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# The Role of Inflation Expectations in the New EU Member States: Consumer Survey Based Results*

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*Abstract*
*The objective of this paper is to analyze the link between inflation expectations and actual inflation in the New EU Member States (NMS). To achieve this goal, the results of a qualitative consumer survey were transformed into a quantitative measure of inflation expectations using the Carlson-Parkin approach. Afterwards, small-scale VAR models capturing actual inflation and inflation expectations were produced. Both the survey data and the quantified values of inflation expectations confirm that inflation expectations increased substantially prior to the NMS accession to the EU (in the case of Slovenia prior to accession to the EMU), with the expected inflation rate surging notably above the observed price increases. The findings of the VAR models indicate that inflation expectations have a positive impact on actual inflation in almost all the NMS; however, the potential problems of omitted variables and short sample period reduce the significance of this result.*

## 1. Introduction

The inflation expectations play an important role in contemporary macroeconomic theory and practice to the extent that they affect the behavior of economic agents and their expenditure, savings, and investment decisions.[1] Higher inflation expectations affect prices from both the demand side, pushing down real interest rates, and the supply side, pushing up nominal wages and hence also production costs. Considering this, strong inflation expectations should be perceived as alarming signal predicting an eventual upward inflationary trend and a potential drop in agents' confidence.

When dealing with inflation expectations, researchers face a problem: inflation expectations are not directly observable. There are two approaches to assessing the magnitude of inflation expectations. First, the researcher can make a number of assumptions about the expectation generation mechanism based on economic theory (e.g., forward-looking rational expectations) and build an economic model incorporating an inflation expectations variable. In this case, the indirect estimate of inflation expectations will strongly depend on the assumptions regarding expectations formation. Direct measurement of inflation expectations is an alternative approach for the assess-

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[1] More details about the role of expectations in economic theory can be found in (Evans, Honkapohja, 2001).

ment of inflation expectations. The related measurements can be built either on financial market indicators or the results of business and consumer surveys.

The objective of this paper is to analyze the link between inflation expectations and actual inflation in the New EU Member States (NMS).[2] In order to do this, the results of a qualitative consumer survey carried out by the EC were transformed into a quantitative measure of inflation expectations in the NMS using the Carlson--Parkin approach. Afterwards, small-scale VAR models capturing actual inflation and quantified inflation expectations in the NMS were produced. Although the impulse response functions of the VAR models give some information about the factors affecting inflation expectations, no inferences related to the rationality and forward--looking behavior of economic agents are made in this study.[3]

Section 2 reviews the statistical data on consumer surveys. Section 3 describes the probability or Carlson-Parkin approach to quantifying inflation expectations, while Section 4 provides an assessment of perceived and expected inflation in the NMS. Section 5 analyses the interaction between inflation and inflation expectations using a small-scale VAR model. The results are summarized in the conclusion.

## 2. Consumer Survey Data on Inflation Expectations in the New EU Member States

In the European Union countries, consumer surveys are conducted within the framework of the Joint Harmonised EU Programme of Business and Consumer Surveys. The data, published by the European Commission (EC), are based on surveys carried out by public and private institutions in the Member States. The consumer surveys are carried out on a monthly basis, although some additional questions are included in quarterly surveys. The presentation and methods of these monthly and quarterly surveys are the same across countries, while the questions are harmonized following EU guidelines. The sample size of the survey varies from 800 in Estonia to 1,500 in Hungary and Slovenia. To make the results comparable, the same time period for all NMS was used in our analysis. Therefore, the survey data starts in May 2001, as for some countries data was not available for earlier periods.

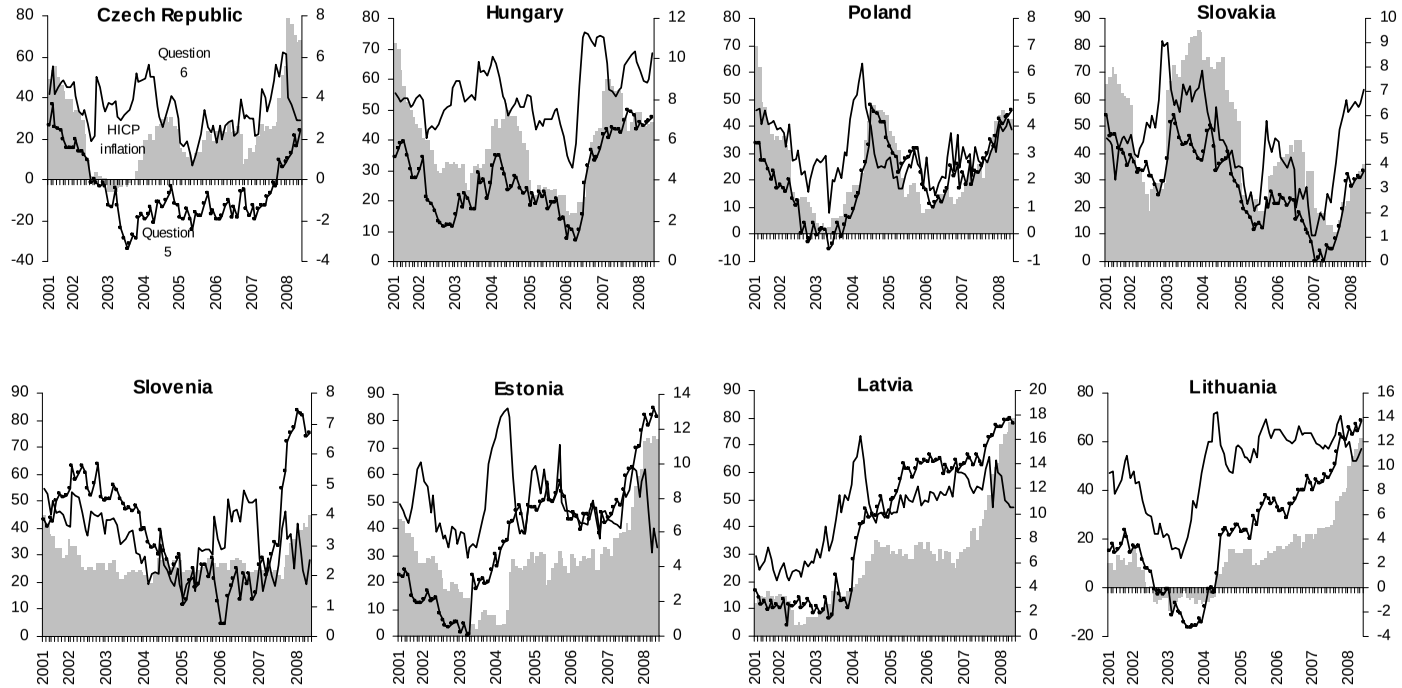
As the study focuses on the analysis of inflation expectations, the respondents' answers to two questions – Question 5 and Question 6 – are analyzed. The respondents were asked to evaluate the current consumer price level vis-à-vis that of 12 months ago and to express their opinion concerning anticipated price movements in the next 12 months (the precise formulations of the questions and answers are presented in the Appendix). As a rule, the response statistics are published as balances or the difference between the positive and negative response options (see equation (7) in the Appendix).

*Figure 1* demonstrates that the option balances for Question 5, which represents consumers' perception of price changes, is in most cases correlated with actual inflation. Consumers' perception of inflation decreased in line with a slowdown in the actual inflation rate, which was especially pronounced for the period between

[2] The analysis was performed for the Central European and Baltic States that joined the European Union in 2004: the Czech Republic, Hungary, Poland, Slovakia, Slovenia, Estonia, Latvia, and Lithuania.

[3] An excellent example of research assessing the rationality of inflation expectations is (Forsells, Kenny, 2004).

FIGURE 1 Perception of Actual and Expected Inflation Based on Survey Data




*Notes*: Response balances for Question 5 and Question 6 (left hand scale), % for annual HICP growth (right hand scale). Question 5 refers to perceived inflation while Question 6 – to expected inflation. Sample period: May 2001–May 2008.

*Sources*: European Commission; Eurostat

2001 and mid-2003. A positive correlation can also be observed for the periods of rising inflation.

However, we must emphasize that in some cases consumers' perceptions differed from the actual situation. First, consumers poorly captured changes in actual inflation when the level of actual annual inflation was moderate (within 1–3 %). One example is the Czech Republic between 2004 and 2007, when, despite some fluctuations in annual HICP growth between 1 % and 3 %, the option balances for Question 5 as well as the distribution of the responses were rather stable. Another example is Latvia, where the option balance for Question 5 was stable within the range of 10–20 points and the distribution of the answers was also steady during 2001–2003, despite changes in the actual inflation rate. Perhaps, as the moderate inflation rate did not hinder the economic decision-making process, the respondents did not perceive such changes in HICP growth.

The analysis of the detailed survey data (the distribution of the answers, which can be found in the database attached to the article) shows some misperception of inflation also in periods of deflation (the beginning of 2003 in the Czech Republic and 2002–2003 in Lithuania). Although the balances of the responses to Question 5 show a low level of perceived inflation in both cases, the distribution of the responses shows that consumers perceived slight growth of prices rather than deflation. For Czech consumers, the most popular answer shortly after a period of deflation was that prices "stayed about the same," while only 10–15 % assumed that prices "fell" and more than 30 % thought that prices increased. In Lithuania during the deflation period, only 10 % of consumers answered that prices "fell," while more than half of the respondents stated that prices were increasing.

With regards to inflation expectations, the survey data report that there was a substantial increase in inflation expectations prior to accession to the EU. This was especially pronounced for Poland and the three Baltic countries. Right before accession to the EU, the share of respondents expecting prices to "increase more rapidly" reached more than 40 % in the Czech Republic and Hungary and more than 50 % in Poland and Slovakia, while the most pessimistic consumers were in the Baltic States: more than 60 % of consumers expected inflation to accelerate (almost 80 % in Estonia).

The only country that did not experience rising inflation expectations prior to EU accession was Slovenia. However, there was a notable acceleration of expectations in 2006, which was apparently linked to the forthcoming introduction of the euro. After Slovenia joined the EMU at the beginning of 2007, inflation expectations declined to the previous level.

In other countries, inflation expectations calmed down almost immediately after accession to EU (although in Latvia and Lithuania they settled at a higher level than before) and in most cases remained stable until 2007. During that period, the most popular answer in almost all the NMS was that prices would "increase at the same rate". However, it should be noted that the actual growth in prices ("the same rate") proceeded at a significantly faster pace in the Baltic countries. Finally, inflation expectations were on the rise in 2007 as more and more respondents expected prices to "increase more rapidly," and the level of expectations compared to actual inflation is similar to the peak before accession.

## 3. Assessment of Inflation Expectations: The Carlson-Parkin Approach

The consumer survey data provide useful information about how the respondents assess the actual situation and what their inflation expectations may be. The data, however, have some disadvantages. First, it should be noted that the formulation of Question 6 implies a comparison with the current situation. Hence, the magnitude of inflation expectations is expressed not only in the answers to Question 6, but also in the perception of the current situation. Second, the survey data are difficult to interpret, as they are not directly comparable with actual inflation. Consequently, it would be beneficial to express expected inflation as the expected annual percentage growth of prices.

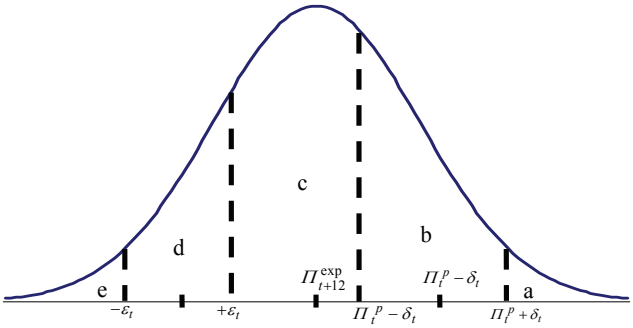
Such disadvantages can be eliminated by inflation expectations estimates or quantification methods under which the survey data are transformed into an annual percentage rate of change in prices. The probability or Carlson-Parkin approach is most often used in the quantification of inflation expectations. Initially, Carlson and Parkin (1975) developed an original technique for quantifying the results of a three--category survey with the following three response options: "prices will rise," "prices will stay the same," and "prices will fall." Later, Batchelor and Orr (1988) extended this initial quantification methodology to five response options, which are currently used in the EC surveys.

Under the probability approach, the response shares from each question of the survey can be treated as maximum likelihood estimates of the areas under the aggregate density function of expected inflation. There is an important assumption about the existence of a range of price increases that are close to zero: the respondents are incapable of distinguishing small changes from no change at all. In addition, expected inflation is surrounded by an area of price hikes that respondents are incapable of distinguishing from the perceived rate of price increases. At first, Carlson and Parkin (1975) assumed that the expectation distribution range is the same for all respondents and constant over time; Batchelor and Orr (1988) later assumed that the distribution range may vary over time; Seitz (1988) further softened the constraint, assuming that the range can be asymmetric and stochastic. For the purposes of quantifying inflation expectations, we use the probability or Carlson-Parkin approach. As the EC consumer survey has five categories, we selected the Carlson-Parkin approach adjusted by Batchelor and Orr (1988). The short time series of the New EU Member States' consumer surveys precluded the application of another approach proposed by Seitz (1988).

The probability approach assumes that individuals have formed expectations about inflation in the coming 12 months based on a subjective probability distribution $f_i\left(\Pi_{i,t+12}\middle|I_{i,t}\right)$, conditional on the subjective information set $I_{i,t}$. The individual subjective probability distributions can be aggregated to obtain the joint probability distribution of expectations $g\left(\Pi_{t+12}\middle|\Omega_t\right)$, conditional on the joint information set $\Omega_t$. Quantification is an exercise of finding the mean of the joint distribution of inflation expectations $\Pi_{t+12}^{\exp} = E\left(\Pi_{t+12}\middle|\Omega_t\right)$.

As mentioned above, the response shares from each question of the survey can be interpreted as maximum likelihood estimates of the areas under the joint density

FIGURE 2 Aggregate Density Function of Inflation Expectations




*Notes*: a) increase more rapidly; b) increase at the same rate; c) increase at a slower rate; d) stay about the same; e) fall

*Source*: (Batchelor, Orr, 1988)

function (see *Figure 2*). Those respondents who opted for the answer "don't know" were proportionally allocated to the remaining response categories. Moreover, the Carlson-Parkin method cannot be employed in cases where some shares of respondents are equal to zero. Therefore, as in some months the response share in the "falling prices" category was zero, the study assumes that in such cases the response share is 0.05 %.

To quantify inflation expectations, the Carlson-Parkin approach uses a number of assumptions. It is assumed that close to zero there exists a range of price changes which respondents cannot distinguish from constant prices, and close to the perceived inflation rate there exists a range of price increases at a rate that cannot be distinguished from the perceived rate of inflation. Hence, the respondent considers that prices will not change and chooses answer d) when expected inflation is within the range $-\varepsilon_t$ to $\varepsilon_t$, where $\varepsilon_t$ denotes the size of the range. The respondent believes that the annual inflation rate will not change either and chooses answer b) when expected inflation is within the range $\Pi_t^p - \delta_t$ to $\Pi_t^p + \delta_t$, where $\Pi_t^p$ represents perceived inflation and $\delta_t$ stands for the size of the range. Moreover, it is assumed that these indifference areas close to zero and perceived inflation are exactly the same for all respondents, yet they can change over time.

Another assumption is made about the distribution function. It is assumed that the aggregate distribution function follows a normal distribution, which is justified by the Central Limit Theorem (see (Carlson, Parkin, 1975)). However, some authors also use other distribution functions. Thus, Bachelor and Orr (1988) used the standard logistic distribution function, whereas Łyziak (2003) employed the uniform distribution function. However, the studies of Nielsen (2003) and Berk (1999) prove that alternative distribution functions do not influence the outcomes significantly.

According to the Carlson-Parkin approach, the next step is standardization of the key points under the distribution function ($\sigma_{t+12}$ is the standard error of the joint distribution of inflation expectations):

$$Z_{t+12}^1 = \frac{\Pi_t^p + \delta_t - \Pi_{t+12}^{\exp}}{\sigma_{t+12}} \tag{1}$$

$$Z^2_{t+12} = \frac{\Pi^p_t - \delta_t - \Pi^{\exp}_{t+12}}{\sigma_{t+12}} \tag{2}$$

$$Z^3_{t+12} = \frac{\varepsilon_t - \Pi^{\exp}_{t+12}}{\sigma_{t+12}} \tag{3}$$

$$Z^4_{t+12} = \frac{-\varepsilon_t - \Pi^{\exp}_{t+12}}{\sigma_{t+12}} \tag{4}$$

Under the assumption of the cumulative density function, we can derive estimates for $Z^i_{t+12}$ from the shares of the responses to Question 6. Thus, $\Phi\left(Z^1_{t+12}\right)$ is the share of respondents who opt for answers b) to e), $\Phi\left(Z^2_{t+12}\right)$ represents the share of answers c) to e), $\Phi\left(Z^3_{t+12}\right)$ is the share of those who chose answers from d) to e), and $\Phi\left(Z^4_{t+12}\right)$ is the share of respondents whose answer is e). $\Phi(\cdot)$ denotes the cumulative normal distribution function.

Now we have four unknown variables ( $\Pi^{\exp}_{t+12}$, $\sigma_{t+12}$, $\delta_t$, $\varepsilon_t$ ) and a system of four equations. The transformation of equations (1)–(4) leads to an inflation expectations equation (see (Berk, 1999) for more details on the derivation of $\sigma_{t+12}$, $\delta_t$, and $\varepsilon_t$ ):

$$\Pi^{\exp}_{t+12} = -\frac{Z^3_{t+12} + Z^4_{t+12}}{Z^1_{t+12} + Z^2_{t+12} - Z^3_{t+12} - Z^4_{t+12}} \cdot \Pi^p_t \tag{5}$$

As Question 6 incorporates a comparison with the current situation, perceived inflation $\Pi^p_t$ is of great importance for the estimation of inflation expectations. Perceived inflation can be estimated in several ways. First, it may be assumed that the respondents perceive actual inflation correctly, hence its rate will coincide with the officially published inflation ( $\Pi^p_t = \Pi_t$ ).

Alternatively, perceived inflation can be assessed in a similar way using the Carlson-Parkin approach, building on the percentage share of answers to Question 5.

$$\Pi^p_t = -\frac{A^3_t + A^4_t}{A^1_t + A^2_t - A^3_t - A^4_t} \cdot \Pi^m_t \tag{6}$$

where $A^i_t$ is analogous to $Z^i_{t+12}$ in equations (1)–(4). However, there is a problem in that Question 5 has only one anchor point, i.e., answer d) (zero inflation in this case). The existing literature suggests using answer b) as the second anchor point $\Pi^m_t$, which corresponds to moderate inflation. In such a case, an additional assumption is to be made as to what respondents consider to be a moderate rate of inflation. The following assumptions for this moderate rate of inflation are used:

– average annual inflation over the sample period – see (Reckwerth, 1997);
– the average from the beginning of the sample period to the point of conducting the survey – see (Nielsen, 2003);

– linear interpolation between the average of the first half of the period and the average of the second half of the period – see (Curto Millet, 2006).

## 4. Quantifying Inflation Expectations in the New EU Member States

According to the Carlson-Parkin methodology, prior to the quantification of inflation expectations, perceived inflation should be evaluated. One way to do that is to assume that respondents perceive actual inflation correctly. However, one can argue that the assumption of an absolutely correct perception of actual inflation by respondents is questionable, as the previous analysis in Section 2 showed that there are cases where inflation perceptions do not coincide with actual inflation. Therefore, perceived inflation should be quantified using equation (6).

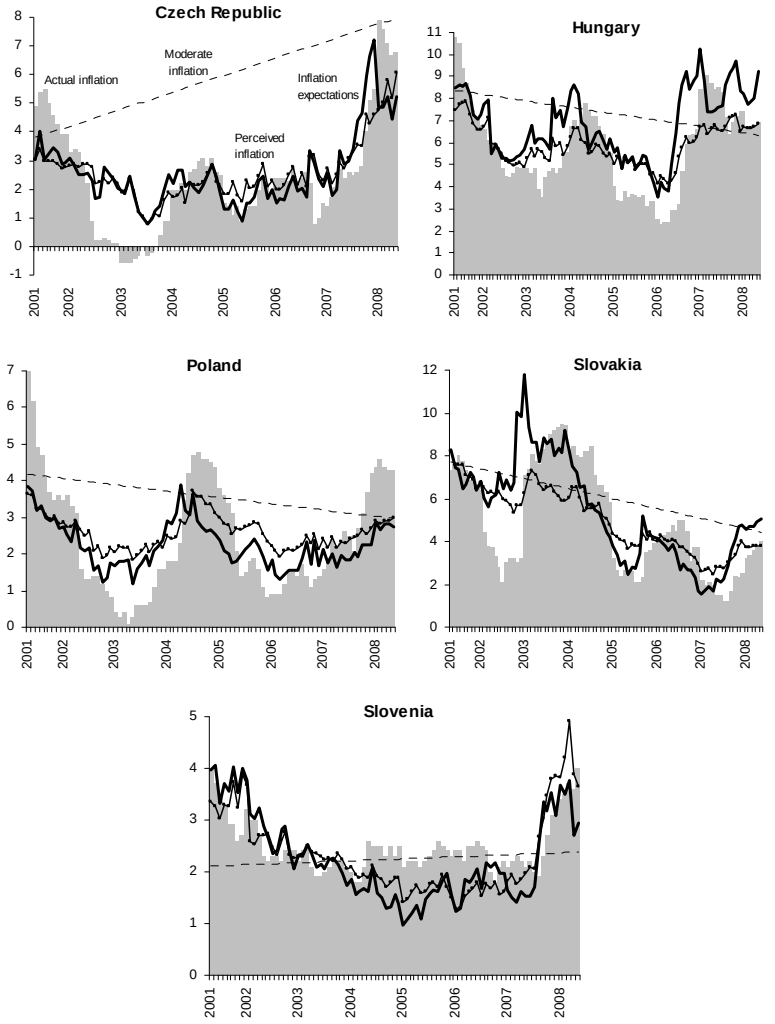
Now the key issue becomes precisely what inflation rate is considered moderate by the respondents in the NMS. After considering all the methods described at the end of Section 3 and evaluating moderate inflation and inflation expectations, two findings must be emphasized. First, the levels of quantified perceived and expected inflation are very sensitive to the choice of moderate inflation, as can also be seen from equations (5) and (6). Second, all the above-mentioned approaches lead to implausibly low perceived and expected inflation in some NMS countries (the Czech Republic, Poland, and Slovakia). For example, for the Czech Republic the assumption that moderate inflation is equal to average inflation over the sample period leads to perceived and expected inflation below 1 % during 2004–2006 and between 1 % and 2 % during 2007–2008. Similar results were obtained using another two assumptions of moderate inflation.

To mitigate the previously mentioned drawbacks, the following way of estimating the level of moderate inflation in equation (6) can be proposed. The main assumptions are that consumers do not make systematic errors in their perceptions and that the average level of perceived inflation is equal to the average level of actual inflation during the sample period. The other assumption, which was made for simplicity reasons, is that moderate inflation changes linearly. Therefore, we need to find moderate inflation at the beginning and the end of the sample to minimize the sum of square differences between actual and quantified perceived inflation.

*Figure 3* shows perceived inflation and inflation expectations in the Central European NMS, while *Figure 4* depicts perceived inflation and inflation expectations in the Baltic States quantified by the Carlson-Parkin approach, evaluating moderate inflation by the method described above.

The Carlson-Parkin approach results for the Czech Republic show that quantified perceived inflation was much more stable than actual inflation in 2001–2003; hence, it was still positive (1–2 %) during the deflationary period. Afterwards, perceived inflation was rather close to actual inflation in the Czech Republic. As for the quantified expectations, they were similar to perceived inflation except for several months at the end of 2007, when expected inflation exceeded perceived annual inflation by ~2 p.p. This similarity to perceived inflation was determined by the fact that answer b) to Question 6 (increase at the same rate) has the largest share during the sample period, except for a short period prior to EU accession and the end of 2007.

FIGURE 3 Quantified Inflation Expectations and Perceived Inflation in Central European NMS

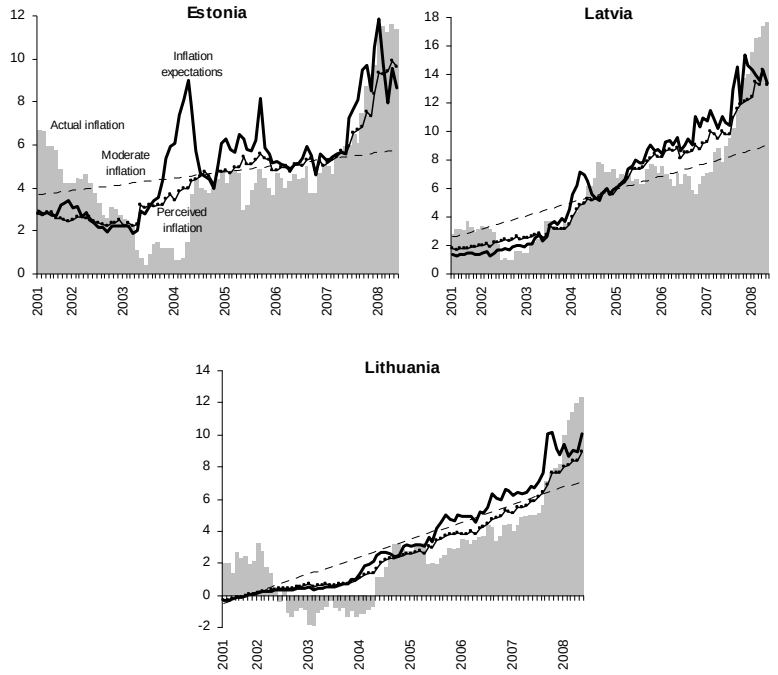



*Notes*: % for actual, moderate, perceived and expected annual inflation. Inflation expectations and perceived inflation quantified using Carlson-Parkin approach for five category survey (see (Batchelor, Orr, 1988), equations (5) and (6)). Moderate inflation evaluated assuming that it changes linearly and minimizing the sum of square differences between actual and perceived inflation. Sample period: May 2001–May 2008.

*Sources*: European Commission; Eurostat; own calculations

Quantified perceived inflation is correlated with actual inflation in Hungary, although perceived inflation has smaller fluctuations. Its relatively higher actual inflation compared to the Czech Republic also determines higher moderate inflation, which was estimated to be between 7 % and 9 % during the sample period. Quantified expected inflation is similar to perceived inflation, although there were two periods when expectations significantly exceeded perceptions: before accession to the EU and starting from mid-2006, when expected inflation was ~2 p.p. higher than perceived inflation.

FIGURE 4 Quantified Inflation Expectations and Perceived Inflation in Baltic States




*Note*: % for actual, moderate, perceived and expected annual inflation. Inflation expectations and perceived inflation quantified using Carlson-Parkin approach for five category survey (see (Batchelor, Orr, 1988), equations (5) and (6)). Moderate inflation evaluated assuming that it changes linearly and minimizing the sum of square differences between actual and perceived inflation. Sample period: May 2001–May 2008

*Sources*: European Commission; Eurostat; own calculations

Inflation expectations were lower than perceived inflation during the observed period in Poland (with a single exception before the accession date), as many respondents considered that prices would "stay about the same" or "increase at a slower rate" than before. Households' expectations were below perceptions even at the beginning of 2008, despite a notable increase in actual inflation. As in previous cases, perceived inflation correlates with actual inflation in Poland, although perceived inflation is more stable than actual inflation.

Despite significant fluctuations in actual inflation in Slovakia, quantified household perceptions gradually decreased from 8 % in 2001 to 4 % in mid-2007, with a slight increase afterwards. As in the other Central European NMS, inflation expectations significantly exceeded perceptions prior to EU accession and at the end of the sample period. In other periods, expectations in Slovakia were close to or below perceived inflation.

Perceived inflation and inflation expectations gradually declined in Slovenia, reaching ~1.5 % at the beginning of 2005. Inflation expectations exceeded perceived inflation in 2006, apparently due to the forthcoming introduction of the euro. However, afterwards, expectations were lower than the perceived inflation rate. Starting from mid-2007, both perceptions and expectations increased together with actual inflation.

Before 2004, perceptions did not capture actual inflation well in Estonia – perceived inflation was even growing in mid-2003 when actual inflation was declining. However, there was a strong link between actual and perceived inflation starting from mid-2004. The difference between inflation expectations and perceived annual inflation before accession to the EU in Estonia was the highest among the NMS (almost 5 p.p.). In other periods, expectations were close to perceptions except for some months in 2005 and the end of 2007. Finally, despite still high actual inflation, expectations decreased substantially at the beginning of 2008, which could be explained by the cooling down of the economy.

In 2001–2002, the perceived rate was stable in Latvia despite some variance in actual annual inflation. Perceived inflation started to increase in the second half of 2003 and kept on rising until the end of the sample period. Inflation expectations were very close to the perceived inflation rate except for the period before accession to the EU and 2006–2007, when an upward leap in quantified inflation expectations was observed.

As in the other Baltic States, quantified perceived inflation in Lithuania was stable before 2004, despite some changes in the actual figures. It was even positive (although quite low, ~1 %) during the deflation in 2002–2003. However, starting from mid-2004, perceived inflation captured the changes in the actual figures well. Quantified inflation expectations in Lithuania were similar to perceived inflation until the end of 2003, but expectations exceeded perceptions afterwards.

## 5. VAR Model with Inflation Expectations for the New EU Member States

One way to find out the role of inflation expectations in inflation formation is to include quantified expectations in a new Keynesian Phillips curve. An excellent example of such a study is Paloviita (2006), who uses direct measures of inflation expectations instead of imposing the rational expectations restriction to the Phillips curve. However, this approach omits the question about the formation of expectations. Therefore, in order to find out how and to what extent inflation expectations are linked to inflation in the NMS, a VAR model has been employed. A similar approach to determining the role of inflation expectations was shared by Paloviita and Virén (2005) for the euro area and Benkovskis and Paula (2007) for Latvia, who estimated a VAR model for three variables: actual inflation, inflation expectations, and the output gap.

In this paper, we use VAR models in differences. Depending on the exchange rate regime of the NMS, we employ two different sets of variables. In the case of the fixed exchange rate regime (Slovenia, Estonia, Latvia, and Lithuania[4]), the VAR model has the following endogenous variables:[5]

– $CORE_t$ denotes the log-differenced HICP excluding unprocessed food and energy components, capturing the actual consumer price level in the country. We will denote this variable core inflation (note that it may not coincide with national definitions of core inflation).

[4] The national currencies of Estonia and Lithuania are fixed to the euro (currency board). The Latvian lats was pegged to SDR prior to 2005 and pegged to the euro afterwards (with fluctuation margins of ±1 %). Slovenia became a member of the EMU in 2007, but previously, according to (Frömmel, Schobert, 2006), it *de facto* followed a crawling peg to the euro.

[5] In this case, the list of endogenous variables is the same as in (Paloviita, Virén, 2005).

– $EXP_t$ are inflation expectations relative to perceived inflation. As we use a VAR model in differences, it is not possible to use quantified inflation expectations expressed as expected annual changes in consumer prices. Therefore, we use inflation expectations quantified by the Carlson-Parkin approach (equation (5)) divided by perceived inflation. The advantage of this approach is the indifference of $EXP_t$ to the assessment of perceived inflation, so the results of the VAR models are not sensitive to the assumptions on moderate inflation. The ratios of inflation expectations to perceived inflation in the NMS countries are shown in *Figure 7* on the journals web page.
– $GAP_t$ is the output gap, measured using the simple Hodrick–Prescott filter (as monthly data have been used, $\lambda = 14{,}400$). In this model, the output gap captures the domestic demand of the economy. As only quarterly GDP data are available, interpolation was carried out, and the quarterly data were broken into monthly data with an unchanged quarterly sum total maintained. The interpolation was done using the state space model on the basis of real industrial output and retail trade turnover at constant prices (monthly data).[6]

For the other NMS, where the exchange rate is not fixed (the Czech Republic, Hungary, Poland, and Slovakia), we introduce two additional endogenous variables into the VAR model:[7]

– $NEER_t$ is the log-differenced nominal effective exchange rate of the national currency against the currencies of 41 major trade partners. The exchange rate is important due to the openness of the NMS economy as well as the share of tradable goods in the HICP basket of goods. This variable is not included as an endogenous variable set for the countries with fixed exchange rate regimes, as in this case movements in the nominal effective exchange rate are purely exogenous.
– $I\_3M_t$ is the first difference of the domestic currency's 3-month money market rate, which is traditionally the indicator of domestic monetary policy. In the case of the fixed exchange rate regime, this variable was not included in the VAR model due to the marginal role of domestic monetary policy.

When developing a VAR model which includes changes in the consumer price level, the strong pressure on inflation from a number of supply-side factors in NMS countries should be taken into account. These factors are to be included in the model; otherwise, the effects of demand and inflation expectations on prices would be misestimated. Thus, the following exogenous variables are included in the VAR model:

– $OIL_t$ is log-differenced Brent crude oil prices (in the domestic currency). As fuel prices largely depend on global oil prices, the latter should also be included in the model as an exogenous indicator.
– $P\_EU_t$ is the log-differenced PPI in the EU-27, capturing the producer price level in a major trade partner of the NMS. This is the underpinning factor affecting prices of tradable goods.

[6] The state space model results for real GDP in the NMS are available from the author upon request.

[7] For Central European countries, we use almost the same set of endogenous variables as in (Peersman, Smets, 2003) and (Mojon, Peersman, 2003). There are two differences, however. The nominal exchange rate is used instead of the real exchange rate, and inflation expectations are included in the VAR model.

- $FOOD_t$ denotes the log-differenced producer price index of the domestic food industry, representing supply shocks for food products (harvests, epidemics, etc.). In the case of Slovakia, we used the unprocessed food component of the HICP due to the absence of sufficiently long PPI data.
- $ENERGY_t$ is the log-differenced producer price index of the domestic energy sector, representing supply shocks for energy products apart from oil price changes (it should be noted that energy prices for consumers and producers are still regulated by local authorities in many NMS). Similar to the case of food prices, we used the energy component of the HICP for Slovakia and Slovenia.
- $I\_EUR\_3M_t$ is the first difference of the EURIBOR 3-month money market rate, which describes the monetary policy of the ECB.
- $NEER_t$ – for Slovenia, Estonia, Latvia, and Lithuania, the log-differenced nominal effective exchange rate of the national currency against the currencies of 41 major trade partners is included as an exogenous variable.

In addition to the above-mentioned variables, we use impulse dummy variables to describe shifts in the price level determined by administrative decisions not captured by the other variables, e.g. indirect tax changes. The price indices (HICP and PPI) were seasonally adjusted using the X-12-ARIMA program. According to the Augmented Dickey-Fuller test, all the variables included in the VAR models are stationary.

In order to test the interaction among the endogenous variables of the VAR model, impulse response functions were constructed. In doing so, the Choleski decomposition technique was used. The sequence of variables for countries with fixed exchange rate regimes is as follows: $GAP_t$, $CORE_t$, $EXP_t$. The output gap does not react immediately to the shock to actual inflation and inflation expectations, while expectations react immediately to all shocks in the model.

The sequence of variables for the other NMS is as follows: $GAP_t$, $CORE_t$, $\Delta I\_3M_t$, $NEER_t$, $EXP_t$.[8] Similar to the case of the fixed exchange rate, the output gap does not react immediately to any shock, while expectations react immediately to all shocks. The inflation level does not react immediately to changes in the domestic interest rate and exchange rate. At the same time, the monetary authorities change the interest rate in reaction to this period's output and inflation shocks. Finally, the nominal effective exchange rate dynamics immediately take into account all shocks except expectations shocks.

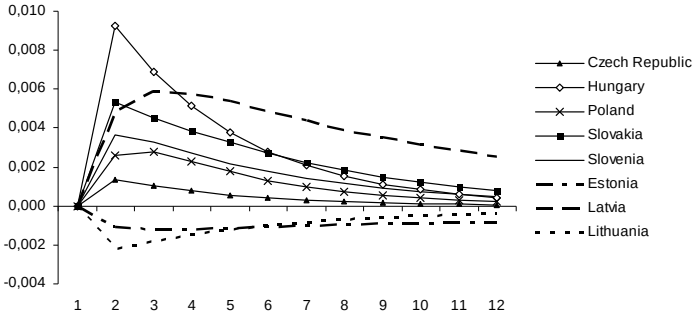
The VAR models are estimated for the period from May 2001 to March 2008 on a monthly basis. The choice of lag length for the model was made according to information criteria.[9]

The VAR model impulse response functions demonstrate that the reaction of core inflation to shocks in inflation expectations is positive in almost all the NMS (see *Figure 5*). The highest response of core inflation to a shock in expectations is observed in the VAR model for Hungary. The responses are also positive in the VAR

[8] The sequence of variables is similar to that in (Peersman, Smets, 2003) and (Mojon, Peersman, 2003) and expectations are added to the end of the list. It is possible, however, that expectations should stand before the exchange rate, as the exchange rate could react immediately to changes in inflation expectations. Nevertheless, changing the sequence of variables in the Choleski decomposition does not affect the results, as the correlations between the residuals in the expectations and exchange rate equations are minor.

[9] According to the Schwarz information criteria, the lag length was chosen to be 1 in all the VAR models.

FIGURE 5 Responses of Core HICP to Shock in Expectations




*Notes:* Responses of changes in monthly core inflation (percentage points) to a unit shock in expectations' variable (expectations' ratio to perceived inflation). Results from small-scale VAR models with inflation expectations.

*Source*: own calculations

models for Slovakia, Latvia, Slovenia, Poland, and the Czech Republic; moreover, the responses are positive and statistically significant for Hungary, Latvia, Poland, and Slovakia. The shock in inflation expectations has a negative, although statistically insignificant, impact on prices in the VAR models for Estonia and Lithuania. In all cases, the reaction of core inflation to the shock in expectations is quick, the strongest response being observed in the second or third month after the shock.

The full set of impulse response functions for all eight VAR models is given in *Figures 8–15*. Given space limitations in the printed version of the journal, Figures 8 to 15 are available online only. (See http://journal.fsv.cuni.cz.) Here, we briefly review the VAR model results for all the NMS, focusing on inflation, inflation expectations, and monetary policy responses.

### *Czech Republic*

The VAR model's impulse response functions demonstrate that the reaction of core inflation in the Czech Republic to the inflation expectations shock is positive, although not statistically significant. The impulse response function of inflation to the output gap has the expected (positive) sign, although the response is not statistically significant.

Inflation expectations have a significant reaction only to the expectations shock, showing that backward-looking behavior is important for the formation of inflation expectations. *Figure 8* on the journals web page indicates that expectations do not react to actual core inflation, which is determined by the definition of the expectations variable in the VAR model. The expectations variable is defined as the ratio of expected to perceived inflation, meaning that if the reaction of the expected inflation rate to a change in perceived inflation is one to one, the above-mentioned impulse response in the model should be equal to zero.

The money market interest rate has a statistically significant reaction to several shocks: a positive reaction to the output gap shock and a negative reaction to the exchange rate shock. It is interesting to note that according to the VAR model, both

inflation and inflation expectations shocks have a positive, although not statistically significant, effect on monetary policy in the Czech Republic.

***Hungary***

The reaction of inflation in Hungary to the expectations shock is positive and statistically significant. The reaction of prices to the output gap has the expected signs, but is not statistically different from zero (see *Figure 9*, on the journals web page).

As in the VAR model for the Czech Republic, the impulse response function shows a relatively high degree of inertia in expectations, which could partly explain the inflation persistence in Hungary. In addition, expectations positively and statistically significantly react to the demand shock. According to the VAR model's impulse response functions, monetary policy in Hungary, represented by the 3-month money market rate, does not have statistically significant reactions to any shocks apart from the monetary and exchange rate shocks.

***Poland***

Inflation in Poland positively and statistically significantly responds to the expectations shock. The other endogenous factors have no significant impact on consumer prices in Poland; however, core inflation has a positive response to the demand shock and a negative reaction to the interest rate shock (see *Figure 10*, on the journals web page).

The VAR model shows that the ratio of expectations to perceived inflation is positively and statistically significantly affected by the output gap shock. According to the VAR model impulse response functions, monetary policy in Poland is aware of domestic demand, the exchange rate, and inflation, although only the reaction to the output gap is statistically significant.

***Slovakia***

The VAR model for Slovakia has a positive and statistically significant impulse response of core inflation to the expectations shock. In addition, inflation positively reacts to the demand shock and negatively to the exchange rate shock (although in both cases the responses are not statistically significant – see *Figure 11*, on the journals web page).

According to the results, expectations in Slovakia are positively driven by the output gap shock. Notably, a significant and negative response of the expectations variable to the monetary policy shock is present. The money market interest rate is statistically significantly driven by the exchange rate shock, and there is a positive reaction to the inflation shock.

***Slovenia***

Although inflation has a positive response to the expectations shock, this reaction is not statistically significant. Moreover, inflation does not react to the output gap shock. The expectations variable has a significant reaction only to the expectations shock, indicating that expectations in Slovenia have some inertia – see *Figure 12*, on the journals web page.

***Estonia***

In Estonia, the reaction of actual inflation to the expectations shock is negative and not statistically significant. The demand shock has a negative impact on

actual core inflation (see *Figure 13*, on the journals web page), which could indicate some omitted supply side factors in the exogenous part of the model. The expectations variable has positive and significant reactions to the domestic demand and expectations shocks.

***Latvia***

The VAR model's impulse response functions for Latvia demonstrate that the reactions of core inflation to the expectations and demand shocks are positive, although the latter is statistically insignificant (see *Figure 14*, on the journals web page). The expectations variable has a significant reaction only to the expectations shock.

***Lithuania***

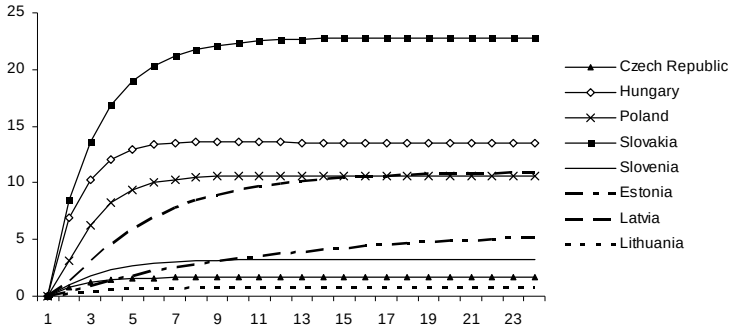
For Lithuania, the VAR model shows a negative and insignificant reaction of actual inflation to the shock in expectations. The expectations variable has a significant reaction to the demand and expectations shocks (see *Figure 15*, on the journals web page).

Now we can draw some overall conclusions about the results of the VAR models with inflation expectations for the NMS. As was stated before, the VAR models indicate a positive impact of a shock in expectations on actual core inflation for almost all the NMS from our set (the effect being statistically significant for four countries), the strongest response being observed in the second or third month after the shock. This is perhaps the most stable result coming out of the VAR models. On the one hand, the prompt inflation response to an inflation expectations shock may in part be associated with the inflation forecasting horizon, which is rather short. According to Nielsen (2003), when giving answers to survey questions respondents usually predict inflation for the next 3–6 months.

On the other hand, this could be a sign that some inflation-driving factors were not included in the model, while consumers were able to incorporate these factors into expectations a few months in advance. In this case, the positive response to the expectations shock just reflects the effect of omitted variables on inflation. Although quite a long list of exogenous variables was included in the VAR models, we cannot reject this possibility, as it is almost impossible to account for all changes in indirect taxes or administratively regulated prices. Moreover, the VAR models for the Czech Republic, Hungary, Poland, and Slovakia do not show any significant response of prices to the exchange rate shock, which could indicate overestimation of the responses to the expectations shocks.

Inflation expectations change in line with actual inflation (as indicated by the neutral response of the ratio of expectations to actual inflation to the inflation shock). Moreover, the VAR models indicate that when forming inflation expectations, consumers take into account changes in domestic demand (Hungary, Poland, Slovakia, Estonia, and Lithuania) as well as interest rates (Slovakia). Inflation expectations have some inertia in them, which shows that inflation expectations in the NMS are to a large extent backward-looking. The inflation expectations inertia is something to be reckoned with, because it means that as the effects of demand and supply shocks on actual core inflation subside, the inflation expectations inertia will not let actual core inflation fall instantly, thus indicating some degree of persistence

FIGURE 6 Contribution of Shock in Expectations to Variance of Core Inflation




*Note*: %, contributions of shock in expectations' variable (expectations' ratio to perceived inflation) to variance of core inflation
*Source*: own calculations

with respect to actual core inflation as well. Finally, according to the VAR models, inflation expectations do not play an important role in determining monetary policy.

Finally, to access the relative importance of expectations shocks to core inflation, a variance decomposition analysis of the VAR models was performed. *Figure 6* shows the contribution of the shock in expectations to the variance of core inflation.

The shock in expectations is very important in explaining the variation of core inflation in four NMS countries: Slovakia, Hungary, Latvia, and Poland, as the contribution from expectations shocks for these countries is in the range of 10–25 % (reported two years after the shock). However, these results should be treated with caution, for several reasons. First, only the variance driven by the endogenous variables is decomposed, leaving apart the variation created by exogenous variables such as energy, food prices, and tax changes. However, these variables are very important for inflationary processes in the NMS countries. Second, even taking into account the absence of supply-side factors in the variance decomposition, the contribution of the expectations shock still seems implausibly high, especially compared to the contributions of other shocks. For example, the contribution of the exchange rate shock to the variance of core inflation is very small in the VAR models for Slovakia, Hungary, and Poland (less than 3 %), which is hard to believe for such open economies. Such small contributions from the exchange rate shock stem from the above-mentioned fact that none of the VAR models for the NMS with flexible exchange rates indicated a statistically significant response of inflation to the exchange rate.

Overall, the evidence on the impact of expectations on actual inflation obtained from the VAR models is controversial, as on the one hand the models indicate a positive impact of shocks in expectations on actual inflation for almost all the NMS, therefore suggesting that shocks before accession to the EU contributed to actual inflation afterwards. On the other hand, the potential problems of omitted variables and short sample period reduce the significance of this result, indicating that further research is necessary in this area.

## 6. Conclusions

Consumer surveys are a valuable source of information, providing data on the inflation levels actually perceived and expected by the population. The employment of the probability approach allows for modification of the survey data so as to express perceived inflation and inflation expectations as annual percentage price increases.

The survey data on perceived inflation in the NMS correlates with actual inflation. However, there were some cases where consumers' perception of inflation differed from the actual situation. First, consumers did not capture changes in actual inflation when the level of inflation was moderate, i.e., in the range of 1–3 % (this was pronounced for the Czech Republic in 2004–2007 and Latvia in 2001–2003). The second misperception of inflation could be noticed in periods of deflation (the beginning of 2003 in the Czech Republic and 2002–2003 in Lithuania), when consumers still perceived some moderate positive inflation rate.

Regarding expectations, both the surveyed data and the quantified values of inflation expectations confirm that inflation expectations increased substantially prior to NMS accession to the EU, with the expected inflation rate surging notably above the actually observed price increases. After EU accession, the expected inflation rates returned to the levels of actual inflation, and in most cases the expected inflation rate stayed close to perceived inflation until 2007. Finally, inflation expectations were on the rise in 2007, with the level of expectations compared to actual inflation being similar to the peak levels before accession to the EU in the Czech Republic, Hungary, Slovakia, and Lithuania. The only country that did not experience rising inflation expectations prior to EU accession was Slovenia. However, there was a notable acceleration of expectations in 2006, which was apparently linked to the forthcoming introduction of the euro. After Slovenia joined the EMU at the beginning of 2007, inflation expectations declined to the previous level.

The VAR models indicate a positive impact of shocks in expectations on actual core inflation for almost all the NMS from our set (the effect being statistically significant for Hungary, Latvia, Poland, and Slovakia), the strongest response being observed in the second or third month after the shock. On the one hand, the prompt inflation response to an inflation expectations shock may in part be associated with the inflation forecasting horizon, which is rather short. On the other hand, this could be a sign that some inflation-driving factors were not included in the model, while consumers were able to incorporate these factors into expectations a few months in advance. Moreover, the VAR models for the Czech Republic, Hungary, Poland, and Slovakia do not show any significant response of prices to the exchange rate shock, which could indicate overestimation of the responses to the expectations shocks.

Inflation expectations change in line with actual inflation. Moreover, the VAR models indicate that when forming inflation expectations, consumers take into account changes in domestic demand (Hungary, Poland, Slovakia, Estonia, and Lithuania) as well as interest rates (Slovakia). Inflation expectations have some inertia in them, which shows that inflation expectations in the NMS are to a large extent backward-looking. The inflation expectations inertia is something to be reckoned with, because it means that as the effects of demand and supply shocks on actual core inflation subside, the inflation expectations' inertia will not let actual core inflation fall

instantly, thus determining some degree of persistence with respect to actual core inflation as well. Finally, according to the VAR models, inflation expectations do not play an important role in determining monetary policy.

Overall, the evidence on the impact of expectations on actual inflation obtained from the VAR models is controversial, as on the one hand the models indicate a positive impact of shocks in expectations on actual inflation for almost all the NMS, therefore suggesting that shocks before accession to the EU contributed to actual inflation afterwards. On the other hand, the potential problems of omitted variables and short sample period reduce the significance of this result, indicating that further research is necessary in this area.

## APPENDIX

Question 5: How do you think that consumer prices have developed over the last 12 months?

a) risen a lot
b) risen moderately
c) risen slightly
d) stayed about the same
e) fallen
f) don't know

Question 6: By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will…

a) increase more rapidly
b) increase at the same rate
c) increase at a slower rate
d) stay about the same
e) fall
f) don't know

Response statistics are usually published as balances of positive and negative response options. Response balances for Question 5 and 6 are calculated using the following formula (see (European Commission, 2004)):

$$\Sigma = a + 0.5 \cdot b - 0.5 \cdot d - e \tag{7}$$

where $\Sigma$ is the response balance and *a, b, d, e* are percentages of responses a), b), d) and e).

REFERENCES


Batchelor RA, Orr AB (1988): Inflation Expectations Revisited. *Economica*, 55:317–331.

Beņkovskis K, Paula D (2007): Inflation Expectations in Latvia: Consumer Survey Based Results. *Bank of Latvia Working Paper*, no. 1/2007, http://www.bank.lv/eng/main/all/pubrun/workingpap/2007/.

Berk JM (1999): Measuring Inflation Expectations: a Survey Data Approach. *Applied Economics*, 31:1467–1480.

Carlson JA, Parkin JM (1975): Inflation Expectations. *Economica*, 42:123–138.

Curto Millet F (2006): Finding the Optimal Method of Quantifying Inflation Expectations on the Basis of Qualitative Survey Data. *Narodowy Bank Polski Conference Materials*. http://www.nbp.pl/Konferencje/BBM/millet.pdf.

European Commission (2007): *The Joint Harmonised EU Programme of Business and Consumer Surveys. User Guide*. http://ec.europa.eu/economy_finance/indicators/business_consumer_surveys/userguide_en.pdf.

Evans GW, Honkapohja S (2001): *Learning and Expectations in Microeconomics*. Princeton University Press, Princeton NJ.

Forsells M, Kenny G (2004): Survey Expectations, Rationality and the Dynamics of Euro Area Inflation. *Journal of Business Cycle Measurement and Analysis*, 1:13-41.

Frömmel M, Schobert F (2006): Exchange rate regimes in Central and East European countries: Deeds vs. words. *Journal of Comparative Economics*, 34:467–483.

Łyziak T (2003): Consumer Inflation Expectations in Poland. *European Central Bank Working Paper*, no. 287, http://www.ecb.int/pub/pdf/scpwps/ecbwp287.pdf.

Mojon B, Peersman G (2003): A VAR description of the effects of monetary policy in the individual countries of the euro area. In: Angeloni I, Kashyap AK, Mojon B (eds): *Monetary Policy Transmission in the Euro Area.* Cambridge University Press, Cambridge: 56–74.

Nielsen H (2003): Inflation Expectations in the EU – Results from Survey Data. *Discussion Papers of Interdisciplinary Research Project 373*, Humboldt-Universität zu Berlin, no. 13. http://sfb.wiwi.hu-berlin.de/papers/2003/dpsfb200313.pdf.zip.

Paloviita M (2006): Inflation Dynamics in the Euro Area and the Role of Expectations. *Empirical Economics*, 31:847–860.

Paloviita M, Virén M (2005): The Role of Expectations in the Inflation Process in the Euro Area. Bank of Finland Discussion Paper, no. 6. http://www.bof.fi/en/julkaisut/tutkimukset/keskustelualoitteet/2005/dp2005_06.htm.

Peersman G, Smets F (2003): The monetary transmission mechanism in the euro area: evidence from VAR analysis. In: Angeloni I, Kashyap AK, Mojon B (eds): *Monetary Policy Transmission in the Euro Area.* Cambridge University Press, Cambridge: 36–55.

Reckwerth J (1997). Inflation and Output in Germany: The Role of Inflation Expectations. *Deutsche Bundesbank Discussion Paper,* no. 5.

Seitz H (1988): The Estimation of Inflation Forecasts from Business Survey Data. *Applied Economics*, 20:427–438.