

The interdependences of central bank's forecasts and inflation expectations of consumers

Magdalena Szyszko*

Submitted: 17 April 2012. Accepted: 19 September 2012.

Abstract

This paper focuses on the relationship between inflation forecast and inflation expectations of households measured on the basis of conducted surveys. Two hypotheses are presented. The first one assumes that there are interdependences between the inflation forecast results and consumers inflation expectations. The second hypothesis implies that the existence of the interdependences between the inflation forecasts and inflation expectations depends neither on detailed solutions in the field of forecasting inflation applied by central banks nor on their attitude towards inflation forecast targeting implementation. The research covers 4 central banks: of the Czech Republic, Hungary, Poland and Romania.

Keywords: inflation forecasts, inflation forecast targeting, inflation expectations

JEL: E52, E58

* Poznan School of Banking; e-mail: magdalena.szyszko@wsb.poznan.pl.

1. Introduction

According to the broadly accepted consensus (so-called New Neoclassical Synthesis, NNS), shared by central bankers and academics, modern monetary policy should have a forward-looking character. The fact that today's situation is decisive for future results of the economy, including price development, implies that inflation expectations and inflation forecasts play an important role in monetary policy. The importance of forward-looking components in monetary policy results also from the fact that monetary authorities can affect economy with lags.

There are a few discussion areas on the role of inflation expectations and forecasts in monetary policy. Some of them show a close relationship between these variables. Inflation expectations should influence the behaviour of economic agents (pricing decisions), while inflation forecasts or policy path announcement itself should have an impact on expectations. The latter will be evaluated empirically in this paper. Monetary authorities want to influence inflation expectations via, inter alia, inflation forecast as this helps to govern price development. Moreover, inflation expectations and inflation forecasts, being the most important information variables in a forward-looking analysis, support a decision-making process of the monetary policy committees. The expectations are a predictor of future inflation. The forecast shows the most probable development of the economy consistent with the central bank's view on the economy structure and the transmission mechanism.

Therefore, the importance of inflation expectations and inflation forecasts of central banks is not questionable. Several authors focus on this issue showing its theoretical and empirical aspects. Some of them focus on the nature of inflation expectations (Forsells, Kenny 2004) and their role in inflation dynamics also in New Member States (Gábríel 2010; Benkovskis 2008).

In this paper, inflation expectations and inflation forecasts are analyzed jointly. One argues that inflation forecasts ought to help to shape inflation expectations of the economic agent. The paper contributes to a broader analysis of the forward-looking attitude of these central banks which implement inflation targeting and declare to use inflation forecast as an input to the decision-making process (inflation forecast targeting – IFT).

The paper also concerns the discussion on transparency of monetary policy. The forecasts' disclosure should increase the monetary policy predictability, which limits the volatility of the interest rates. It should also anchor inflation expectations more precisely – foster the central bank's control over markets' expectations. The optimal level of transparency is not unambiguously determined. The research on transparency does not give a simple answer to the question whether it is sufficient to reveal the forecast, or whether the policy path should also be revealed.

This paper focuses on the relationship between inflation forecast and inflation expectations of households measured on the basis of surveys conducted. Two hypotheses are presented. The first one assumes that the interdependences between the inflation forecast results and consumers inflation expectations exist. The central bank's credibility is necessary for the existence of such interdependences. There are theoretical premises for such a hypothesis.

The second hypothesis implies that the existence of the interdependences between the inflation forecasts and inflation expectations of consumers depends neither on detailed solutions in the field of forecasting inflation applied by central banks nor on their attitude towards inflation forecast targeting implementation.

The research focuses on households expectations. Consumers are the least qualified group of economic agents in terms of their knowledge of economy and its forces. They are “secondary readers” of the central bank’s information, including inflation forecast. Their awareness of current and future economic situation is low in comparison with companies and financial markets analysts. The assessment of their expectations is quite problematic. However, central banks pay a lot of attention to consumers’ expectations as they drive future economic outcomes. The expected interdependences of inflation forecast and consumers’ expectations will be of moderate strength – probably weaker than in the case of the expectations of businesses and specialists. This is in line with empirical results of the research: formation of the inflation expectations depends on the capability of perceiving information, which is the weakest for the households (Łyziak 2012).

The level of perception of the information by households justifies the second hypothesis. Consumers do not read the forecast itself. They do not know or understand the details of forecasting procedures. Those details are also not exposed in media. Moreover, consumers do not pay attention to the central banks’ decisions consistency with the inflation forecast. The actual (not only declared) inflation forecast targeting implementation does not have a direct impact on the formation of consumers’ expectations. Its impact on professionals’ expectations and forecast is possible and therefore it may influence indirectly households expectations.

The territorial scope of the research covers four European economies: the Czech Republic, Hungary, Poland and Romania. All of them are countries with derogation, implementing inflation targeting strategy and using interest rate as the main monetary policy instrument on the macroeconomic and operational level. Their central banks produce inflation forecasts and use them as an input in a decision-making process. Four central banks covered by the study claim that they accept the NNS frameworks, which is reflected in their forecasting models (described in: Andrle et al. 2009; Fic et al. 2005; Gălătescu 2008; Jakab et al. 2004). It implies the acceptance of the importance of inflation expectations and the forward-looking (or hybrid) character of inflation. This is the background to formalized forecasting inflation process. Nevertheless, the differences between these central banks’ practices are substantial and they impose the character of the research: a case study, limited in some cases by the data availability, precedes a comparative analysis.

The central banks in question started to publish inflation forecasts between 2001 and 2005. For each central bank the research starting point is the date of the first forecast disclosure. The Czech National Bank (CNB) and the National Bank of Hungary (NBH) published their forecast for the first time in 2001, the National Bank of Poland (NBP) – in 2004 and the National Bank of Romania (NBR) – in 2005. The examination period finishes with the end of 2010.

2. Monetary theory and inflation expectations

The New Neoclassical Synthesis is a broadly accepted consensus on monetary policy and its impact on economy. The NNS frameworks were described in literature (Mankiw 1990; Goodfriend, King 1997; Galí 2002). The NNS models emphasize the forward-looking nature of inflation. This property is the result of a price setting model which is in line with Calvo model (Calvo 1983). Inflation depends on today’s inflation expectations and the output gap. In a standard transmission model an aggregate demand channel is accompanied with the expectations channel that allows the central

banker to affect inflation expectation, which, in turn, affects inflation both directly and indirectly – via wage and price-setting behaviour (Svensson 1998). Bearing in mind that price readjusting may not be possible in the following period, firms are taking into account not only the current level of aggregate demand but also the expected one. It brings the necessity to shape market expectations in the way in which interest rates, inflation and income for the following periods will be consistent with the central bank goals. If it is possible for a central bank to affect expectations, this should be an important tool of stabilization policy. The fact that prices may remain unchanged for some time naturally implies that firms must be forward-looking, assessing not just the current economic environment but also the outlook for the future. Not only expectations about policy matters, but very little else matters. The ability of a central bank to influence expenditure, and hence pricing decisions, is crucially dependent upon its ability to influence market expectations regarding the future path of overnight interest rate, and not merely their current level (Woodford 2003).

Regarding this theoretical background, the modern monetary policy strategy focuses on expectations stabilization. One potential benefit from a successful implementation of inflation targeting is the anchoring of expectations with its stabilizing effect on macroeconomic activity. Failing to anchor expectations might result in undesired fluctuations and economic instability (Eusepi, Preston 2007). Well-anchored expectations help obviously in achieving inflation target with less volatility in the real sphere.

The short overview on modern monetary policy shows that from the theoretical point of view the expectation channel is the most efficient in transmitting monetary policy impulses. The first, and the most important question is how to support shaping private sector expectations. Policy commitment and proper communication with the market, including inflation forecast publishing, are a possible choice in this field.

3. Inflation forecast targeting

The inflation forecast is an immanent part of a fully-fledged inflation targeting strategy. A central bank produces its own forecasts, uses them in a decision-making process and reveals them. Inflation targeting, which is perceived to be the best monetary policy strategy in the light of NNS findings, may become inflation forecast targeting (IFT), where inflation forecast plays the role of an intermediate objective of monetary policy. One argues that subscribing the function of an intermediate target to the inflation forecast simplifies implementing and monitoring monetary policy (Svensson 1996). IFT is a simple rule of monetary policy. The central bank's inflation forecast for the period of inflation forecast targeting horizon becomes an intermediate target. Hence the instrument should be set so as to make the inflation forecast equal to the inflation target. If the inflation target is above (below) the target, the main rate of the monetary policy should be raised (lowered). Following this rule is claimed to be the best central bank's practice. Ex post inflation may differ from the targeted level because of forecast errors (Svensson 1996). The decision-making procedure of IFT is repeated by the monetary committee at any decision point. The forecasts and interest rate level are brought up to date if it is necessary. This is why IFT becomes a dynamic optimization procedure.

The central bank inflation forecast can be perceived as a quite good intermediate target. It is by definition a current variable which is the most correlated with the final goal, it is more controllable

than the final goal, and it can be made more observable. It can also be made very transparent and facilitate the central bank's communication with the public (Debelle 1997; Svensson 1996). Moreover, inflation forecast integrates a broad set of historical and current information. It means that one variable – the forecast – includes the idea of analysing various information, simultaneously giving the simplicity of following an intermediate target commitment.

Inflation forecast as an intermediate target may fulfil internal and external functions. The former is connected with supporting decision procedures of a monetary committee. However, the IFT is the rule of thumb (closed loop policy). The central bank is not obliged by any legal act to follow this rule. At any decision point it analyzes the forecast as well as other information. The consequence of following the rule depends on various factors of mostly qualitative nature.

The external functions of the forecast are connected with a growing importance of transparency and other qualitative aspects of the monetary policy. These factors are in turn connected with the importance of expectations of economic agents for the effectiveness of the monetary policy. The main reason why the forecasts are revealed is the need to shape inflation expectations of the public. Publishing inflation forecast may help to guide longer-term expectations. Inflation forecast can also anchor expectations when the inflation target is temporarily missed. It can serve as such a temporary anchor, especially in situations where the target is missed because of shocks that are out of control of the central bank. Anticipated course of inflation, showed by a credible central bank may limit the expectations' growth (Skořepa, Kotlán 2003). Publication of the forecast gives also the central bank a chance to ex post explanation and justification of its actions.

The discussion on the optimal transparency level of the central bank is still on. It focuses mostly on the forecast publication. Formal models, as well as empirical studies (Chortareas, Stasavage, Sterne 2002) show that publishing forecasts could improve macroeconomic outcomes (reduction of the inflation bias, lower inflation rate, loss function minimization). The opponents of augmented transparency refer to deficiencies of forecasting procedures as well as to the quality of the forecast itself. As a result, the central bank can be bound more tightly by the publication of an inflation forecast than is actually warranted by the quality of that forecast (Remsperger, Worms 1999). There are theoretical papers that show that knowledge transparency (concerning disclosure of the central bank of private information on linkages between monetary policy, inflation and real sphere as well as on shocks) might be socially harmful (Gersbach 2003) or that it is beneficial up to a certain extent (Cecchetti, Krause 2002; Jensen 2001).

The discussion on forecast disclosure goes further. It focuses on the choice of conditional or unconditional forecast and on the way of revealing the path of future (expected) policy interest rates. There are several reasons why the explicit policy path should be disclosed, mostly concerning the context of expectations formation (Khan 2007; Archer 2005). The opponents of policy path revealing underline that it limits the central bank's flexibility since the path is perceived as the commitment. The public does not understand its conditionality. Moreover, it is extremely difficult to reach the consensus concerning the policy path. The decision-making procedures are inconsistent with giving an explicit policy path for the period longer than the interval between monetary policy committee meetings (Khan 2007). A theoretical analysis shows that gains from disclosing the path of the future interest rate by central banks that have already engaged in publishing macroeconomic projections may be lower than those achieved after embarking on disclosing macro-projections and macro models on the basis of which these projection were made (Brzoza-Brzezina, Kot 2008).

The empirical research also confirms that revealing policy path is ambiguous. Some research proves that the publication of the expected interest rate path has a significant impact on expectations (Ferrero, Scchechi 2007; Holmsen et al. 2008). It focuses on financial market expectations, not the expectations of consumers. On the other hand, there is an empirical analysis that shows that the forecasts of interest rates had little or no informational value when the horizon exceeded two quarters (six months), although they were good in the next quarter and reasonable in the following one (Goodhart, Bin Lim 2011).

The discussion on transparency and its optimal level means nowadays deliberations on central bank's forecast relevance as well as publishing other information connected with forecasting procedures (assumptions, model, errors, risk assessment, policy path). The optimal level of transparency cannot be easily determined. The theoretical discussion on this issue is still in progress. The central banks' practices in this field are not unique and their choices are justified differently. However, the transparency level of monetary policy is largely aligned. The public knows the main goal, instruments and main premises of the decision making process, including forecasts. Moreover, the monetary authority explains the decision which has just been made. The differences are mainly connected with the intentions of future actions demonstration.

4. Inflation forecast targeting in practice

This section examines briefly practical aspects of inflation forecasting procedures and the related institutional framework in four central banks. It is necessary for the second hypothesis verification. Table 1 presents the main facts on forecasting systems and procedures in the countries covered by the study. The implementation of inflation targeting strategy is a precondition of the IFT implementation.

Fully-fledged inflation targeting implies a floating exchange rate. The intermediate regimes are also acceptable but such a situation may reveal inconsistency in the MPC behaviour. If the central bank declares that the forecast is an important premise in a decision making process and the forecast is revealed, the public may understand that the decision on interest rates is not in line with the forecast. It undermines the declaration on forecast importance and lowers its significance as a tool that helps to shape inflation expectations. Such a situation occurred in Hungary (an about 7-year-period of coexistence of fixed exchange rate with declared inflation targeting) and Romania (so called "fear of floating").

Table 2 presents a summary of the comparison of the IFT implementation in four countries. Four features are considered: formal declaration on the importance of inflation forecasts, consistency of the decision of the MPC with the inflation forecast results, decision timing and finally – the way in which the decisions on interest rate were justified.

Usually central banks explain why the forecast is made and published. This declaration should exhibit the importance of the forecast as the rationale for interest rate adjustments. The central banks underline first of all the internal function of the forecast: supporting the decision-making of the MPC. The theory focuses on external functions – shaping inflation expectations. Forecast disclosure accompanied with the declaration that it will be quite an important input in a decision-

-making process certainly opens the possibility of fulfilling this function of the forecast – the central bank can guide the market indirectly via expected instruments adjustments.

The declaration on the forecast importance is not sufficient for the market participants, however, it can serve as the starting point. If the forecast is to be taken into consideration while making decisions by market participants, the central bank has to prove that it really implements IFT. The assessment of consistency of the central bank actions with its forecasts is quite difficult. Such consistency occurs if the central bank's decisions are not in the opposite direction with respect to the direction suggested by the forecast. For the policy path given (the case of the Czech Republic) the decision is in line with the forecast results if the MPC follows the future interest rate path. When the new forecast appears, the newest policy path should be followed. For the projection – the relation of projected level of inflation to the inflation target during transmission horizon is crucial. When the projection misses the target but remains within the accepted fluctuation band of the target, the decision is perceived as consistent also when there is no change of interest rates. The assessment of central bank's consistency has some limitations:

- assessment of IFT should show a broader context of communication with the market; it is not the situation where the decision was not in line with the forecast that is important, but the reason why and the frequency of such behaviour; IFT is closed loop policy, which means ex ante allowance for not following the rule in a specific situation, no automatic procedure is ever possible; but those situations where the IFT is not followed should be rare and well accounted for,

- sometimes there is no simple solution given by forecast results; the central banks implement flexible inflation targeting; they may postpone their decision on interest rate change, especially when the forecasted inflation is within the fluctuation band of the target.

Qualitative analysis of the practice of the four central banks in question can give the results presented briefly below and summarized in Table 2. The Board of Czech National Bank was very consistent in IFT implementation. When it did not follow the forecast results, it was clearly explained why. Usually the reason laid beyond the impact of the central bank.¹ If there was a need for the interest rate change, CNB did not hesitate to do so when the forecast was the most up to date without taking wait and see position. Moreover, the communication with the public focused on the forecast, policy path and risk assessment.

Different attitude was presented by the Hungarian Monetary Council. For several years, the NBH claimed that the forecast is its intermediate target. At the same time the projection was neglected. The interest rates changes were mainly caused by exchange rate fluctuations. The NBH often changed them in the direction opposite to the forecast suggestion, however, it seems that the NBH has been changing its attitude since the managed floating exchange rate introduction. Starting from February 2008 only once the decision was not in line with the forecast results.

In Poland the Monetary Policy Council adopted a rather eclectic approach to defining the role of inflation projections in a decision-making process. Its decisions were generally in line with the forecast results. However, there are two important issues proving that the projection was not of primary importance: the moment of the decision-making (the NBP often took the wait and see position) and its explanation (referring to the factors other than inflation projection).

¹ In April 2003 the message of the forecast suggested that there should be no change of interest rates. The rates were cut in June. The CNB explained that the wrong assumption on time and extent of direct tax change was made. In the meantime the government postponed the changes. Similar situation took place in January 2006. The exchange rate appreciation was stronger than expected. It meant more tight monetary condition than planned without interest rate rise.

The National Bank of Romania had similar attitude as the NBP. However, the starting point of the analysis was a little bit different. In Poland the forecast was revealed for the first time in the sixth year of inflation targeting implementation. In Romania the forecast was disclosed just after the introduction of the new monetary frameworks. The operational level of the monetary policy was still being adjusted. The impact of NBR measures on short term interest rates was assessed as unsatisfactory. This was the first reason why the Bank Board decisions were not in accordance with the forecast result. The second reason was connected with an eclectic approach to the economic analysis. Sometimes the Board simply decided that current development of the economy was more important and it reacted in the counter-forecast direction or took wait and see position. The forecast was not the central point in the decision rationale.

The analysis of the IFT implementation was the starting point for verifying the second hypothesis: the central banks under examination apply different forecasting rules, showing at the same time different approach to the decision-making input. Market participants can assess the importance of the forecast in decision-making procedures as well as its reliability. Then they decide whether the forecast should be taken into consideration while shaping the expectations. The ability of consumers to understand the central banks' actions is limited. But the consequence of IFT implementation may be important for professionals while presenting the forecast and central bank's actions in media. Preliminary conclusion that can be drawn here implies that the relations between inflation forecasts and expectations should be the strongest in the case of the CNB and the weakest in the case of Hungarian central bank.

5. Interdependences of the forecasts and inflation expectations

The existence of interdependences between the inflation forecast and inflation expectations of households is empirically verified in this section. This section describes the data, methodological issues and finally, it presents the results of the study. However, a few general remarks need to be presented beforehand.

First of all, the data availability limits the research perspective. Unique information on forecasts and expectations, except balances, for the four countries in question simply does not exist. Each central bank presents the forecast differently. Only the information that is published may influence expectations. A similar problem – limited accessibility of the time series – concerns inflation expectations.

For each country two sets of variables are analyzed: one on the forecast results and the other – on the inflation expectations of consumers. Because of the reason described above they do not cover exactly the same time series. The idea was to use the data that have similar informational value. In certain cases, especially for the Czech Republic, additional information is used (policy path). It results from the fact that the divergences in forecasting procedures, in the way of publishing forecast and in the expectations measurement exist.

The interdependences between the forecast results and expectations are tested in a few areas. Obviously, the correlation does not bring any information on the causality. The theoretical underpinnings suggest that the forecast should influence expectations, but the correlation refers to any statistical relationships. However, a priori no result can be expected, and moreover – it

cannot be indicated as a proper one. It can be only assumed that there should be a statistically significant relationship between these two variables. Even the existence of a negative correlation can be interpreted: for example, when the forecast shows that inflation is above the target but the goal is exceeded less than the last forecast suggested, the expectations may fall. Another example is connected with a conditional forecast: when the central path is above the target and the society understands the conditionality of the forecast, it will expect the main rate to rise and its inflation expectations may fall.

5.1. Inflation forecast results and inflation expectations

To make the data comparable and to enable the use of the longest time series possible, the information on the forecast is processed to present forecast results in a qualitative way. The relation between the inflation forecast results and the inflation target at the horizon of $t + 4Q$ is taken into consideration. It is the most coherent with the way in which the expectations of economic agents are measured in surveys. This way of coding inflation forecast results is also coherent with the way how the forecast is presented in the media. Consumers do not read Inflation Reports or central banks' documents. They learn the forecast results indirectly. Analysts present the forecast results also referring to the relation of the forecast and the central bank goal.

Two cases are distinguished. The first one – and simpler – assumes three possibilities: the forecast is below the inflation target, it is at the level of inflation target, it is above the inflation target. This version (henceforth referred to as 3 possibilities case) does not account for the situation when the central path shows that the target will be missed but at the same time the inflation rate will remain within the accepted fluctuation band and the situation when central path is below or above lower or upper boundary of the fluctuation band.

The inflation targeters usually implement flexible inflation targeting. They accept fluctuation around the targeted level of inflation. It limits output fluctuations giving the central bank possibility not to react in case of certain shocks (usually predefined and published). This is why in the second case the forecast results are simplified to five possible positions of the central path of the forecast in relation to the inflation target at the horizon $t + 4Q$ (henceforth referred as 5 possibilities case): it is below the upper boundary of the fluctuation band, it is below the inflation target but within the fluctuation band, it is at the target level, it is below the inflation target but within the fluctuation band, it is below the lower boundary of the fluctuation band.

The additional solution is applied in the case of the Czech National Bank. It produces an unconditional forecast. Together with the central path of the forecasted inflation, a policy path is given in Inflation Reports. This is the reason why, for this country, the direction of change of the policy path in the period following the disclosure is also taken into consideration. The length of the sample is also different for different countries. The details are given in Table 3.

Inflation expectations cannot be directly observed. There are different ways of measuring inflation expectations. Survey-based measures of inflation expectations are the most popular measures of expectations.² In the case of consumer surveys conducted by the European

² In another approach, not used in this paper, direct measures of inflation expectations are derived on the basis of the prices of financial assets.

Commission, survey questions are qualitative. Consumers do not give the exact level of expected inflation but they answer questions on their inflation perception³ and expectations.⁴ The balance of answers that is calculated on the basis of the European Commission surveys and used in this study is given as:

$$B = (PP + \frac{1}{2}P) - (\frac{1}{2}M + MM)$$

where:

- PP* – the percentage of respondents who chose the option “the most positive” (consumer prices have risen a lot for the inflation perception and they will increase more rapidly for expected inflation);
- P* – “moderately positive” answer (consumer prices have risen moderately for inflation perception and they will increase at the same rate for expected inflation);
- M* – the percentage of respondents who chose the “moderately negative option” (consumer prices stayed about the same for inflation perception and they will stay about the same for expected inflation);
- MM* – the percentage of respondents who chose the option “very negative” (consumer prices have fallen for inflation perception and they will fall in next 12 months for expected inflation) (EC 2007).

These balance values range from -100, when all the respondents choose the most negative option to +100, when all the respondents choose the most positive one.

This kind of survey is conducted monthly by the European Commission. It covers the new member states as well: the Czech Republic from 1995, Hungary from February 1993, Poland and Romania from May 2001. The balance of answers presented in *Business and Consumer Surveys Results* together with detailed survey responses, does not directly measure the inflation expectations, thus it cannot be interpreted in a straightforward way. When it is positive it means that the number of respondents who expected prices to increase more rapidly over the next 12 months than in the past exceeded the number of those who expected prices to remain the same or increase more slowly than in the past. When the indicator (balance) of the expected inflation turns negative, it suggests that the number of respondents who expect prices not to rise over the next 12 months is higher than the number of those who expect prices to remain the same or increase more rapidly than in the past. This is how the balance has been presented and interpreted by the Czech National Bank in its Inflation Reports since April 2007.

Using the balances as the simplified measure of inflation expectations enables the straightforward interpretations of the relationship between them and inflation forecast: the inflation forecast influences private individuals' opinion on the development of consumers' prices in the next 12 months in comparison with the past situation. It is quite consistent with the limited knowledge and understanding of economic actions of consumers.

³ The question is: How do you think that consumer prices have developed over the last 12 months? And the answers to chose from: They have...risen a lot, risen moderately, risen slightly, stayed about the same, fallen, don't know.

⁴ The question is: By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? And the answers to chose from: They will...increase more rapidly, increase at the same rate, increase at a slower rate, stay about the same, fall, don't know.

The balances from *Business and Consumer Surveys* are directly used as the source of information on inflation expectations. Despite the drawbacks described above (the balances still do not measure directly inflation expectations as well as they are not easily interpreted) they have another important advantage. The same data with the time series longer than time series for inflation forecast are accessible for all the countries covered by the examination.

Two different approaches, except for balances, to expectations are considered: the level of expectations and the direction of its change. The level of expectations may be derived from qualitative surveys of the European Commission that publishes also survey responses distribution or derived from central banks own surveys with quantitative question.

The structure of the answers to the surveys' questions can be quantified using Carlson-Parkin method of quantification (described in Łyziak 2003). Quantified data on inflation expectations have been available for Poland monthly since 1992. These data are also an input to the research. However, there is no obligation of expectations quantification on the national level. The central bank may assess expectations in surveys based on quantitative questions: household sector respondents are asked about their inflation expectations at chosen horizon, usually 12-month horizon. The CNB and the NBH collected information on expectations in this way up to 2007. This procedure was unsatisfactory for the reasons why it is not applied to households: their awareness of current economic situation as well as of inflation target is limited. Qualitative questions are easier for consumers. The expectations measured in purely quantitative way are volatile. This is why this way of measuring expectations was abandoned. No national survey has been conducted in the Czech Republic and in Hungary. The European Commission data are used and presented in Inflation Report but only in a descriptive manner, using the balance for perceived and expected inflation. However, the direction of the change in inflation expectations of the households is explicitly presented in Inflation Report.

For Romania only the EC surveys are available. The national surveys only refer to financial market expectations.

Table 3 presents details on expectations and forecasts that were examined for each country with their time extent. Three approaches to expectations are applied:

- unique data delivered by EC surveys on balances of answers on expected inflation,
- the national data on quantified expectations of households or the expectations derived from quantitative surveys of the central banks;
- the direction of expectation change that was described in Inflation Reports or derived from the change of quantified value of expectations.

The question on lags appears at this point. The forecast is produced with lower frequency than the surveys on expectations are made. From the theoretical point of view, the forecast should be one of the most decisive signals affecting inflation expectations. However, this signal is issued only at a low frequency and can therefore become stale over time. As a result, financial market participants are likely to increasingly base their views on private information. In this case, market volatility may increase (Ehrmann, Sondermann 2009). In the light of these study results, the influence of inflation forecast on expectations should be the strongest when the lag is quite short. Two lag options (1M and 2M) are tested wherever it is possible. It seems reasonable to check the existence of the interdependences with longer lag for Poland starting from 2008, when the frequency of the forecast was lowered. The time series would be quite short here, which is

why the idea was dropped. Due to the timing of the survey and the inflation forecast publications, no-lag version was not tested.

Quarterly, the forecast results (5 or 3 possibilities) are confronted with:

- the balance that was calculated on the basis of the next month survey,
- the balance that was calculated on the basis of the survey that took place 2 months after the forecast was revealed,
- the average of balance that was calculated on the basis of the next month survey and two subsequent balances (quarterly average),
- the average of balance that was calculated on the basis of survey that took place 2 months after the forecast was revealed and two subsequent balances (quarterly average).

The first and the second option check whether there is an correlation between the inflation forecast results and the expected inflation (balance of answers) covering only one survey. One or two month lag is assumed. The third and the fourth options assume that the forecast results affect the structure of answers to the question on expected inflation up to the time when the new forecast is revealed. Again the lag is assumed, i.e. July forecast results are confronted with the quarterly average balances calculated for August, September and October (1 month lag) or calculated for September, October and November.

With the balances of the answers given with lower frequency than the forecast results the alternative approach is also tested – the forecast results are repeated for the two (or three, it depends on the forecast frequency) subsequent months and are assumed to influence the answers separately in each month (repeated version, also referred to as monthly approach).

The time series on balances of answers to the survey questions were the same for four countries. As the time series on the level and the direction of expectations differ, the interdependences tested also cover various versions: 6 for the Czech Republic, 4 for Hungary, 20 for Poland. The restriction on lags is placed due to surveys frequency. In the Czech Republic and Hungary the survey was held a month before the forecast disclosure. As a consequence, in each case where the lag is not described, 2M lag is considered. Still, for Poland having monthly observation on expectations, a similar approach as with the balances is applied.

The Hungarian case presents the basic scope of the research. The correlation between the deviations of forecasted inflation (with 3 and 5 possibilities) from the inflation target and inflation expectations (levels up to 3Q 2007 and direction of the change) is calculated. The case of the Czech Republic covers also additional cases: correlation of policy path and expectations. In Poland having the time series of monthly frequency was confronted with the forecast that was made quarterly or 3 times a year. The poorest access to the data for Romania means that only the correlation of the inflation forecast and balances of answers was tested.

5.2. Measures applied

The correlation between inflation forecast and expectations measures a degree of monotonic association between these two variables. This statistical relation is imposed by the range of data availability which also implies that only non-parametric correlation measures can be used. A range of measures, depending on the character of time series – qualitatively expressed forecast

results are accompanied by qualitative (directions of change) or quantitative (levels, balances) information on expectations – is used. The Spearman and Kendall correlation coefficients are suitable for the situation where the data are in the form of ranks or are on ordinal scale. A chi-square test and related statistics can be used when data are enumerative (counts or frequencies). The statistical hypotheses that are to be tested are also presented in Diagram 1. Under a null hypothesis there is no monotonic association between inflation forecast results and expectations or the two variables are independent for $\alpha = 0.05$. The Spearman rank correlation coefficient is the basic measure of interdependences that can be used here regardless of the way in which the expectations are expressed. It is the only measure applied in the case of testing relations between inflation forecast and balances of answers. The rationale for using other measures in the case of levels of expectations and the direction of changes is poorer time series quality.

5.3. Results and comments

The results are presented in Tables 4–9. They are divided into 3 groups. The starting point is testing correlation between the inflation forecast results and expectations expressed as the balances of answers to survey questions. Since the same time series presented in *Business and Consumer Surveys Results* by the European Commission are available for the four countries, this time the Romanian case can be covered as well as the other three. This approach offers better comparability of results. The Spearman rank correlation coefficient (denoted as r_s) is given in Table 4.

None of the interdependences proved to be statistically significant for the significance level of 5% in the case of the CNB. The null hypothesis is thus not rejected. This result is quite interesting considering the preliminary assumption that the correlation here should be quite strong because of the CNB consistency in IFT implementation. This consistency should influence the specialists' opinions on the central bank's actions and indirectly – consumers expectations. Figure 1 shows the time series for central path for 3 possibilities (left scale) and quarterly average of balances with 1M lag (right scale). The inconsistency between the time series appears to be the strongest from 2002 to 2004. A few explanations can be given. First of all, the introduction of unconditional forecast in mid-2002 might have changed the perception of the forecast. However, an almost 3-year-period seems to be too long for learning how to interpret the forecast. The second explanation is connected with the way how the CNB formulated the main goal up to the end of 2005. Only the range for inflation was given. This is not consistent with expressing inflation forecast results in 5 possibilities, which would explain the lack of relations. On the other hand, it is consistent with 3 possibilities and none of these options proved to be statistically significant as well. The third explanation is connected with the nature of unconditional forecast. In the case of unconditional forecast it is the policy path that may guide market expectations directly. The Spearman rank correlation coefficients for policy path and balances are presented in Table 5. The coefficients are statistically significant in 5 out of 6 cases and their strength is moderate. It means that the consumers in the Czech Republic take into consideration the policy path, not the forecast itself, which is in line with the central bank's intentions. However, the coefficients are positive. In the case of the Czech Republic the decisions were in line with the policy path. Considering at least a month lag, it would mean that the results show the correlation between the decision of the MPC and the balances of the answers.

Yet, the policy path explanation is not the only possible one. Possible explanations for the period 2002–2004 are also valuable in the light of the additionally tested relations. The same pair of variables was tested for the case of the CNB for the period 2005–2010. Here the relations between inflation forecast results and balances exist and have moderate strength, whereas for the policy path they are even stronger (around 0.7).

In Hungary the correlation between the inflation forecast results and the balances of answers to the survey questions on expected inflation exists. The Spearman rank correlation coefficients are positive, but the strength of correlation is moderate, around 0.5 for every pair of variables. Again the result is surprising, regarding the practice of the NBH. This time the explanation seems to be simpler: the consumers may not perceive the projection as the tool of deriving the next step of the monetary authorities but rather as an indicator of the future inflation. When the forecast is above the target the expectations (here balances) rise. The households do not expect the central bank to dampen inflation.

In Poland, only the interdependences of variables analyzed monthly are statistically significant but they are quite weak. This result is consistent with the practice of the NBP. The forecast is neither decisive input in a decision-making process nor in communication of its rationale. Moreover, the frequency of the forecast was reduced. Regardless of the sound explanation of the central bank of such a step, it manifests that the forecast is probably losing its importance in Polish monetary policy.

In Romania 3 out of interdependences given in a monthly cycle and 3 out of 8 relations in a quarterly cycle are statistically significant. Here the interpretation is limited because of the reasons that were already described: the NBR operated in different market conditions than the other banks.

The next step in the quantitative analysis is testing the existence of interdependences between inflation forecast results and the level of inflation expectations or their direction of change. Table 6 presents the Spearman and Kendal coefficients (τ). The second one can be interpreted in the terms of probability of having concordant pairs. Both of them indicate the existence (or not) of monotonic association between the two variables.

Taking into consideration the Spearman rank correlation coefficient for the Czech Republic, 1 out of 6 correlations is statistically significant, 2 out of 4 for Hungary and 9 out of 20 for Poland. The Kendall tau correlation coefficient gives similar results for the significance level of 5% (for the Czech Republic one more relation is statistically significant). The strength of correlation is not impressive: it never approaches 1, and rarely approaches 0.7. Once it attains 0.704 (the association of the central path, case with 3 possibilities and the direction of consumers expectations change with 1M lag for Poland). It is the strongest relation, considering both measures of rank correlation. The coefficients that are statistically significant are positive – inflation forecast results and inflation expectations are changing in the same direction. Taking into consideration coding of the forecast results it means that if the inflation forecast is above the target, the expectations rise.

For the Czech Republic only 1 correlation is statistically significant and 2 for Hungary. It is not in contradiction with previously obtained results (Table 4) – here the expectations come from the central banks' own survey. For Poland 4 versions (with comparison to the results obtained for balances) with repeated forecast are again statistically significant. 5 possibilities case for inflation forecast is also correlated with average of the inflation expectations for 1M and 2M lag. Two other pairs of variables (central path with 5 possibilities/direction of expectations change, central path

with 3 possibilities/direction of expectations change) are also statistically significant. They were not tested with balances.

The last scope of the empirical part of the research concerns the time series of the lowest quality: both inflation forecast and expectations are now expressed on ordinal scale. The alternative statistic is used: chi-square test for independence and Cramér's V as the measure of interdependence.

Three relations are tested for the Czech Republic (Table 7). For the significance level of 5%, a null hypothesis says that inflation expectations are independent of inflation forecast results. The hypothesis assuming that the direction of the change of inflation expectations of households does not depend on the relation of the central path of inflation forecast to the inflation target within the transmission horizon cannot be rejected. As a result, the measures of interdependence: Cramér's V is not statistically significant. The same is true for the other pairs of variables. Table 8 presents the results for Hungary. Only two possible dependences were tested. None of them proved to be statistically significant. The similar outcome is for Poland (Table 9) where only one pair of variables: central path (case with 3 possibilities)/direction of consumers expectations change (1M lag) is dependent.

The chi-square test for independence and measures derived from it offer the possibility to test interdependences between variables that are expressed in an enumerative way. However, here the results should be interpreted with caution – in several cases theoretical (expected) frequencies of certain events occurrence are lower than 5. The above calculations present only a rough picture of the interdependence between inflation forecast and expectations.

Some general conclusions can be drawn for a cross-country comparison. 5 cases version does not seem to reflect the interdependences better than 3 cases version of the central path relation to the goal. The same is true for lags. It should be noticed that in the case of the Czech Republic and Hungary (levels and directions) the lag of 2M was imposed. The balances of the answers to the survey questions are here the time series that provide the greatest comparability. In this case no version proved to be more suitable for 4 countries. The analysis of expectations in terms of the direction of change proved to be the poorest solution.

6. The results interpretation

Insofar as the measures applied allow, it can be stated that the theoretical underpinnings pointing to the inflation expectations formation being the most important function of inflation forecasts revealed by central banks are not empirically confirmed for consumer inflation expectations in the economies under consideration. If they were, there should be a strong correlation between the two variables. The interdependences are not statistically significant or their strength is, at the most, moderate. It simply means that consumers do not take into consideration the inflation forecast or they treat it as one of the various factors of expectations formation. The results of this research are the voice in favour of a hybrid nature of the expectations: partly adaptive and partly forward-looking (which is confirmed in various research, Gerberding 2001; Forsells, Kenny 2002). They confirm that the inflation forecast does not stand for the most important factor in the process of shaping expectations for households. It is in line with the fact that the forecast is quite

specialised piece of information. It is also in accordance with the understanding of the central bank's information by the consumers, who are only "secondary readers" of the forecast.

There are a few possible explanations of the results. The first one is connected with the understanding of the central bank forecast and its actions by the public. Revealing the forecast only means that the institutional transparency (the scope of information revealed, not its understanding) of the central banker increases. It does not necessarily mean that the forecast, especially the projection, is properly interpreted. The correlation coefficients are positive. It shows that when inflation forecast is above the target consumers inflation expectations increase – the consumers do not believe that the target will be achieved.

It may be connected with the understanding of the forecast, as well as with its quality. The forecast is not published as the single information. It appears at the same time as the Inflation Report that includes more information on the central bank's view on the economy. It can influence the expectations as well as the forecast does. The appropriateness of information published by the central bank can also be questionable. The research shows that the forecast presented in Inflation Report, as well as Report itself are not clear (Faust, Lepper 2005; Lepper 2003). This feature may be decisive mostly in the case of specialists. Consumers' ability to assess the central banks information is limited. They are not able to efficiently process central bank forecasts.

The second reason why the results are not unambiguous is connected with the central banks' behaviour. The MPC may ignore the forecast message for any reason. It may rely on current issues, including exchange rate fluctuations as the main inflation determinant while making decisions on interest rates. The public (at least the specialists) should see that the forecast results are reflected in central bank actions. The three countries covered by the examination did not prove to be consistent.

In this context it is necessary to focus for a while on the Czech Republic case. The Czech National Bank really intended to target inflation forecast. Moreover, the forecast was exposed in communication with the markets. One can assume that the interdependences between the inflation forecast results and inflation expectations should be the strongest in the case of the Czech Republic. In fact they are not. The lack of interdependences for this country can be explained with the policy path announcement that should guide market expectations directly. The versions with the central path should show negative correlation coefficient assuming that the public understand the forecast (rising interest rates will dampen economic activity and expected inflation should decrease). In fact the coefficients proved to be positive.

The central bank itself may lower the value of the forecast emphasizing the inadequacy of the model. If the model does not capture economic situation properly, the forecast is biased, of which the monetary policy committee is aware. The committee does not perceive the forecast as the main input to the decision-making process. This behaviour may be intensified temporarily – especially in turbulent periods, the MPC may underline the inadequacy of the model. The public realizes the inconsistency of the MPC and does not take into consideration the inflation forecast while making economic decisions.

Moreover, the theory itself does not seem satisfactory for the central bankers. The NNS framework was subject to criticism even before the global crisis erupted in 2007. The reproaches *inter alia* are: weak empirical evidence, unrealistic Calvo pricing model, and difficulty in obtaining parameters in New Keynesian Models. One argues that this theory does not determine the price

level or the inflation rate (Cochrane 2007). The discussion on monetary policy framework was enforced by the crisis that revealed some deficiencies in a prevailing theory and monetary frameworks. The new consensus in the monetary policy is being developed. It is broadly agreed that the way monetary policy transmission is described in macroeconomic models needs to be fundamentally reworked. Transmission is oversimplified, especially regarding various channels related to financial institutions (Frait, Komárková, Komárek 2011). The drawbacks of the theory are one of the reasons why the forecasting models are inadequate.

The last reason for not finding strong interdependences of the two variables may be connected with the territorial scope of the research. The time series for the countries covered by the examination are relatively short. The central banks still develop forecasting procedures. The forecast has been revealed for a few years (especially in Poland and Romania) only. The MPCs are not always consistent in IFT implementation, which discourages the public to take the forecast into account.

It is also worth to refer to the central banks' credibility. The forecast may influence expectations when the central bank is credible. The credibility was not the scope of this research but there is other research that enables the reference to the credibility of the central banks. An index of credibility⁵ proposed by Mackiewicz-Łyziak (2010) shows that the Czech National Bank was more credible than the NBP and the NBH. At the same time the correlations for the NBH (referring only to balances) were the most substantial (all of them proved to be statistically significant of moderate strength). It is difficult to assess whether the lower credibility influenced the possibility of shaping expectations via forecast. It is also impossible to determine the level of credibility that is sufficient for supporting expectations formation by the central bank forecast.

The hypotheses are not confirmed. The first one because of the lack of unambiguous results. It assumes that the interdependences between the inflation forecast and the expectations of consumers exist. It was not true for all the countries covered by the examination. However, in several cases such interdependences are statistically important and they have weak or moderate strength. It is consistent with the consumers' perception capabilities.

The second hypothesis – stating that the existence of the interdependences between the inflation forecasts and inflation expectations does not depend on detailed solutions in the field of forecasting inflation applied by central banks – cannot be confirmed because the first one is not. The study covers four countries that were chosen due to certain similarities. In spite of these, there are numerous divergences, even on the strategy level (exchange rate regime) not mentioning the effectiveness of monetary policy. Forecasting tools and procedures differ as well. The Czech central bank was the only one to produce unconditional forecasts. The central banks seem to put different attention to the forecast results. None of applied solutions proved to support the relationship between the inflation forecast and expectations.

7. Conclusions

This paper contributes to the literature on modern monetary policy strategy and its implementation. It focuses on the relation of the inflation forecast results and inflation expectations.

⁵ It does not cover Romania. The time extend is 1999–2007.

The expectations of households derived from surveys are taken into consideration. There is a sound theoretical background showing the importance of inflation expectations in the modern monetary policy as well as the usefulness of the inflation forecast in shaping the expectations. These theoretical underpinnings accompanied with the behaviour of the central banks (producing and revealing inflation forecasts) led to the presentation of two hypotheses. The first one assumes that the interdependences between the inflation forecast results and consumers' inflation expectations exist. In order to verify the first hypothesis the review of the literature and the practice of the central bank is made. The crucial part of the study is of an empirical nature – existence of interdependences between several pairs of variables is verified. Such relations were not found or they were of weak or moderate strength. The results were similar regardless of the country. This is why the second hypothesis assuming that no solution in the field of forecasting inflation may be perceived as more appropriate may not be verified.

Regardless of the barriers of the study, it can be the first step in the direction to measure this kind of relations. There are also a few possible extensions of the study: extending the territorial scope of the research to countries that have implemented IFT for a longer period of time, quantifying surveys data, and, finally, alternative coding of inflation forecast message. The analysis could also take into consideration the credibility of the central bank and ex post errors of the forecast.

References

- Andrle M., Hlédik T., Kameník O., Vlček J. (2009), *Implementing the new structural model of the Czech National Bank*, Working Paper Series, 2, CNB, Prague.
- Archer D. (2005), *Central bank communication and the publications of interest rates projections*, paper for the Conference on inflation targeting: implementation, communication and effectiveness, Sveriges Riksbank, Stockholm.
- Benkovskis K. (2008), The role of inflation expectations in the new EU Member States: a survey based results, *Czech Journal of Economics and Finance*, 58(7–8), 298–317.
- Brzoza-Brzezina M., Kot A. (2008), *The relativity theory revisited: Is publishing interest rates forecast really so valuable?*, NBP Working Paper, 52, National Bank of Poland, Warsaw.
- Calvo G. (1983), Staggered prices in utility-maximizing frameworks, *Journal of Monetary Economics*, 12, 383–398.
- Cecchetti S.G., Krause S. (2002), *Central bank structure, policy efficiency, and macroeconomic performance: exploring empirical relationships*, The Federal Reserve Bank of St. Louis Review, July/August, St. Louis.
- Chortareas G., Stasavage D., Sterne G. (2002), *Does it pay to be transparent? International evidence form central bank forecasts*, The Federal Reserve Bank of St. Louis Review, July/August, St. Louis.
- Cochrane J.H. (2007), *Determinacy and indeterminacy with Taylor rules*, NBER Working Paper Series, 13409, Cambridge.
- Debelle G. (1997), *Inflation targeting in practice*, Working Paper, 35, International Monetary Fund, Washington, D.C.

- Ehrmann M., Sondermann D. (2009), *The reception of public signals on the financial markets. What if central bank communication become stale?* ECB Working Paper Series, 1077, Frankfurt am Main.
- EC (2007), *The joint harmonized EU programme of business and consumer surveys, user guide*, July, European Commission, Brussels.
- Eusepi S., Preston B. (2007), *Central bank communication and expectations stabilization*, NBER Working Paper Series, 13259, Cambridge.
- Faust J., Lepper E.M., (2005), *Forecasts and inflation reports: an evaluation*, prepared for the Sveriges Riksbank conference on Inflation targeting: implementation, communication and effectiveness, June 11–12.
- Ferrero G., Secchi A. (2007), *The announcement of future policy intentions*, Third conference on money, banking and finance: monetary policy design and communication, Bank of Italy, Rome.
- Fic T., Kolasa M., Kot A., Murawski K., Rubaszek M., Tarnicka M. (2005), *Model gospodarki polskiej ECOMOD*, Materiały i Studia, 194, Narodowy Bank Polski, Warszawa.
- Forsells M., Kenny G. (2002), *The rationality of consumers' inflation expectations: survey-based evidence for the euro area*, ECB Working Papers Series, 163, Frankfurt am Main.
- Forsells M., Kenny G. (2004), Survey expectations, rationality and the dynamics of euro area inflation, *Journal of Business Cycle Measurement and Analysis*, 1(1), 13–41.
- Frait J., Komárková Z., Komárek L. (2011), Monetary policy in a small economy after the tsunami: a new consensus on the horizon? *Czech Journal of Economics and Finance*, 61(1), 5–33.
- Gábel P. (2010), *Households inflation expectations and inflation dynamic*, MNB Working Papers, 12, Budapest.
- Gălățescu A. (2008), *The forecasting and modeling process of the National Bank of Romania*, presented at the Forecasting models and procedures of EU central banks, April 23, Sofia.
- Galí J. (2002), *New perspective on monetary policy, inflation and business cycles*, NBER Working Paper Series, 8767, Cambridge.
- Gerberding Ch. (2001), *The information content of survey data on expected price developments for monetary policy*, Discussion Paper, 9/01, Economic Research Center of the Deutsche Bundesbank, Frankfurt am Main.
- Gersbach H. (2003), On the negative social value of central banks' knowledge transparency, *Economics of Governance*, 4, 91–102.
- Goodfriend M., King R.G. (1997), *The new neoclassical synthesis and the role of monetary policy*, Working Paper, 5, Federal Reserve Bank of Richmond, Richmond.
- Goodhart Ch.A.E., Bin Lim W. (2011), Interest rate forecast – a pathology, *International Journal of Central Banking*, June, 135–171.
- Holmsen A., Qvigstad J.F., Røisland Ø., Solberg-Johansen K. (2008), *Communicating monetary policy intentions: the case of Norges Bank*, Norges Bank Working Paper, 20, Oslo.
- Jakab Z.M., Kovacs M.A., Parkanyi B., Reppa Z. (2004), *The Hungarian quarterly projection model (N.E.M.). Non-technical summary*, Magyar Nemzeti Bank, www.mnb.hu.
- Jensen H. (2001), *Optimal degrees of transparency in monetary policymaking*, Discussion Paper, 04/01, Economic Research Center of the Deutsche Bundesbank, Frankfurt am Main.
- Khan G. (2007), *Communicating a policy path: the next frontier in central bank transparency?* Federal Reserve Bank of Kansas City, Economic Review, Q1, Kansas City.

- Lepper E.M. (2003), *An "Inflation Reports" report*, NBER Working Paper, 10089, Cambridge.
- Łyziak T. (2003), *Consumer inflation expectations in Poland*, ECB Working Paper Series, 287, Frankfurt am Main.
- Łyziak T. (2012), *Inflation expectations in Poland*, NBP Working Paper, 115, National Bank of Poland, Warsaw.
- Mackiewicz-Łyziak J. (2010), *Wiarygodność banku centralnego*, Difin, Warszawa.
- Mankiw N.G. (1990), *A quick refresher course in macroeconomics*, NBER Working Paper Series, 3256, Cambridge.
- Remsperger H., Worms A. (1999), *Transparency in monetary policy*, CFS Working Paper, 16, Frankfurt am Main.
- Skořepa M., Kotlán V. (2003), *Assessing future inflation in inflation targeting: forecasts or simulations?*, in: *Monetary policy in changing environment*, 19, Bank for International Settlements, <http://EconPapers.repec.org/RePEc:bis:bisbpc:19-06>.
- Svensson L.E.O. (1996), *Inflation forecast targeting: implementing and monitoring inflation targets*, NBER Working Paper, 5797, Cambridge.
- Svensson L.E.O. (1998), *Inflation targeting as a monetary policy rule*, NBER Working Paper, 6790, Cambridge.
- Woodford M. (2003), *Interest and prices. Foundations of theory of monetary policy*, Princeton University Press.

Appendix

Table 1

Inflation forecasting in the Czech Republic, Hungary, Poland and Romania

| | The Czech Republic | Hungary | Poland | Romania |
|----------------------------------|--|---|---|--|
| Inflation targeting introduction | 1998 | 2001 (June) | 1999 | 2005 (August) |
| Forecast disclosure | from April 2001 | from August 2001 | from August 2004 | from August 2005 |
| Output | forecast of inflation and GDP, fan chart (inflation, GDP, policy path for 2008 and exchange rate path from 2009) | forecast of inflation and GDP, fan chart (inflation, from February GDP) | forecast of inflation and GDP, fan chart (inflation, GDP) | forecast of inflation (fan chart) |
| Forecast frequency | quarterly: January, April, July, October; from 2008: February, May, August, November | quarterly: February, May, August, November | quarterly up to the end of 2007 (schedule of publication was changed a few times), then 3 times per year: February, June, October | quarterly: February, May, August, November |
| Set of data | 39 forecasts | 38 projections | 22 projections | 22 projections |
| Conditionality | unconditional from July 2002 policy path disclosure form 2008 | conditional (projection) | conditional (projection) | conditional (projection) |
| Forecast horizon | first, 6 quarters, then up to 8 quarters | first, 6 quarters, then 8 quarters | first, 2 years, then up to 3 years | 8 quarters |
| Transmission horizon | 4–6 quarters | 4–6quarters | 5–7 quarters | 4–6 quarters |

| | | | | |
|-------------------------------|--|---|---|---|
| Main model | <ul style="list-style-type: none"> – QPM: Quarterly Projection Model up to May 2008, – Q3 from August 2008 | <ul style="list-style-type: none"> – Analytical Scheme up to the end of 2003, – QPM: Quarterly Projection Model from February 2004, – DELPHI (Dynamic Econometric Large-scale Prognosticator of Hungarian Inflation) from May 2010 | <ul style="list-style-type: none"> – New Analytical Scheme and MSMI (Small Structural Inflation Model) up to February 2005, – ECMOD up to February 2008, – NECMOD from June 2008 | <ul style="list-style-type: none"> – MAPM: model for medium term analysis and projection |
| MPC and forecasting procedure | Discrete involvement | Discrete involvement | No involvement | Iterative involvement |

Source: Inflation Reports of the Czech National Bank, the National Bank of Hungary, the National Bank of Poland and the National Bank of Romania.

Table 2
Inflation forecast targeting implementation

| | The Czech Republic | Hungary | Poland | Romania |
|---|---|--|--|--|
| Declaration on the forecast role in monetary policy | the forecast is of greatest relevance in decision-making | partial input in decision-making process; previously: intermediate objective | partial input in decision-making process | partial input in decision-making process |
| Consistency in IFT implementation | 4 times the MPC did not follow the forecast result; each time it was due to exogenous factors and clearly explained | low, numerous decisions were not in line with the forecast result, they were explained by the current economic situation | the MPC decisions were in line with the forecast result; however a flexible approach to input in decision-making process dominated | the decisions were in line with the forecast result, except for 3 cases which were explained by current economic situation; in other cases – flexible approach to input in decision-making process |
| Timing of decision-making | just after the forecast is made | wait and see position | wait and see position | wait and see position |
| The forecast in decision explanation | main factor, even in the months when the new forecast was not revealed | one of the numerous factors, sometimes neglected | one of the numerous factors, sometimes neglected | one of the numerous factors, sometimes neglected |

Table 3
Data availability and time extent

| | The Czech Republic | Hungary | Poland | Romania |
|---|-----------------------------|-----------------------------|---------------------------------------|-----------------|
| Inflation forecast | | | | |
| Central path of inflation in relation to inflation target | 2001 Q2–2010 Q4 | 2001 Q3–2010 Q4 | 2004 Q3–2010 Q4 | 2005 Q3–2010 Q4 |
| Policy path | 2002 Q3–2010 Q4 | x | x | x |
| Inflation expectations | | | | |
| Balances (monthly) | 2001 Q2–2010 Q4 | 2001 Q3–2010 Q4 | 2004 Q3–2010 Q4 | 2005 Q3–2010 Q4 |
| Expected inflation (quantified) | 2001 Q2–2007 Q2 (quarterly) | 2002 Q2–2007 Q3 (quarterly) | August 2004 – December 2010 (monthly) | x |
| Direction of changes in expectations (monthly) | 2001 Q2–2010 Q4 | 2001 Q3–2010 Q4 | 2004 Q3–2010 Q4 | x |

Table 4a

The interdependences between the forecasts results and the balances of the answers

| | Variables | | | | | | | |
|---|--------------------|----------------------|---------------|----------|------------|----------------------|---------------|--------------|
| | <i>N</i> | <i>r_s</i> | <i>t(N-2)</i> | <i>p</i> | <i>N</i> | <i>r_s</i> | <i>t(N-2)</i> | <i>p</i> |
| | The Czech Republic | | | | Hungary | | | |
| Quarterly | | | | | | | | |
| Central path (5 possibilities) / balances 1M lag | 39 | 0.13 | 0.81 | 0.423 | 38 | 0.51 | 3.59 | 0.000 |
| Central path (5 possibilities) / balances 2M lag | 39 | 0.03 | 0.18 | 0.860 | 38 | 0.51 | 3.57 | 0.001 |
| Central path (3 possibilities) / balances 1M lag | 39 | 0.09 | 0.57 | 0.571 | 38 | 0.52 | 3.62 | 0.000 |
| Central path (3 possibilities) / balances 2M lag | 39 | 0.03 | 0.16 | 0.872 | 38 | 0.50 | 3.46 | 0.001 |
| Central path (5 possibilities) / average balance 1M lag | 39 | 0.07 | 0.42 | 0.678 | 38 | 0.53 | 3.73 | 0.000 |
| Central path (5 possibilities) average balances 2M lag | 39 | 0.10 | 0.63 | 0.532 | 38 | 0.54 | 3.83 | 0.000 |
| Central path (3 possibilities) / average balance 1M lag | 39 | 0.06 | 0.39 | 0.695 | 38 | 0.51 | 3.55 | 0.001 |
| Central path (3 possibilities) / average balances 2M lag | 39 | 0.12 | 0.71 | 0.484 | 38 | 0.50 | 3.44 | 0.001 |
| Monthly | | | | | | | | |
| Central path repeated (case with 5 possibilities) / balances 1M lag | 117 | 0.10 | 1.07 | 0.286 | 113 | 0.51 | 6.17 | 0.000 |
| Central path repeated (case with 5 possibilities) / balances 2M lag | 117 | 0.13 | 1.36 | 0.176 | 113 | 0.50 | 6.10 | 0.000 |
| Central path repeated (case with 3 possibilities) / balances 1M lag | 117 | 0.09 | 0.98 | 0.326 | 113 | 0.49 | 5.94 | 0.000 |
| Central path repeated (case with 3 possibilities) / balances 2M lag | 117 | 0.13 | 1.45 | 0.148 | 113 | 0.47 | 5.66 | 0.000 |

Note: statistically significant interdependences are bolded.

Table 4b
The interdependences between the forecasts results and the balances of the answers

| | Variables | | | | | | | |
|---|-----------|----------------------|---------------|--------------|-----------|----------------------|---------------|--------------|
| | <i>N</i> | <i>r_s</i> | <i>t(N-2)</i> | <i>p</i> | <i>N</i> | <i>r_s</i> | <i>t(N-2)</i> | <i>p</i> |
| | Poland | | | | Romania | | | |
| Quarterly | | | | | | | | |
| Central path (5 possibilities) / balances 1M lag | 22 | 0.21 | 0.98 | 0.340 | 22 | 0.60 | 3.34 | 0.003 |
| Central path (5 possibilities) / balances 2M lag | 22 | 0.25 | 1.15 | 0.261 | 22 | 0.15 | 0.69 | 0.495 |
| Central path (3 possibilities) / balances 1M lag | 22 | 0.16 | 0.73 | 0.471 | 22 | 0.56 | 2.99 | 0.007 |
| Central path (3 possibilities) / balances 2M lag | 22 | 0.22 | 1.01 | 0.322 | 22 | 0.12 | 0.55 | 0.590 |
| Central path (5 possibilities) / average balance 1M lag | 22 | 0.32 | 1.51 | 0.145 | 22 | 0.46 | 2.32 | 0.030 |
| Central path (5 possibilities) / average balances 2M lag | 22 | 0.32 | 1.52 | 0.143 | 22 | 0.36 | 1.71 | 0.103 |
| Central path (3 possibilities) / average balance 1M lag | 22 | 0.30 | 1.41 | 0.174 | 22 | 0.39 | 1.89 | 0.073 |
| Central path (3 possibilities) / average balances 2M lag | 22 | 0.31 | 1.46 | 0.160 | 22 | 0.28 | 1.28 | 0.214 |
| Monthly | | | | | | | | |
| Central path repeated (case with 5 possibilities) / balances 1M lag | 77 | 0.30 | 2.77 | 0.007 | 65 | 0.37 | 3.14 | 0.002 |
| Central path repeated (case with 5 possibilities) / balances 2M lag | 77 | 0.37 | 3.43 | 0.000 | 65 | 0.30 | 2.51 | 0.014 |
| Central path repeated (case with 3 possibilities) / balances 1M lag | 77 | 0.27 | 2.45 | 0.016 | 65 | 0.32 | 2.73 | 0.008 |
| Central path repeated (case with 3 possibilities) / balances 2M lag | 77 | 0.34 | 3.16 | 0.002 | 65 | 0.24 | 1.96 | 0.054 |

Note: statistically significant interdependences are bolded.

Table 5

The interdependences between policy path and balances for the CNB

| | Variables | | | |
|---------------------------------------|------------|-------------|-------------|--------------|
| | N | r_s | $t(N-2)$ | p |
| Quarterly | | | | |
| Policy path / balances $t+1$ | 34 | 0.57 | 3.88 | 0.000 |
| Policy path / balances $t+2$ | 34 | 0.30 | 1.78 | 0.084 |
| Policy path / average balances $t+1$ | 34 | 0.38 | 2.32 | 0.027 |
| Policy path / average balances $t+2$ | 34 | 0.34 | 2.05 | 0.048 |
| Monthly | | | | |
| Policy path repeated / balances $t+1$ | 102 | 0.40 | 4.36 | 0.000 |
| Policy path repeated / balances $t+2$ | 102 | 0.36 | 3.82 | 0.000 |

Note: statistically significant interdependences are bolded.

Table 6
The Spearman rank and Kendall tau correlation coefficients

| | Variables | | | | | |
|--|-----------|--------|----------|----------|--------|----------|
| | N | r_s | $t(N-2)$ | p_{rs} | τ | p_τ |
| The Czech Republic | | | | | | |
| Central path (case with 5 possibilities) / consumers expectations | 24 | 0.418 | 2.157 | 0.042 | 0.352 | 0.016 |
| Central path (case with 5 possibilities) / direction of consumers expectations change | 39 | -0.019 | -0.113 | 0.911 | -0.007 | 0.944 |
| Central path (case with 3 possibilities) / consumers expectations | 24 | 0.398 | 2.034 | 0.054 | 0.324 | 0.026 |
| Central path (case with 3 possibilities) / direction of consumers expectations change | 39 | -0.046 | -0.278 | 0.783 | -0.035 | 0.753 |
| Policy path / consumers expectations | 19 | 0.258 | 1.103 | 0.285 | 0.184 | 0.269 |
| Policy path / direction of consumers expectations change | 34 | 0.084 | 0.475 | 0.638 | 0.075 | 0.532 |
| Hungary | | | | | | |
| Central path (case with 5 possibilities) / consumers expectations | 22 | 0.539 | 2.865 | 0.010 | 0.430 | 0.005 |
| Central path (case with 5 possibilities) / direction of consumers expectations change | 38 | 0.136 | 0.823 | 0.416 | 0.120 | 0.288 |
| Central path (case with 3 possibilities) / consumers expectations | 22 | 0.600 | 3.355 | 0.003 | 0.493 | 0.001 |
| Central path (case with 3 possibilities) / direction of consumers expectations change | 38 | 0.097 | 0.582 | 0.564 | 0.091 | 0.418 |
| Poland | | | | | | |
| Central path (case with 5 possibilities) / consumers expectations (1M lag) | 22 | 0.396 | 1.931 | 0.068 | 0.314 | 0.041 |
| Central path (case with 5 possibilities) / direction of consumers expectations change (1M lag) | 22 | 0.609 | 3.436 | 0.003 | 0.553 | 0.000 |
| Central path (case with 5 possibilities) / consumers expectations (2M lag) | 22 | 0.439 | 2.183 | 0.041 | 0.353 | 0.021 |
| Central path (case with 5 possibilities) / direction of consumers expectations change (2M lag) | 22 | 0.071 | 0.317 | 0.755 | 0.067 | 0.662 |

| | | | | | | |
|---|-----------|--------------|--------------|--------------|--------------|--------------|
| Central path (case with 3 possibilities) / consumers expectations (1M lag) | 22 | 0.227 | 1.041 | 0.310 | 0.179 | 0.244 |
| Central path (case with 3 possibilities) / direction of consumers expectations change (1M lag) | 22 | 0.704 | 4.430 | 0.000 | 0.656 | 0.000 |
| Central path (case with 3 possibilities) / consumers expectations (2M lag) | 22 | 0.294 | 1.376 | 0.184 | 0.238 | 0.121 |
| Central path (case with 3 possibilities) / direction of consumers expectations change (2M lag) | 22 | 0.101 | 0.456 | 0.653 | 0.093 | 0.543 |
| Central path (case with 5 possibilities) / average consumers expectations (1M lag) | 22 | 0.396 | 1.931 | 0.068 | 0.314 | 0.041 |
| Central path (case with 5 possibilities) / average consumers expectations (2M lag) | 22 | 0.439 | 2.183 | 0.041 | 0.353 | 0.021 |
| Central path (case with 3 possibilities) / average consumers expectations (1M lag) | 22 | 0.227 | 1.041 | 0.310 | 0.179 | 0.244 |
| Central path (case with 3 possibilities) / average consumers expectations (2M lag) | 22 | 0.294 | 1.376 | 0.184 | 0.238 | 0.121 |
| Central path repeated (case with 5 possibilities) / consumers expectations (1M lag) | 77 | 0.378 | 3.534 | 0.001 | 0.294 | 0.000 |
| Central path repeated (case with 5 possibilities) / direction of consumers expectations change (1M lag) | 76 | 0.002 | 0.015 | 0.988 | 0.003 | 0.973 |
| Central path repeated (case with 5 possibilities) / consumers expectations (2M lag) | 77 | 0.376 | 3.519 | 0.001 | 0.300 | 0.000 |
| Central path repeated (case with 5 possibilities) / direction of consumers expectations change (2M lag) | 75 | -0.059 | -0.508 | 0.613 | -0.051 | 0.519 |
| Central path repeated (case with 3 possibilities) / consumers expectations (1M lag) | 77 | 0.241 | 2.150 | 0.035 | 0.196 | 0.012 |
| Central path repeated (case with 3 possibilities) / direction of consumers expectations change (1M lag) | 76 | 0.069 | 0.591 | 0.556 | 0.062 | 0.427 |
| Central path repeated (case with 3 possibilities) / consumers expectations (2M lag) | 77 | 0.257 | 2.306 | 0.024 | 0.217 | 0.005 |
| Central path repeated (case with 3 possibilities) / direction of consumers expectations change (2M lag) | 75 | -0.010 | -0.085 | 0.932 | -0.009 | 0.905 |

Note: statistically significant correlations are bolded.

Table 7
Chi-square test for independence – the Czech Republic

| | Statistics | | |
|---|------------|--------|-----------|
| | χ^2 | df | p |
| Central path (case with 5 possibilities) / direction of consumers expectations change | | | |
| Pearson's χ^2 | 9.3426 | df = 8 | p = 0.314 |
| χ^2 of the highest credibility | 9.2685 | df = 8 | p = 0.320 |
| Cramér's V | 0.3461 | | |
| Central path (case with 3 possibilities) / direction of consumers expectations change | | | |
| Pearson's χ^2 | 4.871379 | df = 4 | p = 0.300 |
| χ^2 of the highest credibility | 5.026195 | df = 4 | p = 0.284 |
| Cramér's V | 0.24990 | | |
| Policy path / direction of consumers expectations change | | | |
| Pearson's χ^2 | 0.64866 | df = 4 | p = 0.957 |
| χ^2 of the highest credibility | 0.65117 | df = 4 | p = 0.957 |
| Cramér's V | 0.09766 | | |

Table 8
Chi-square test for independence – Hungary

| | Statistics | | |
|---|------------|--------|-----------|
| | χ^2 | df | p |
| Central path (case with 5 possibilities) / direction of consumers expectations change | | | |
| Pearson's χ^2 | 5.174706 | df = 8 | p = 0.738 |
| χ^2 of the highest credibility | 6.675948 | df = 8 | p = 0.571 |
| Cramér's V | 0.26093 | | |
| Central path (case with 3 possibilities) / direction of consumers expectations change | | | |
| Pearson's χ^2 | 2.401389 | df = 4 | p = 0.662 |
| χ^2 of the highest credibility | 3.390794 | df = 4 | p = 0.494 |
| Cramér's V | 0.17775 | | |

Table 9
Chi-square test for independence – Poland

| | Statistics | | |
|---|-----------------|---------------|------------------|
| | χ^2 | df | p |
| Central path (case with 5 possibilities) / direction of consumers expectations change (1M lag) | | | |
| Pearson's χ^2 | 13.20000 | df = 8 | p = 0.105 |
| χ^2 of the highest credibility | 16.48927 | df = 8 | p = 0.035 |
| Cramér's V | 0.54772 | | |
| Central path (case with 5 possibilities) / direction of consumers expectations change (2M lag) | | | |
| Pearson's χ^2 | 6.678571 | df = 8 | p = 0.571 |
| χ^2 of the highest credibility | 7.849231 | df = 8 | p = 0.448 |
| Cramér's V | 0.38959 | | |
| Central path (case with 3 possibilities) / direction of consumers expectations change (1M lag) | | | |
| Pearson's χ^2 | 12.32000 | df = 4 | p = 0.015 |
| χ^2 of the highest credibility | 15.30433 | df = 4 | p = 0.004 |
| Cramér's V | 0.52915 | | |
| Central path (case with 3 possibilities) / direction of consumers expectations change (2M lag) | | | |
| Pearson's χ^2 | 3.775794 | df = 4 | p = 0.437 |
| χ^2 of the highest credibility | 5.112453 | df = 4 | p = 0.275 |
| Cramér's V | 0.29293 | | |
| Central path repeated (case with 5 possibilities) / direction of consumers expectations change (1M lag) | | | |
| Pearson's χ^2 | 5.730035 | df = 8 | p = 0.677 |
| χ^2 of the highest credibility | 5.418060 | df = 8 | p = 0.712 |
| Cramér's V | 0.19415 | | |
| Central path repeated (case with 5 possibilities) / direction of consumers expectations change (2M lag) | | | |
| Pearson's χ^2 | 6.237344 | df = 8 | p = 0.620 |
| χ^2 of the highest credibility | 5.935405 | df = 8 | p = 0.654 |
| Cramér's V | 0.203917 | | |
| Central path repeated (case with 3 possibilities) / direction of consumers expectations change (1M lag) | | | |
| Pearson's χ^2 | 1.468189 | df = 4 | p = 0.832 |
| χ^2 of the highest credibility | 1.427284 | df = 4 | p = 0.839 |
| Cramér's V | 0.098280 | | |
| Central path repeated (case with 3 possibilities) / direction of consumers expectations change (2M lag) | | | |
| Pearson's χ^2 | 4.046806 | df = 4 | p = 0.399 |
| χ^2 of the highest credibility | 3.840728 | df = 4 | p = 0.427 |
| Cramér's V | 0.164252 | | |

Note: statistically significant interdependences are bolded.

Figure 1
Central path and balances for the Czech Republic

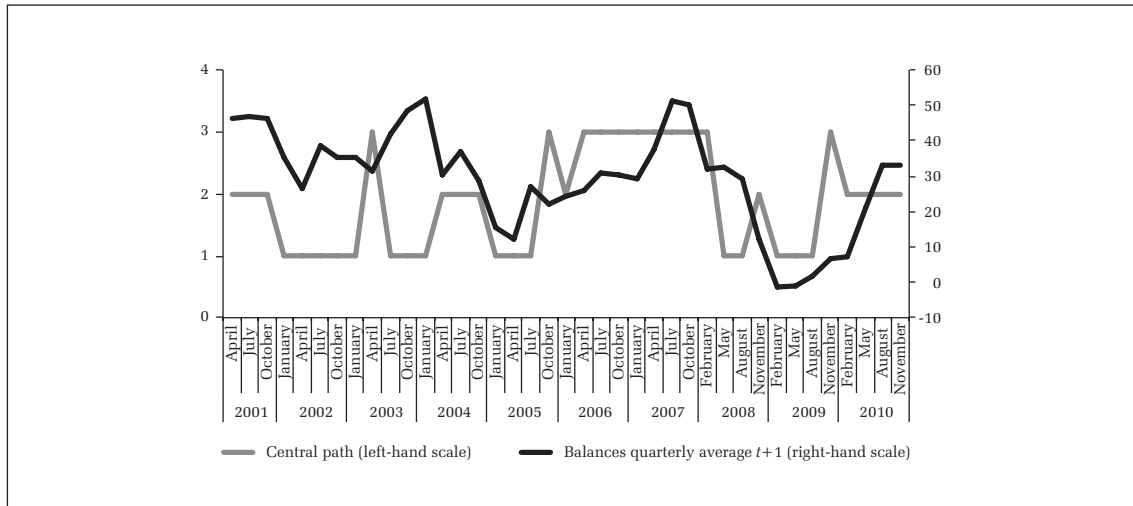


Diagram 1
 Statistics and range of associations tested

