Consumer inflation expectations

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

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Abstract

We apply 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 leads 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 when estimating New Keynesian Phillips curves we relax that theoretical assumption.

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

JEL Classification: C42, D12, D84, E58

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Introduction

The aim of this paper is to analyse the role of consumer inflation expectations as an inflation driving force. 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 a 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 are done only for the Czech Republic and Poland.

The 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.

1. Theoretical aspects

In the late 1990s the New Keynesian Phillips Curve (NKPC) has become the standard macroeconomic model of inflation. It was introduced as a micro-founded model with clear theoretical foundations[1] that were to secure the straightforward structural interpretation of this model. The most popular way to introduce the NKPC is based on Calvo model of price setting.[2] This model assumes that in each period of time a fraction α 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:

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

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:

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

[1] See Woodford (2003), ch. 3, or Paloviita (2005), Annex 2, for a detailed derivation.

[2] Roberts (1995) shows that both 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.

where *β* is a discount factor, and *fv* is a variable representing an inflation pressure coming from the economic activity. This is usually either an output gap or real marginal cost gap.[3] Solving (2) and combining it with (1) we obtain the NKPC in the form of:

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

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

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

When confronted with data this basic formulation of the NKPC failed and the model has evolved into more empirically viable hybrid form with added lagged inflation term.[4] Initial motivation for this change was mostly empirical [cf. Gali and Gertler (1999)]. However, in the subsequent literature 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:

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

maintains its structural interpretation, with lagged inflation being simply a proxy for $E_{t-1}\pi_t$. Alternative interpretation is based directly on 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 the reduced-form relationship.

Further developments include other theoretical explanations of the hybrid model. One of them suggests 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)]. Other similar explanation is the original proposal formulated by Gali and Gertler (1999), where standard Calvo model applies only to a subset of firms changing prices in the given period, while a remaining group adjusts their prices according to a rule of thumb depending on the lagged inflation.

Relative Wage Model, introduced by Fuhrer and Moore (1995) results also in a hybrid model of a form depicted by equation (4), with β and γ equal to 0.5, but this model is based not on price-setting behavior of firms, but on assumptions concerning the real wage contracting mechanism.

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[3] Gap means a deviation of the variable from its value for a frictionless state of the economy. There is 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 that [cf. Rudd and Whelan (2005), Neiss and Nelson (2005)].

[4] This failure also triggered a lengthy discussion about issues other than the model specification, e.g. estimation methods, 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].

The quest for 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 costs of acquiring information and/or of price reoptimization – 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 is an important part of forming inflation expectations by economic agents should be in itself treated as an outcome of rational (optimizing) behavior. These issues have serious implications for the traditional understanding of rationality of survey-based inflation expectations, or rather for traditional way of testing for this rationality.[5] Briefly, they may be summarized here as giving strong support to the idea of using directly 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.[6] Data availability and comparability across countries under consideration caused that we had to limit ourselves to qualitative 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.

2.1. Survey data on consumers' inflation expectations

In our analysis we employ data from the European Commission's Consumer Surveys, conducted on monthly basis in all European Union countries, including the new member states, which joined the EU in May 2004. In the 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 are available only for a relatively short period, 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 start in 1993, we decided to use a shorter sample period 1999-2005. In this way in all CEE4 economies the periods we take into account are characterised 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 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*

[5] See also Andolfatto et al. (2005) and Branch (2004).

[6] See Roberts (1995) and other papers quoted in section 3.2 of this paper.

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 ago: *"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".*

Considering the common sample period, i.e. 2001-2005, survey responses on changes in prices perceived and expected by consumers point to some differences across analysed countries (Table 1, Table 2). In all of them a majority of respondents tend to notice increase in prices in the course of last 12 months – however, average fraction of these respondents is relatively small in the Czech Republic (59.9%) in comparison with Poland (77.4%), Hungary (83.8%) and Slovakia (91.0%). In all economies there is also a larger share of respondents expecting that during next 12 months prices will increase than of those predicting stable or falling prices. Consumers expecting an increase in the price level account approximately for 75% in the Czech Republic and Poland, while in the case of two other countries this fraction is significantly higher (89.5% in Slovakia and 94.0% in Hungary). The comparison of fractions of respondents choosing the non-decisive response shows that uncertainty in assessing past and future price developments is higher in the Czech Republic (respectively 4.7%, and 9.9% of consumers do not know how prices evolved and how they will change) and Poland (3.5% and 8.5%) than in the remaining economies (1.3% and 4.5% in the case of Hungary, 1.9% and 3.3% in the case of Slovakia).

Table 1. Survey data on perceived price changes†

Response:	Czech Rep.	Hungary	Poland	Slovakia
(1): "prices have risen a lot"	5.6%	16.6%	9.8%	24.1%
(2): "prices have risen moderately"	19.7%	33.1%	36.4%	31.8%
(3): "prices have risen slightly"	34.6%	34.1%	31.1%	35.1%
(4): "prices have stayed about the same"	28.9%	11.6%	18.2%	6.4%
(5): "prices have fallen"	6.5%	3.4%	1.2%	0.7%
(6): "I do not know"	4.7%	1.3%	3.2%	1.9%

† Average fraction of respondents choosing respective responses, common sample: May 2001 – July 2005.

Source: EC Consumer Survey, own calculations.

Table 2. Survey data on expected price changes†

Response:	Czech Rep.	Hungary	Poland	Slovakia
(1): "prices will increase more rapidly"	23.2%	27.6%	15.6%	29.1%
(2): "prices will increase at the same rate"	43.5%	53.0%	48.0%	47.1%
(3): "prices will increase at slower rate"	7.4%	13.2%	13.1%	12.9%
(4): "prices will stay about the same"	13.5%	1.1%	13.9%	6.7%
(5): "prices will fall"	2.4%	0.5%	0.7%	0.8%
(6): "I do not know"	9.9%	4.6%	8.5%	3.3%

† Average fraction of respondents choosing respective responses, common sample: May 2001 – July 2005.

Source: EC Consumer Survey, own calculations.

2.2. Quantification methods

The choice of quantification algorithm, with which expected inflation is extracted from the survey data, influences the outcome. Therefore, in order to check robustness of the results, we use various versions of two most popular quantification approaches: probability and regression ones.[7]

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 in the population. Quantification outcome is a product of survey responses embodied in the balance statistics Φ consistent with the normal distribution assumption[8] and the perceived rate of inflation, which plays the role of a scaling factor. 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 survey question pertaining to the recently observed price developments (Berk, 2000; Forsells and Kenny, 2004). Indicators of inflation

[7] 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).

[8] Balance statistics Φ is calculated in the following way: $\Phi = \frac{F^{-1}(1-a-b-c)+F^{-1}(e)}{F^{-1}(1-a-b-c)+F^{-1}(e)-F^{-1}(1-a)-F^{-1}(1-a-b))}$, where F^{-1} denotes the inverse of the cumulative standardized normal distribution function and *a*, *b*, *c* are fractions of respondents declaring that prices will, respectively, rise faster, at the same rate and more slowly, while *e* is a percentage of respondents expecting prices to go down.

expectations quantified with a survey measure of recent price changes' perception are called subjectified.[9]

The regression method of expectations quantification was introduced in application to business surveys by Pesaran (1984, 1987) who reinterpreted and developed the Anderson's (1952) concept. In general, this method is based on estimation of the relationship between current inflation (measured by official statistics) and its perception by firms (survey respondents). Existence of such relationship is justified by the fact that inflation rate in the economy might be presented as a weighted average change of prices of goods sold by firms. It is assumed that the same relationship holds between inflation expectations (expressed quantitatively) and qualitative opinions of firms (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. Simmons and Weiserbs (1992) interpreted inflation rate in the economy as an average of inflation rates specific to each consumer which allowed them to employ this method for quantification of consumer surveys on expectations. Construction of the regression method restricts its application to surveys including questions on both expected and past inflation with appropriately long history. Moreover, questions on inflation perception and expectation should be symmetric[10].

There are several models which can be employed to approximate the relationship between inflation and the survey data[11]. 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:

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

where π_t indicates yearly inflation rate, R_t – proportion of respondents declaring that prices have risen during last 12 months and F_t – proportion of respondents declaring that prices have fallen during last 12 months, ε_t – error term[12]. Table 3 provides estimates of the parameters of the quantification equation.

[9] 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.

[10] 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.

[11] 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 a function of a specific regression model.

[12] We use 12-month lagged inflation rate in order to avoid overlapping of periods.

Table 3. Estimates of parameters of the quantification equation[(1)]

	Czech Republic	Hungary	Poland	Slovakia
α_0	0.023 (0.003)	---	0.006 (0.001)	0.009 (0.003)
α_1	0.823 (0.086)	0.977 (0.019)	0.934 (0.024)	0.956 (0.032)
α_2	-0.151 (0.070)	0.077 (0.015)	0.044 (0.006)	-0.019 (0.001)
β_0	---	0.151 (00.29)	-0.055 (0.028)	---
β_1	---	---	2.216 (0.738)	---
β_2	-2.040 (1.00)	---	---	---
Sample	2001:01-2005:07	1999:02 – 2005:07	2001:05-2005:05[(2)]	2000:04-2005:07
adj. R^2	0.83	0.70	0.94	0.51

[(1)] NLS estimators; Newey-West standard errors in parentheses.

[(2)] Due to disturbances in the recent survey responses (resulting probably 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.

2.3. 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 one (presented in Annex). As shown in Table 4, they exhibit significant degree of convergence in Poland and Slovakia, while in the case of the Czech Republic and Hungary they are characterised by considerable dispersion. There are two factors in the quantification algorithms applied, which may affect the dispersion of analysed measures of inflation expectations. Firstly, it is the volatility of the current rate of inflation, which enters all quantification methods, although in a different way. Secondly, it is the structure of responses to survey questions concerning inflation perception and expectations.[13] Taking into consideration indicators presented in Table 4, it seems that differences in relative dispersion of inflation expectations in analysed economies may be attributed to differences in survey data rather than in inflation volatility.

[13] 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 4. Dispersion of inflation expectations' measures vs. inflation volatility

	Czech Rep.	Hungary	Poland	Slovakia
[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 quantified 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 limitations of quantification procedures and specific features of survey data, some of the inflation expectations measures we obtained may be less reliable than the other ones. Therefore, before moving to analysis of 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 criteria. The first one concerns the loss of information resulting from the aggregation of fractions of respondents declaring that in previous 12 months they noticed a sizeable, moderate and a slight increase in the price level. The second one compares balance statistics describing the patterns of responses to the survey question on inflation perception consistent with the normal-distribution-based quantification method with a more intuitive balance statistics calculated as a 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 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 the equation relating current inflation to survey data on inflation perception, similarly as in the case of objectified probability measures, the closer is 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[14] 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 experiencing high inflation rates, like Hungary.

Table 5 summarizes the usefulness of inflation expectations 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

[14] In the case of Hungary, the share of respondents declaring fall in prices in the perception question is positively correlated with the current rate of inflation.

trustworthy; therefore we do not use them in testing the relationship between inflation expectations and the price dynamics.

Table 5. Usefulness of different measures of expectations in economies considered

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

3. Inflation expectations in the Phillips curve

3.1. 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 α and β in the equation (6) should be equal to zero and one, respectively:[15]

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

where π_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 ε_t is a white-noise error.

The results of unbiasedness tests of consumer inflation expectations in the Czech Republic and Poland (Table 6, Table 7) show that this assumption is violated. In the analysed period 2001-2004, the relationship between actual inflation ex-post and the expected inflation in both economies was even insignificant. It may be caused by extremely small number of observations available, which imposes constraints on verifying unbiasedness, which is a long-run phenomenon.[16] Additionally, the period under consideration was characterised by different types of shocks. Both economies experienced a fast disinflation and fairly unexpected fall of inflation to historically lowest levels in 2003. Moreover, starting from mid-2003 the perspective of accession to the European Union (May 2004) made consumers afraid of a rapid price increase. This effect was noted in both countries, although in the Czech Republic it was weaker than in Poland.[17] Specificity of the analysed period limits the economic interpretation of the unbiasedness tests' results. Using alternative survey data on Polish consumers' inflation expectations covering much longer period (1992-2004), there is a cointegration between both variables, but the unbiasedness hypothesis is still rejected.[18]

Table 6. Unbiasedness test – Czech Republic†

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

† OLS estimators; Newey-West standard errors in parentheses.

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

[15] See: H. Bakhshi and A. Yates (1998), p. 9.

[16] Cf. Andolfatto et al. (2005), p. 5 and 6.

[17] As shown in Łyziak (2005), there were significant shifts in the patterns of responses to the survey question on inflation expectations in a 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.

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

Table 7. Unbiasedness test – Poland[1]

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:05-2004:09 *[1992:01-2004:09]*[2]	2001:05-2004:09	2001:05-2004:09
α	0.04 (0.01) *[0.01 (0.01)]*	0.04 (0.01)	0.05 (0.01)
β	-0.62 (0.19) *[1.32 (0.09)]*	-0.45 (0.16)	-0.83 (0.22)
F [H_0: (α, β) = (0, 1)]	74.81 (0.00) *[19.83 (0.00)]*	47.27 (0.00)	48.20 (0.00)

[1] OLS estimators; Newey-West standard errors in parentheses.

[2] Tests performed with the use of alternative indicators of inflation expectations quantified on the basis of Ipsos survey data.

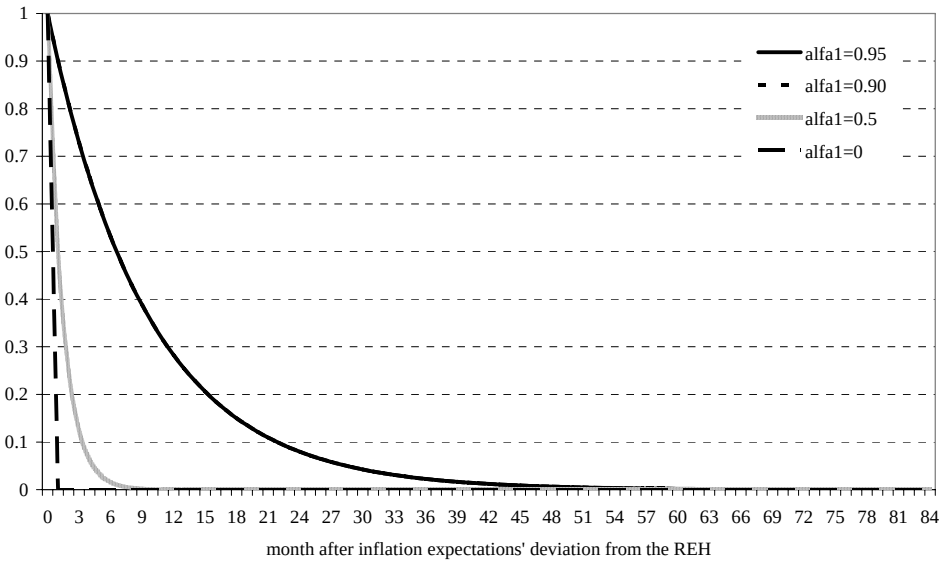
Source: EC Consumer Survey, Ipsos, GUS, own calculations.

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, except testing the unbiasedness property, it is also important to check whether inflation expectations tend to rational expectations outcome in the long-run. Estimating the following equation:

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

a long-run convergence of inflation expectations towards the actual inflation takes place if the coefficients α_1 and α_2 add to one. Moreover, the lower is α_1, the faster is the convergence process (Figure 1).

Figure 1. Speed of convergence of expectations towards actual inflation



Source: own calculations.

Consumer inflation expectations in the Czech Republic and Poland seem to converge to the actual inflation ex-post in the long run[19], although the speed of convergence is very low. According to estimation results presented in Table 8 and Table 9, the coefficient α_1 amounts to 0.9-0.95 for the measures of inflation expectations considered. It is a bit lower, i.e. it equals 0.81, in the case of Polish consumer inflation expectations analysed in the longer horizon, 1992-2004.

Table 8. Long-run convergence of expectations towards actual inflation – Czech Republic†

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:02-2004:07	2001:02-2004:07	2001:02-2004:07
α_1	0.95 (0.04)	0.93 (0.02)	0.91 (0.04)
α_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	---

† OLS estimators; Newey-West standard errors in parentheses.

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

[19] The only exception is the regression measure of inflation expectations of Czech consumers.

Table 9. Long-run convergence of expectations towards actual inflation – Poland[(1)]

	Probability measure		Regression measure
	Objectified	Subjectified	
Sample period	2001:06-2004:09 *[1992:02-2004:09]*[(2)]	2001:06-2004:09	2001:06-2004:09
α_1	0.93 (0.03) *[0.81 (0.05)]*	0.91 (0.02)	0.90 (0.03)
α_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

[(1)] OLS estimators; Newey-West standard errors in parentheses.

[(2)] 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.

3.2. Estimates of the Phillips curve

Should direct measures of inflation expectations quantified on the basis of qualitative surveys play any role in macroeconometric models, or should they constitute a fully independent source of information, clearly separated from other ones? 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 necessarily needed to model price behaviour. 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 researchers examining survey expectations demonstrate that they are not perfectly rational.[20] Therefore, the most general use of survey measures of inflation expectations in macroeconometric 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 behaviour in the hybrid-type Phillips curves.

[20] 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 neither. Svendsen (1996) proves that Norwegian firms' price expectations (or plans) are not rational. Roberts (1997) estimates the degree of nonrationality in two US survey-based 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 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.

There are attempts to make use of direct measures of inflation expectations in macroeconometric modeling. 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 forward-looking New Keynesian Phillips curve for 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 Consensus Economic survey. Estimating hybrid Phillips curves, Forsells and Kenny (2004) show that consumer expectations play 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 [Kłos et al. (2005)].

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

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

Similarly as in the version of the aggregate supply curve used by Forsells and Kenny (2004) in analysing price dynamics in the euro area, the annual inflation (π) is driven by its past values, inflation expectations (π^e) and a measure of excess demand in the economy (x). Additionally the real exchange rate (e^r) is among explanatory variables due to 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 fuels 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 α_1 and α_2 add to one – is rejected for almost all specifications estimated for both countries[21], we present unrestricted estimates only (Table 10, Table 11). 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.

[21] F statistics for H0: α1+α2=1: 6.93 (75.0) for the Phillips curve estimated with OLS, in which 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 10. Estimates of the hybrid Phillips curve – Poland[(1)]

	α_1	α_2	α_3	α_4	R^2_{adj}	n
Objectified probability measure (i=3, j=1), OLS	0.53 (0.06)	0.38 (0.03)	0.15 (0.08)	-0.03 (0.01)	0.98	18
	[0.28 (0.10)][(2)]	*[0.57 (0.07)]*	*[0.42 (0.17)]*	*[-0.04 (0.02)]*	*[0.98]*	*[34]*
Objectified probability measure (i=4, j=1), TSLS	0.56 (0.06)	0.36 (0.02)	0.15 (0.09)	-0.03 (0.01)	0.97	17
	[0.31 (0.13)][(2)]	*[0.55 (0.08)]*	*[0.37 (0.16)]*	*[-0.04 (0.02)]*	*[0.98]*	*[34]*
Subjectified probability measure (i=3, j=2), OLS	0.38 (0.10)	0.45 (0.05)	0.38 (0.06)	-0.06 (0.02)	0.98	18
Subjectified probability measure (i=3, j=2), TSLS	0.45 (0.10)	0.44 (0.05)	0.35 (0.06)	-0.06 (0.02)	0.97	17
Regression measure (i=3, j=2), OLS	0.23 (0.07)	0.44 (0.05)	0.41 (0.07)	-0.07 (0.02)	0.98	18
Regression measure (i=3, j=2), TSLS	0.36 (0.13)	0.39 (0.08)	0.34 (0.08)	-0.07 (0.02)	0.96	17

[(1)] OLS/TSLS estimators; Newey-West standard errors in parentheses. In the case of TSLS the list of instruments comprises explanatory variables with inflation expectations replaced with their lag.

[(2)] 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.

Table 11. Estimates of the hybrid Phillips curve – Czech Republic[†]

	α_1	**α_2**	**α_3**	**α_4**	**R^2_{adj}**	**n**
Objectified probability measure (i=1, j=1), OLS	0.54 (0.08)	-0.23 (0.04)	0.30 (0.11)	-0.06 (0.02)	0.93	18
Objectified probability measure (i=1, j=1), TSLS	0.49 (0.15)	-0.22 (0.04)	0.39 (0.21)	-0.09 (0.04)	0.93	17
Subjectified probability measure (i=2, j=1), OLS	0.62 (0.27)	-0.49 (0.13)	0.84 (0.19)	-0.04 (0.06)	0.86	18
Subjectified probability measure (i=2, j=1), TSLS	1.12 (0.38)	-0.58 (0.18)	0.70 (0.11)	0.05 (0.10)	0.89	17
Regression measure (i=1, j=0):						
· unrestricted estimates, OLS	0.51 (0.10)	0.27 (0.10)	1.15 (0.10)	-0.07 (0.03)	0.88	18
· unrestricted estimates, TSLS	0.90 (0.13)	0.50 (0.11)	1.03 (0.19)	-0.01 (0.00)	0.80	17
· restricted estimates, OLS	0.63 (0.03)	0.27	1.13 (0.09)	-0.05 (0.02)	0.88	18

[†] OLS/TSLS estimators; Newey-West standard errors in parentheses. In the case of TSLS the list of instruments comprises explanatory variables with inflation expectations replaced with their lag.

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 α_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 a bit 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 a negative sign of the coefficients on the past inflation in the case of the Phillips curves with probability measures of inflation expectations estimated for the Czech Republic.

To address the problem of low number of observations available for our analysis, we estimated the Phillips curve (8) on pooled data from both countries (Annex 3). The results do not differ much and confirm our conclusions on the significance of direct inflation expectations measures in inflation modelling.

4. 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 to 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 is 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 low 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 Kokoszczyński, 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 macroeconometric 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 Doktoravhandlinger* No. 28, Universitetet I Oslo

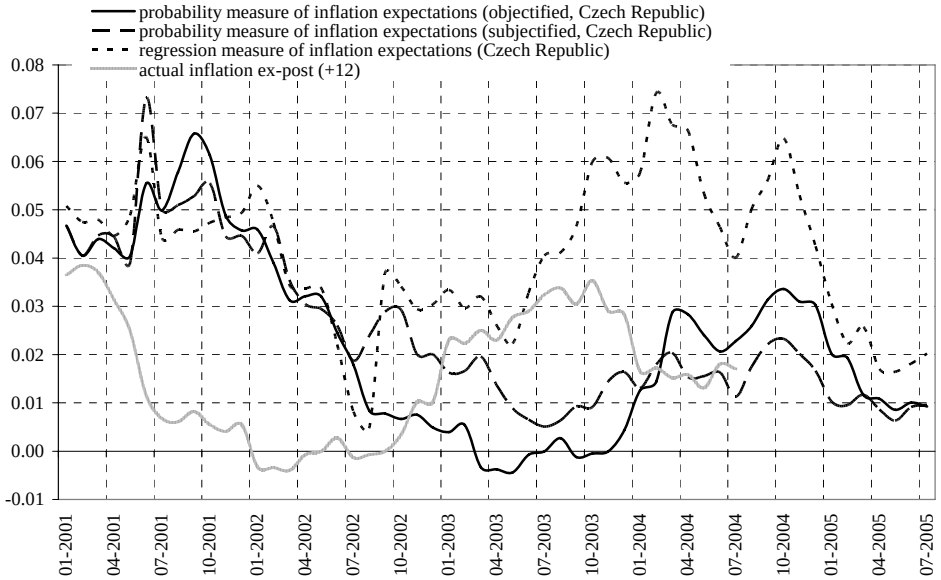
Taylor, Mark P. (1988), What do investment managers know? An empirical study of practitioners' predictions. *Economica* 55, 185-202

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

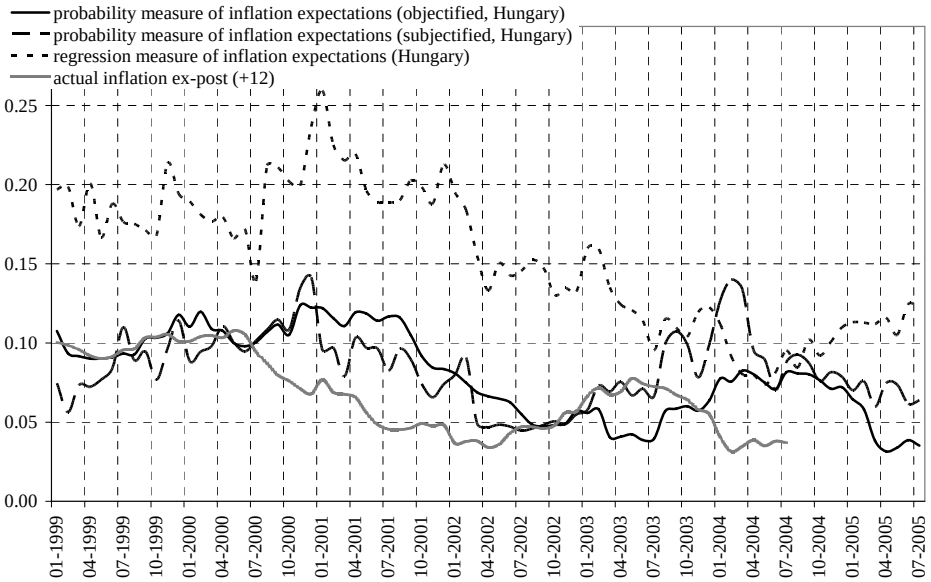
Annex 1

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



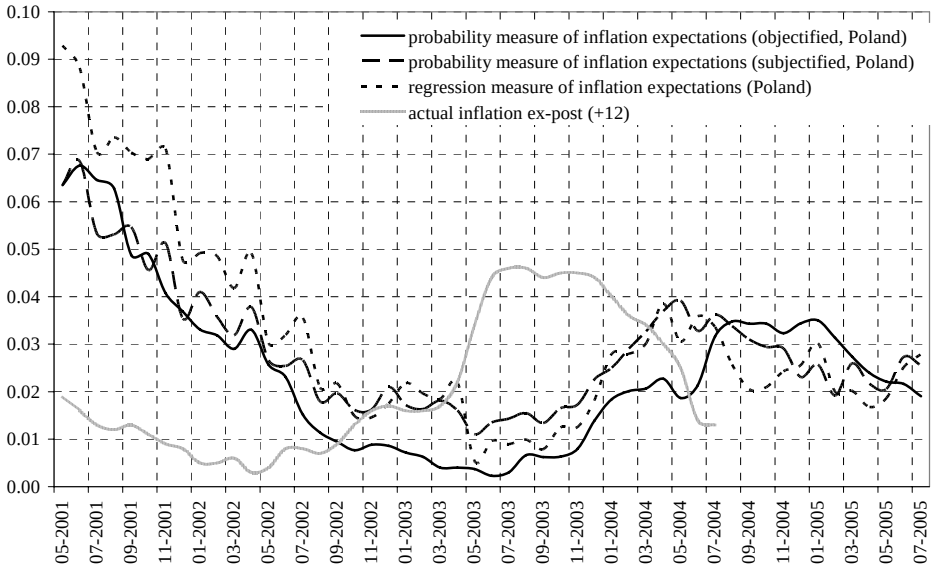
Source: EC Consumer Survey, International Financial Statistics, own calculations.

Figure 3. Measures of consumer inflation expectations in Hungary



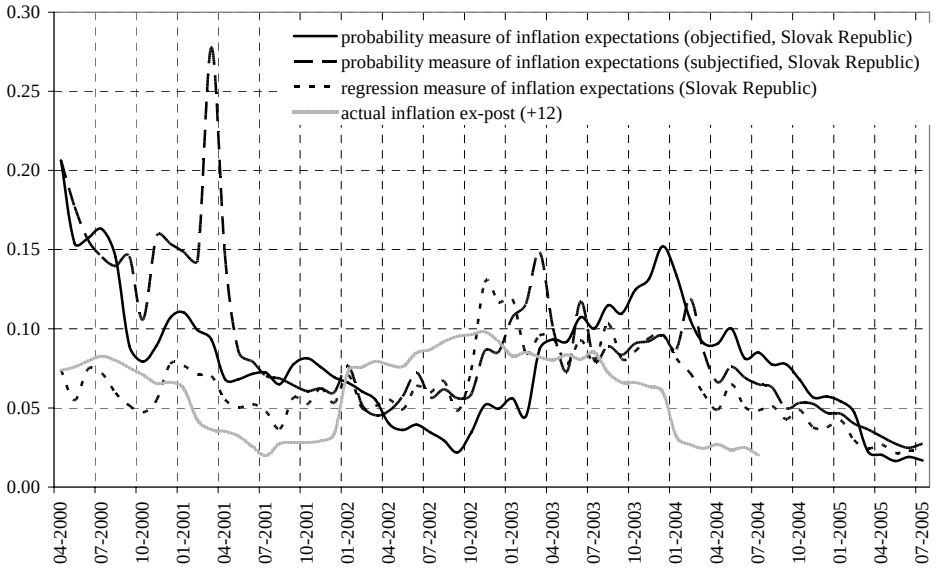
Source: EC Consumer Survey, International Financial Statistics, own calculations.

Figure 4. Measures of consumer inflation expectations in Poland



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

Figure 5. Measures of consumer inflation expectations in Slovakia



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

Annex 2

Table 12. 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 4)	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 13. Usefulness of objectified probability measures of inflation expectations

	Czech Republic	Hungary	Poland	Slovakia
Correlation:				
CP balance statistics[(1)] and CPI inflation	0.80	0.59	0.86	0.54
AC balance statistics[(2)] and CPI inflation	0.75	0.16	0.83	0.68

[(1)] 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).

[(2)] 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 14. Usefulness of subjectified probability measures of inflation expectations

	Czech Republic	Hungary	Poland	Slovakia
Correlation (CP[1] and AC balance statistics[2])	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[3]	1.21	3.12	1.57	2.47

[1] 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).

[2] 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.

[3] 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 15. Usefulness of regression measures of inflation expectations

	Czech Republic	Hungary	Poland	Slovakia
Correlation:				
current inflation and fraction of respondents declaring perceived rise of prices	0.80	0.54	0.82	0.66
current inflation and 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[1]	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[2]	1.34	6.57	1.56	2.40

[1] 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.

[2] 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.

Annex 3

We estimated the Phillips curve, as specified in the equation (8), on pooled data for Poland and the Czech Republic, using both pooled and fixed effect estimators.[22] As group specific effects turned out to be insignificant in the case of the models, in which probability measures of inflation expectations were used, these results are not presented (Table 16). Estimates of all the parameters – except output gap coefficient in the specification with the probability measure of inflation expectations – have correct signs and are highly significant. The dynamic homogeneity restriction, similarly as in the Phillips curves estimated for both countries separately, is in most cases unfulfilled.

Table 16. Estimates of the hybrid Phillips curve – pooled Poland and Czech Republic data(1)

	α_1	α_2	α_3	α_4	R^2_{adj}	H_0: $\alpha_1+\alpha_2=1$
Objectified probability measure (i=2, j=1)	0.77 (0.10)	0.24 (0.10)	-0.17 (0.17)	-0.001 (0.000)	0.92	0.28(3)
Subjectified probability measure (i=2, j=1)	0.56 (0.10)	0.34 (0.10)	0.30 (0.09)	-0.001 (0.000)	0.89	0.00(3)
Regression measure (i=2, j=1)	0.42 (0.09)	0.31 (0.05)	0.38 (0.01)	-0.002 (0.000)	0.91	0.00(3)
Regression measure(2) (i=3, j=1)	0.44 (0.09)	0.31 (0.04)	0.40 (0.01)	-0.057 (0.019)	0.90	0.00(3)

(1) GLS estimators with cross-section weights; White period standard errors in parentheses; sample: 2001Q1-2005Q3; unbalanced panel; n=36;

(2) Fixed effects model (constant).

(3) P-value for Wald coefficient restriction test;

Source: own calculations on the basis of IFS data.

22 Due to low number of cross-section units relative to number of coefficients to be estimated, we were not able to estimate random effects model, which from theoretical point of view would be the most appropriate.