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The interdependences of central bank's forecasts and economic agents inflation expectations. Empirical study

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Abstract

This paper focuses on the associations between the inflation forecasts of the central bank and inflation expectations of the households. The first part is of a descriptive nature. It gives the theoretical background of modern monetary policy focusing on the role of expectations. It also presents the idea of inflation forecast targeting. Then the framework of the inflation forecast targeting in four countries: the Czech Republic, Hungary, Poland and Romania is presented. The empirical part of the study is an attempt to find associations between the inflation forecasts results and inflation expectations of consumers derived on the basis of surveys. The theory gives sound background for the existence of such relationships. The interdependences are tested in several ways. The last part of the paper focuses on the results and conclusions.

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. **First of all**, inflation expectations should influence the behavior 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. **Secondly**, 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 reliable 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. **Thirdly**, monetary authorities want to influence inflation expectations and inflation forecasts as this helps to govern price development.

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 (Gábriel 2009, Benkovskis 2008).

In this paper, inflation expectations and inflation forecasts are analyzed jointly. One argues that inflation forecasts ought to help to shape inflation expectation of the economic agent. On the other hand, inflation expectations serve as an input into the inflation forecast. The paper contributes to a broader analysis of the forward-looking attitude of these central banks which implement both direct inflation targeting (DIT) as well as inflation forecast targeting (IFT).

The paper also concerns the discussion on transparency of monetary policy which is an immanent part of DIT strategy. 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. However, there the optimal level of transparency is not unambiguously determined. The research 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. There are theoretical and qualitative premises of such existence. The second hypothesis implies that the existence of the associations 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 territorial scope of the research covers four European economies: the Czech Republic, Hungary, Poland and Romania. All of them are countries with derogation, implementing DIT strategy and using interest rate as the main monetary policy instrument on the macroeconomic and operational level. Their central banks produce inflation forecast and use it as an input in a decision-making process. Four central banks covered by the study claim that they accept the NNS frameworks. It implies the acceptance of inflation expectations' importance and the forward-looking character of inflation. They also use inflation expectations in formalized forecasting process. Nevertheless, the differences in 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 relevance[1]. The examination period finishes with the end of 2010.

The paper is organized as follows: Section 2 focuses on the role and importance of inflation expectations in modern monetary policy; Section 3 shows the idea of inflation forecast targeting; the fourth part of the paper presents the background of inflation forecasting

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[1] The Czech National Bank (CNB) and the National Bank of Hungary (NBH) published the forecast for the first time in 2001, the National Bank of Poland (NBP) - in 2004 and the National Bank of Romania (NBR) - in 2005.

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in the four countries covered by the examination; Section 5 describes the methodology of the research and the results themselves; Section 6 presents the interpretation of the empirical results and the final part draws conclusions.

2. Modern monetary policy and inflation expectations

The New Neoclassical Synthesis is a broadly accepted consensus on monetary policy and its impact on economy. It integrates the classical elements with Keynesian approach (imperfect competition and nominal rigidities) and Real Business Cycles models. The NNS frameworks were described in literature (Mankiv 1990, Goodfriend, King 1997, Galí 2002). The conclusions on monetary policy impact on the economy are as follows (Goodfriend, King 1997):

- monetary policy actions can have an important influence on the real economy, which can persist over several years due to gradual adjustment of individual prices and general price level; this monetary nonneutrality is caused by the presence of rigidities in the economy,

- there is little long-run trade-off between inflation and real activity, even if price adjustment is costly,

- eliminating inflation brings significant gains because of increased transaction efficiency and elimination of relative price distortion,

- credibility plays an important role in understanding monetary policy.

Inflation dynamics is directly connected with modern transmission mechanism perception. 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. The model assumes that the prices cannot be reset continuously and price revision is non-synchronous. Each price setter is allowed to change its price at the random chosen moment. The probability of this change in period *t* is independent of the moment of the last price change and it is also independent across the firms. A firm knows that the change of price may not be possible in the following period. That is why a company is assumed to set its price taking into account the expected average price and the state of the market (excess demand) in the future (Calvo 1983). Firms re-setting their prices nowadays recognize that the prices they choose are likely to remain effective for more than one period. Such firms will find it optimal, when making their current pricing decisions, to take into consideration their expectations regarding future cost and demand conditions. Since changes in the aggregate price level are (by definition) a consequence of current pricing decisions inflation must be an important forward-looking component. That property appears to be clearly reflected in the so-called New Keynesian Phillips curve (Galí 2002), formally the New Phillips Curve, which is presented by the inflation equation given below:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + kx_t + \varepsilon_t$$

where:

π_t – current inflation figure,

$E_t\{\pi_{t+1}\}$ - inflation expected for the next period,

x_t – output gap,

ε_t – random disturbance.

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The output gap is directly connected with the marginal costs in economy[2]. The average markup is the ratio of price level to marginal cost for an average firm. It depends on the productivity and the cost of labor and materials. Because of the fact that price adjustment is costly and is not possible at any time, firms consider changing their product prices only if demand and cost conditions threaten to compress or elevate actual markups significantly and persistently with reference to flexible-price profit-maximizing levels. Firms consider increasing products prices if the marginal cost moves above trend because labor productivity falls below its trend, or if strong aggregate demand increases the intensity of resource utilization and thereby causes wage or materials costs to rise relative to trend. Conversely, firms consider cutting product prices if labor productivity rises relative to trend, or if weak aggregate demand relaxes resource utilization and thereby causes wage or materials costs to fall relative to trend. To sustain low inflation, monetary policy must manage aggregate demand while taking aggregate productivity into account, so that marginal cost rises at the targeted rate of inflation — then firms will raise product prices at the targeted rate of inflation because they are confident that doing so will keep actual markups at flexible-price profit-maximizing markups (Goodfriend 2007).

The inflation equation shows also the importance of inflation expectations. 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 behavior) as inflation equation shows (Svensson 1998). Knowing that price readjusting may not be possible in the next 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

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[2] The output gap concept in NNS models differs form traditional approach. Output gap is proportional to deviations of the real marginal cost form steady state. In other words, it is the deviation of output form its equilibrium level in the absence of nominal rigidities.

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 and its role in the economy shows that the expectation channel is the most important transmission channel. Simultaneously, it is the most difficult to be modeled formally. 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.

The fact that the frameworks of monetary policy are being rethought nowadays is worth noticing. The NNS does not close the discussion on monetary policy. The associations of the inflation forecast and expectations may be influenced by drawbacks of this framework, which is described in the last section of this paper.

3. The idea of inflation forecast targeting

The inflation forecast is an immanent part of a fully-fledged direct inflation targeting strategy (DIT). A central bank produces its own forecasts, uses them in decision-making process and reveals them. Inflation targeting, which is perceived to be the best monetary policy strategy by the consensus of NNS, may become **inflation forecast targeting** (IFT), where inflation forecast is 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). The idea of IFT has been broadly described in the literature. The main threads of this discussion are presented below.

Inflation forecast targeting 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.

Two version of IFT may be discussed. The first one assumes that inflation forecast targeting horizon is equal to the inflation control lag (the shortest period when a central bank can affect inflation). Only one choice will be optimal for the monetary policy if the central bank has only one argument in its loss function (inflation). Within such a strict DIT strategy, the central bank in period *t* should choose a sequence of current and future main rates so as to minimize the loss function (the expected squared deviations of the future inflation rate form the inflation target). Instead of minimizing the expected squared deviations of the future inflation rate from the inflation target, the central bank can minimize the squared deviation of the current forecast within the forecast-targeting horizon from the inflation target (Svensson 1996).

The other version occurs when inflation forecast targeting horizon is longer that the inflation control lag. Right now the policy path is not unambiguously determined. The policy can become more contradictory (or lax) sooner or later. This is why the additional restriction is put on the policy – constant interest rate condition. The interest rate is now set at the rate

which, on the assumption that it is kept constant throughout the forecast-targeting horizon, will ensure that the inflation forecast is on target. If the inflation forecast at the forecast-targeting horizon is not on target, assuming that the prevailing interest rate level is given, the interest rate is exactly adjusted to correct this (Leitemo 2006). Under forecast targeting, the central bank first constructs conditional inflation, output-gap, and interest-rate forecasts corresponding to alternative feasible policies, and then chooses the preferred scenario according to the specified loss function (Svensson, Woodford 2002). This procedure assumes that the central bank has more than one goal, however, price stability can be a priority.

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 data as well as expectations. It means that one variable – the forecast – includes the idea of analyzing various data, simultaneously giving the simplicity of following an intermediate target commitment.

Inflation forecast as an intermediate target may fulfill internal and external functions. The former is connected with supporting decision procedures of a monetary committee. Inflation forecast targeting gives a simple rule of monetary policy, which has already been described. However, the IFT should be treated as 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 data. The consequence of following the rule depends on various factors of mostly qualitative nature which are further presented.

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 connected with the inflation expectation shaping. Central banks can affect economy via expectations of future policy actions. They can directly influence short-term interest rate and they seek to influence longer-term rates. Shaping expectations of future policy actions is the best way to achieve it. While making decisions, economic agents are taking into consideration the whole expected interest rate path. Publishing inflation forecast may help to guide longer-term expectations. Inflation forecast can also anchor expectations when the inflation target is temporarily missed.

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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. However, the forward-looking dimension of revealing the forecasts seems more important.

Nowadays, the pros of publishing forecasts seem to prevail. 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 minimalization). The central bank accepts the importance of expectations in its policy and finds the forecasts a useful tool of shaping these expectations.

The majority of studies show advantages of revealing the forecasts. However, this does not mean that there are no drawbacks. A central bank can be bound more tightly by the publication of an inflation forecast than is actually warranted by the quality of that forecast. In practice a forecast cannot amount to a complete summary of all the information relevant to monetary policy decisions. This is mainly because there is no universally optimal forecasting method. The specification of the macroeconometric model used for forecasting contains a number of degrees of freedom. Moreover, some assumptions also have to be made regarding the exogenous variables (Remsperger, Worms 1999). Another problem is that macroeconometric models cannot adequately capture structural changes. Recognizing transmission mechanism and access to the long enough and reliable set of data can also be problematic.

These problems concern first of all the economies and central banks in transitory periods. The four countries covered by the examination first abandoned central planning. Then, having finished some stage of disinflation process and after implementing a traditional strategy for some time, they adopted the DIT strategy. Finally, they started to produce and reveal inflation forecasts. These changes, taking place during quite a short period, meant enhanced structural changes (entrance to the European Union meant it as well) and new demands for the monetary policy with adopting new frameworks. This is why, even if the central banks see and accept the advantages of using inflation forecast in the monetary policy, they may postpone implementing of IFT. European Central Bank's example shows, that even a central bank that implements modern monetary policy strategy may not accept the forecast as the most valuable input in the analysis.

There are theoretical papers that show that this knowledge transparency might be socially harmful if the central bank possesses private information about real shocks. (Gersbach 2003). There are others that show that transparency is beneficial up to a certain extent (Cecchetti Krause 2002, Jensen 2001).

Despite these augments disclosure of inflation forecast is broadly claimed to be the accepted level of transparency. Central banks publish their own forecast in different ways (numerical results, fan chart with probability distribution, risk assessment, description of the situation). However, at the beginning, usually just after making decision of DIT implementation, they may prefer implicit IFT. It means that the forecast is not revealed as long as the central bank is not satisfied with its reliability, however, this very forecast is discussed by the monetary committee during the decision process.

This conclusion does not close the discussion on the desired transparency level. The term *inflation forecast* includes unconditional forecast as well as conditional forecast (projection). The latter implies assumption that the central bank does not change the level of its interest rate throughout the forecast horizon. The differences between conditional and unconditional forecasts and their implications for the central bankers open another discussion. And again, no unambiguous solution is elaborated.

Research on the advantages of conditional or unconditional forecast does not give simple results, it usually depends on the assumptions that lay beneath the model. Some of it shows that only the publication of the projections reduces uncertainty about inflation target and enhances the central bank to built its reputation. In addition, it gives the central bank greater flexibility to respond to shocks in the economy (Geraats 2001). Other research, on the other hand, gives contradictory results, showing that unconditional forecasts include all the information from which the policy target can be inferred (Tarkka, Mayes, 1999).

The choice of the unconditional forecast opens the possibility to disclose the most likely future evolution of the central bank's interest rate. It can be done in a descriptive way (qualitatively) or quantitatively (on the fan chart). There is an empirical analysis that shows that the communication of future policy intentions, either quantitative or qualitative, improves the ability of market participants to predict monetary policy decisions (Ferrero, Secchi, 2007).

The central bank can go further and publish also a policy path which is the sequence of current and expected settings of the policy rate, consistent with achieving its goals. Formulating and communicating a policy path is the next frontier in monetary policy transparency (Khan 2007). Neither theory nor formal models show a sound and unambiguous

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justification for publishing a policy path. However, several pros of publishing policy path are connected with the context of shaping expectations.

Firstly, communicating a policy path may help demonstrate central banker's commitment to long-term goals, showing the way in which they can be achieved. If such a commitment helps to built longer-term expectations, temporary shocks on inflation are less likely to transform into persistently higher expectations. As a result, the policy path disclosure helps to enforce optimal policy (Khan 2007, Archer 2005).

Secondly, the policy path announcement can also contribute to shaping short-term expectations. Announcing inflation target should first of all anchor medium and longer term expectations, which is consistent with the monetary policy horizon. When the inflation is above the target, the short-term expectations can be above the central bank desired level. The policy path should anchor them more explicitly than just the forecast of inflation. It limits the near-term concern about monetary policy actions. It allows the market to price more efficiently financial assets, both short-term and long-term ones. Announcing the policy path may give the policymakers greater leverage over the long-term interest rates (Khan 2007).

Moreover, disclosing a policy path explicitly may enforce the forecasts quality as well as it improves the central bank's accountability. Without the information on the future path of the economy only ex post evaluation of the central bank is possible (Mishkin 2004). Due to the lags in the monetary policy, the monetary policy committee term may be over when its actions influence the economy. The arguments in favor of publishing a policy path are also supported by a theoretical analysis.

Despite the arguments that show that the policy path publishing can bring benefits, minority of the central banks – inflation targeters - have decided to do so. There are a few reasons why.

First of all, they do not have such a path (Khan 2007). While the policymakers may have a sense of direction of the future policy rate changes, in most cases they do not reach agreement on an explicit policy path. The problem occurs not only in the area of choosing the monetary policy rule, which can be quite controversial,[3] but also because of the inconsistency of the decision making procedures with giving an explicit policy path for the period longer that the interval between monetary policy committee meetings. It is not possible, and

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3 Usually the Taylor–type rule is applied as the monetary policy committee reaction function. It has several disadvantages that are described in (*Taylor Interest…*1999). Despite these pitfalls the effort was taken to make Taylor-type rules operational. The Taylor-type rules in forward-looking version are broadly applied in central banks' formal models. They can be quite good prescriptive tools if the models are well micro-founded.

reasonable, to make binding decision on an interest rates path instead of a one-step change. There is empirical research that confirms 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). Moreover, the risk or uncertainty temporarily connected with the forecast as well as with policy path can be substantial.

Secondly, the public may perceive a given policy path as a commitment. Market participants will adjust their behavior to the new conditions and economic outlook more sluggishly. They can feel cheated by the central bank if its subsequent decisions on the interest rate are different from the announced policy path. From the central bank's point of view, the latter may create limited willingness to change a policy path which was once announced, even if the forecast changes. Such an approach may limit the flexibility of the central bank (Khan 2007). There is also another problem connected with perceiving a policy path as a commitment. It can influence credibility negatively if the public does not understand conditional nature of such a path (Woodford 2005).

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 macromodels on the basis of which these projection were made. Weighted against the fears of revealing the future interest rate path, this may explain the reluctance of certain central banks to push their transparency framework that far (Brzoza–Brzezina, Kot, 2008).

However, to underline the ambiguity of the results described above, the results of the other research – empirical one this time - is worth mentioning. The study (Ferrero, Sccheci 2007) shows that even for a very transparent central bank (Reserve Bank of New Zealand), the publication of the expected interest rate path has a significant impact on market expectations. Moreover, the change in market interest rates in the period between two publications of the interest rate path was similar to the revision of the published path, thus suggesting that market operators well understood the conditionality of the central bank's projections.

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). Transparency is beneficial when it serves to simplify communication with the public and

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helps generate support for central banks to conduct the monetary policy optimally with an appropriate focus on long-run objectives. However, it can complicate the communication process and weaken support for a central bank focus on long-run objectives (Mishkin 2004). 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.

The countries covered by the examination also implement different solutions in this field, which is described in the next section.

4. Inflation forecast targeting in practice

This section examines practical aspects of inflation forecasting procedures and the related institutional framework in four central banks: the Czech National Bank (CNB), the National Bank of Hungary (NBH), the National Bank of Poland (NBP) and the National Bank of Romania (NBR). They all declare the acceptance of the NNS frameworks, including the importance of inflation expectations and the role of forecast in the monetary policy. Table 1 presents the main facts on forecasting systems and procedures in the countries covered by the study.

The implementation of DIT strategy is a precondition of the IFT implementation[4]. Direct inflation targeting strategy can be implemented in various ways. It means that within the set of standard features of such a strategy, the central bank can operate in different frameworks and implement diverse solutions at an operational level. This brings consequences for IFT. This is why the starting point for the analysis focuses on selected aspects of monetary policy strategy.

One remarkable feature for the monetary policy implementation is **the choice of exchange rate regime**. Fully-fledged DIT implies a floating exchange rate. However, the intermediate solutions are also acceptable. Such a temporary situation may reveal inconsistency in the MPC behavior. If the central bank declares that the forecast is an important premise in a decision making process and the forecast is revealed, the public will 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 shaping inflation expectations. Such an ambiguous situation occurred in Hungary and Romania.

In Hungary DIT was declared to be the official strategy of the NBH in 2001. However, a fixed exchange rate with the fluctuation band of 15% around the central parity was introduced in October 2001 and abandoned in February 2008. It meant an about 7-year-period of coexistence of fixed exchange rate with inflation targeting. Despite the NBH declaration of DIT implementation, its strategy was quite eclectic. It had numerous features of DIT (numerically set inflation target as the priority, inflation forecast, independence and accountability of the central bank, communication with the public). At the same time the Bank Board quite often reacted to the exchange rate of forint fluctuations, which meant that the forecast was neglected.

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[4] Inflation forecast can be produced even within another monetary policy strategy frameworks but it therefore fulfill different tasks. The role of forecast as the intermediate objective is therefore negligible.

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Table 1. Inflation forecasting in Czech Republic, Hungary, Poland and Romania

	The Czech Republic	Hungary	Poland	Romania
DIT 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, form 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	- QPM: Quarterly Projection Model up to May 2008, - g3 from August 2008	- 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	- New Analytical Scheme and MSMI (Small Structural Inflation Model) up to February 2005, - ECMOD up to February 2008, - NECMOD from June 2008	- MAPM: model for medium term analysis and projection
MPC and forecasting procedure	Discrete involvement	Discrete involvement	No involvement	Iterative involvement

Source: own study based on Inflation Reports of the Czech National Bank, the National Bank of Hungary, the National Bank of Poland and the National Bank of Romania.

In Romania, a floating exchange rate regime was functioning before the DIT implementation. The Romanian case was the example of the existence of the discrepancies between *de jure* and *de facto* regime, so called "fear of floating". It describes the situation where regimes *de jure* are more flexible than *de facto*, as the country follows unofficial exchange rate target usually in the period of large macroeconomic imbalance and low foreign reserves to adopt an official peg (Nerlich 2002). After the DIT introduction in 2005, the exchange rate regime became more floating, however, NBR still reacted sometimes to the exchange rate changes.

In the Czech Republic and Poland direct inflation targeting was introduced in the late nineties. Before its introduction, Czech koruna had already operated in a managed floating regime. The forecast disclosure started in August 2001. Since 2001 DIT strategy in the Czech Republic has been a fully-fledged version.

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In Poland a floating exchange rate was introduced in 2000 after a short period of DIT implementation. At that time the inflation forecast was not published. In Poland the interval between the DIT introduction and the first forecast disclosure was quite long, as the first projection was published in August 2004.

The forecasting procedures in the countries covered by the study evolved over time. The main forecasting tool – the model – was first a quite simple tool that integrated all the relevant data. It also provided consistent frameworks for the analysis (Analytical Schemes, MAPM). Structural changes in national economies (i.e. caused by the access to the European Union), in global economy, as well as the development of econometrics resulted in changes of the main forecasting tools. The most developed tool used in the countries covered by the study is the g3 model of the Czech National Bank. The g3 is a Dynamic Stochastic General Equilibrium Model. DSGE models belong to the fourth generation of macromodels describing the monetary policy impact on the economy. They are perceived as the most advanced methodological approach in macromodeling. However, one argues that they have numerous drawbacks (for further description see: Tovar 2008). All models used for forecasting and policy analysis, regarding their complexity and scale, capture monetary transmission mechanism that lies within the frameworks of New Neoclassical Synthesis.

Nevertheless, a forecast is not the outcome of an automatic modeling procedure. Experts' involvement is necessary as forecasting is an iterative process. Experts' opinions prevail in the short term. They better capture temporary shocks occurring in the economy. On the other hand, models describe longer term relations in a better way. This is why the central

bank forecast is usually a combined forecast: main models', experts' and sometimes forecast produced with an additional tool.

Experts involved in forecasting procedures are central bank staff. However, the expression *central bank forecast* does not specify who the author of the forecast is. The forecast may incorporate the view of the staff and the MPC members. This situation occurs in the Czech Republic, Hungary and Romania. In Romania the Board Members are even involved iteratively. It means consultations between the staff and the Board on subsequent stages of the forecasting round. The forecast produced with an iterative involvement of the MPC members incorporates to a large extent their view on the future course of the economy. And they are the ones who make decisions on interest rates, which means that these decisions are tailored on the basis of their opinion. As a consequence, the forecast is a less objective premise of a decision making process. On the other hand, a decision should be in line with the forecast message as it simplifies the communication with the market.

In Poland the Monetary Policy Council members are not involved in the forecasting process. They have no impact on the forecast which is produced by the staff and discussed during the MPC meeting. No-involvement case also creates a problem as the MPC members may not share the view of the staff on the economic development. As a result, they will not react in the way suggested by the forecast. It may dampen the forecasts' impact on the expectations of economic agents.

Taking into consideration the alternatives described above, one might argue that discrete involvement of monetary policy committee constitutes a satisfactory compromise. In fact, it does not. The involvement of MPC members seems to have no impact on the consequence in IFT implementation. The National Bank of Hungary implemented the same solution as the Czech National Bank (discretionary involvement). The first one does not follow the message of the forecast, while the second one does it with a surprising consistency even in a turbulent period for the financial markets (Szyszko 2009). It seems that there are some other, qualitative aspects which seem to be decisive. One of them could be the belief of the MPC that the forecast is the best supporting tool of a decision-making process or the pressure from the central bank's staff which has equipped the MPC with such a tool.

The second part of the descriptive analysis focuses on inflation forecast targeting implementation in the countries in question. Table 2 presents a summary of the comparison of the IFT implementation. Four features are considered: formal declaration on the importance of inflation forecasts, consistency of the decision of the MPC with the inflation forecast result,

decision timing and finally – the way in which the decisions on interest rate were justified.

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 message of the forecast; 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 message of the forecast; however a flexible approach to input in decision-making process dominated	the decisions were in line with the message of the forecast, 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

Source: own work

Forecast disclosure is usually a part of the communication strategy. Forecast appears in the Inflation Report. This document presents a broader context of the monetary policy in order to provide the public with information relevant for the decision-making process. Inflation forecast targeting is not dependable on detailed solutions on forecasting procedures and forecasts disclosure. As it was shown in table 1 and described above, the systems of forecasting inflation in the Czech Republic, Hungary, Poland and Romania differ. Regardless of the details, revealing the forecast by the central bank is always perceived as a part of a communication strategy that should help to build transparency and hence anchor expectations. This is also the reason why central banks give the rationale for their decision. Usually central banks explain also why the forecast is made and published. This declaration should show the importance of the forecast as the rationale for interest rate adjustments.

The Czech National Bank declares on its website that *the forecast for inflation at the "monetary policy horizon" (about 12–18 months ahead) is of greatest relevance to the*

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decision-making on the current interest rate settings. In its monetary policy decision-making the CNB Bank Board assesses the latest CNB forecast and evaluates the risks of non-fulfilment of this forecast. Based on these considerations the Bank Board then votes on whether and how to change the settings of monetary policy instruments. By changing these instruments the central bank seeks to offset excessive inflationary or disinflationary pressures which are deviating future inflation from the inflation target or from the tolerance band around this target. The first declaration on the forecast importance was given in the CNB Monetary Strategy Document that was published in 1999. It was stated there that the key source material for the CNB Bank Board's decisions would be the CNB's macroeconomic forecast. The central bank of the Czech Republic gave quite a clear picture of the forecast role in the monetary policy.

The National Bank of Hungary, at the beginning of DIT implementation, declared explicitly that inflation forecast played the role of the intermediate target (Monetary Policy in Hungary, 2002). This was quite an unambiguous statement, showing a strong involvement in IFT. In 2010 new information appeared on the website: *In taking its policy decisions, the Monetary Council takes into account the baseline path of the NBH staff's projection, the uncertainty around it and risk scenarios that are judged to be relevant. However, decision-making is not a mechanical exercise, as the Monetary Council may give consideration to other aspects, in addition to the NBH staff's projection.* The latest version demonstrates much less importance of the inflation forecast in a decision making process. At the same time it is more consistent with the behavior of the Hungarian Monetary Council.

In Poland the rationale for projections and their publication was given for the first time in 2004, when the first projection was published. It was limited to the short note in the Inflation Report saying that *the projection is one of the inputs to the Monetary Policy Council's decision-making process.* Monetary Policy Strategy document (*Monetary Policy beyond 2003*) was published in 2003 – before the first projection disclosure. The projections and their role in the monetary policy, however, were not mentioned. Starting form 2005, Monetary Policy Council refers to the projections in Monetary Policy Guidelines. In the latest ones it was stated that *monetary policy is pursued under uncertainty which excludes strict control of economic processes. This uncertainty means that while taking decisions related to monetary policy it is necessary to take into account all available information relevant for inflation developments, rather than the results of inflation projection only. Models used by central banks to forecast inflation may be imperfect in adequately reproducing behavior of*

the economy if only because of its ongoing structural changes. In addition, it is not possible to adopt a simple policy rule which could be known ex ante to market participants (Monetary Policy Guidelines 2010). This declaration shows that in Monetary Council's opinion the projection is not a primary input in a decision making process. It is taken into consideration but has an equal position as the other data. Moreover, it is emphasized that this projection could temporarily be of little importance (rationale for decision-making during the financial crisis).

The National Bank of Romania presents on the Bank's website only one quite a laconic piece of information on inflation forecast importance. It says that *the forecasts generated by the model are a very important input in the NBR Board's policy decision making*. There is neither monetary policy strategy document nor yearly published information on monetary policy assessment. However, just before implementation of the new monetary frameworks in 2005 an effort was made to ensure completion of the models for the analysis and short and medium-term forecasting of inflation. They were to be used as an input for the monetary policy decision-making. *Annual Reports* confirm the declared role of the inflation forecast.

It is remarkable that the central banks underline first of all the internal function of the forecast: supporting the decision-making of the MPC. The theory as well as empirical research focus 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 external functions 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 authorities' declarations, including monetary authorities, may not be reflected in their behavior. Therefore, publishing the forecast will be of little importance for shaping market expectations. Bearing that in mind the assessment of central bank's credibility is quite difficult. It would mean the answer to the question whether inflation forecast is really the input for the decision-making process. This would be the research of mostly qualitative nature, having numerous limitations:

- there is no possibility to measure formal declaration on forecast importance; *main input in a decision-making process*, *greatest relevance to the decision-making*, *not*

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automatic exercise – these are purely descriptive expressions,

- the latest declaration of the HNB and the NBP as well as the CNB and the NBR has almost the same meaning from the linguistic point of view; however, it does not mean that the CB's intentions were the same,

- assessment of IFT should show a broader context of communication with the market; it is not the situation were the rule of IFT was not implemented that is important but the reason why and the frequency of such behavior; 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 the message of the forecast; it is connected with the attitude of the central banks to the DIT strategy; they implement rather flexible inflation targeting; which means in practice that there is an accepted fluctuation band around inflation target; the CB shows commitment to the main goal but simultaneously it sends a message that the inflation level that would be above or below the target may be temporarily accepted, especially when it is due to exogenous shocks (sometimes the list of caveats is presented); not focusing on economic shock supports output stabilization; for the IFT implementation this flexibility means that sometimes there is more than one option of the MPC decision that can be perceived as being in line with the message of the forecast.

Because of the limitations presented above, the examination of IFT implementation may not lead to unambiguous results. 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. It followed the message of the forecast. When it did not - it was clearly explained why. Usually the reason lied beyond the impact of the central bank[5]. 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

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[5] 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 that expected. It meant more tight monetary condition than planned without interest rate rise.

forecast, policy path and risk assessment. Balance of the risk for the forecast was presented even in those months when the new forecast did not appear.

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 as the input for the decision-making process. The official interest rates changes were mainly caused by exchange rate fluctuations. Sometimes other current factors were decisive. The projection seemed to be only an additional input in the decision-making process. The flexibility which is allowed by fluctuation band around the inflation target gives freedom not to change rates or to change them in the direction suggested by the forecast. The National Bank of Hungary often changed them in the direction opposite to the message suggested by the forecast[6]. Such behavior was inconsistent with the strong declaration on the projections importance. In 2010 the declaration was changed. Simultaneously, it seems that the Monetary Council has been slowly changing its attitude since managed floating exchange rate introduction. Starting from February 2008 only once the decision was not in line with the forecast message.

In Poland the Monetary Policy Council proved a rather eclectic approach to choosing the input of a decision-making process. Its decisions were generally in line with the message of the forecast. It might be inferred then that when there is a tolerance band around inflation target, deviation of projected inflation from the targeted level within transmission horizon is often within the band. The MPC can choose whether the reaction is worth producing. However, there are two important issues proving that the projection was not of primary importance: the moment of the decision-making and its explanation. Firstly, the projection was produced quarterly and from 2008, 3 times a year. Just after it was produced it was the most relevant. During the next 2 or 3 MPC meetings, the projection became stale. But at the same time there was a possibility of assessing whether the assumptions were right. When the MPC implements IFT consistently it usually makes a decision in line with the forecast message instead of taking wait and see position. The rationale behind the decision also did not focus on the projection.

The National Bank of Romania had similar attitude as the National Bank of Poland. However, the starting point of the analysis was a little bit different, what should be underlined

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[6] 16 times between August 2001 and the end of 2010 the message of forecast was ignored. The rationale for interest rate change referred sometimes directly to the speculative attacks on Hungarian forint. Usually there was no reference to the forecast in the rationale for the decision. The other reasons were underlined (risk premium change, demand pressure, imbalance of the Hungarian economy).

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while comparing the central banks under examination. In Poland the forecast was revealed for the first time in the sixth year of DIT implementation. As a consequence, the central bank had already finished implementing new operational frameworks. Simultaneously, market participants got used to the interest rate policy and its signaling effects. 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 message of the forecast. The second reason was connected with an eclectic approach to the data analysis. Sometimes the Board simply decided that current data are more important. Between August 2005 and the end of 2010 the Board reacted in the counter-forecast direction 3 times. It also took wait and see position and the forecast was not the central point in decision rationale.

This section gave the background for empirical study. Simultaneously, it was the starting point for verifying the second hypothesis: the central banks under examination apply different forecasting rules, proving at the same time different approach to the decision-making input. Market participants can quite easily asses 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 next section presents the results of a quantitative study on the relationships between inflation forecast and expectations. However, it can be stated as the summary of this section, that the existence of this kind of relationships depends strongly on qualitative aspects, including the central bank's attitude and consistency in IFT implementation. In some countries preconditions for these relationships are fulfilled while in others – they are not. 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. Empirical study on the forecast and inflation expectations

The existence of associations 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 expectation, 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, measuring of which changed over time.

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

The associations between the forecast results and expectation 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 – cannot be indicated as a proper one. It can be only assumed that there should be a statistically important relationship between these two variables. Even the existence a of 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 expectation may fall.

5.1 Inflation forecast results

There is no unique information on inflation forecast that is accessible in the four countries. To make the data comparable and to enable the use of the longest time series

possible, the information on the forecast result is processed to present forecast result in a qualitative way. The relation between the inflation forecast result 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 (which will be described further). The suggested way of coding inflation forecast results is also coherent with the way how the forecast is presented in the media. Consumers do not usually read Inflation Reports or central banks' documents. They learn the forecast results indirectly. Analytics present the message of the forecast referring to the relation of the forecast and the central bank goal.

Two cases were distinguished. **The first one** – and simpler – assumes three possibilities:

- the forecast is below the inflation target;
- it is at the inflation target level;
- 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. Meanwhile, the inflation targeters usually implement flexible inflation targeting. This means that 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 for **the second case** the message of the forecast is 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 lower boundary of the fluctuation band;
- it is below the inflation target but within the fluctuation band.

The other approach could also be tested: the direction of the change in the central path. However, it has a remarkable drawback in comparison with the first approach that is connected with the nature of forecasting tools. The forecasting models are general equilibrium models. In the long run inflation as well as the other economic variables return to equilibrium level, which means – in the case of inflation – the targeted level of it. Usually, when

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transmission horizon starts the shocks that influence the economy at the starting point of the forecast horizon vanish. The new ones cannot be captured by the model. As a consequence, the path of inflation after 4-6 quarters returns to the inflation level. For the countries that miss the target it means usually that the central path of inflation falls.

The other shortcoming of this approach is that it does not capture the relation of central path and the target. When the inflation is supposed to rise, it can rise from the level below the lower boundary of the fluctuation band as well as from the level above the target or even the upper boundary. The impact on the expectations should be different in both cases.

The additional solution is applied in the case of the Czech National Bank. It produces an unconditional forecast. It means that together with the central path of the forecast, a policy path is described 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.

5.2 Inflation expectations

The theoretical discussion on monetary policy and its impact on the economy shows the priority of shaping the expectations in the actions of the central bank. It has already been emphasized that they can be treated as an unbiased predictor of future inflation as well as an indicator of the central bank's credibility. However, inflation expectations, especially those of a household, cannot be directly observed. There are two ways of measuring inflation expectations. The first one consists of conducting economic surveys on a regular basis[7]. The survey is of a qualitative nature. Consumers do not give the exact level of expected inflation but they answer questions on their inflation perception[8] and expectations[9]. Then the answers can be used in two ways. First of all the balance of answers is calculated:

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[7] The second one consists of deriving inflation expectations from the prices of financial assets, which is not subject of this paper.

[8] 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.*

[9] 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.*

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B = (PP + ½P) − (½M + MM)

where PP denotes 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 denotes "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) (*The Joint…* 2007). That 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 made 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* 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 that in the past. When the indicator (balance) of 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 rapiddly 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.

The balances from *Business and Consumer Surveys* are directly used as the source of information on inflation expectations. Despite the drawbacks described above (they sill do not measure directly inflation expectations as well as they are not easily interpreted) they have quite an 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. At the same time, balances can represent roughly the perception of expected inflation by households.

Two different approaches, except for balances, to expectations are considered: the level of expectations (derived form qualitative surveys or central banks surveys with quantitative question) and the direction of its change.

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The structure of the answers to the surveys' question can be quantified using Carlson–Parkin method of quantification (described in Łyziak 2003). The quantification is done in two steps. First, the perceived inflation rate is quantified, then using the perceived inflation, the expected inflation can be also quantified. 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 asses expectations in surveys based on quantitative question: 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.

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Table 3. Data availability and time extent

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

Source: own study.

The CNB still conducts quarterly, quantitative surveys among companies. This is why the examination for the Czech Republic covers also business inflation expectations[10]. Only for the Czech case two groups' expectations are covered.

For Romania no information except for balances calculated in the EC surveys is 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 (and business for the Czech Republic),
- the direction of expectation change that was described in Inflation Reports.

The surveys results, quantified or presented as the balance of answers, have also another shortcoming. They reflect feelings of consumers rather than their real behavior driven by expectations. The latter is better reflected in financial market assets change. Regardless of this drawback, surveys are commonly used to asses expectations by central banks.

5.3 Versions of the analysis

Table 4 and 5 present pairs of variables whose relationships are tested for each country. Table 4 presents the relations tested for balances of answers. In the case of the Czech Republic the associations for the central path are additionally tested. The remaining pairs are the same for each country.

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)[11]. In the light of these study results, the influence of inflation forecast on expectations should be

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[10] The research focuses on consumers expectations. Having time series on business expectations, it was worth to use them and compare with the results for households.

[11] This study focuses on reaction of UK short-term interest rates to the Bank of England's inflation report and to macroeconomic announcements on the one hand, and to the interrelationship between the two on the other hand. The authors proved on the basis on stylized model that macroeconomic announcements and the release of the inflation report clearly lead to a reduction in market volatility. This suggests that public signals serve to homogenize the information sets of market participants, thus reducing the role of private information.

the strongest when the lag is quite short. Two lag options (1M and 2M) are tested wherever it is possible[12]. Due to the timing of the survey and the inflation forecast publications, no-lag version was not tested.

Table 4. Versions of association tested for balances of answers

Quarterly:
Central path (5 possibilities) /balances 1M lag
Central path (5 possibilities) /balances 2M lag
Central path (3 possibilities) /balances 1M lag
Central path (3 possibilities) /balances 2M lag
Central path (5 possibilities)/ average balance 1M lag
Central path (5 possibilities)/ average balances 2M lag
Central path (3 possibilities)/ average balance 1M lag
Central path (3 possibilities)/ average balances 2M lag
Policy path (3 possibilities) /balances 1M lag
Policy path (3 possibilities) /balances 2M lag
Policy path (5 possibilities)/ average balance 1M lag
Policy path (5 possibilities)/ average balances 2M lag
Monthly:
Central path repeated (case with 5 possibilities)/balances 1M lag
Central path repeated (case with 5 possibilities)/balances 2M lag
Central path repeated (case with 3 possibilities)/balances 1M lag
Central path repeated (case with 3 possibilities)/balances 2M lag
Policy path repeated/ balances 1M lag
Policy path repeated/ balances 2M lag

Italics shows relations tested only for the Czech Republic

Source: own study

Quarterly, (which is presented in diagram 1), the forecast result (5 or 3 possibilities) is 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).

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[12] It seems reasonable to check the existence of the associations with longer lag for Poland starting form 2008, when the frequency of the forecast was lowered. However, the time series would be quite short here, which is why the idea was dropped.

The first and the second options check whether there is an association between the inflation forecast result 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 result affects 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[13].

Diagram 1. The associations presented quarterly
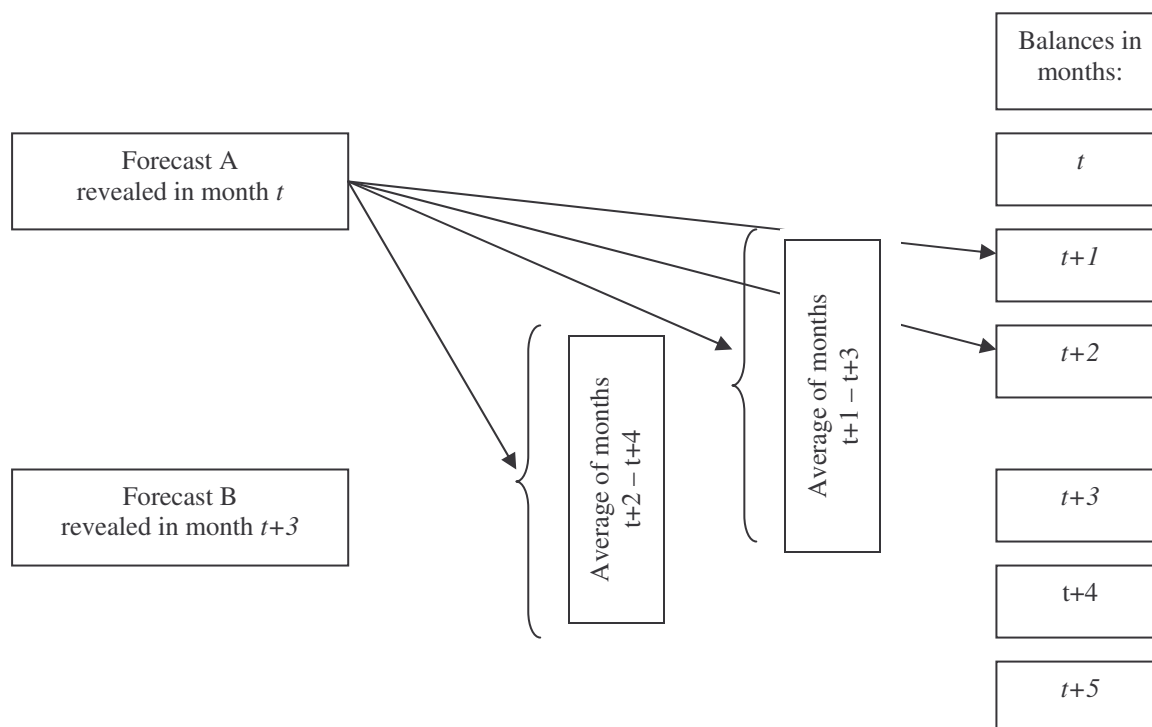
Source: own study.

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

The time series on balances of answers on the survey questions were the same for four countries. As the time series on the level and the direction of expectations differ, the associations tested also cover various versions: 12 for the Czech Republic, 4 for Hungary, 20 for Poland (table 5).

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[13] I.e. July forecast result is confronted with the quarterly average balances calculated for August, September and October (1 month lag) or calculated for September, October and November. It means the assumption that the households need at least a month to read the message of the forecast.

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 expectation, a similar approach as with the balances is applied.

Table 5. Versions of association tested for level and directions of expectations change

	Association tested
CNB (12)	Central path (case with 5 possibilities)/direction of consumers expectations change
	Central path (case with 5 possibilities)/direction of business expectations change
	Central path (case with 3 possibilities)/direction of consumers expectations change
	Central path (case with 3 possibilities)/direction of business expectations change
	Policy path/direction of consumers expectations change
	Policy path/direction of business expectations change
	Central path (case with 5 possibilities)/consumers expectations (limited to 2007Q2)
	Central path (case with 5 possibilities)/ business expectations
	Central path (case with 3 possibilities)/consumers expectations (limited to 2007Q2)
	Central path (case with 3 possibilities)/business expectations
	Policy path/ consumers expectations (limited to 2007Q2)
	Policy path/ business expectations
NBH (4)	Central path (case with 5 possibilities)/direction of consumers expectations change
	Central path (case with 3 possibilities)/direction of consumers expectations change
	Central path (case with 5 possibilities)/consumers expectations (limited to 2007Q3)
	Central path (case with 3 possibilities)/consumers expectations (limited to 2007Q3)
NBP (20)	Central path (case with 5 possibilities)/direction of consumers expectations change (1Mlag)
	Central path (case with 5 possibilities)/direction of consumers expectations change (2Mlag)
	Central path (case with 3 possibilities)/direction of consumers expectations change (1Mlag)
	Central path (case with 3 possibilities)/direction of consumers expectations change (2Mlag)
	Central path (case with 5 possibilities)/consumers expectations (1Mlag)
	Central path (case with 5 possibilities)/consumers expectations (2Mlag)
	Central path (case with 3 possibilities)/consumers expectations (1Mlag)
	Central path (case with 3 possibilities)/consumers expectations (2Mlag)
	Central path (case with 5 possibilities)/ average consumers expectations (1Mlag)
	Central path (case with 5 possibilities)/ average consumers expectations (2Mlag)
	Central path (case with 3 possibilities)/ average consumers expectations (1Mlag)
	Central path (case with 3 possibilities)/ average consumers expectations (2Mlag)
	Central path repeated (case with 5 possibilities)/direction of consumers expectations change (1Mlag)
	Central path repeated (case with 3 possibilities)/direction of consumers expectations change (1Mlag)
	Central path repeated (case with 5 possibilities)/direction of consumers expectations change (2Mlag)
	Central path repeated (case with 3 possibilities)/direction of consumers expectations change (2Mlag)
	Central path repeated (case with 5 possibilities)/consumers expectations (1Mlag)
	Central path repeated (case with 3 possibilities)/consumers expectations (1Mlag)
	Central path repeated (case with 5 possibilities)/consumers expectations (2Mlag)
	Central path repeated (case with 3 possibilities)/consumers expectations (2Mlag)

Source: own study

The Hungarian case presents the basic scope of the research. The associations between the relation of the central path and the inflation target (described as *central path*) in two versions (5 and 3 possibilities) are tested with inflation expectations (levels up to 3Q2007, direction of the change). The case of the Czech Republic covers also additional cases: associations of policy path and expectations as well as business expectations. In Poland

having the time series of monthly frequency was confronted with the forecast that was made quarterly or 3 times a year. This is why in Polish case a few approaches were applied. They were the same as while testing relations for balances of answers.

The poorest access to the data for Romania means that only the correlation of the inflation forecast and balances of answers was tested.

5.4 Measures applied

The correlation between inflation forecast and expectations measures a degree of monotonic association between these two variables. This is one of the simplest statistical relations, however, here it is imposed by the range of data availability that also implies that only non-parametric correlation measures can be used. The diagram with the statistical measures of association is presented below. 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 2.

Under a null hypothesis there is no monotonic association between inflation forecast results and expectations or the two variables are independent for α = 0.05. It should be noticed that *inflation forecast results* as well as *inflation expectations* are expressed in terms described in the previous part of this section. It does not necessarily mean their levels.

The Spearman rank correlation coefficient is the basic measure of associations 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.

Diagram 2. Statistics and range of associations tested

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                              ┌─────────────────┐
                              │   Statistics    │
                              └─────────────────┘
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| The Spearman Rank Correlation Coefficient (r_s) | Kendall Tau Correlation Coefficient (τ) | Chi-Square Test for Independence |

| **H$_0$**: $\rho_s = 0$ **H$_1$**: $\rho_s \neq 0$ | **H$_0$**: $\tau = 0$ **H$_1$**: $\tau \neq 0$ | **H$_0$**: the inflation forecast and inflation expectations are independent of each other. **H$_1$**: the inflation forecast and inflation expectations are dependent. |

| Forecast expressed as the relation to the goal. Expectations – levels. | Forecast expressed as the relation to the goal. Expectations – balances. | Both variables of qualitative nature (ordinal scale): − forecast – relation to the goal, − expectations – directions. |

Source: own study.

5.5 Results and comments

The results are presented in tables 6-11. They are divided into 3 groups. The starting point is testing associations between the inflation forecast results and expectations expressed as the balances of answers on survey questions. As 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 three others. This approach offers greater comparability of results. The Spearman rank correlation coefficient is given it table 6.

Regardless of the broad range of the associations tested, none of them proved to be statistically important 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 preliminary assumption that the association here should be quite strong because of consistency of the CNB in IFT implementation. Chart 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

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Table 6. The associations between the forecasts results and the balances of the answers

Variables:	The Czech Republic				Hungary				Poland				Romania			
	N	r_s	t(N-2)	p	N	r_s	t(N-2)	p	N	r_s	t(N-2)	p	N	r_s	t(N-2)	p
Quarterly																
Central path (5 possibilities) /balances 1M lag	39	0.13	0.81	0.423	38	**0.51**	**3.59**	**0.000**	22	0.21	0.98	0.340	22	**0.60**	**3.34**	**0.003**
Central path (5 possibilities) /balances 2M lag	39	0.03	0.18	0.860	38	**0.51**	**3.57**	**0.001**	22	0.25	1.15	0.261	22	0.15	0.69	0.495
Central path (3 possibilities) /balances 1M lag	39	0.09	0.57	0.571	38	**0.52**	**3.62**	**0.000**	22	0.16	0.73	0.471	22	**0.56**	**2.99**	**0.007**
Central path (3 possibilities) /balances 2M lag	39	0.03	0.16	0.872	38	**0.50**	**3.46**	**0.001**	22	0.22	1.01	0.322	22	0.12	0.55	0.590
Central path (5 possibilities) /average balance 1M lag	39	0.07	0.42	0.678	38	**0.53**	**3.73**	**0.000**	22	0.32	1.51	0.145	22	**0.46**	**2.32**	**0.030**
Central path (5 possibilities) average balances 2M lag	39	0.10	0.63	0.532	38	**0.54**	**3.83**	**0.000**	22	0.32	1.52	0.143	22	0.36	1.71	0.103
Central path (3 possibilities) /average balance 1M lag	39	0.06	0.39	0.695	38	**0.51**	**3.55**	**0.001**	22	0.30	1.41	0.174	22	0.39	1.89	0.073
Central path (3 possibilities) /average balances 2M lag	39	0.12	0.71	0.484	38	**0.50**	**3.44**	**0.001**	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	117	0.10	1.07	0.286	113	**0.51**	**6.17**	**0.000**	77	**0.30**	**2.77**	**0.007**	65	**0.37**	**3.14**	**0.002**
Central path repeated (case with 5 possibilities)/balances 2M lag	117	0.13	1.36	0.176	113	**0.50**	**6.10**	**0.000**	77	**0.37**	**3.43**	**0.000**	65	**0.30**	**2.51**	**0.014**
Central path repeated (case with 3 possibilities)/balances 1M lag	117	0.09	0.98	0.326	113	**0.49**	**5.94**	**0.000**	77	**0.27**	**2.45**	**0.016**	65	**0.32**	**2.73**	**0.008**
Central path repeated (case with 3 possibilities)/balances 2M lag	117	0.13	1.45	0.148	113	**0.47**	**5.66**	**0.000**	77	**0.34**	**3.16**	**0.002**	65	0.24	1.96	0.054

Statistically important associations are bolded.
Source: own calculations.

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 in which 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 result 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 important as well.

Chart 1. Central path and balances for the Czech Republic
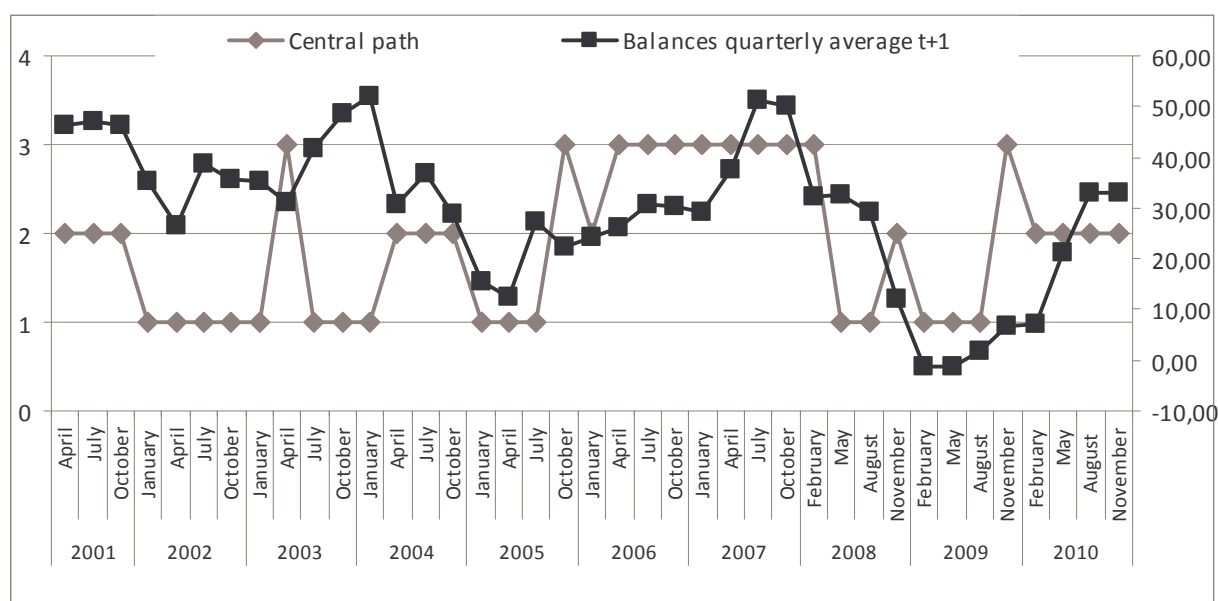
Source: own work.

Table 7. The associations between policy path and balances for the CNB

	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**

Statistically important associations are bolded.
Source: own calculations.

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 7. The coefficients are statistically important in 5 out of 6 cases and their strength is moderate. It means that the consumers in 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 where 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.

However, the policy path explanation is not the only possible one. Previously described options consisting in searching for possible explanation 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 monotonic association 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 association is moderate, around 0.5 for every pair of variables. Again the result is surprising, regarding the practice of the HNB. 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 associations of variables analyzed monthly are statistically important, however, they are quite week. The strength is consistent with the practice of the NBP. The forecast is the decisive input neither 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 loosing its importance in Polish monetary policy.

In Romania three out of four associations given in monthly cycle and 3 out of 8 relations in quarterly cycle are statistically important (positive coefficients of weak or moderate strength). These 3 relations assume 1 month lag. Here the interpretation is limited because of the reasons that were already described: the NBR operated in different market condition than the other banks.

The next step in quantitative analysis is testing the existence of interdependences between inflation forecast results and the level of inflation expectations or their direction of change. Table 8 presents the Spearman and Kendal coefficients. 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.

Table 8. 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 5 possibilities)/business expectations	39	0.277	1.754	0.088	0.204	0.067
Central path (case with 5 possibilities)/direction of business expectations change	**39**	**0.505**	**3.559**	**0.001**	**0.436**	**0.000**
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
Central path (case with 3 possibilities)/business expectations	39	0.232	1.453	0.155	0.173	0.119
Central path (case with 3 possibilities)/direction of business expectations change	**39**	**0.478**	**3.311**	**0.002**	**0.420**	**0.000**
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
Policy path/ business expectations	**34**	**0.587**	**4.100**	**0.000**	**0.499**	**0.000**
Policy path/direction of business expectations change	**34**	**0.507**	**3.331**	**0.002**	**0.454**	**0.000**
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 (1Mlag)	22	0.396	1.931	0.068	0.314	0.041
Central path (case with 5 possibilities)/direction of consumers expectations change (1Mlag)	**22**	**0.609**	**3.436**	**0.003**	**0.553**	**0.000**
Central path (case with 5 possibilities)/consumers expectations (2Mlag)	**22**	**0.439**	**2.183**	**0.041**	**0.353**	**0.021**
Central path (case with 5 possibilities)/direction of consumers expectations change (2Mlag)	22	0.071	0.317	0.755	0.067	0.662

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

Statistically important associations are bolded.
Source: own calculations.

Taking into consideration the Spearman rank correlation coefficient for the Czech Republic, 5 out of 12 associations are statistically important, 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 important). However, the strength of associations is not imposing: a relative indication of the degree of association between inflation forecast result and inflation expectation does never approach 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 with1M lag for Poland) . It is the strongest relation, considering both measures of rank correlation. The coefficients that

are statistically important are positive, which means that inflation forecast results and inflation expectations are changing in the same direction.

Table 9. 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 5 possibilities)/direction of business expectations change			
Pearson's χ^2	12.23724	df=8	p=0.140
χ^2 of the highest credibility	14.63492	df=8	p=0.066
Cramér's V	0.39609		
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		
Central path (case with 3 possibilities)/direction of business expectations change			
Pearson's χ^2	**9.686688**	**df=4**	**p=0.046**
χ^2 of the highest credibility	**11.07218**	**df=4**	**p=0.025**
Cramér's V	**0.35240**		
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		
Policy path/direction of business expectations change			
Pearson's χ^2	**13.18307**	**df=4**	**p=0.010**
χ^2 of the highest credibility	**13.67578**	**df=4**	**p=0.008**
Cramér's V	**0.44030**		

Statistically important associations are bolded.
Source: own calculations.

The calculation presented in table 8 is consistent with those presented in table 6. For the Czech Republic 5 associations are statistically important but only one of them represents households expectations. Business expectations were not represented in EC surveys. Here the results suggest that there is an interdependence between inflation forecast result and expectations of companies. At the same time no relation is found for the consumers expectations except for the central path with 5 possibilities and the levels of consumers expectations. There are two interdependences for Hungary, which is not in contradiction to previously obtained results – here the expectation comes form own survey of the HNB. For Poland 4 version with repeated forecast are statistically important but the relation is of low strength which confirms the results obtained for balances. 5 possibilities case for inflation forecast is also correlated with average of the inflation expectations for 1M and 2M lag. Two other pair of variables (central path with 5 possibilities/direction of expectations change,

central path with 3 possibilities/ direction of expectations change) are also statistically important.

The last scope of the empirical part concerns the context of the time series of the lowest quality: inflation forecast and expectations are now expressed on ordinal scale. The interdependences between them have already been tested. Here the alternative statistic is used: chi-square test for independence and Cramér's V as the measure of interdependence.

Table 10. 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		

Source: own calculations.

Six relations are tested for the Czech Republic (table 9). 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 important. The same is true for the following pairs of variables: central path (case with 5 possibilities)/direction of business expectations change, central path (case with 3 possibilities)/direction of consumers expectations change, policy path/direction of consumers expectations change.

For the case of central path (case with 3 possibilities)/direction of business expectations change and policy path/direction of business expectations change, for the significance level of 5%, null hypothesis can be rejected, and at the same time – alternative hypothesis saying that inflation expectations of business depend on the relation of inflation forecast to the inflation target can be accepted. However, the interdependences are quite weak.

Table 11. Chi-square test for independence - Poland

Statistics	χ^2	df	p
Central path (case with 5 possibilities)/direction of consumers expectations change (1Mlag)			
Pearson's χ^2	13.20000	df=8	p=0.105
$\chi^2$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 (2Mlag)			
Pearson's χ^2	6.678571	df=8	p=0.571
$\chi^2$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 (1Mlag)			
Pearson's χ^2	**12.32000**	**df=4**	**p=0.015**
$\chi^2$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 (2Mlag)			
Pearson's χ^2	3.775794	df=4	p=0.437
$\chi^2$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 (1Mlag)			
Pearson's χ^2	5.730035	df=8	p=0.677
$\chi^2$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 (2Mlag)			
Pearson's χ^2	6.237344	df=8	p=0.620
$\chi^2$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 (1Mlag)			
Pearson's χ^2	1.468189	df=4	p=0.832
$\chi^2$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 (2Mlag)			
Pearson's χ^2	4.046806	df=4	p=0.399
$\chi^2$of the highest credibility	3.840728	df=4	p=0.427
Cramér's V	0.164252		

Statistically important associations are bolded.
Source: own calculations.

Table10 presents the results for Hungary. Only two possible dependences were tested. None of them proved to be statistically important. The similar outcome is for Poland (table 11) where only pair of variables: central path (case with 3 possibilities)/direction of consumers expectations change (1Mlag) is depended.

The chi-square test for independence and measures derived from it offer the possibility to test associations 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 calculations above present only a rough picture of the interdependence between inflation forecast and expectations.

A few general conclusions can be drawn for cross-country comparison. 5 cases version does not seem to reflect the association better than 3 cases version of the central path relation to the goal. The same is true for lags. However, 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 greater comparability. In this case no version proved to be more suitable for 4 countries. However, the analysis of expectations in terms of the direction of change proved to be the poorest solution.

The Czech Republic case included also business expectations. Here the statistically important relationships exist for 4 pairs of variables (levels and directions) whereas there is only 1 for consumer expectations (taking into consideration the same set of variables). Better understanding of the forecast message and higher reliability of surveys held among companies are possible explanations here.

Testing the associations of the inflation forecast results and the expectations gave no unambiguous results. This conclusion should lead to a broader economic interpretation that will be given in the next section.

6. How the results can be interpreted

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 forecast are not empirically confirmed. If they were, there should be an association between the two variables. The interdependences are not statistically important or the strength of association is at the most moderate. The empirical study resulted in no unambiguous conclusions despite a broad range of measures applied and various pairs of variables tested. Simultaneously, the study of the associations between the inflation forecast and inflation expectations has a strong justification in theory. There are several reasons why the study results may seem unsatisfactory with reference to theory.

First of all, the theory itself does not seem satisfactory for all researchers. It is grounded in the NNS framework which 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 (Toedter 2008). One argues that this theory does not determine the price level or the inflation rate (Cochrane 2007). There are two alternative views of the central bankers and academics on the future development of the central banking discussed. The first one - continuity view – does not reject thoroughly the NNS. The central bank, while acknowledging the changes that have occurred, interprets them essentially as unusual "shocks" in the context of a fairly stable macroeconomic environment or model of the economy. By contrast, in the second, or new-environment view, the central bank sees recent economic developments as related to and reinforcing one another. Taken jointly, they would reflect a qualitative change in the macroeconomic environment. Such a change is not so easily captured by economic models and can point to a more significant modification to traditional policy guides. Such a central bank is more likely to adjust its beliefs regarding the operation of the economy and to make corresponding changes in its policy approach (Borio, English, Filardo 2003). 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).

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The empirical research does not also confirm the assumption that the economic agents form their expectations rationally. That assumption lies beneath the NNS framework. The research actually proves that the expectations formation is of a hybrid nature: partly adaptive and partly forward-looking (Gerberding 2001, Forsells, Kenny 2002). It confirms that the inflation forecast cannot stand for the most important factor in expectations shaping process. The composition of expectations is reflected in Hybrid New Keynesian Phillips Curve. Simultaneously rational expectations hypothesis is being weaken taking the form of adaptive learning hypothesis (Cierkoński 2008).

The drawbacks of the transmission models are directly connected with the main focus of this study. They account for the **second reason** why the results do not confirm the theory. If the model does not capture economic situation properly, the forecast is biased, of which the monetary policy committee is aware. It does not perceive the forecast as the main input to the decision-making process. This behavior 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.

The third reason why the results are not unambiguous is an extension of the second one. The MPC may ignore the forecast message for any reason. Not only because it perceives the model as inadequate. It may also rely on current issues, especially on exchange rate fluctuations as the main inflation determinant while making decisions on interest rates. The consequence in inflation forecast targeting is a necessary precondition of fulfilling external function (expectations shaping). 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 result and inflation expectations should be the strongest in the case of the Czech Republic. In fact they are not. There are no statistically important associations between the inflation forecast results and balances of the answers to the question on expected inflation regardless of the version of the analysis. Chi-square test does not confirm the dependence of the inflation forecast result and the expectations as well. The Spearman and Kendall tau rank correlation coefficients are statistically important only once in the case of households expectations. Only most of the relations regarding business

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expectations are statistically important. The lack of associations 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 associations proved to be positive.

Here **the fourth reason** why the results are not satisfactory appears: the understanding of the central bank forecast and its actions by the public. Revealing forecast means only increasing the institutional transparency of the central banker. It does not necessarily mean that the forecast, especially the projection, is properly interpreted. The way of communicating monetary policy stance, the decisions on interest rates as well as revealing inflation forecast are also important. 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. Moreover, the information published can be perceived as more decisive for the MPC, which has been already described. The simultaneity of information publishing is also important: assuming that the conditionality of projection is understood, any change of the interest rate makes the projection invalid. Here the coefficients are positive. It means that the forecast is not read in terms of probable future policy action. It may be connected with the understanding of the forecast as well as with the central bank credibility.

The fifth explanation is connected with the measures of expectations. Surveys results regardless of their shortcomings, are commonly used by the central banks and referred to in the Inflation Reports. No associations between quantitative surveys on households expectations and inflation forecasts could be understood – the surveys were perceived as unreliable and this is the reason why they were abandoned in the Czech Republic and Hungary. However, if only methodological issues lied beneath the results, the interdependences of the forecast results and inflation expectations for Poland, where consistent data on expectations based are available, should be relatively stronger.

The sixth reason for not finding sound associations 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.

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The hypotheses in the introduction are not confirmed. The first one because of not unambiguous results and the second one - 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 – because the firs one is not confirmed. The study covers four countries that were chosen due to certain similarities. In spite of them, 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 message of the forecast. None of applied solutions proved to support the relationship between the inflation forecast and expectations.

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7. Conclusion

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. 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 behavior of the central banks (producing and revealing inflation forecasts) led to the presentation of two hypotheses. The first one assumes that the associations 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 – statistically important interdependences between several pairs of variables are 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 implement 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.

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