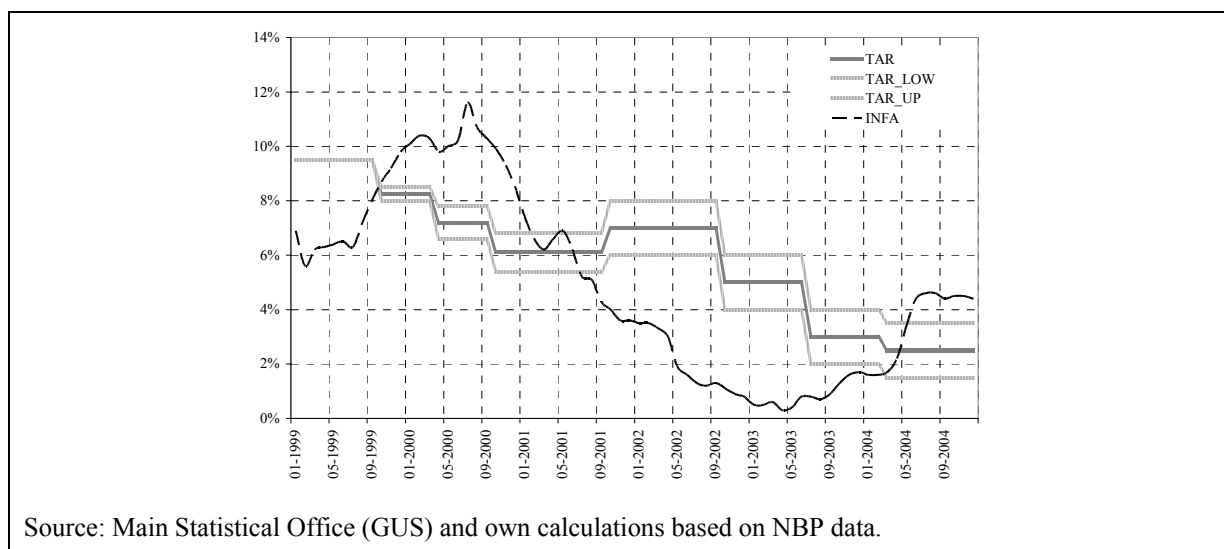


Figure 2. HP-filter target and actual inflation

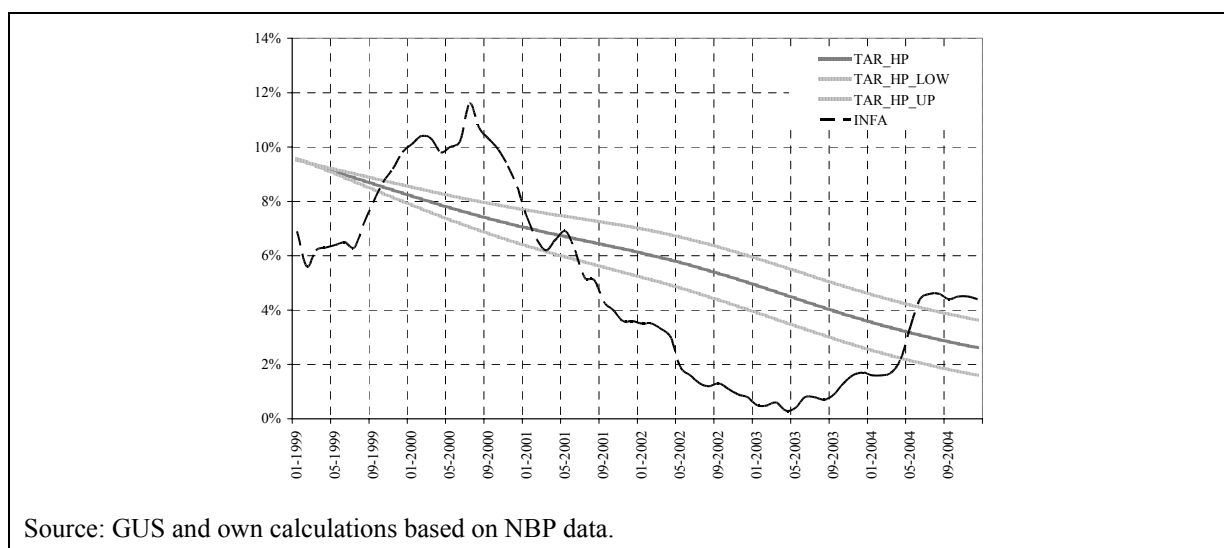
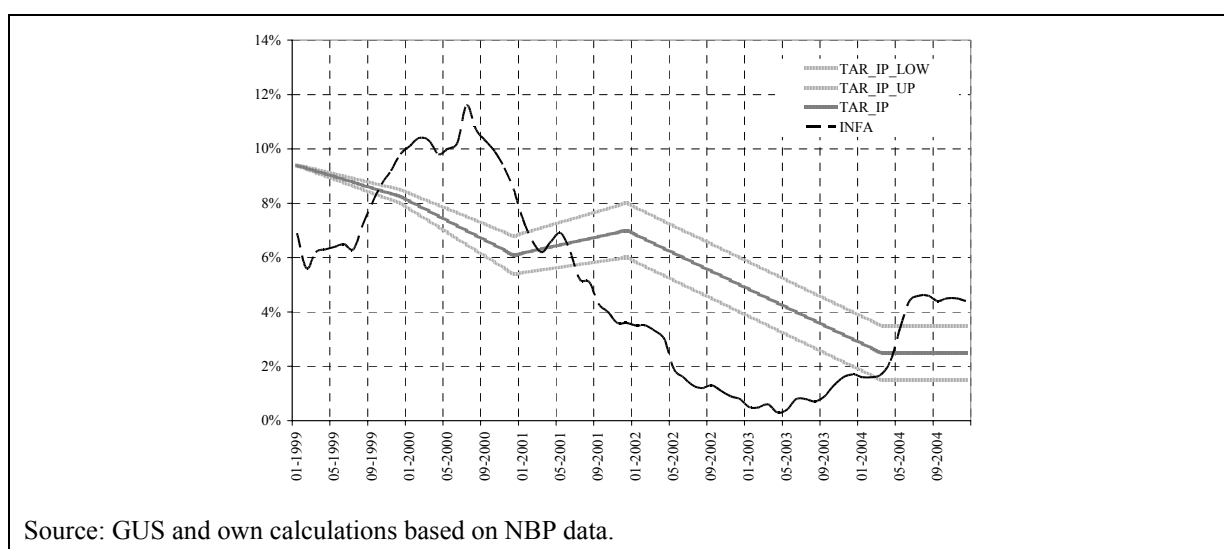


Figure 3. Interpolated target and actual inflation



There were different reasons why inflation deviated from the NBP inflation targets. The way in which short-term (annual) targets were set, especially in the initial period of inflation targeting strategy in Poland (point target in 1998 and narrow intervals in successive years¹⁹) was inconsistent both with lags in the monetary transmission mechanism and with the level and volatility of inflation, which was highly sensitive to supply shocks coming from food and oil markets.²⁰ The conduct of macroeconomic policy is perceived as an even more important explanation of inflation target misses [Jonas and Mishkin (2003)]: unexpected fiscal expansion combined with easy monetary policy led to an acceleration of inflation and the overshooting of inflation targets in 1999-2000, while a subsequent sharp tightening of monetary policy and its slow relaxation in the absence of further easing of fiscal policy reduced inflation sharply and produced a significant undershooting in 2001-2003. Relative price changes connected with EU accession made inflation rise above the NBP inflation target in 2004.

Imperfect knowledge of the monetary transmission mechanism [Christoffersen and Wescott (1999)] and the evolution of this mechanism [Łyziak (2002)] caused by ongoing structural, institutional, and behavioural changes in the economy, amplified the uncertainty faced by the monetary policymakers. As a result, interest rate policy was not fully adequate with respect to the NBP inflation targets officially declared. Model-based counterfactual simulations show that the NBP interest rate policy can be seen as excessively expansive *ex-post* in 1999Q1-2001Q3 and 2003Q2-2003Q4, while excessively restrictive in 1998Q4 and 2001Q4-2003Q1. In order to follow the annual inflation targets more successfully, a much more active interest rate policy would have been required [Kokoszcyński et al. (2005)].

¹⁹ The width of the NBP inflation target range, expressed as a percent of its central value in the initial years of inflation targeting in Poland, was relatively low: it amounted to approximately 16% in 1999, 23% in 2000 and 29% in 2001. Then it rose to 67% in 2002 and 2003. In 2004 the inflation target range was 80% of its central value.

²⁰ The average weight of foodstuffs and fuels in the CPI basket in 1998-2004 was about 30% and 3.2% respectively.

2.2. Transparency of the inflation targeting framework in Poland

The inflation targeting framework in Poland evolved in 1998-2004. In particular, communication patterns and the quantity of information shared by the National Bank of Poland with the public were subject to considerable changes. In this section we calculate different measures describing the transparency of IT framework in Poland and present some cross-country comparisons.

Analysing monetary policy frameworks on the basis of a survey carried out among 94 central banks, Mahadeva and Sterne (2000) measure the transparency focusing on the information published by central banks that could help the public to understand the central bank policy, analyses and forecasts. The overall measure of how fully monetary policy is explained attaches equal weight to the extent to which monetary policy decisions, assessment of the economy, forecasts and forward-looking analyses are revealed and explained to the public. The results presented in Table 2 indicate that central banks describing themselves as inflation targeters are characterized by a higher degree of transparency in comparison to the total sample of banks included in the survey. IT central banks explain monetary policy decisions and share forward-looking considerations with the public in a much more open and detailed manner. Moreover, the number of research publications in this group of banks is significantly higher. As far as the National Bank of Poland is concerned, the transparency indicator calculated in 2000 was a bit lower with respect to the average value in the sub-sample of inflation targeters. However, significant changes were introduced to the NBP information policy in August 2004, as reflected in the publication of an inflation projection with a formal risk assessment. Therefore, following the methodology of Mahadeva and Sterne (2000), we decided to calculate the current value of that indicator, which now stays well above the average value in the sub-sample of inflation targeters in 2000.

Table 2. Measure of policy explanations [Mahadeva and Sterne (2000)]

Questions:	Question weight	Scores	Categories of answer	Distribution of results: fraction of central banks in the sample / subsample			
				All economies (94 central banks)	Subsample of inflation targeters (15 central banks) ⁽¹⁾	Poland, 2000	Poland, 2005 ⁽²⁾
Explanation of policy decisions							
1. Central bank provides explanations on day policy changed?	1.5	100	Yes	80.9%	100.0%	◆	◆
		0	No	19.1%	0.0%		
2. Explanations provided when policy-makers meet and do not change policy	0.3	100	Yes	16.0%	26.7%	◆	◆
		50	Sometimes	5.3%	13.3%		
		0	No	78.7%	60.0%		
3. Policy decisions discussed in standard bulletins and reports	2	100	At least twice a year	64.9%	86.7%	◆	◆
		50	At least annually	12.8%	13.3%		
		0	No	22.3%	0.0%		
4. Minutes of policy meetings published	1	100	Within a month of meeting	12.8%	46.6%		◆
		50	More than a month after	5.3%	13.3%	◆	
		0	No	81.9%	40.0%		
5. Voting patterns published	0.5	100	Yes	6.4%	20.0%	◆	◆
		0	No	93.6%	80.0%		
Published forward-looking analysis							
6. Forward-looking analysis in standard bulletins and reports	2	100	More than annually	41.5%	60.0%	◆	◆
		50	At least annually	25.6%	26.7%		
		25	Unspecified	10.6%	6.7%		
		0	Otherwise	22.3%	6.7%		
7. Form of publication	1.5	100	Words, one of numbers and graphs	37.2%	26.7%		◆
		50	One of words, numbers and graphs	26.6%	46.7%	◆	
		25	Unspecified	13.8%	20.0%		
		0	None	22.3%	6.7%		
8. Risks to forecasts published	1	100	Words and one of numbers and graphs	9.6%	20.0%		◆
		50	One of words, numbers and graphs	24.5%	26.7%		
		0	None	66.0%	53.3%	◆	
9. Discussion of past forecast errors	1	100	Yes	22.3%	40.0%		
		50	Sometimes	9.6%	20.0%		
		0	No	68.1%	40.0%	◆	◆
Assessment and analysis							
10. Analysis in standard bulletins and reports	2	100	More than annually	91.5%	100.0%	◆	◆
		50	At least annually	7.4%	0.0%		
		0	Otherwise	1.1%	0.0%		
11. Frequency of speeches	2	100	At least monthly	41.5%	53.3%		
		66	At least quarterly	27.7%	20.0%		
		33	Less than quarterly / occasional	30.9%	26.7%	◆	◆
		0	Never, almost never	0.0%	0.0%		
12. Working papers and other research publications	1	100	More than 10 each year	37.2	73.3%	◆	◆
		66	More than 5 each year	20.2%	6.7%		
		33	More than 2 / occasional	19.1%	6.7%		
		0	Never	23.4%	13.3%		
Total score (percent of maximum)				59 ⁽³⁾	73	69	85

⁽¹⁾ 15 banks describing themselves as inflation targeters. This group includes the central banks of: Albania, Armenia, Australia, Botswana, Canada, Chile, the Czech Republic, Israel, Jamaica, Mexico, Mongolia, New Zealand, Poland, Sweden, and the UK.

⁽²⁾ In 2004 the National Bank of Poland started publishing inflation projections with a risk assessment in the form of a fan chart. Therefore, we present an updated measure of the NBP transparency: own calculations based on the Mahadeva and Sterne (2000) method.

⁽³⁾ Average value.

Source: L. Mahadeva, G. Sterne [ed.] (2000) and own calculations based on Table 4.6 and Table A.7.

A commonly used measure of monetary policy transparency mentioned in Section 1 is the EG index proposed by Eijffinger and Geraats (2002).²¹ The index consists of fifteen components²², which include the formalization and quantification of goals, the publishing of economic data, models and forecasts, the releasing of minutes and voting records, the prompt announcement of policy decisions and its explanations, as well as discussions of transmission disturbances and control errors. The authors compiled the index for nine major central banks²³ for the years 1998-2002. The results indicate that in this period the overall degree of transparency significantly increased.²⁴ Furthermore, the most transparent central banks in the survey were all inflation targeters. However, the authors stressed that this should not be seen as a general rule.

As Poland was not included in the survey, we compiled the EG index for the National Bank of Poland to compare its transparency performance with other central banks. Table 3 presents the results for the least and the most transparent banks in the sample²⁵ and the NBP in 2002 as well as the current value of the index for the NBP. Had the National Bank of Poland been included in the survey, it would have been placed in the sub-top of the ranking – the degree of its transparency in 2002 was a bit higher than the average value of 10.7. As far as respective aspects of transparency are concerned, the Polish central bank obtained the lowest score on economic transparency. However, that score increased in 2004 and 2005²⁶ as a result of the publication of an inflation projection (August 2004) and macroeconomic models (December 2004, March 2005).²⁷ Concerning other aspects of transparency, the NBP made no progress, so there is still room for some improvement.

²¹ The EG index is based on the classification introduced by Geraats (2001). It focuses on disclosure practices of central banks and distinguishes five aspects of monetary policy transparency, namely: political, economic, procedural, policy, and operational transparency. Details in Section 1.

²² Each aspect of central bank transparency consists of three components. The authors assign a value from 0 to 1 to each component of the index, so the maximum score is 15.

²³ The central banks of Australia, Canada, Japan, New Zealand, Sweden, Switzerland, England, US, and the European Central Bank.

²⁴ Only two central banks in the sample did not improve their overall performance, namely the Bank of Canada and the Bank of Japan.

²⁵ There were two central banks with the score of 14: the Swedish Riksbank and the Reserve Bank of New Zealand.

²⁶ The increase in economic transparency is a general trend among central banks. From 1998 to 2002 most of the central banks included in the survey improved their performance in this field.

²⁷ A detailed description of macroeconomic models used at the NBP was published in December 2004 in Polish and in March 2005 in English. See: Kłós et al. (2005).

Table 3. Central bank transparency – Eijffinger-Geraats index

Central bank transparency	Switzerland, 2002	Sweden, 2002	Poland, 2002 ⁽¹⁾	Poland, 2005 ⁽¹⁾
<i>1. Political</i>	2,5	3	3	3
a. Formal Objectives	0,5	1	1	1
b. Quantitative Targets	1	1	1	1
c. Institutional Arrangements	1	1	1	1
<i>2. Economic</i>	1,5	2	1	3
a. Economic Data	1	1	1	1
b. Policy Models	0	0	0 ⁽²⁾	1
c. Central Bank Forecasts	0,5	1	0	1
<i>3. Procedural</i>	1	3	2	2
a. Explicit Strategy	1	1	1	1
b. Minutes	0	1	0 ⁽³⁾	0 ⁽³⁾
c. Voting Records	0	1	1	1
<i>4. Policy</i>	2	3	3	3
a. Prompt Announcement	1	1	1	1
b. Policy Explanation	1	1	1	1
c. Policy Inclination	0	1	1	1
<i>5. Operational</i>	0,5	3	2	2
a. Control Errors	0,5	1	1	1
b. Transmission Disturbances	0	1	0,5	0,5
c. Evaluation Policy Outcome	0	1	0,5	0,5
Total	7,5	14	11	13

⁽¹⁾ Own calculations.

⁽²⁾ Models used in monetary policy-making were described in different publications, although their role in the decision process was not clear.

⁽³⁾ This score is different from the assessment presented in the case of the policy explanation measure (Table 2), although it does not affect our general conclusions. It seems that, responding to the survey of Mahadeva and Sterne (2000), official press releases of the NBP Monetary Policy Council and its *Inflation Reports* were treated as a substitute for the minutes. Although this classification seems debatable, we decided to update Mahadeva and Sterne (2000) index in a way consistent with the scores presented for Poland in their study.

Source: S. Eijffinger, P. Geraats (2002) and own calculations.

Another, more specific, measure of the transparency of central banks pursuing an inflation targeting strategy may be the content and quality of *Inflation Reports*, which constitute the main information tool used in those banks to communicate with the public.

Fracasso, Genberg and Wyplosz (2003) conducted a survey assessing both the above mentioned features of *Inflation Reports* published by twenty IT central banks²⁸ and found evidence that banks producing high-quality *Inflation Reports* were more predictable. However, as the authors stress, this relation does not imply causality. The survey consisted of 85 questions divided into 9 categories.²⁹ Table 4 presents the scores achieved by the NBP on individual questions and on average in each category.³⁰ As a benchmark we use the scores of the Bank of England's *Inflation*

²⁸ Australia, Brazil, Canada, Chile, the Czech Republic, Hungary, Iceland, Israel, Mexico, New Zealand, Norway, Peru, the Philippines, Poland, South Africa, South Korea, Sweden, Switzerland, Thailand, and the UK.

²⁹ Five graduate students in economics read and assessed one *Inflation Report* of each country, which was the latest one available in English (the survey was conducted in the second half of 2002).

³⁰ One category of questions, concerning inflation forecasts, is not presented in the table.

Report, which earned the highest scores in almost all categories and mean scores across all countries participating in the survey.

The *Inflation Report* published by the NBP was evaluated below average in all categories. In the overall assessment it gathered 5.7 points (which placed it in 17th position), with the highest scores for being not intimidating to economists and for writing style, and the lowest for completeness. As far as other categories are concerned, the Polish *Inflation Reports* performed quite well in showing the assumptions made at the decision-making time (with the exception of foreign financial conditions, financial markets, and uncertainty). On the other hand, presenting insufficient information concerning committee discussions about policy and about objections that could be raised to decisions, and giving too few arguments for future decisions, were among its main weaknesses. These factors are very important for the central bank transparency, but almost all countries achieved low scores in these areas.

A group of questions not presented in Table 4 is related to publishing inflation forecasts. At the time the survey was conducted, the National Bank of Poland was the only central bank participating in the questionnaire that did not report its forecasts. Moreover, there were delays in publishing *Inflation Reports* and little information about models used for inflation forecasts was provided, which is indicated as a possible cause of the low transparency at that time [Zieliński (2001)]. The first inflation projection was published in August 2004 which coincided with considerable changes introduced to the structure of the *Inflation Report*. We may, therefore, assume that its assessment now would be much more favourable.

It should also be noted that *Inflation Reports* are only one of many means of communication that central banks use, and therefore the results presented may not fully reflect the existing degree of transparency.³¹

³¹ The content of *Inflation Reports* and their role in monetary policy-making in twenty inflation targeting countries is also analyzed in Schmidt-Hebbel and Tapia (2002). They take into account publication frequency, coverage of past performance and projections, forecasts of variables reported, preparation and distribution issues, coincidence between monetary policy meetings and the publication of *Inflation Reports* as well as consistency between *Inflation Reports* and policy decisions.

Table 4. Evaluation of NBP Inflation Reports – survey results

Questions:	Poland	IT mean	UK
Quality of information provided (1=bad; 10=good)	3.6	4.6	7.1
Time to read entire report (minutes)	151.0	130.0	169.0
Discussion of past decisions	4.4	4.8	8.2
Discussion of current challenges	5.0	6.5	8.8
Presentation of the strategy	4.0	6.0	8.8
Disagreements within committee	3.6	1.9	5.4
Arguments for future decisions	1.2	3.7	4.2
Clarity on assumptions made at time of decision (1=bad; 10=good)	5.7	6.4	8.8
Exchange rate	6.8	6.4	7.4
Private domestic demand	7.4	7.3	9.6
Public domestic demand	6.2	5.8	9.0
Foreign demand	7.2	6.8	9.0
Foreign financial conditions	3.2	5.9	9.0
Financial markets	4.6	6.4	9.2
Uncertainty	4.4	6.5	8.4
Quantity of information provided (0=not enough; 10=too much; 5=ideal)	3.0	3.5	4.6
Inflation	6.0	4.6	4.8
Detailed prices	4.6	4.2	6.2
Growth	1.6	4.0	4.8
Risks	2.2	3.8	4.6
Policy discussion in committee	0.4	0.7	2.4
How demanding is it to find information (1=difficult; 1=very easy)	5.2	6.3	8.1
Who decides?	9.8	8.3	9.2
When are decisions taken?	2.0	4.2	5.8
What are the objectives of policy?	5.8	7.8	9.0
What information is used as input?	5.2	7.0	9.6
How is the information processed?	3.2	4.5	6.8
Presentation of the policy-making process (1=bad; 10=good)	3.9	5.4	8.2
Length (pages)	2.0	5.9	4.0
Time to read (minutes)	4.4	12.1	12.3
Provides efficient summary	5.4	6.8	9.3
Conveys rationale of policy decisions	4.6	6.6	9.0
Deals with objections	1.0	2.0	5.8
Generally convincing	4.6	6.2	8.8
Executive summaries: size and readability (understandable by: 1=yes; 0=no)			
Length (pages)	5.0	2.9	3.0
Time to read (minutes)	10.4	6.7	9.4
Economists only:			
PhDs only	0.0	0.0	0.0
Graduates only	0.2	0.1	0.0
Undergraduates	0.8	0.9	1.0
Non economists			
Highly educated	1.0	1.0	1.0
Educated	1.0	0.9	1.0
Non educated	0.0	0.0	0.0
Journalists	1.0	1.0	1.0
Politicians	0.8	1.0	1.0
Quality of the executive summary (1=bad; 10=good)	4.2	5.2	7.1
Effective summary	6.4	7.3	9.6
Conveys rationale of policy decisions	4.2	6.1	8.8
Deals with objections	1.0	1.1	2.0
Generally convincing	5.2	6.4	8.0
Overall assessment (1=bad; 10=good)	5.7	6.8	8.8
Convincing	5.2	6.4	9.2
Bank's expertise	5.8	6.3	8.8
Completeness of the report	4.2	5.9	8.9
Writing style	7.0	7.6	10.0
Information provided	5.8	6.5	9.2
Not intimidating to economists	7.6	8.6	9.1
Not intimidating to non-economists	4.6	6.2	6.3

Source: A. Fracasso, H. Genberg, and Ch. Wyplosz (2003).

All measures analysed above suggest, either explicitly or implicitly that there was an increase in the transparency of NBP monetary policy frameworks.

2.3. Transparency of interest rate decisions

In this section we refer to Winkler's (2000) concept of transparency which implies that other things being unchanged, greater transparency of monetary policy should lead to greater ability of the private sector to predict interest rate changes.

The predictability of interest rate decisions in Poland has been examined in previous studies focused on analysing the influence of the NBP interest rate announcements on various financial instruments. Zieliński (2001) and Jarmuzek et. al. (2004) compared yield curve reaction to NBP interest rate changes before and after the introduction of IT, but they reached contradictory conclusions. Zieliński (2001) finds that the surprise element of these events observed in the short end of the curve decreased slightly after the IT adoption, but the diminishing effect was not statistically significant. On the contrary, the results obtained by Jarmuzek et. al. (2004) suggest substantial improvement in monetary policy transparency. In other study Ziarko-Siwiek (2004) provides some evidence that the MPC's decisions used to surprise the market, which imply incompletely transparent monetary policy under IT. Market players were able to foresee the direction of NBP interest rates changes, but their size came as a surprise. The study indicates also a little improvement over time in predicting MPC decisions.

In our paper we take a different approach, similar to that of Swanson (2004), and compare the performance of short-term interest rate forecasts made by commercial bank analysts in two subsamples: before and after the introduction of IT. For this purpose we employ data derived from the Reuters survey.³² At the beginning of each month survey respondents are asked about expected interbank interest rates (WIBOR 3M) for the end of the current month and for the end of the same month in the following year. As interbank interest rates depend heavily on NBP headline interest rates, greater predictability of MPC decisions should result in greater accuracy of WIBOR 3M forecasts.³³ Figure 4 and Figure 5 present forecast errors (defined as the difference

³² Reuters has conducted its survey on a monthly basis since 1994. About 30 bank analysts participate in the survey. Respondents are asked for predictions of several economic variables, like CPI, PPI, WIBOR, exchange rates, output, etc., typically for the end of the current month, for the end of the year, and for the next 12 months. The number of participants and questions has been changing over time.

³³ WIBOR 3M forecasts serve as a proxy for expected NBP interest rates.

between the predictions of bank analysts formed at a given period and the actual interest rate *ex-post*) at these two forecast horizons in absolute terms and relative to actual WIBOR 3M. Basic measures of forecast performance are provided in Table 5.

Figure 4. WIBOR 3M forecast errors (forecasts for the end of the current month)

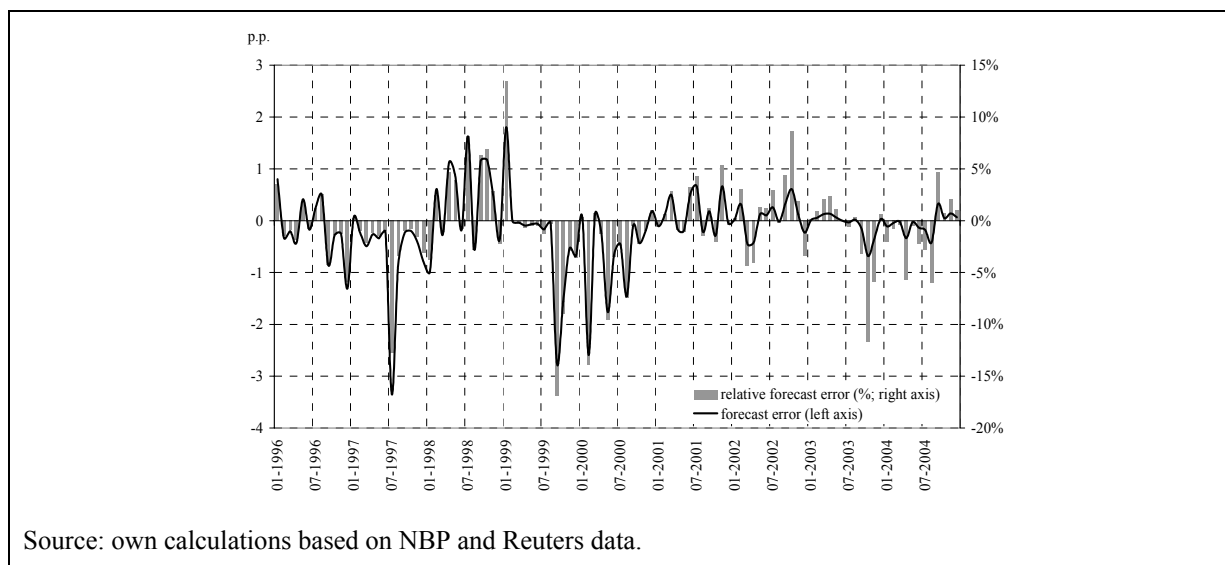


Figure 5. WIBOR 3M forecast errors (forecasts for the end of the same month next year)

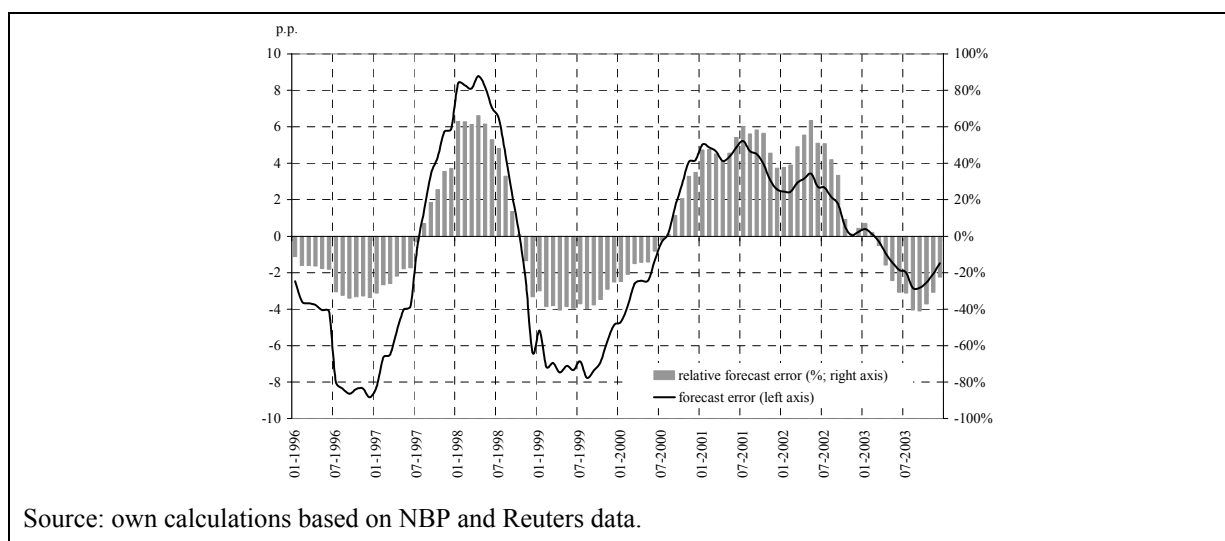


Table 5. Measures of forecast accuracy

<i>Forecasts of WIBOR 3M at the end of the current month</i>			
	01.1996 – 12.2004	Sub-sample: 01.1996 – 09.1998	Sub-sample: 10.1998 – 12.2004
ME	-0.14	-0.18	-0.13
MAE	0.45	0.62	0.38
MAPE	2.9%	2.7%	3.0%
RMSE	0.73	0.87	0.66
<i>Forecasts of WIBOR 3M at the end of the analogous month next year</i>			
	01.1996 – 12.2003	Sub-sample: 01.1996 – 09.1998	Sub-sample: 10.1998 – 12.2003
ME	-0.63	-0.75	-0.56
MAE	4.22	5.76	3.42
MAPE	31.4%	30.9%	31.7%
RMSE	4.92	6.24	4.06

Source: own calculations based on NBP and Reuters data.

In the entire period sampled and in both forecast horizons, commercial bank analysts, on average, underestimated future short-term rates. Mean error (ME) amounted to minus 14 basis points for a one-month forecast horizon and minus 63 basis points for a year horizon. This suggests that banking analysts expected a less restrictive monetary policy than actual. The bias decreased over time. Taking into consideration the mean absolute forecast error (MAE) and root mean square error (RMSE), a clear improvement in the forecast accuracy under inflation targeting regime can be noted. However, due to serious changes of the level of interest rates in the sample, which moved down from 22.4% in January 1996 to 6.7% in December 2004, it is more appropriate to evaluate relative errors. The mean absolute percentage error (MAPE) increased slightly in the second sub-sample, suggesting no improvement in the accuracy of forecasts. This applies to both forecast horizons.

When predicting interest rates becomes easier, the heterogeneity of individual forecasts should diminish. Therefore we investigate whether commercial bank analysts have become more conforming when it comes to predicting short-term interest rates. The degree of forecasters' heterogeneity can be measured as a difference between the 90th and the 10th percentile forecasts. Figure 6 and Figure 7 present such a measure in absolute and relative terms for both forecast horizons. It can be noted that – similarly as in the case of prediction errors presented above – the absolute measure of forecasts dispersion decreases over time, but the relative one does not.

Figure 6. Dispersion measures of individual interest rate forecasts for the end of current month

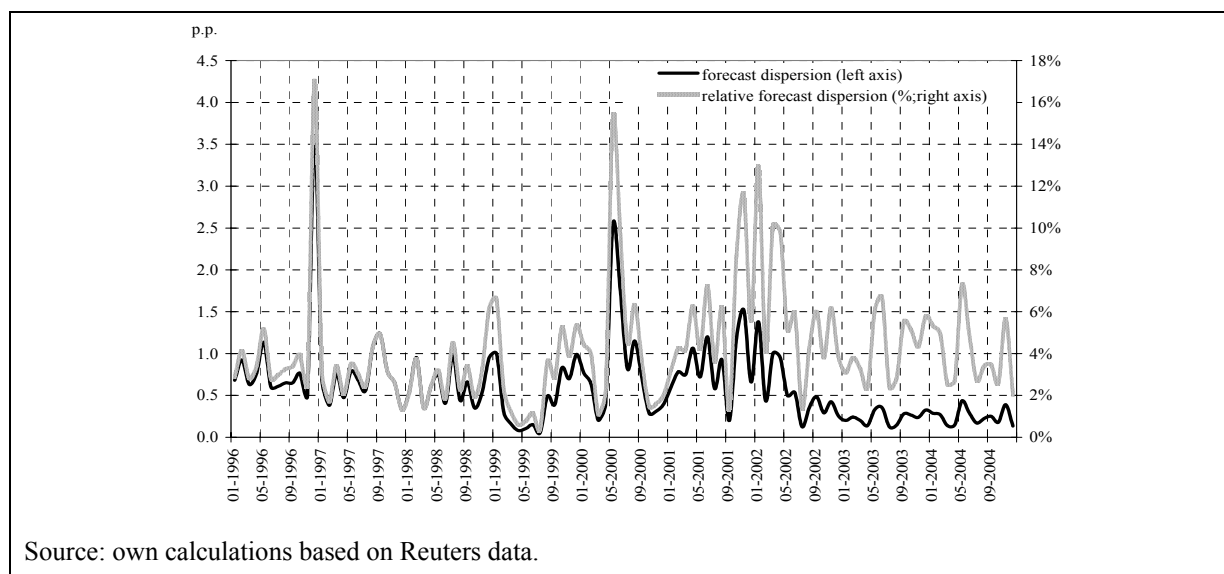
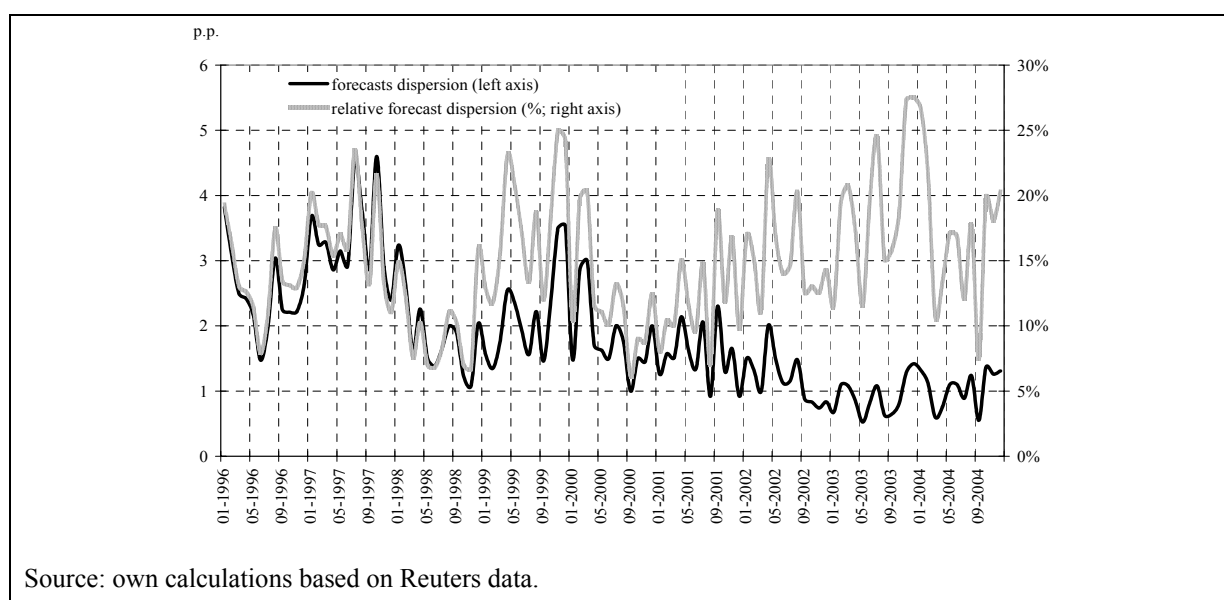


Figure 7. Dispersion measures of individual interest rate forecasts for the end of the same month next year



Summing up, the measures of forecast errors and forecast dispersion presented above suggest no improvement in forming the predictions of interest rates by commercial bank analysts, and therefore no improvement in monetary policy transparency. Interest rate expectational errors may suggest that the available information was differently interpreted by commercial bank analysts and by the NBP Monetary Policy Council. In order to shed some light on this problem in the next section we examine the macroeconomic efficiency of interest rate expectations.

2.4. *Macroeconomic efficiency of interest rate expectations*

The condition of macroeconomic efficiency requires that agents incorporate all relevant information available at the time when they set their expectations. In the context of our study, fulfilment of the requirement of efficiency of interest rate expectations would entail that while forming their predictions, commercial bank analysts take all available information into account exactly in the same way as the monetary policymakers do while deciding about the short-term interest rate levels. This would suggest that the decision-making process is fully transparent.

To check the efficiency of commercial bank analysts' interest rate expectations in Poland we refer to a method used by Forsells and Kenny (2002) to assess the efficiency of consumer inflation expectations in the euro area. They estimate a sequence of equations of the following structure:

$$[5] \quad e_t = \alpha + \beta \cdot \Omega_t + u_t,$$

where e denotes expectational errors and Ω represents the set of information variables that are relevant for predicted variable and are available at the time when expectations are formed. Due to possible problems with multicollinearity that could appear while estimating the equation [5] in a multivariate context, univariate regressions are run. A statistically significant β suggests that agents failed to take account of the selected information variable in an optimal way in setting their expectations. Because of the autocorrelation of forecast errors, we estimate additionally an extended version of the test equation, with the lagged forecast error on its right-hand side, which improves the statistical properties of the estimation results.

In both versions of the test equation, short-term interest rate expectational errors are explained by an information set that includes variables effectively known to the agents at the time when the expectations are formed (we make allowance for lags in the publication of variables).

Table 6. Macroeconomic efficiency of interest rate expectations – test results

	01.1996 – 12.2004		Sub-sample 01.1996-09.1998		Sub-sample 10.1998-12.2004	
	β	prob.	β	prob.	β	prob.
<i>Equation 1: $e_t = \alpha + \beta\Omega_t + u_t$</i>						
Δ WIBOR3M	-0.17	0.14	-17.24	0.14	-0.17	0.35
Δ WIBOR3MR	-14.27	0.08*	-19.09	0.21	-9.34	0.18
Δ CPI	-18.60	0.13	14.94	0.53	-31.74	0.01***
Δ PPI	-12.34	0.07*	-6.94	0.45	-21.57	0.04**
Δ PLN/EUR	-0.46	0.67	-1.48	0.62	-0.29	0.78
Δ PLN/USD	-1.10	0.08*	-3.06	0.45	-0.91	0.15
Δ U	1.07	0.95	49.89	0.35	-10.00	0.48
Δ IOUT	0.07	0.90	2.35	0.15	-0.58	0.08*
$\Delta\pi^c$	-0.07	0.83	0.46	0.23	-0.80	0.00***
Δ CPI(+1)	-43.95	0.01***	-49.56	0.26	-45.60	0.01***
Δ PPI(+1)	-12.73	0.04**	-8.66	0.14	-20.18	0.03**
<i>Equation 2: $e_t = \alpha + \alpha_1 e_{t-1} + \beta\Omega_t + v_t$</i>						
Δ WIBOR3M	-0.09	0.58	-24.49	0.36	-0.03	0.86
Δ WIBOR3MR	-15.06	0.03**	-24.84	0.13	-10.32	0.19
Δ CPI	-10.98	0.41	21.18	0.47	-23.47	0.10
Δ PPI	-9.80	0.11	-6.13	0.49	-16.98	0.08*
Δ PLN/EUR	-0.42	0.68	-1.08	0.73	-0.34	0.72
Δ PLN/USD	-0.82	0.14	-3.50	0.50	-0.63	0.19
Δ U	0.21	0.99	42.48	0.43	-10.85	0.36
Δ IOUT	-0.05	0.93	2.60	0.16	-0.96	0.03**
$\Delta\pi^c$	0.03	0.93	0.52	0.25	-0.63	0.08*
Δ CPI(+1)	-39.75	0.01***	-51.20	0.26	-40.18	0.02**
Δ PPI(+1)	-8.63	0.17	-5.43	0.41	-15.12	0.07*

WIBOR3M – 3 month interbank offer rate; WIBOR3MR – WIBOR3M in real terms; CPI – consumer price index (y/y); PPI – producer price index (y/y); PLN/EUR – PLN against EURO exchange rate; PLN/USD – PLN against USD exchange rate; U – unemployment rate; IOUT – industrial output (m/m); π^c – bank analysts' inflation expectations; Δ – first difference operator.

The data is monthly. All equations are estimated using OLS with the Newey-West (1987) variance-covariance correction matrix.

Source: own calculations based on GUS, NBP, and Reuters data.

The results presented in Table 6 indicate that in declaring interest rate expectations, commercial bank analysts do not use all macroeconomic data in an efficient manner. Expectational errors can be explained by price indices (CPI and PPI) and industrial output; however the results are partly sensitive to the equation specification. It seems important to note that in both test equations banks' inflation expectations are statistically significant (at a level of 10% or lower). This may suggest that differences in actual and predicted interest rates result, among other causes, from different inflation predictions of banks and of the NBP.

Due to the fact that bank analysts form their expectations without knowing the latest data on CPI and PPI, which is, however, published before the MPC takes decision about interest rates, we include in our test also these variables. As they are found to be statistically significant (in the whole sample and in the second sub-sample), part of the forecast error can be attributed to different information set of bank analysts and the MPC.

The results obtained do not support the hypothesis that transparency has increased after the adoption of IT in Poland. On the contrary, compared with the pre-IT period, when macroeconomic efficiency requirement was met, the IT period is characterized by a significant deterioration in the way of forming interest rate expectations by commercial bank analysts.

3. Credibility of the inflation targeting strategy in Poland

3.1. Commercial banks' and consumers' inflation expectations in Poland

The process of formation of Polish consumers' inflation expectations has been examined in a number of previous studies. Łyziak (2003) has found that consumers' expectations do not meet the conditions of unbiasedness and macroeconomic efficiency, thus they are not rational. No evidence of any improvement of the expectations' formation process and the increase of their forward-lookingness after introducing IT has been found.³⁴ The properties of Polish commercial bank analysts' inflation expectations have not been yet examined in a rigorous way as far as we know. However, some preliminary evidence combined with studies on the forecasts of economists conducted in other countries suggests that this group of agents may also form their expectations inconsistently with the rational expectations hypothesis.³⁵ Table 7 presents forecast performance statistics of consumers' and banks' inflation expectations³⁶ under the inflation targeting and compares them to the naive forecast.

Table 7. Forecast performance of consumers' and banks' inflation expectations, 10/1998-12/2003 ⁽¹⁾

	consumers' expectations	banks' expectations	naive forecast ⁽²⁾
ME	1.17	0.56	1.02
MAE	3.26	2.41	3.23
MAPE	1.51	1.61	1.61
RMSE	3.82	2.76	3.67

⁽¹⁾ Banks' and consumers' expectations are not fully comparable due to different forecast horizons – for consumers it amounts to 12 months, for banks it was changed from 12 to 11 months in November 2000.

⁽²⁾ The most recent inflation known to respondents while declaring their expectations.

Source: own calculations based on GUS, Ipsos, and Reuters data.

³⁴ The sample ended December 2002.

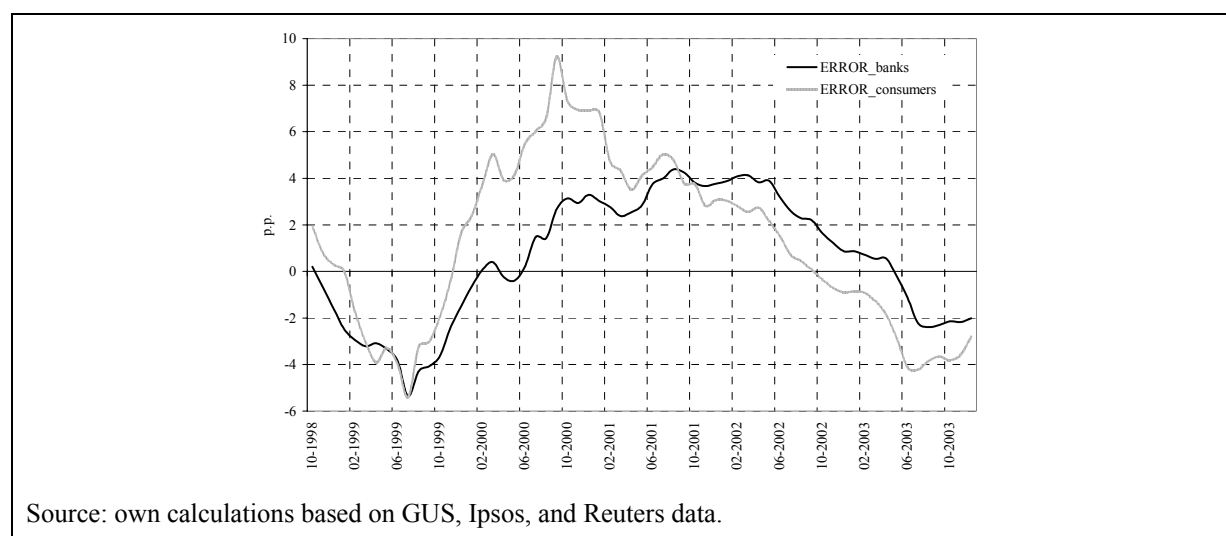
³⁵ Lloyd (1999) examined US inflation expectations derived from the Livingstone survey of economists and found that they were unbiased and rational only in a weak form. Baghestani and Kianian (1993) studied data from the American Statistical Association and the National Bureau of Economic Research survey of professional economic forecasters and their results indicate a lack of either unbiasedness or rationality of consumer price index expectations.

³⁶ Consumer inflation expectations are quantified on the basis of Ipsos qualitative survey data with the use of probability approach, which is described in detail in Łyziak (2003). Commercial bank analysts' expectations are taken from Reuters quantitative questionnaires (see: footnote 32).

Not surprisingly, commercial bank analysts are more accurate in their predictions than consumers, whose expectations perform very closely to the naive forecast. Both groups of agents overstate future inflation rates on average. For bank analysts the bias amounts to 0.56 p.p. and for consumers it is twice that much, i.e. it equals 1.17 p.p.

Figure 8 presents inflation forecast errors in the analysed period. Despite the different magnitude of errors, the observed pattern for consumers and banks is similar. In 2000, the downward trend of price dynamics reverted surprisingly (due to supply shocks and easy monetary and fiscal policy). As a result, the actual inflation exceeded expectations. In the next two and a half years, the opposite situation took place. The economy slowed down and the effects of restrictive monetary policy started to be visible. Consequently, a fast disinflation process took place. The consumer price index ended up below the NBP target, as well as below consumers' and banks' expectations (in April 2003, yearly CPI reached, at 0.3%, its lowest level). The most recent, also unexpected rise in price dynamics can be attributed mainly to relative price changes connected with Poland's accession to the EU as well as to the oil price increase.

Figure 8. Consumers' and bank analysts' inflation expectational errors

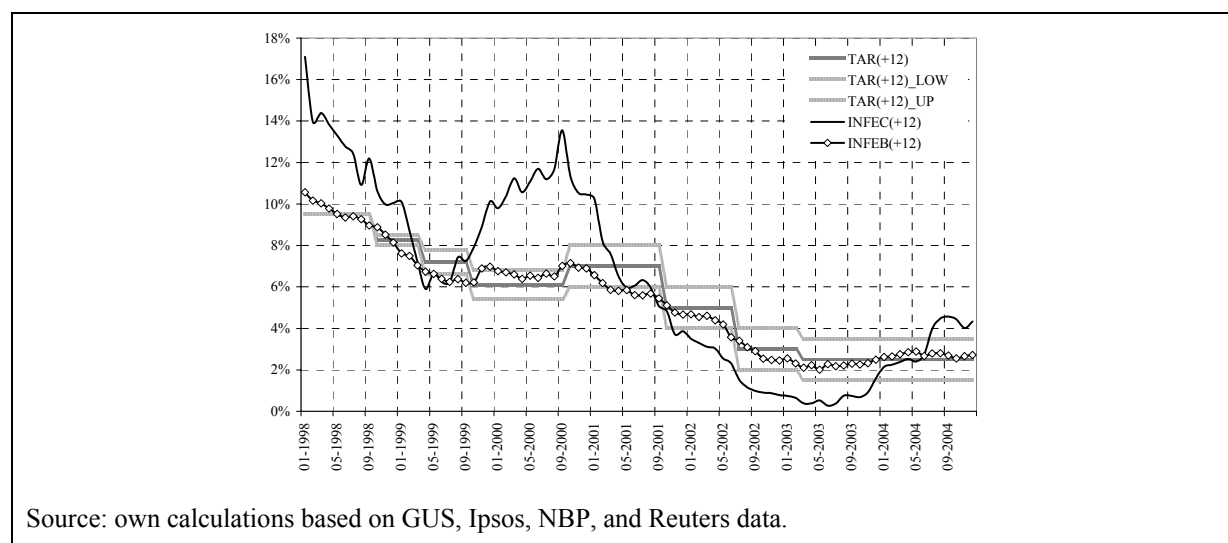


3.2. Credibility of inflation targets in Poland

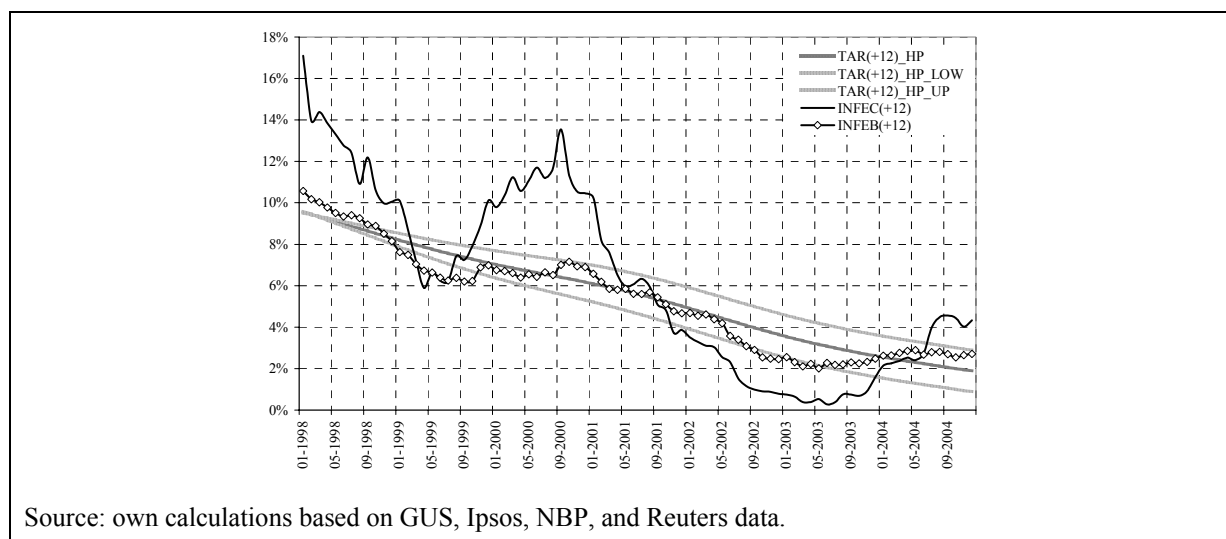
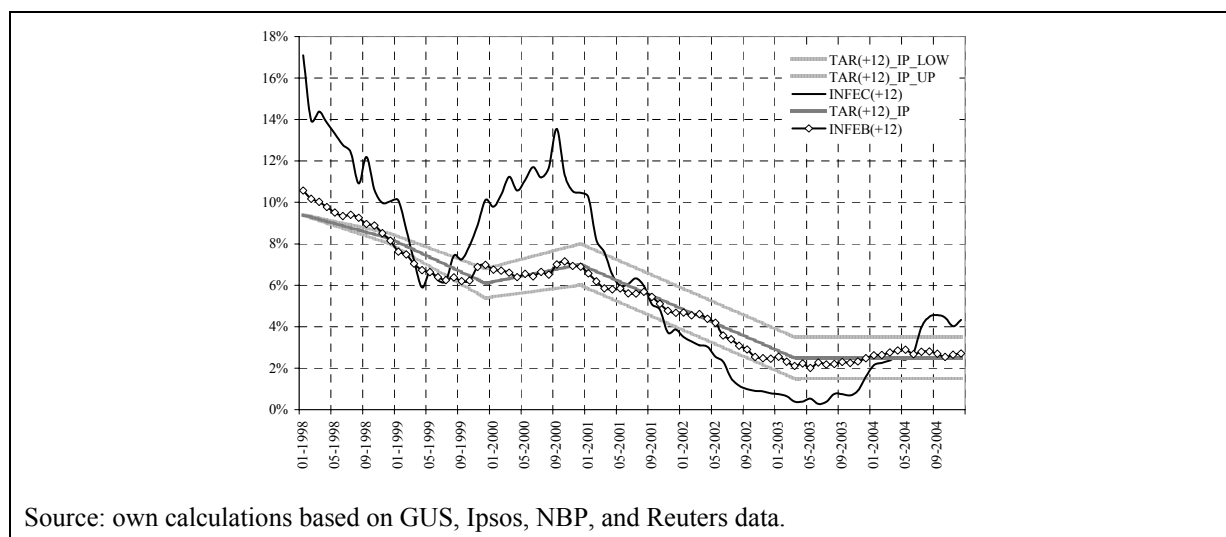
As suggested in the literature, we measure the credibility of the NBP inflation targets by analysing differences between inflation expectations formed by both analysed groups of economic agents and the inflation target.

While inflation expectations set by commercial bank analysts were broadly consistent with the NBP inflation target³⁷, inflation expectations of Polish consumers – characterized by a strong backward-lookingness – were deviating considerably from the targeted values (Figure 9, Figure 10, Figure 11). In 1999-2004, the frequency of inflation expectations being within the NBP target range amounted to approximately 72% in the case of bank analysts and 21% in the case of consumers.

Figure 9. Banks' and consumers' inflation expectations and the NBP inflation target (official target for a given year)



³⁷ Analysing shifts of the yield curve after interest rate decisions Zieliński (2001) and Ziarko-Siwiek (2004) have found evidence that the NBP monetary policy was credible.

Figure 10. Banks' and consumers' inflation expectations and the NBP inflation target (HP filter target)**Figure 11. Banks' and consumers' inflation expectations and the NBP inflation target (interpolated target)**

To assess the weight attached by consumers and commercial bank analysts to the NBP inflation target in the formation of their inflation expectations, we made use of the Bomfim and Rudebush (1997) approach, estimating the credibility parameter λ in the following equation:

$$[6] \quad \pi_{T|t}^e = \lambda \cdot \pi_T^{tar} + (1 - \lambda) \cdot \pi_t^0,$$

where: $\pi_{T|t}^e$ denotes inflation expectations formed in t for the period T , π_T^{tar} the inflation target for the period T , and π_t^0 the most recent inflation known in the period t . Estimation results for

inflation expectations of consumers and commercial bank analysts in relation to different measures of the NBP inflation target are presented in Table 8.

Table 8. Estimation of the credibility parameter λ

Measure of the NBP target	Consumers' inflation expectations ⁽¹⁾		Commercial bank analysts' inflation expectations ⁽²⁾	
	λ (standard errors in parentheses)	R ² and residuals' diagnostics	λ (standard errors in parentheses)	R ² and residuals' diagnostics
Official target for a given year	-0.16 (0.05)	R ² [adjusted R ²] – 0.98 [0.98] DW – 0.75 JB [probability] – 0.09 [0.96] ADF [probability] – -3.18 [0.03]	0.83 (0.04)	R ² [adjusted R ²] – 0.91 [0.91] DW – 0.36 JB [probability] – 4.03 [0.13] ADF [probability] – -9.84 [0.00]
HP filter target	-0.13 (0.05)	R ² [adjusted R ²] – 0.98 [0.98] DW – 0.64 JB [probability] – 0.99 [0.60] ADF [probability] – -2.73 [0.07]	0.80 (0.06)	R ² [adjusted R ²] – 0.93 [0.93] DW – 0.11 JB [probability] – 2.01 [0.37] ADF [probability] – -8.68 [0.00]
Linear interpolation	-0.16 (0.05)	R ² [adjusted R ²] – 0.98 [0.98] DW – 0.69 JB [probability] – 0.48 [0.78] ADF [probability] – -3.06 [0.03]	0.90 (0.04)	R ² [adjusted R ²] – 0.96 [0.96] DW – 0.23 JB [probability] – 2.35 [0.31] ADF [probability] – -7.84 [0.00]

⁽¹⁾ $T = t + 12$, sample period: 1998:10-2004:12, equations are estimated by OLS using the covariance matrix corrections suggested by Newey and West (1987).

⁽²⁾ $T = t + 12$ until October 2000 and $T = t + 11$ since November 2000, sample period: 1998:10 to 2004:12, equations are estimated by OLS using the covariance matrix corrections suggested by Newey and West (1987).

Source: own calculations based on GUS, Ipsos, NBP, and Reuters data.

There is a significant divergence in the way both groups of agents form inflation expectations. In setting their predictions consumers seem to rely heavily on the current rate of inflation, which is consistent with the results of other studies [Łyziak (2003)]. The credibility parameter is significant, but negative, which implies a lack of credibility.³⁸ On the other hand, commercial bank analysts follow closely the NBP inflation target³⁹ with a lower weight attached to current price behaviour.

In analysing the probability of future inflation being within the NBP inflation target range (Figure 12, Figure 13) it turns out that although it differs significantly for both groups of economic agents, it is characterized by a positive trend, indicating a gradual increase of credibility of the NBP inflation target.⁴⁰ Two major exceptions from this tendency are connected with a fast disinflation 2002-2003 as well as the EU-accession shock in 2004. Differences in the volatility

³⁸ As explained in Section 1, parameter λ in the Bomfim and Rudebush (1997) approach may be interpreted as a fraction of the analysed population believing in the inflation target. In the case of Polish consumers, parameter λ is negative, which is not consistent with such an interpretation.

³⁹ Maliszewski (2002) finds similar conclusions analysing the weight of the NBP inflation target vs. VAR forecast in commercial bank analysts' inflation expectations.

⁴⁰ It should be underlined that it is partly due to the fact that inflation target bands, primarily relatively narrow, were gradually becoming wider.

of banks' and consumers' assessments concerning the probability of achieving the NBP inflation target interval result mainly from a difference in the method applied to derive both indicators. In the case of consumers we refer to a density function, whose parameters are estimated on the basis of qualitative survey data, while in the case of commercial banks we measure it as a fraction of banks declaring their predictions consistently with the NBP inflation target range. Frequent and sizeable changes in the number of banks participating in the survey lead to a relatively high volatility of estimated probabilities.

Figure 12. Probability of being within the NBP inflation target range – consumers

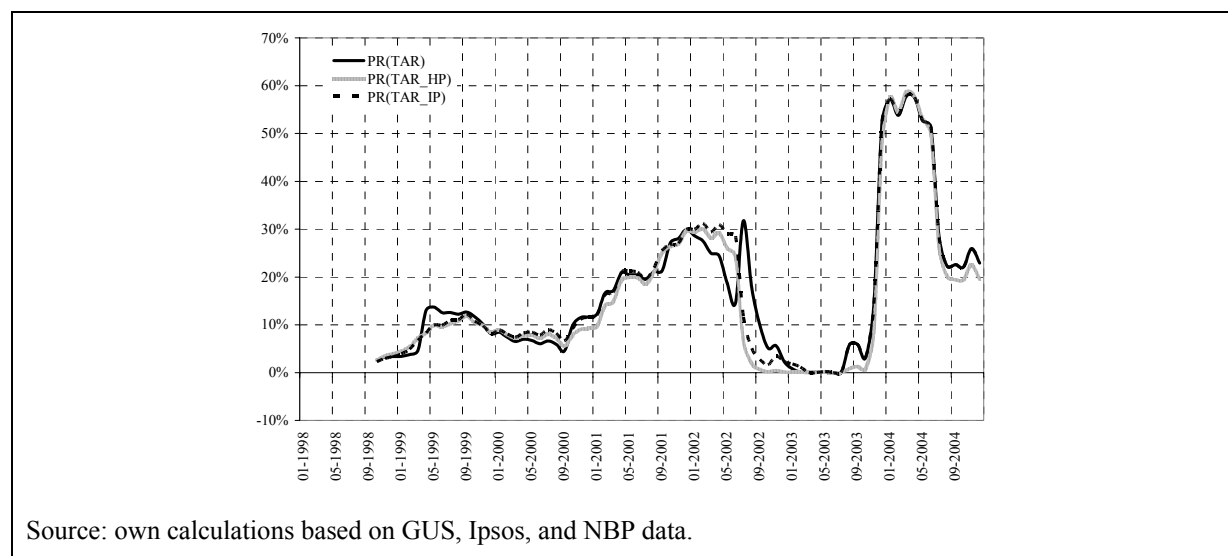
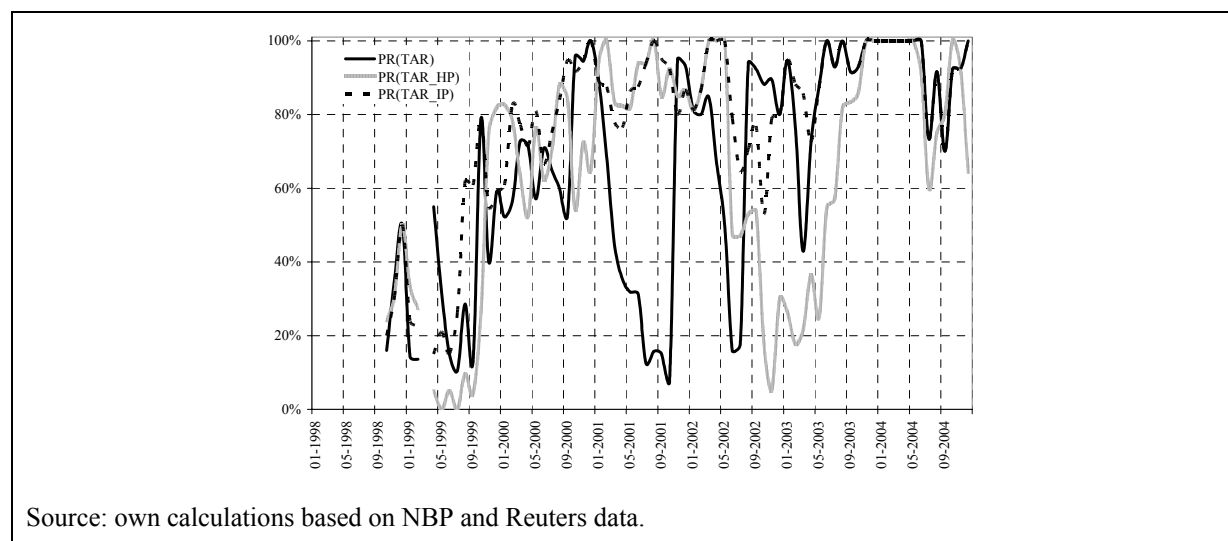


Figure 13. Probability of being within the NBP inflation target range – commercial bank analysts



3.3. Explaining deviations of inflation expectations from inflation targets

In measuring deviations of inflation and inflation expectations from the NBP inflation targets, we make reference to four measures, consistently with Leiderman (2004):

$$[7] \quad Dev_1 = \begin{cases} \pi - \pi_{tar}^L & \text{if } \pi < \pi_{tar}^L \\ 0 & \text{if } \pi_{tar}^L < \pi < \pi_{tar}^U \\ \pi - \pi_{tar}^H & \text{if } \pi > \pi_{tar}^U \end{cases} ,$$

$$[8] \quad Dev_{1R} = \begin{cases} \frac{\pi - \pi_{tar}^L}{\pi_{tar}^L} & \text{if } \pi < \pi_{tar}^L \\ 0 & \text{if } \pi_{tar}^L < \pi < \pi_{tar}^U \\ \frac{\pi - \pi_{tar}^H}{\pi_{tar}^H} & \text{if } \pi > \pi_{tar}^U \end{cases} ,$$

$$[9] \quad Dev_2 = \pi - \pi_{tar} ,$$

$$[10] \quad Dev_{2R} = \frac{\pi - \pi_{tar}}{\pi_{tar}} ,$$

where: π denotes inflation or inflation expectations, π_{tar} the middle point of the NBP inflation target range, π_{tar}^L and π_{tar}^U its lower and upper limit. All measures of deviations of Polish commercial banks' and consumers' inflation expectations from the inflation target are presented in the Appendix.

To explain what influences deviations of commercial bank analysts' and consumers' inflation expectations from the NBP inflation target, we analyse their correlations with current inflation's deviations from the current inflation target and the target 12 months ahead (Table 9, Table 10, Table 11). Due to the fact that deviations of current inflation from the current and future inflation target are highly correlated with each other, we do not draw conclusions concerning their relative importance in explaining the gaps between inflation expectations and the NBP inflation

target within a single group of economic agents, but rather we make comparisons across these groups.

Table 9. Correlation matrix – official target for a given year, Dev₁ [Dev₂]

		Deviations of:			
		banks' inflation expectations from the NBP inflation target	consumers' inflation expectations from the NBP inflation target	current inflation from the NBP inflation target 12 months ahead	current inflation from the current NBP inflation target
Deviations of:	banks' inflation expectations from the NBP inflation target	1.00 [1.00]	0.27 [0.64]	0.28 [0.61]	0.18 [0.39]
	consumers' inflation expectations from the NBP inflation target	0.27 [0.64]	1.00 [1.00]	0.98 [0.99]	0.83 [0.87]
	current inflation from the NBP inflation target 12 months ahead	0.28 [0.61]	0.98 [0.99]	1.00 [1.00]	0.85 [0.89]
	current inflation from the current NBP inflation target	0.18 [0.39]	0.83 [0.87]	0.85 [0.89]	1.00 [1.00]

Source: own calculations based on GUS, Ipsos, NBP, and Reuters data.

Table 10. Correlation matrix – HP filter target, Dev₁ [Dev₂]

		Deviations of:			
		banks' inflation expectations from the NBP inflation target	consumers' inflation expectations from the NBP inflation target	current inflation from the NBP inflation target 12 months ahead	current inflation from the current NBP inflation target
Deviations of:	banks' inflation expectations from the NBP inflation target	1.00 [1.00]	0.34 [0.77]	0.40 [0.82]	0.49 [0.84]
	consumers' inflation expectations from the NBP inflation target	0.34 [0.77]	1.00 [1.00]	0.98 [0.98]	0.95 [0.98]
	current inflation from the NBP inflation target 12 months ahead	0.40 [0.82]	0.98 [0.98]	1.00 [1.00]	0.98 [1.00]
	current inflation from the current NBP inflation target	0.49 [0.84]	0.95 [0.98]	0.98 [1.00]	1.00 [1.00]

Source: own calculations based on GUS, Ipsos, NBP, and Reuters data.

Table 11. Correlation matrix – interpolated target, Dev₁ [Dev₂]

		Deviations of:			
		banks' inflation expectations from the NBP inflation target	consumers' inflation expectations from the NBP inflation target	current inflation from the NBP inflation target 12 months ahead	current inflation from the current NBP inflation target
Deviations of:	banks' inflation expectations from the NBP inflation target	1.00 [1.00]	0.19 [0.65]	0.24 [0.64]	0.26 [0.55]
	consumers' inflation expectations from the NBP inflation target	0.19 [0.65]	1.00 [1.00]	0.98 [0.98]	0.91 [0.95]
	current inflation from the NBP inflation target 12 months ahead	0.24 [0.64]	0.98 [0.98]	1.00 [1.00]	0.93 [0.97]
	current inflation from the current NBP inflation target	0.26 [0.84]	0.91 [0.95]	0.93 [0.97]	1.00 [1.00]

Source: own calculations based on GUS, Ipsos, NBP, and Reuters data.

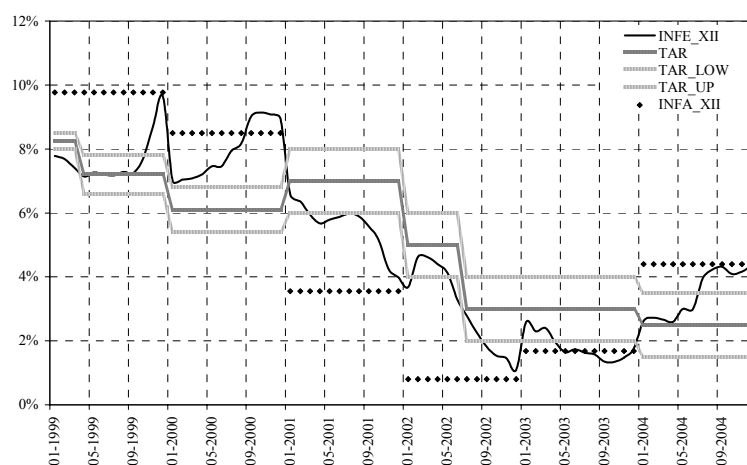
For all measures of inflation expectations' deviations from the NBP inflation target, correlation indices show that Polish consumers perceive twelve-month-ahead inflation target as not credible when the current rate of inflation deviates from the inflation target. Unsuccessful attempts to hit the target in the past signal that future targets may be missed too. In the case of commercial bank analysts, such behaviour is much less pronounced and banks' inflation predictions in a relatively smaller extent are explained by the gap between the current rate of inflation and the NBP inflation target.

In the approach presented above, the official NBP inflation targets, formed for the end of subsequent years, were transformed to a continuous target in order to be comparable with measures of inflation expectations. To avoid the discrepancy between the forecast and the target horizon, we compare the official inflation target with banks' inflation expectations formed for the end of each year.⁴¹ It can be easily seen from the Figure 14 that at the beginning of each year, banks' expectations used to be close or within the target range. Despite the fact that the NBP had missed the target in previous years, bank analysts believed that the target set for the current year would be reached. This is consistent with our previous finding suggesting that in the opinion of commercial bank analysts, the NBP targets were credible for the most of the analysed period. However, as the forecast horizon was becoming shorter and the current inflation was deviating

⁴¹ It should be kept in mind that in the case of this measure of inflation expectations, the forecast horizon is not constant and diminishes from 12 months for expectations formed in January to 0 for expectations formed in December of each year.

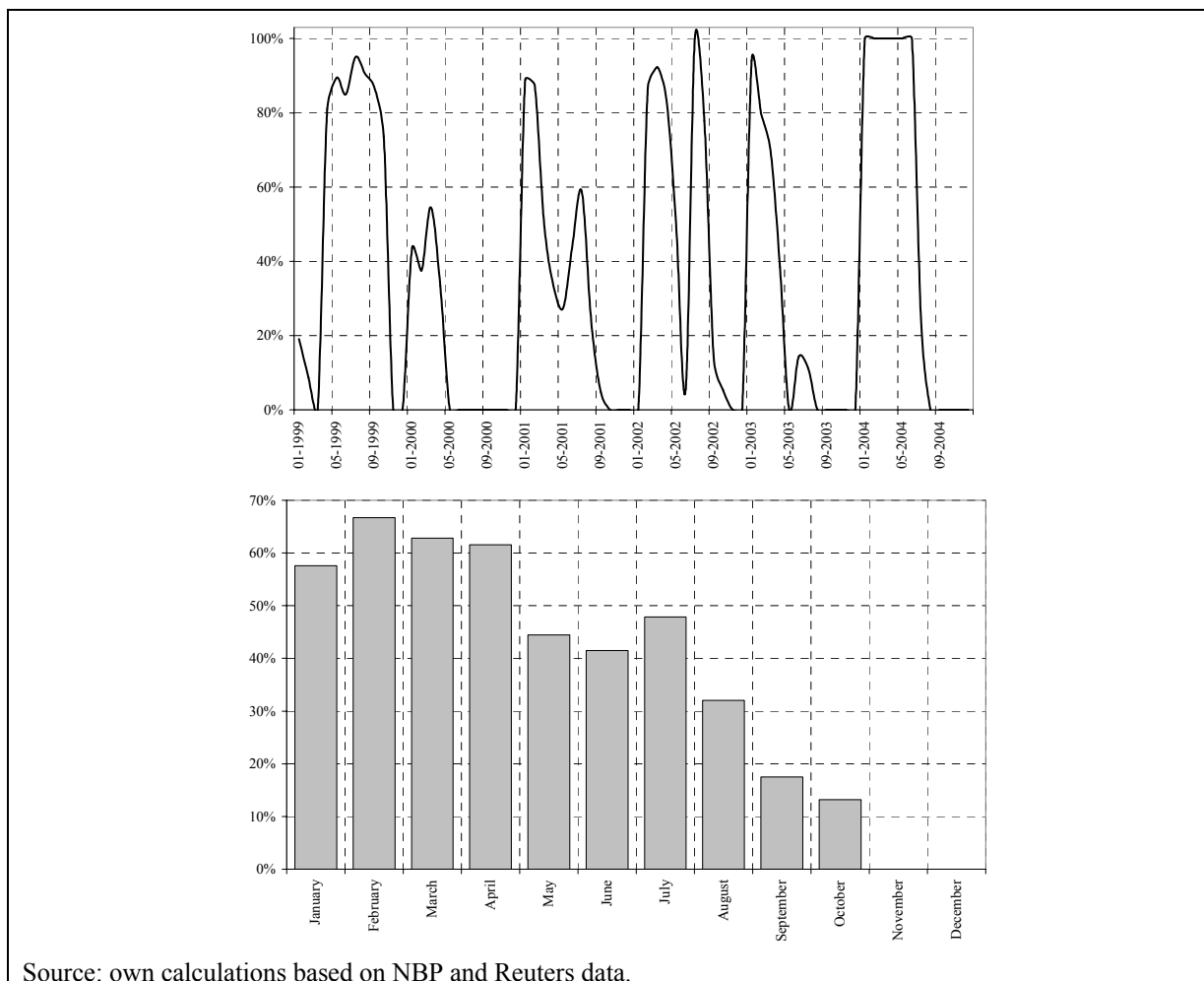
from the target, analysts were revising their opinion about the probability of hitting the target and their expectations were converging to the actual inflation rate (which was far from the target) at the end of a year. The correlation between the deviation of banks' inflation expectations and the current inflation from the NBP target amounts to 0.79 for the Dev_1 and 0.85 for the Dev_2 measure. This pattern is clearly seen in Figure 15, which shows the probability of being within the NBP inflation target range. The NBP's credibility was high when the new target was set or revised in the course of the year, but then it was falling rapidly: in the first quarter, average probability of being within the target range amounted to 62% and only to 4% in the fourth quarter.

Figure 14. The NBP official target for the end of the year and banks' expectations for December of the current year



Source: own calculations based on Reuters, GUS, and NBP data.

Figure 15. Probability of being within the NBP inflation target range at the end of the year – bank analysts



The example presented above shows that previous incidents of missing the inflation target seem not to influence analysts' trust in the central bank. Current inflation being far from the target is the principal factor making banks' inflation expectations deviate from the target at the end of subsequent years.

4. Concluding remarks

The central bank transparency and credibility are closely related to each other. There is a consensus in the theoretical literature that greater transparency should lead to greater credibility.

In verifying the transparency of the NBP monetary policy, we inspected separately the transparency of monetary policy frameworks and of monetary policy decisions. As far as the former dimension is concerned, our study, based on several indicators suggested in the literature, leads us to the conclusion that the transparency of the National Bank of Poland is relatively high. It increased sizeably after changes introduced to NBP *Inflation Reports* in August 2004, when the NBP staff inflation projection was published for the first time. On the other hand, our study suggests that the accuracy of interest rates expectations formed by commercial bank analysts did not improve under IT, so the transparency of monetary policy decisions seems to be fairly low.⁴² Moreover, macroeconomic efficiency of interest rate expectations has deteriorated substantially after the IT adoption.

The credibility of monetary policy is usually measured as the deviation of inflation expectations from the central bank inflation target or forecast. As far as Polish experiences are concerned, in the empirical part of our paper we estimated the weight attached to the NBP inflation target in the formation of consumers' and commercial bank analysts' inflation expectations. There is a clear difference between both groups of agents. In the case of commercial banks, inflation target constitutes an important information variable taken into account while forming inflation predictions. Polish consumers do not pay attention to the NBP inflation target while declaring their expectations regarding the behaviour of prices in the future. It seems that in contradiction to bank analysts, a lack of credibility in this group of agents is caused mainly by deviations of current inflation from the target. The probability attached by consumers to being within the NBP inflation target range was significantly lower compared with opinions of bank analysts. It was characterized, however, by a positive trend, indicating a gradual increase of credibility of NBP

⁴² Policy explanations and predictability are important dimensions of central bank transparency. However, even they both seem to be insufficient to draw unequivocal conclusions on the overall degree of transparency, which is a multidimensional phenomenon and comprises not only the release of information by the central bank, but also its proper understanding by the public. Extending our study it would be needed to check whether our results based on surveys carried out among commercial bank analysts would be confirmed by analogous tests based on financial market data. Moreover, it would be necessary to consider other groups of economic agents to verify their understanding of information released by the National Bank of Poland and its monetary policy actions.

inflation targets. Two major exceptions from this tendency were related to a fast disinflation 2002-2003 as well as to the effects of EU-accession in 2004.

As the theoretical literature suggests, increased transparency of a monetary policy framework, reflected in the improvement of communication patterns, should lead to better predictability of monetary policy actions. From that point of view, having relatively high transparency indices characterizing the IT framework of the National Bank of Poland and low predictability of the NBP interest rates is puzzling, especially taking into account the high credibility of inflation targets resulting from the assessment of commercial bank analysts' inflation expectations. It occurs that despite repeated inflation target misses and interest rate decisions being inconsistent with their expectations, commercial bank analysts' trust in the NBP inflation targets was unexpectedly stable.

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Appendix

Figure 16. Deviations of inflation (+12 months) from the NBP inflation target – Dev₁ and Dev₂

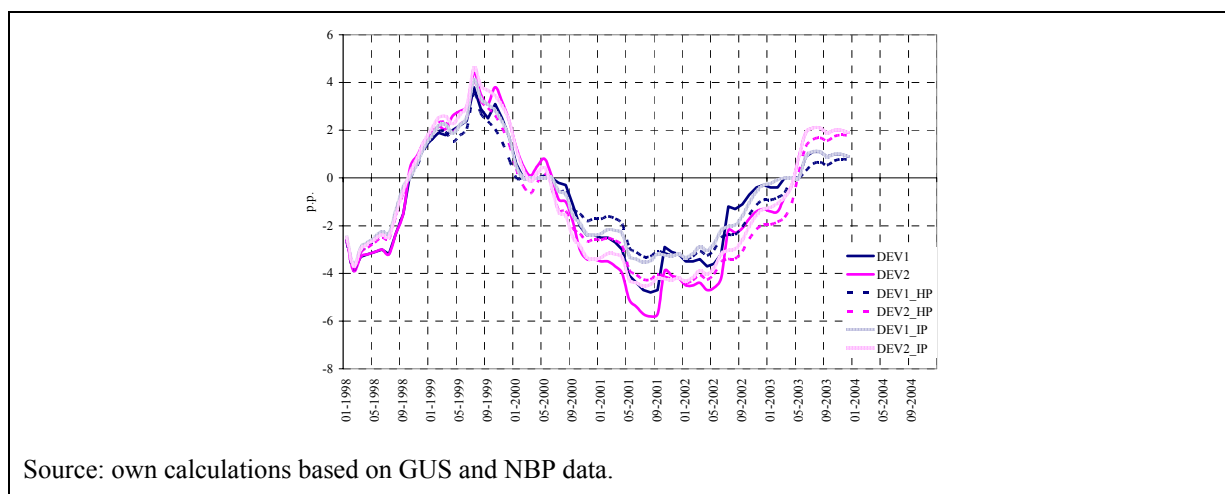


Figure 17. Deviations of inflation (+12 months) from the NBP inflation target – Dev_{1R} and Dev_{2R}

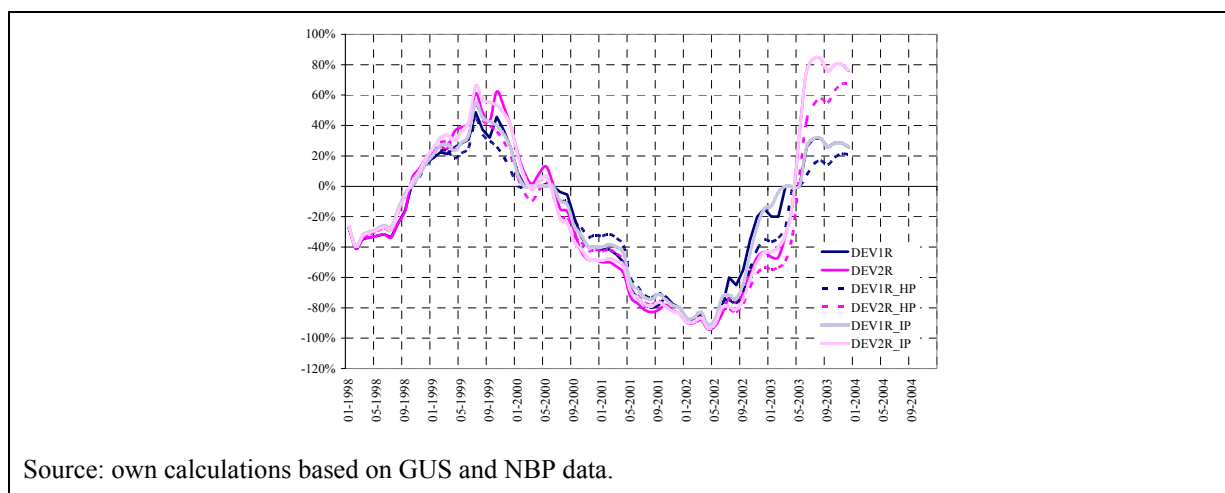


Figure 18. Deviations of consumer inflation expectations from the NBP inflation target – Dev₁ and Dev₂

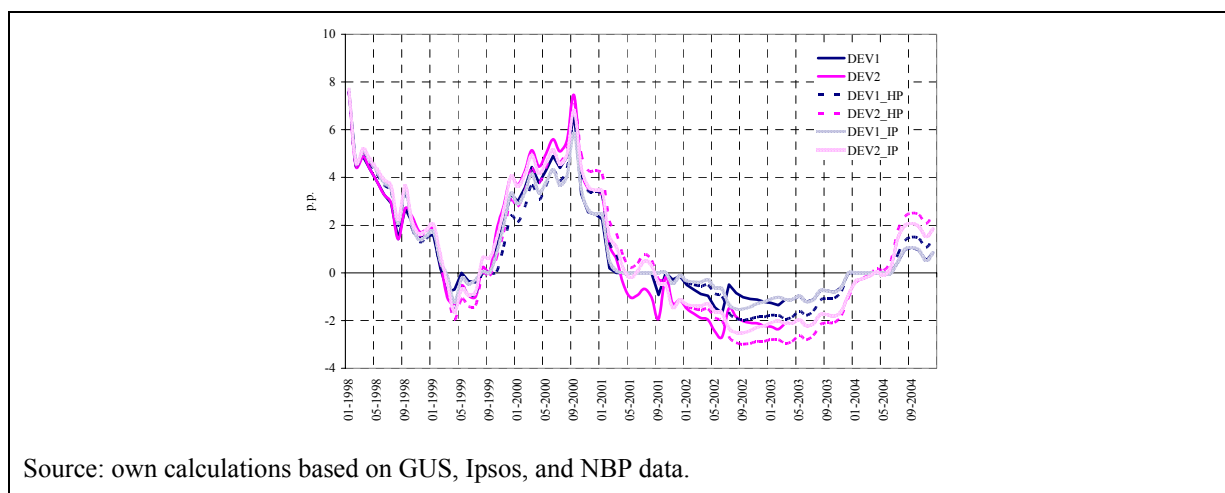


Figure 19. Deviations of consumer inflation expectations from the NBP inflation target – Dev_{1R} and Dev_{2R}

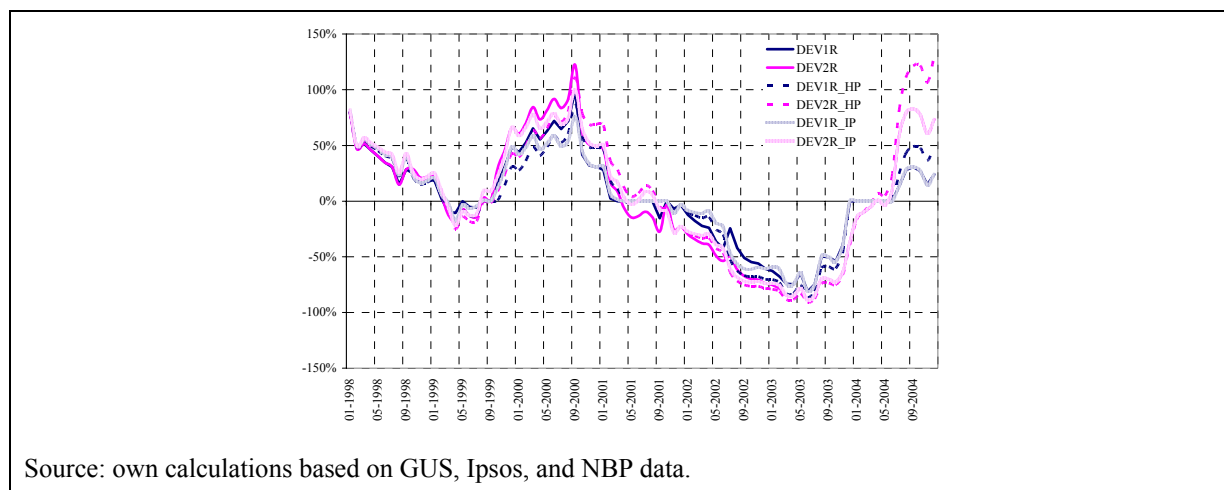


Figure 20. Deviations of banks' inflation expectations from the NBP inflation target – Dev₁ and Dev₂

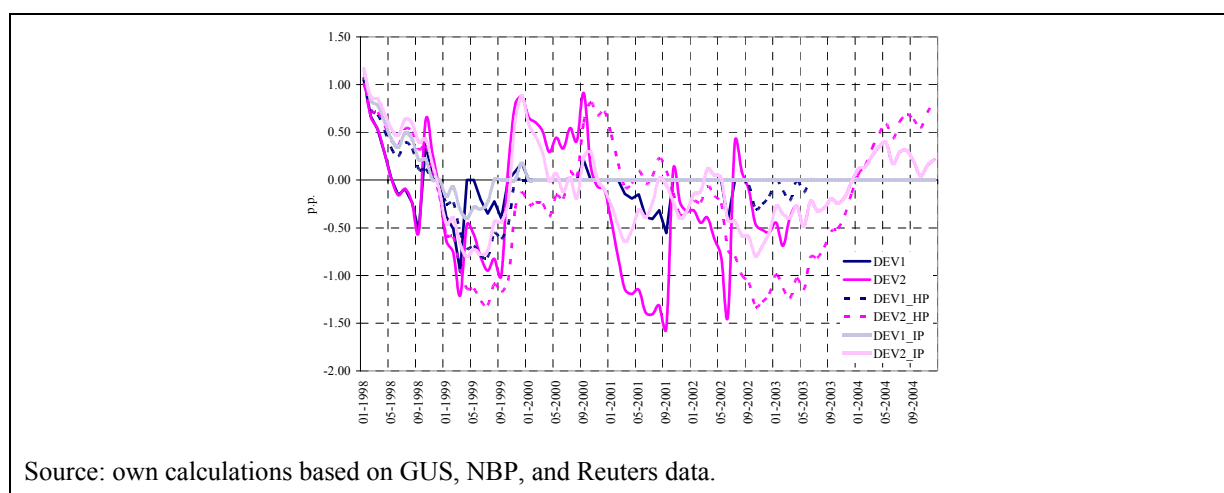


Figure 21. Deviations of banks' inflation expectations from the NBP inflation target – Dev_{1R} and Dev_{2R}

