

## CONSUMER INFLATION EXPECTATIONS

### *Usefulness of survey-based measures – a cross-country study*

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## **Abstract**

We have applied different versions of probability and regression methods to quantify consumers' inflation perception and expectations in the Czech Republic, Hungary, Poland and Slovakia. The assessment of their usefulness has led us to the conclusion that survey-based measures are not sufficiently reliable in Hungary and Slovakia. Therefore, analysing one of the requirements of the rational expectations hypothesis, namely their unbiasedness, we constrain our analysis to Czech and Polish consumers. It seems that consumer inflation expectations in both economies do not fulfil rational expectations. Therefore, in estimating New Keynesian Phillips curves we have relaxed that theoretical assumption.

**Key Words:** Inflation expectations, Surveys, Rationality, New Keynesian Phillips Curve

**JEL Classification:** C42, D12, D84, E58

## Introduction

The aim of this paper is to analyse the role of consumer inflation expectations in price formation. Instead of assuming that inflation expectations are rational – which is a feature of the New Keynesian Phillips Curve – we refer to direct measures of consumer expectations quantified on the basis of qualitative surveys and use them in estimating the hybrid-type Phillips curve. Our attempts to perform such analysis for all CEE4 countries were not fully successful due to the constrained reliability of quantified measures of expectations in the case of Hungary and Slovakia. Hence, empirical tests verifying the degree of consumer inflation expectations' unbiasedness and their influence on price dynamics have been conducted only for the Czech Republic and Poland.

This paper is organized in the following way. The first section introduces the workhorse setup dominating inflation dynamics modelling in the last decade, i.e. the New Keynesian Phillips Curve. The second section outlines quantification methods used to quantify consumer inflation expectations on the basis of European Commission Consumer Surveys and evaluates their results for the Czech Republic, Hungary, Poland and Slovakia. The third section tests the role of inflation expectations of Czech and Polish consumers in affecting price dynamics and discusses the degree, to which the unbiasedness requirement of the rational expectations hypothesis is met. The last section concludes the study.

## 1. Theoretical aspects

In the late 1990s, the New Keynesian Phillips Curve (NKPC) became the standard macroeconomic model of inflation. It was introduced as a micro-founded model with clear theoretical foundations<sup>2</sup> that were to secure the straightforward structural interpretation of this model. The most popular way to introduce the NKPC is based on the Calvo model of price setting.<sup>3</sup> This model assumes that in each period of time a fraction  $\alpha$  of firms can reset their prices, while all other producers have to keep their prices unchanged. The (log) price level  $p_t$  is thus given by:

$$p_t = (1 - \alpha) \cdot p_t' + \alpha \cdot p_{t-1}, \quad (1)$$

where  $p_t'$  is the optimal price chosen by the producers who can change their prices in  $t$ . Producers would set their prices (within the imperfect competition framework) as a fixed markup over marginal cost and the optimal price is given by:

$$\sum_{k=t}^{\infty} (\alpha\beta)^{k-t} E_t(p_t' - p_k - \lambda(fv)) = 0, \quad (2)$$

where  $\beta$  is a discount factor, and  $fv$  is a variable representing inflation pressure coming from the economic activity. This is usually either an output gap or real marginal cost gap.<sup>4</sup> Solving (2) and combining it with (1) we obtain the NKPC in the form of:

$$\pi_t = \beta \cdot E_t \pi_{t+1} + \kappa(fv_t), \quad (3)$$

where  $\kappa = \frac{(1 - \alpha)(1 - \alpha\beta)}{\alpha} \lambda > 0$ .

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<sup>2</sup> See Woodford (2003), ch. 3, or Paloviita (2005), Annex 2, for a detailed derivation.

<sup>3</sup> Roberts (1995) shows that both the Taylor model of staggered price setting and Rotemberg model of quadratic price adjustment costs may have the same closed-form solutions, relating current inflation to future inflation and the current state of (excess) demand.

<sup>4</sup> Gap means a deviation of the variable from its value for a frictionless state of the economy. There are a number of approaches used in empirical models for representing both output gap and real marginal cost, though it seems that there is still a lack of consensus on the best way of doing this [cf. Rudd and Whelan (2005), Neiss and Nelson (2005)].

Thus, the New Keynesian Phillips Curve links current inflation,  $\pi_t$ , to expected future inflation and the current excess demand indicator. Hence, this model is entirely forward-looking and there is no place for inflation persistence therein.

When confronted with the data this basic formulation of the NKPC failed and the model has evolved into more empirically viable hybrid form with an added lagged inflation term.<sup>5</sup> The initial motivation for this change was mostly empirical [cf. Gali and Gertler (1999)]. However, in the subsequent literature the lagged inflation term found some behavioral explanation. According to the more traditional view, economic agents form their expectations in a backward-looking manner. That causes past inflation to become an important factor in explaining their price-setting behavior. Within this framework a hybrid form of equation (3) given by:

$$\pi_t = \beta \cdot E_t \pi_{t+1} + \gamma \cdot \pi_{t-1} + \kappa(fv_t) \quad (4)$$

maintains its structural interpretation, with lagged inflation being simply a proxy for  $E_{t-1}\pi_t$ . An alternative interpretation is based directly on a rational expectations concept. Lagged inflation appears in equation (4) because it is correlated with the rational expectations of inflation in the next period. However, that changes the nature of the model – it is now only a reduced-form relationship.

Further developments include other theoretical explanations of the hybrid model. One of them suggests a different form of price adjustment – some fraction of price-setters reoptimize their prices, while others apply a simple price indexation formula, with indexation tied to the past inflation rate [Christiano et al. (2005)]. Another similar explanation is the original proposal formulated by Gali and Gertler (1999), where the standard Calvo model applies only to a subset of firms changing prices in the given period, while the remaining group adjusts their prices according to a rule of thumb depending on the lagged inflation.

The Relative Wage Model, introduced by Fuhrer and Moore (1995) results also in a hybrid model in a form depicted by equation (4), with  $\beta$  and  $\gamma$  equal to 0.5, but this model is not

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<sup>5</sup> This failure also triggered a lengthy discussion about issues other than the model specification, e.g. estimation methods, the exact nature of regressors representing the current state of demand etc. Those issues are far beyond the scope of this paper and are nicely summarized in easily available literature [cf. Rudd, Whelan (2005) and a special 2005 issue of *Journal of Monetary Economics* on the econometrics of the New Keynesian price equation].

based on the price-setting behavior of firms, but on assumptions concerning the real wage contracting mechanism.

The quest for a microfounded theoretical and simple model of inflation dynamics has recently gone far beyond the sticky-price setup. Mankiw and Reis (2002) suggest that – because of the costs of acquiring information and/or price reoptimisation – pricing decisions are not always based on current information. Hence current inflation depends on output (as a measure of demand conditions) and past expectations of current inflation and output growth. They call the resulting equation the sticky-information Phillips curve.

This sticky-information approach goes much beyond the scope of this paper, as it includes not only inflation expectations, but also output growth expectations. However, there is one important input here, developed further by Reis (2005) and Sims (2005), suggesting that the process of acquiring and processing information that forms an important part of forming inflation expectations by economic agents should be in itself treated as an outcome of rational (optimising) behavior. These issues have serious implications for the traditional understanding of rationality of survey-based inflation expectations, or rather for the traditional way of testing this rationality.<sup>6</sup> Briefly, they may be summarized here as giving strong support to the idea of directly using inflation expectations of economic agents when modeling inflation dynamics within the Phillips curve framework (Section 3 describes this in greater detail).

## **2. Survey measures of inflation expectations**

There are two major problems to be solved before applying direct measures of inflation expectations in inflation modelling. The first is the choice of type of agents who are surveyed. Most studies use either surveys of professional forecasters or household (consumer) surveys.<sup>7</sup> Data availability forced us to limit ourselves to surveys conducted among households. The second issue is how to quantify qualitative responses coming from the households' survey. This section presents a detailed description of this process.

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<sup>6</sup> See also Andolfatto et al. (2005) and Branch (2004).

<sup>7</sup> See Roberts (1995) and other papers quoted in section 3.2 of this paper.

### ***1.1. Survey data on consumers' inflation expectations***

In our analysis we employ data from the European Commission's Consumer Surveys, conducted on a monthly basis in all European Union countries, including the new member states, which joined the EU in May 2004. In this paper we focus on four Central European economies (CEE4), i.e. the Czech Republic, Hungary, Poland and Slovakia. Monthly data for the countries under consideration is available only for a relatively short period of time, beginning in January 2001 for the Czech Republic, February 1993 for Hungary, May 2001 for Poland and April 2000 for Slovakia. Although the survey data for Hungary starts in 1993, we decided to use a shorter sample period, i.e. 1999-2005. In this way, in all CEE4 economies the periods we take into account are characterized by one-digit inflation dynamics, which makes our analysis more comparable across countries. Additionally, in Section 3, we use a comparable survey carried out by Ipsos firm for Poland, covering a much longer period (since 1992).

The question concerning inflation expectations in the EC and the Ipsos survey is designed in a qualitative way, i.e., the respondents do not give precise quantitative responses regarding future inflation, but declare the expected direction and magnitude of change in prices, comparing their predictions to the price movements currently observed. The question has the following form: *“By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months? They will ... (1) increase more rapidly, (2) increase at the same rate, (3) increase at a slower rate, (4) stay about the same, (5) fall, (6) don't know”*. There is an additional question concerning the perception of current price movements in the EC survey, which can be useful in assessing the perceived rate of inflation. Responding to this question, consumers compare the present level of prices with the price level 12 months before: *“How do you think that consumer prices have developed over the last 12 months? They have... (1) risen a lot; (2) risen moderately; (3) risen slightly; (4) stayed about the same; (5) fallen; (6) don't know”*.

## 1.2. *Quantification methods*

The choice of quantification algorithm influences the outcome. Therefore, in order to check the robustness of the results, we use various versions of two most popular quantification approaches: the probability and regression approaches.<sup>8</sup>

The original probability method first employed by Theil (1952), as well as its further implementations by Knöbl (1974), Carlson and Parkin (1975) and Taylor (1988), refers to surveys in which respondents are questioned whether prices are expected to “*go up*”, “*stay the same*” or “*go down*”. The EC Consumer Survey contains more response categories, meaning that the quantification procedure has to be adjusted. The adjusted probability method makes use of the fact that, in replying to the survey question regarding inflation expectations, respondents compare their predictions with the rate of price change as perceived at the time when the survey is carried out. Indeed, two replies – that prices will “*rise at the same rate*” or “*stay at their present level*” – are in fact quantitative in nature. The broader scope of information limits the number of assumptions to be made to only two – referring to the type of distribution of the expected rate of inflation and to a measure of perceived inflation. The probability approach used in this paper refers to the canonical Carlson and Parkin (1975) method and assumes that, if the number of respondents is sufficiently large, the expected rate of price change is normally distributed throughout the population. As far as the second assumption is concerned, a frequently used proxy for the perceived rate of price change is the current rate of inflation (Berk, 1997; Łyziak, 2005), i.e. the most recent inflation rate available to respondents when answering the survey question regarding future prices. In this case, quantified measures of inflation expectations are described as objectified, since they assume that the respondents perceive the current price dynamics correctly. Alternatively, the perceived rate of inflation may be derived on the basis of a survey question pertaining to the recently observed price developments (Berk, 2000; Forsells and Kenny, 2004). Indicators of inflation expectations quantified with a survey measure of recent price changes’ perception are called subjectified.<sup>9</sup>

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<sup>8</sup> The detailed description of the versions of probability and regression method used in this paper can be found in Łyziak (2005) and Łyziak and Stanisławska (2006).

<sup>9</sup> The probability method to quantify perceived inflation used in this paper is consistent with the approach followed by Forsells and Kenny (2004) while deriving numerical measures of the perceived inflation in the euro area.

The regression method of expectations quantification was introduced by Pesaran (1984, 1987) who reinterpreted and developed the Anderson's (1952) concept. In general, this method is based on the estimation of the relationship between current inflation (measured by official statistics) and its perception by survey respondents. It is assumed that the same relationship holds between inflation expectations (expressed quantitatively) and qualitative opinions of respondents concerning future inflation. As Pesaran (1987) stresses, this relationship should not be treated as causative, but rather as a simple tool to approximate unknown values. Such a construction of the regression method restricts its application to surveys including questions on both expected and past inflation with an appropriately long history. The regression method was initially created for firms' expectations, but Simmons and Weiserbs (1992) give the rationale for using it for the quantification of consumer inflation expectations.

There are several models which can be employed to approximate the relationship between inflation and the survey data<sup>10</sup>. In our paper we use a version of the dynamic nonlinear regression model suggested by Smith and McAleer (1995). In this model the perceived price changes (both positive and negative) depend on the current and past inflation rates. These assumptions lead to the following specification<sup>11,12</sup>:

$$\pi_t = \frac{\alpha_0 R_t - \beta_0 F_t + \alpha_2 R_t \pi_{t-12} + \beta_2 F_t \pi_{t-12}}{1 - \alpha_1 R_t - \beta_1 F_t} + \varepsilon_t, \quad \alpha_1 R_t + \beta_1 F_t \neq 1, \quad (5)$$

where  $\pi_t$  indicates the yearly inflation rate,  $R_t$  – the proportion of respondents declaring that prices have risen during the last 12 months and  $F_t$  – the proportion of respondents declaring that prices have fallen during the last 12 months,  $\varepsilon_t$  – error term. Table 1 provides estimates of the parameters of the quantification equation.

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<sup>10</sup> As pointed out by Smith and McAleer (1995), in the probability method the quantified measures are a function of a specific probability distribution, whereas in the regression method they are a function of a specific regression model.

<sup>11</sup> The regression method requires the perception and the expectation questions to be symmetric. Therefore, we aggregate some categories of responses in the EC survey in such a way as to obtain information only about direction of price movements.

<sup>12</sup> We use 12-month lagged inflation rate in order to avoid overlapping of periods.

**Table 1. Estimates of parameters of the quantification equation<sup>(1)</sup>**

Country	Czech Republic	Hungary	Poland	Slovakia
$\alpha_0$	0.023 (0.003)	---	0.006 (0.001)	0.009 (0.003)
$\alpha_1$	0.823 (0.086)	0.977 (0.019)	0.934 (0.024)	0.956 (0.032)
$\alpha_2$	-0.151 (0.070)	0.077 (0.015)	0.044 (0.006)	-0.019 (0.001)
$\beta_0$	---	0.151 (0.029)	-0.055 (0.028)	---
$\beta_1$	---	---	2.216 (0.738)	---
$\beta_2$	-2.040 (1.00)	---	---	---
Sample	2001:01-2005:07	1999:02 – 2005:07	2001:05-2005:05 <sup>(2)</sup>	2000:04-2005:07
adj. R <sup>2</sup>	0.83	0.70	0.94	0.51

<sup>(1)</sup> NLS estimators; Newey-West standard errors in parentheses.

<sup>(2)</sup> Due to disturbances in the recent survey responses (resulting from high oil prices), which caused some estimation problems, the sample was cut in May 2005.

Source: EC Consumer Survey, International Financial Statistics, own calculations.

### 1.3. Quantification results

By applying various quantification procedures we obtained three measures of inflation expectations for each country, namely the objectified and subjectified probability measure as well as the regression measure (presented in Annex). As shown in Table 2, they exhibit a significant degree of convergence in Poland and Slovakia, while in the case of the Czech Republic and Hungary they are characterized by considerable dispersion. There are two factors in the quantification algorithms applied that may affect the dispersion of analysed measures of inflation expectations. First, it is the volatility of the current rate of inflation, which comprises all quantification methods, although in a different way. Second, it is the structure of responses to survey questions concerning inflation perception and expectations.<sup>13</sup> Taking into consideration indicators presented in Table 2, it seems that differences in relative dispersion of inflation expectations in analysed economies may be attributed to differences in survey data rather than differences in inflation volatility.

<sup>13</sup> Both these factors are closely related to each other. In particular, the reaction of quantification outcomes to changes in the current rate of inflation depends on the patterns of responses to survey questions.

**Table 2. Dispersion of inflation expectations' measures vs. inflation volatility**

	<b>Czech Republic</b>	<b>Hungary</b>	<b>Poland</b>	<b>Slovakia</b>
[1] relative dispersion of inflation expectations' measures (in %)	59.6	43.1	28.4	23.0
[2] inflation volatility (standard deviation relative to the mean, in %)	81.1	33.4	64.9	38.8
Relative dispersion of quanti- fied measures of inflation expectations expressed in units of inflation volatility (i.e. [1]/[2])	0.73	1.30	0.44	0.59

Source: EC Consumer Survey, International Financial Statistics, GUS, own calculations.

Due to the limitations of quantification procedures and specific features of survey data, some of the obtained inflation expectations' measures may be less reliable than the other ones. Therefore, before proceeding to the analysis of the inflation process, we assess the usefulness of measures of inflation expectations generated from different quantification algorithms according to a set of criteria. Objectified probability measures of inflation expectations are treated as trustworthy if the survey data on inflation perception is highly correlated with official indicators of price dynamics. In the context of our study, this condition is satisfied in Poland and the Czech Republic, while it is questionable in Hungary and Slovakia. The reliability of subjectified measures of inflation expectations is evaluated with two conditions. The first concerns the loss of information resulting from the aggregation of fractions of respondents declaring that in the previous 12 months they noticed a sizeable, moderate and a slight increase in the price level. The second compares balance statistics describing the patterns of responses to the survey question on inflation perception consistent with the normal-distribution-based quantification method with more intuitive balance statistics calculated as the difference between the fraction of respondents declaring a perceived increase in prices and their decrease. If significant differences between both balance statistics occur, it suggests that changes in the perceived inflation quantified may be unintuitive with respect to the scale of changes in patterns of responses to the survey question.

Verification of both of these conditions shows that subjectified measures of inflation expectations are insufficiently reliable in Slovakia and Hungary, while they are useful in the Czech Republic. In the case of Poland, the results are mixed. Since the regression method is based on

an equation relating current inflation to survey data on inflation perception, similarly as in the case of objectified probability measures, the closer the relation between survey fractions and the current price movements measured by official statistics, the better. Among CEE4 countries, respondents in Slovakia (probably due to rapid and considerable changes in regulated prices) and Hungary<sup>14</sup> had the greatest problems with assessing current inflation. The second issue affecting the reliability of regression measures of inflation expectations concerns the aggregation of respondents claiming that prices are much higher, quite a bit higher and a little higher into one group. Information on the intensity of price changes is relatively more important than information on the direction of price changes in countries with high inflation rates, such as Hungary.

Table 3 summarizes the usefulness of inflation expectation measures in economies under consideration, whereas detailed assessment criteria are presented in Annex 2. According to the criteria adopted, the only reliable measures of inflation expectations are those from the Czech Republic and Poland. In the case of Hungary and Slovakia none of the quantified measures is trustworthy; therefore we do not use them in testing the relationship between inflation expectations and price dynamics.

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<sup>14</sup> In the case of Hungary, the share of respondents declaring a fall in prices in the perception question is positively correlated with the current rate of inflation.

**Table 3. Usefulness of different measures of inflation expectations in economies considered**

	Probability measure		Regression measure
	Objectified	Subjectified	
<b>Czech Republic</b>	Useful · survey data on inflation perception highly correlated with CPI inflation	Useful · aggregation of respondents' fractions does not constrain information content of the survey · volatility of perceived inflation intuitive	Useful · aggregation of respondents' fractions does not constrain information content of the survey · survey data on inflation perception highly correlated with CPI inflation
<b>Hungary</b>	Constrained usefulness · survey data on inflation perception relatively less correlated with CPI inflation	Constrained usefulness · aggregation of respondents' fractions leads to considerable loss of information · quantification procedure generates unintuitive volatility in perceived inflation	Constrained usefulness · aggregation of respondents' fractions leads to considerable loss of information · survey data on inflation perception relatively less correlated with CPI inflation
<b>Poland</b>	Useful · survey data on inflation perception highly correlated with CPI inflation	Useful / constrained usefulness · aggregation of respondents' fractions does not constrain information content of the survey · quantification procedure generates unintuitive volatility in perceived inflation	Useful · aggregation of respondents' fractions does not constrain information content of the survey · survey data on inflation perception highly correlated with CPI inflation
<b>Slovakia</b>	Constrained usefulness · survey data on inflation perception relatively less correlated with CPI inflation	Constrained usefulness · aggregation of respondents' fractions leads to considerable loss of information · quantification procedure generates unintuitive volatility in perceived inflation	Constrained usefulness · aggregation of respondents' fractions leads to considerable loss of information · survey data on inflation perception relatively less correlated with CPI inflation

Source: own assessment, see Annex 2 for details.

## 2. Inflation expectations in the Phillips curve

### 2.1. Unbiasedness of inflation expectations

A necessary requirement of the rational expectations hypothesis tested in this section of the paper is that expectations constitute an unbiased predictor of future inflation, with respect to which they are formed. The unbiasedness assumption means that economic agents fully exploit all available information and do not commit systematic forecast errors, thus the actual inflation is equal to expected inflation on average, and to expected inflation plus a random forecast error period by period. In line with the hypothesis of unbiasedness, the coefficients  $\alpha$  and  $\beta$  in the equation (6) should be equal to zero and one, respectively.<sup>15</sup>

$$\pi_{t/t-n}^e = \alpha + \beta \cdot \pi_t + \varepsilon_t, \quad (6)$$

where  $\pi_t$  denotes the actual inflation in period  $t$ ,  $\pi_{t/t-n}$  is the expectation of inflation at time  $t$  formed at time  $t-n$ , while  $\varepsilon_t$  is a white-noise error.

The results of unbiasedness tests of consumer inflation expectations in the Czech Republic and Poland (Table 4, Table 5) show that this assumption is violated. In the analysed 2001-2004 period, the relationship between actual inflation ex-post and the expected inflation in both economies was even insignificant. This may be caused by the extremely small number of observations available, which imposes constraints on verifying unbiasedness, which is a long-run phenomenon.<sup>16</sup> Additionally, the period under consideration was characterized by different types of shocks. Both economies experienced fast disinflation and a fairly unexpected fall of inflation to historically low levels in 2003. Moreover, starting from mid-2003 the perspective of accession to the European Union (May 2004) made consumers afraid of rapid price increases. This effect was noted in both countries, although in the Czech Republic it was weaker than in Poland.<sup>17</sup> The specificity of the analysed period limits the economic interpreta-

<sup>15</sup> See: H. Bakhshi and A. Yates (1998), p. 9.

<sup>16</sup> Cf. Andolfatto et al. (2005), p. 5 and 6.

<sup>17</sup> As shown in Łyziak (2005), there were significant shifts in the patterns of responses to the survey question on inflation expectations in the majority of the acceding countries before the EU enlargement. It seems that the perspective of EU accession was the major cause of those shifts with some country-specific factors (changes in indirect taxes, price deregulations, increase of the current domestic inflation) and external factors (the increase of the oil price in international markets) playing a minor role. A substantial increase of inflation expectations relative to the current rate of inflation was recorded in the majority of EU acceding countries with Cyprus and Slovenia being the only exceptions.

tion of the unbiasedness tests' results. Using alternative survey data on Polish consumers' inflation expectations covering a much longer period (1992-2004), there is a cointegration between both variables, but the unbiasedness hypothesis is still rejected.<sup>18</sup>

**Table 4. Unbiasedness test – Czech Republic<sup>†</sup>**

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:01-2004:07	2001:01-2004:07	2001:01-2004:07
$\alpha$	0.03 (0.01)	0.03 (0.01)	0.04 (0.01)
$\beta$	-0.53 (0.43)	-0.43 (0.32)	0.30 (0.24)
F [ $H_0: (\alpha, \beta) = (0, 1)$ ]	8.07 (0.00)	18.51 (0.00)	26.24 (0.00)

<sup>†</sup> OLS estimators; Newey-West standard errors in parentheses.

Source: EC Consumer Survey, International Financial Statistics, own calculations.

**Table 5. Unbiasedness test – Poland<sup>(1)</sup>**

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:05-2004:09 [1992:01-2004:09] <sup>(2)</sup>	2001:05-2004:09	2001:05-2004:09
$\alpha$	0.04 (0.01) [0.01 (0.01)]	0.04 (0.01)	0.05 (0.01)
$\beta$	-0.62 (0.19) [1.32 (0.09)]	-0.45 (0.16)	-0.83 (0.22)
F [ $H_0: (\alpha, \beta) = (0, 1)$ ]	74.81 (0.00) [19.83 (0.00)]	47.27 (0.00)	48.20 (0.00)

<sup>(1)</sup> OLS estimators; Newey-West standard errors in parentheses.

<sup>(2)</sup> Tests performed with the use of alternative indicators of inflation expectations quantified on the basis of Ipsos survey data.

Source: EC Consumer Survey, Ipsos, GUS, own calculations.

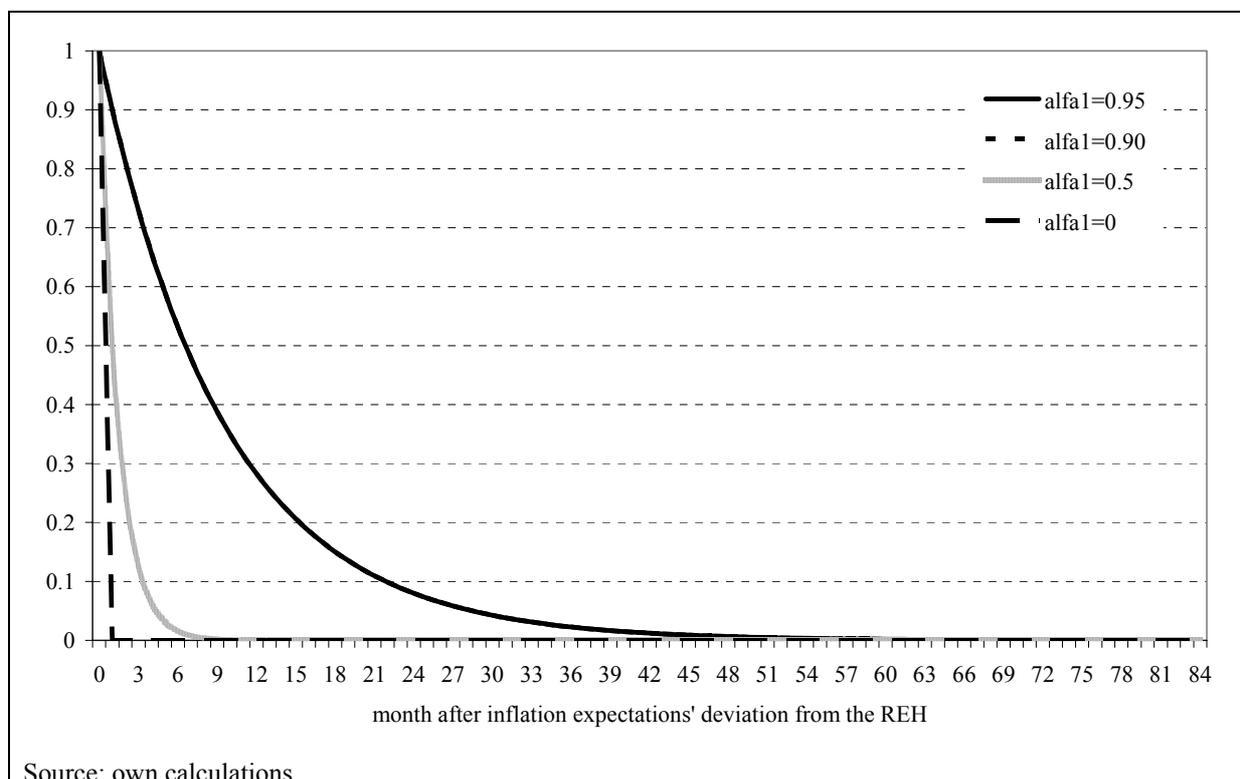
As mentioned above, biasedness of inflation expectations may (to some extent) result from short samples available to verify this feature, which is a long-run phenomenon. Even in the Polish case, with survey data on inflation expectations available from 1992, the expectations' formation might have been substantially disrupted by high and volatile inflation, which reached one-digit levels only at the end of 1998. For this reason, in addition to testing the unbiasedness property, it is also important to check whether the inflation expectations approach rational expectations outcome in the long-run. Estimating the following equation:

$$\pi_{t/t-n}^e = \alpha_1 \cdot \pi_{t-1/t-n-1}^e + \alpha_2 \cdot \pi_t + \varepsilon_t, \quad (7)$$

<sup>18</sup> Also another condition of the rational expectations hypothesis, namely their macroeconomic efficiency, is rejected in the case of Polish consumer inflation expectations [Łyziak (2005)].

a long-run convergence of inflation expectations towards the actual inflation takes place, if the coefficients  $\alpha_1$  and  $\alpha_2$  add to one. Moreover, the lower  $\alpha_1$  is, the faster the convergence process (Figure 1).

**Figure 1. Speed of convergence of expectations towards actual inflation**



Consumer inflation expectations in the Czech Republic and Poland seem to converge to the actual inflation ex-post in the long run<sup>19</sup>, although the speed of convergence is very slow. According to the estimation results presented in Table 6 and Table 7, the coefficient  $\alpha_1$  amounts to 0.9-0.95 for the measures of inflation expectations considered. It is slightly lower, i.e. it equals 0.81, in the case of Polish consumer inflation expectations analysed in the longer horizon, i.e. 1992-2004.

<sup>19</sup> The only exception is the regression measure of inflation expectations of Czech consumers.

**Table 6. Long-run convergence of expectations towards actual inflation – Czech Republic<sup>†</sup>**

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:02-2004:07	2001:02-2004:07	2001:02-2004:07
$\alpha_1$	0.95 (0.04)	0.93 (0.02)	0.91 (0.04)
$\alpha_2$	0.05 (0.03)	0.04 (0.03)	0.20 (0.07)
F [ $H_0: \alpha_1 + \alpha_2 = 1$ ]	0.00 (0.95)	0.39 (0.54)	4.10 (0.05*)
Speed of convergence (half life of expectations' deviation from REH)	14 months	10 months	---

<sup>†</sup> OLS estimators; Newey-West standard errors in parentheses.

Source: EC Consumer Survey, International Financial Statistics, own calculations.

**Table 7. Long-run convergence of expectations towards actual inflation – Poland<sup>(1)</sup>**

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:06-2004:09 [1992:02-2004:09] <sup>(2)</sup>	2001:06-2004:09	2001:06-2004:09
$\alpha_1$	0.93 (0.03) [0.81 (0.05)]	0.91 (0.02)	0.90 (0.03)
$\alpha_2$	0.05 (0.02) [0.24 (0.07)]	0.08 (0.03)	0.07 (0.04)
F [ $H_0: \alpha_1 + \alpha_2 = 1$ ]	0.48 (0.49) [2.56 (0.11)]	0.01 (0.91)	0.54 (0.47)
Speed of convergence (half life of expectations' deviation from REH)	10 months [4 months]	8 months	7 months

<sup>(1)</sup> OLS estimators; Newey-West standard errors in parentheses.

<sup>(2)</sup> Estimated with the use of alternative indicators of inflation expectations quantified on the basis of Ipsos survey data.

Source: EC Consumer Survey, Ipsos, GUS, own calculations.

## 2.2. Estimates of the Phillips curve

Should direct measures of inflation expectations quantified on the basis of qualitative surveys play any role in macroeconomic models, or should they constitute a fully independent source of information, clearly separated from other sources? On the one hand, information content of quantified measures of inflation expectations may be limited due to the fact that respondents may not base their actual decisions on the survey responses [Berk (2000)]. On the other hand, survey data may be useful in identifying how inflation expectations are formed, which is absolutely needed to model price behavior. When estimating the New Keynesian Phillips curves it is assumed that inflation expectations are rational. Contrary to this assumption, which is questionable even on theoretical basis (Section 1), most empirical research ex-

aming survey expectations demonstrates that they are not perfectly rational.<sup>20</sup> Therefore, the most general use of survey measures of inflation expectations in macroeconomic models would aim at replacing the assumption of perfectly rational expectations with survey indicators. Direct measures of inflation expectations may also be used to estimate weights on backward- and forward-looking behavior in the hybrid-type Phillips curves.

There have been attempts to make use of direct measures of inflation expectations in macroeconomic modelling. In the estimation of the Phillips curve, Driver et al. (1999) employ the measure of expected inflation constructed from Gallup and GfK consumer confidence surveys, while Paloviita (2002) refers to OECD forecasts as empirical proxies of economic agents' inflation expectations. Adam and Padula (2003) allow for non-rationality of inflation expectations in the forward-looking New Keynesian Phillips curve for the US by employing Survey of Professional Forecasters data. In a similar analysis conducted for France, Germany and Italy, Gorter (2005) uses direct measures of inflation expectations constructed from the Consensus Economic survey. Estimating hybrid Phillips curves, Forsells and Kenny (2004) show that consumer expectations play a role in determining the actual dynamics of inflation in the euro area. Similarly, direct measures of Polish consumers' inflation expectations are used in the small structural model of monetary transmission mechanism in Poland [Łyziak (2002)] and one of the forecasting models of the National Bank of Poland, namely the NSA model [Kłós et al. (2005)].

The hybrid Phillips curve, which we use to show the role of consumer inflation expectations in price formation has the following form:

$$\pi_t = \alpha_0 + \alpha_1 \cdot \pi_{t+4/t}^e + \alpha_2 \cdot \pi_{t-4} + \alpha_3 \cdot x_{t-i} + \alpha_4 \cdot e_{t-j}^r + \varepsilon_t. \quad (8)$$

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<sup>20</sup> For instance, Bakhshi and Yates (1998), analysing inflation expectations of UK employees, conclude that respondents are making systematic errors in forecasting inflation; they appear – like consumers in Poland – to be over-predicting. Pesaran (1987) demonstrates that inflation expectations of UK manufacturing sector's firms do not support rational expectations hypothesis, either. Svendsen (1996) proves that Norwegian firms' price expectations (or plans) are not rational. Roberts (1997) estimates the degree of nonrationality in two US surveys measures of inflation expectations ("Livingston" survey of economists inflation forecast and the University of Michigan survey carried out among households) identifying that they reflect an intermediate degree of rationality, being neither perfectly rational nor as unsophisticated as a simple autoregressive model would suggest. Forsells and Kenny (2004) show that consumer inflation expectations in the euro area satisfy an intermediate form of rationality: they provide an unbiased predictor of inflation one year ahead, but they are not fully rational with respect to all the available information.

Similarly as in the version of the aggregate supply curve used by Forsells and Kenny (2004) in analysing price dynamics in the euro area, annual inflation ( $\pi$ ) is driven by its past values, inflation expectations ( $\pi^e$ ) and a measure of excess demand in the economy ( $x$ ). Additionally, the real exchange rate ( $e^r$ ) is among explanatory variables due to a higher degree of openness of Czech and Polish economies. Instead of estimating the Phillips curve in terms of headline inflation, we use core inflation measures, excluding regulated prices in the case of the Czech Republic and foodstuffs and fuel prices in the case of Poland. The excess demand in the economy is measured by the output gap, defined as a percentage deviation of actual output from its HP-filter-value. Since the dynamic homogeneity restriction, making the coefficients  $\alpha_1$  and  $\alpha_2$  add to one – is rejected for almost all specifications estimated for both countries<sup>21</sup>, we present unrestricted estimates only (Table 8, Table 9). The exception is the Phillips curve estimated with the regression measure of Czech consumers' inflation expectations, for which both unrestricted and restricted estimates are shown.

**Table 8. Estimates of the hybrid Phillips curve – Poland<sup>(1)</sup>**

	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$R^2_{adj}$	$n$
Objectified probability measure (i=3, j=1)	0.53 (0.06) [0.28 (0.10)] <sup>(2)</sup>	0.38 (0.03) [0.57 (0.07)]	0.15 (0.08) [0.42 (0.17)]	-0.03 (0.01) [-0.04 (0.02)]	0.98 [0.98]	18 [34]
Subjectified probability measure (i=3, j=2)	0.38 (0.10)	0.45 (0.05)	0.38 (0.06)	-0.06 (0.02)	0.98	18
Regression measure (i=3, j=2)	0.23 (0.07)	0.44 (0.05)	0.41 (0.07)	-0.07 (0.02)	0.98	18

<sup>(1)</sup> OLS estimators; Newey-West standard errors in parentheses.

<sup>(2)</sup> The Phillips curve estimated with the use of alternative indicators of inflation expectations quantified on the basis of Ipsos survey data, i=2, j=1.

Source: own calculations.

<sup>21</sup> F statistics for  $H_0: \alpha_1 + \alpha_2 = 1$ : 6.93 (75.0) for the Phillips curve, in which the objectified probability measure of inflation expectations of Polish (Czech) consumers is used, 8.59 (16.39) for the specification with subjectified probability measure and 159.77 (1.41) for the specification with the regression measure. In the case of the price equation using alternative indicators of Polish consumers' inflation expectations quantified on the basis of Ipsos survey data, F statistics equals 20.21.

**Table 9. Estimates of the hybrid Phillips curve – Czech Republic<sup>†</sup>**

	$\alpha_1$	$\alpha_2$	$\alpha_3$	$\alpha_4$	$R^2_{adj}$	<b>n</b>
Objectified probability measure (i=1, j=1)	0.54 (0.08)	-0.23 (0.04)	0.30 (0.11)	-0.06 (0.02)	0.93	18
Subjectified probability measure (i=2, j=1)	0.62 (0.27)	-0.49 (0.13)	0.84 (0.19)	-0.04 (0.06)	0.86	18
Regression measure (i=1, j=0):						
· unrestricted estimates	0.51 (0.10)	0.27 (0.10)	1.15 (0.10)	-0.07 (0.03)	0.88	18
· restricted estimates	0.63 (0.03)	0.27	1.13 (0.09)	-0.05 (0.02)	0.88	18

<sup>†</sup> OLS estimators; Newey-West standard errors in parentheses.

Source: own calculations on the basis of IFS data.

The estimation results show that direct measures of inflation expectations are useful in explaining price dynamics in both economies – in all equations estimates of the parameter  $\alpha_1$  are positive and statistically different from zero at significance level 0.10 or lower. For Poland they vary from 0.23 to 0.53, while for the Czech Republic they are slightly higher and range from 0.51 to 0.62. All other variables enter significantly the estimated equations and their signs are consistent with theoretical requirements. The only exception is the negative sign of the coefficients on past inflation in the case of the Phillips curves with probability measures of inflation expectations estimated for the Czech Republic.

### 3. Concluding remarks

Probability and regression methods offer a useful way to measure inflation expectations on the basis of qualitative survey data. However, the reliability of measures of this kind should be assessed rigorously before using them in macroeconomic modelling. The need for such an assessment refers to the economic sense of raw survey data as well as possible disturbances introduced by quantification algorithms. For this reason, before making use of different measures of consumers' inflation expectations in the CEE4 countries, we evaluated their trustworthiness by analysing the dispersion of inflation expectations' measures, correlation of survey data on inflation perception with CPI inflation figures, the loss of information resulting from the need to aggregate some fractions of respondents and the consistency between changes in quantified indicators of inflation perception and intuition based on simple balance statistics. According to the criteria adopted, the only reliable measures of consumer inflation expectations are those from the Czech Republic and Poland. In the case of Hungary and Slovakia none of the quantified measures are trustworthy; therefore we do not use them in testing the relationship between inflation expectations and price dynamics.

Czech and Polish consumers' inflation expectations seem to converge to the actual inflation, with respect to which they are formed, in the long run. However, the speed of convergence is very slow and they do not fulfil the unbiasedness requirement of the rational expectations hypothesis. Therefore estimating the hybrid-type Phillips curve we relax this theoretical assumption. Estimation results indicate that direct measures of inflation expectations are useful in explaining price dynamics in both economies.

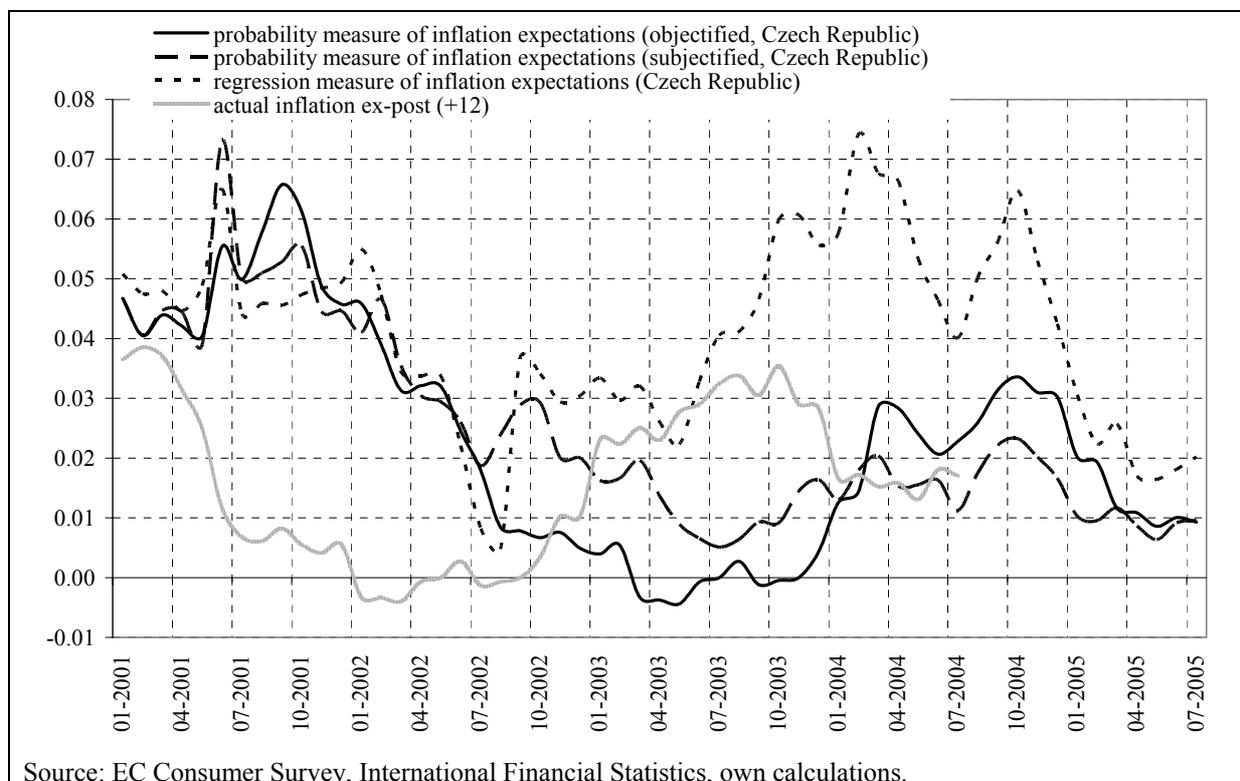
## References

- Adam, Klaus, and Mario Padula (2003). Inflation dynamics and subjective expectations in the United States. *ECB Working Paper* No. 222, European Central Bank
- Anderson, Oskar Jr. (1952) The business test of the IFO-Institute for economic research, Munich, and its theoretical model. *Revue de l'Institut International de Statistique* 20, 1-17
- Andolfatto, David, Scott Hendry, Kevin Moran (2005), Are Inflation Expectations Rational?, mimeo
- Bakhshi, Hasan and Anthony Yates (1998) Are UK inflation expectations rational? Bank of England Working Paper Series, No. 81
- Berk, Jan M. (1997) Measuring inflation expectations: a survey data approach. DNB-Staff Reports, De Nederlandsche Bank
- Berk, Jan M. (2000) Consumer inflation expectations and monetary policy in Europe. DNB-Staff Reports, De Nederlandsche Bank
- Branch, William A. (2004), The Theory of Rationally Heterogenous Expectations: Evidence from Survey Data on Inflation Expectations, *Economic Journal*, 114, 592-621
- Carlson, John A. and Parkin, Michael (1975) Inflation expectations. *Economica* 42, 123-138
- Christiano, Lawrence, Martin Eichenbaum, Charles Evans (2005), Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy, *Journal of Political Economy*, 113, 1-45
- Driver Rebecca L., Paul G. Fisher, Lavan Mahadeva, John D. Whitley (1999), Inflation and the output gap, typescript, Bank of England
- Forsells, Magnus and Geoff Kenny (2004), Survey expectations, rationality and the dynamics of euro area inflation. *Journal of Business Cycle Measurement and Analysis*, 1, 13-42
- Fuhrer, Jeffrey, George Moore (1995), Inflation Persistence, *Quarterly Journal of Economics*, 110, 127-159
- Gali, Jordi, Mark Gertler (1999), Inflation dynamics: A structural econometric analysis, *Journal of Monetary Economics*, 44, 195-222
- Gorter, Janko (2005), Subjective expectations and New Keynesian Phillips curves in Europe, *DNB Working Paper* 049/2005, De Nederlandsche Bank
- Kłos, Bohdan, Ryszard Kokoszcyński, Tomasz Łyziak, Jan Przystupa, Ewa Wróbel (2005) Structural econometric models in forecasting inflation at the National Bank of Poland. *NBP Paper* No. 31, National Bank of Poland
- Knöbl, Adalbert (1974) Price expectations and actual price behavior in Germany. *International Monetary Fund Staff Papers* 21, 83-100
- Łyziak, Tomasz (2002) Monetary transmission mechanism in Poland. The strength and delays. *NBP Paper* No. 26, National Bank of Poland
- Łyziak, Tomasz (2005) Inflation targeting and consumer inflation expectations in Poland. A success story? *Journal of Business Cycle Measurement and Analysis* 2(2), 185-212

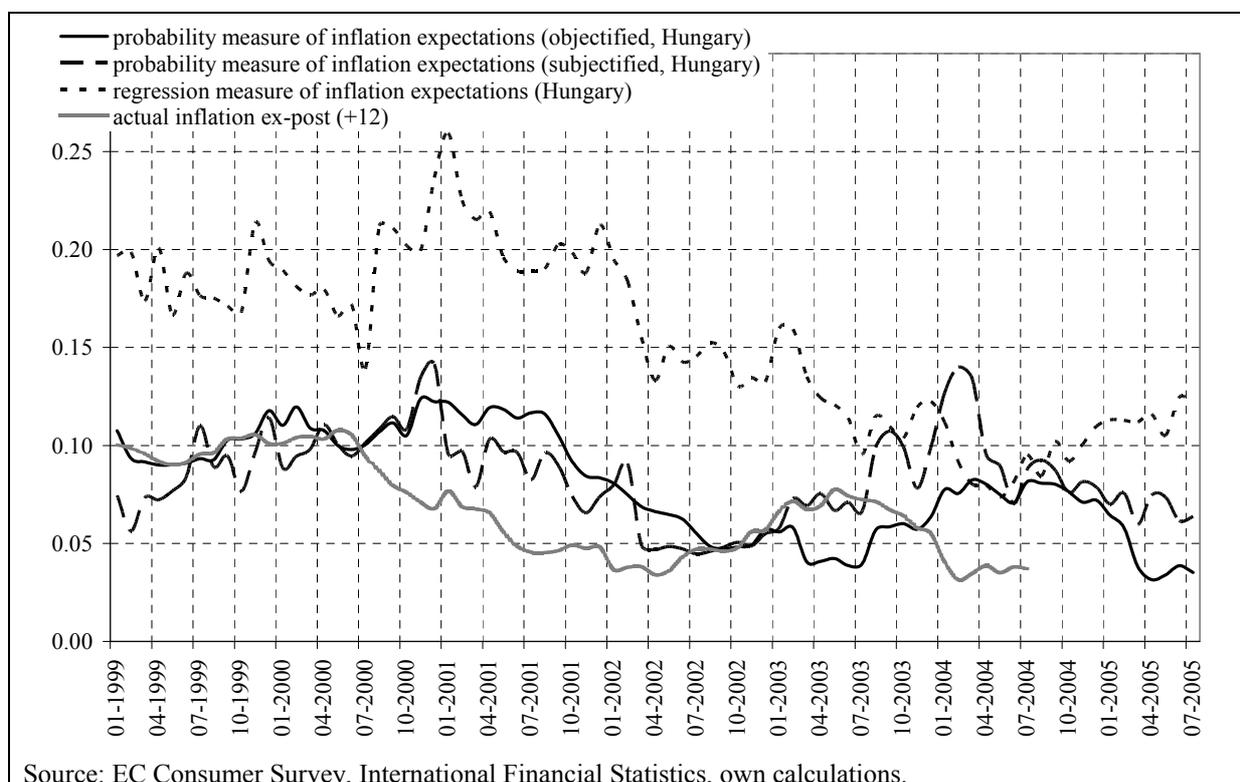
- Łyziak, Tomasz and Ewa Stanisławska (2006) Consumer inflation expectations. Survey questions and quantification methods – the case of Poland. *NBP Papers*, NBP (forthcoming)
- Mankiw, N. Gregory, Ricardo Reis (2002), Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve, *Quarterly Journal of Economics*, 117, 1295-1328
- Neiss, Katharine S., Edward Nelson (2005), Inflation Dynamics, Marginal Cost, and the Output Gap: Evidence from Three Countries, *Journal of Money, Credit, and Banking*, 37 (6), 1019-1045
- Noble, Nicholas R., T. Windsor Fields (1982), Testing the Rationality of Inflation Expectations Derived from Survey Data: A Structure-Based Approach, *Southern Economic Journal*, 49, 361-373
- Paloviita Maritta (2002), Inflation dynamics in the euro area and the role of expectations, *Discussion Paper 20/2002*, Bank of Finland
- Paloviita, Maritta (2005), The role of expectations in euro area inflation dynamics, *Bank of Finland Studies E:32*
- Pesaran, Hashem M. (1984) Expectations formations and macroeconomic modelling. In Pierre Malgrange and Pierre-Alain Muet (eds.), *Contemporary macroeconomic modelling*, Oxford: Basil Blackwell
- Pesaran, Hashem M. (1987) *The limits to rational expectations*. Oxford: Basil Blackwell
- Reis, Ricardo (2005), Inattentive Producers, *NBER Working Paper 11820*
- Roberts, John M. (1995), New Keynesian Economics and the Phillips Curve, *Journal of Money, Credit, and Banking*, 27 (4), 975-984
- Roberts John M. (1998), Inflation expectations and the transmission of monetary policy, *Finance and Economics Discussion Series 1998-43*, Federal Reserve Board
- Rudd, Jeremy, Karl Whelan (2005), Modelling Inflation Dynamics: A Critical Review of Recent Research, *Finance and Economics Discussion Series 2005-66*, Federal Reserve Board
- Simmons, Peter and Daniel Weiserbs (1992), Consumer price perceptions and expectations. *Oxford Economic Papers* 44, 35-50
- Sims, Christopher A. (2005), Rational inattention: a research agenda, *Discussion Paper No. 34/2005*, Deutsche Bundesbank
- Smith, Jeremy and Michael McAleer (1995), Alternative procedures for converting qualitative response data to quantitative expectations: an application to Australian manufacturing. *Journal of Applied Econometrics* 10, 165-85
- Svendsen Ingvild (1996), Empirical evidence on expectations, *Økonomiske Doktoravhandling* No. 28, Universitetet I Oslo
- Taylor, Mark P. (1988), What do investment managers know? An empirical study of practitioners' predictions. *Economica* 55, 185-202
- Theil, Henri (1952), On the time shape of economic microvariables and the Munich business test. *Revue de l'Institut International de Statistique* 20, 105-20
- Woodford, Michael (2003), *Interest and Prices. Foundations of a Theory of Monetary Policy*, Princeton University Press, Princeton, NJ

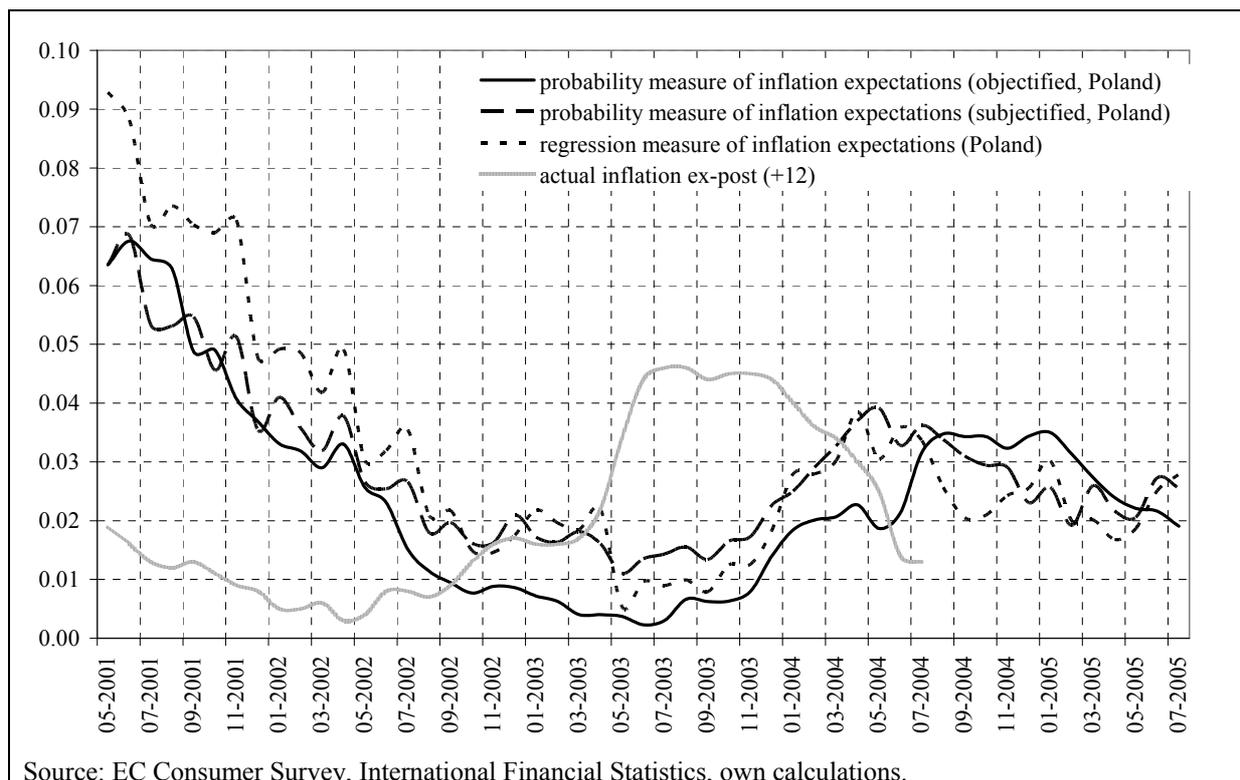
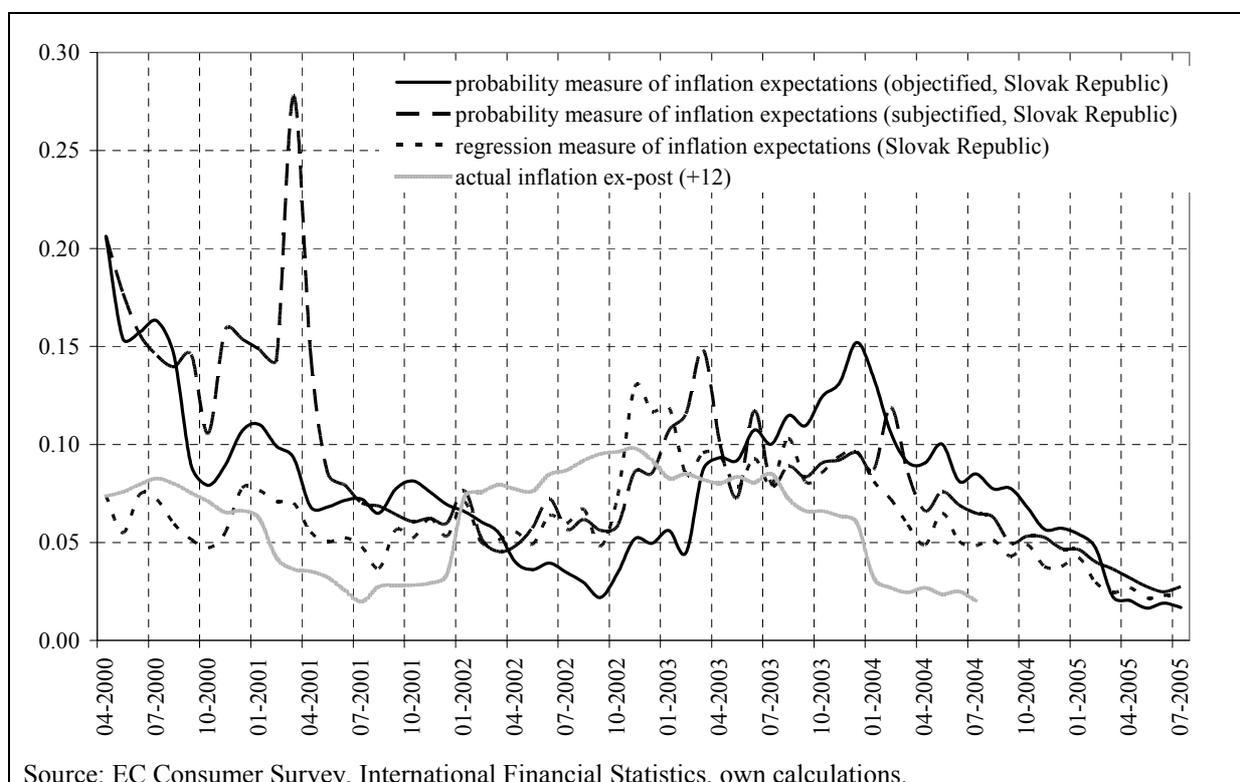
## Annex 1. Measures of inflation expectations

**Figure 2. Measures of consumer inflation expectations in the Czech Republic**



**Figure 3. Measures of consumer inflation expectations in Hungary**



**Figure 4. Measures of consumer inflation expectations in Poland****Figure 5. Measures of consumer inflation expectations in Slovakia**

## Annex 2. Usefulness of survey measures of inflation expectations

**Table 10. Overall degree of uncertainty**

	Czech Republic	Hungary	Poland	Slovakia
Relative dispersion of quantified measures of inflation expectations expressed in units of inflation volatility (see: Table 2)	0.73	1.30	0.44	0.59
Correlation:				
· objectified probability measure and subjectified probability measure	0.85	0.59	0.90	0.66
· objectified probability measure and regression measure	0.39	0.71	0.88	0.42
· subjectified probability measure and regression measure	0.31	0.19	0.95	0.43

Source: own calculations.

**Table 11. Usefulness of objectified probability measures of inflation expectations**

	Czech Republic	Hungary	Poland	Slovakia
Correlation:				
· CP balance statistics <sup>(1)</sup> and CPI inflation	0.80	0.68	0.86	0.54
· AC balance statistics <sup>(2)</sup> and CPI inflation	0.75	0.09	0.83	0.68

<sup>(1)</sup> CP balance statistics shows the impact of patterns of responses to the survey question on inflation perception on the quantification outcome in the standard Carlson and Parkin (1975) quantification method (normal distribution of the perceived rate of inflation).

<sup>(2)</sup> AC balance statistics is defined as a difference between fractions of respondents claiming that there was an increase and decrease in the price level.

Source: own calculations.

**Table 12. Usefulness of subjectified probability measures of inflation expectations**

	Czech Republic	Hungary	Poland	Slovakia
Correlation (CP <sup>(1)</sup> and AC balance statistics <sup>(2)</sup> )	0.96	-0.04	0.91	0.66
Relative volatility of CP balance statistics expressed in units of relative volatility of AC balance statistics	0.41	5.00	1.29	6.08
The loss of information resulting from the aggregation of respondents declaring that they noticed a sizeable, moderate and slight increase in the price level <sup>(3)</sup>	1.21	3.12	1.57	2.47

<sup>(1)</sup> CP balance statistics shows the impact of patterns of responses to the survey question on inflation perception on the quantification outcome in the standard Carlson and Parkin (1975) quantification method (normal distribution of the perceived rate of inflation).

<sup>(2)</sup> AC balance statistics is defined as a difference between fractions of respondents claiming that there was an increase and decrease in the price level; it is the simplest and the most intuitive quantitative description of patterns of responses to the survey question.

<sup>(3)</sup> Relative volatility of the balance statistics considering all 5 fractions of respondents (weights: 3 for respondents noticing a sizeable increase in prices, 2 – a moderate increase, 1 – a slight increase, 0 – for respondents declaring no change in the price level, -1 – for those perceiving a fall in the price level) expressed in units of relative volatility of the AC balance statistics.

Source: own calculations.

**Table 13. Usefulness of regression measures of inflation expectations**

	Czech Republic	Hungary	Poland	Slovakia
Correlation:				
· current inflation and the fraction of respondents declaring perceived rise of prices	0.80	0.54	0.82	0.66
· current inflation and the fraction of respondents declaring perceived fall of prices	-0.67	0.29	-0.49	-0.46
The loss of information resulting from the aggregation of fractions of respondents declaring that they noticed a sizeable, moderate and slight increase in the price level <sup>(1)</sup>	1.21	3.12	1.57	2.47
The loss of information resulting from the aggregation of fractions of respondents declaring that they expect that prices will rise at faster rate, the same rate and slower rate <sup>(2)</sup>	1.34	6.57	1.56	2.40

<sup>(1)</sup> Relative volatility of the balance statistics considering all 5 fractions of respondents (weights: 3 for respondents noticing a sizeable increase in prices, 2 – a moderate increase, 1 – a slight increase, 0 – for respondents declaring no change in the price level, -1 – for those perceiving a fall in the price level) expressed in units of relative volatility of the AC balance statistics.

<sup>(2)</sup> Relative volatility of the balance statistics considering all 5 fractions of respondents (weights: 3 for respondents expecting that prices will rise at faster rate, 2 – at the same rate, 1 – at slower rate, 0 – for respondents expecting no change in the price level, -1 – for those predicting a fall in the price level) expressed in units of relative volatility of the AC balance statistics.

Source: own calculations.