GRBER Global Review of Business and Economic Research
Vol. 9 • No. 2 • Autumn 2013 : 117-132

AN EMPIRICAL ASSESSMENT OF THE EXPECTED INFLATION QUANTIFICATION METHODS: A PAN-EUROPEAN STUDY

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Abstract: *This article analyses the consumers' inflation expectations in 24 individual European Union countries. Based on Consumer Survey data, the authors employ three different quantification techniques (Carlson-Parkin, nonlinear regression approach and a Bachelor-type indicator) in order to obtain a numerical indicator of expected inflation. For each observed country the three stated estimators are compared in terms of their forecasting accuracy with regards to actual inflation dynamics. That way the "optimal" indicator is chosen for each country. Additionally, the paper empirically tests whether the extracted inflation expectations are rational (in the sense of unbiasedness). The obtained results to a large extent point to the conclusion that European consumers are not able to produce unbiased estimates of future inflation dynamics.*

JEL classification: *C32, E31, E52*

Key words: *expected inflation, consumer surveys, quantification method, rational expectations*

1. INTRODUCTION

Almost every economic decision involves a forward-looking component related to its uncertain future effects. Therefore most contemporaneous macroeconomic models incorporate agents' expectations on future economic tendencies. One of the crucial variables in that context is *expected inflation*. Today it represents a constitutive element of both the theoretical and empirical research on consumer behavior, monetary policy, labor economics, investment analysis and firm theory.

Prior to any further discussion on the issue of inflation expectations, it is necessary to properly define the term itself. Since expectations *per se* represent a purely subjective and non-measurable category, researchers apply various statistical techniques in order to measure and econometrically assess them. In that context, two separate empirical strands have evolved in the literature.

The first one does not make an effort to empirically measure expectations, but derives the existence of rational expectations from microeconomic foundations. The most prominent example is the estimation of the New Keynesian Phillips curve

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(NKPC) (Gali and Gertler, 1999; Gali, Gertler and López-Salido, 2005). Namely, that model presumes rational expectations, which are then used as conditional moments in the estimation of NKPC via the Generalized Method of Moments (GMM).

However, there is no *a priori* reason to assume that agents' inflation expectations indeed are strictly rational. As Stock (2012) points out, "it is important to study how the expectations of real people, not a model's rational agents, are actually formed". That is the main reason why the second literature strand relies on survey data in order to directly obtain professionals' or consumers' attitudes on future inflation developments. Based on survey data, researchers are able to quantify expected inflation and empirically test whether the obtained expectations are rational, adaptive, or do they follow some other learning mechanism.

This paper follows the latter path, basing the empirical analysis solely on the data obtained through Consumer Surveys (CS) in EU countries. CS have firstly been conducted in 1946 at the University of Michigan (Campbell and Katona, 1946). They have continuously gained significance since then, resulting in the fact that (within the overall EU harmonization process) the member states decided to harmonize the methodology of conducting CS (European Commission, 2007).

Among other questions, *The Joint Harmonised EU Programme of Business and Consumer Surveys* also includes two questions regarding the consumers' inflation perceptions in the last year and expectations for the following year (European Commission, 2007).

Q5 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

N 9 don't know.

Q6 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

N 9 don't know.

The aggregate distribution of consumers' responses to this question enables the researcher to obtain an exact numerical indicator of inflation expectations. The existing literature points to several different quantification methods, but does not offer a consensus about the optimal one.

Therefore this article adds to the literature by analyzing the following research questions.

- Which quantification method yields the highest forecasting accuracy of inflation expectations?
- Are consumers' inflation expectations rational?
- Are the obtained conclusions uniform for all observed member states? If no, what are the reasons for the observed heterogeneity?

The analysis is conceptualized as follows. The next two sections offer a detailed theoretical review on the state-of-the-art of inflation expectations quantification methods and an overview of the prevailing conclusions in recent empirical research. Section 4 explains the observed dataset and clarifies the applied rationality tests. Empirical results are presented in section 5, followed by the obtained conclusions, policy implications and recommendations for future research.

2. A REVIEW OF THE QUANTIFICATION METHODS

In order to obtain numerical indicators of expected inflation, researchers apply various quantification techniques. The simplest existing form of such indicator is the balance of responses (European Commission, 2007), given by the following equation.

$$B = (a^e + 0{,}5b^e) - (0{,}5d^e + e^e) \tag{1}$$

where B is the balance of responses, while a^e, b^e, d^e and e^e are the fractions of respondents declaring that prices in the following year will increase more rapidly, increase at the same rate, increase at a slower rate, and fall (respectively). Accordingly, let c^e be the share of respondents expecting the prices to stay the same in the next 12 months. However, B is expressed in index form and as such is not directly comparable to actual inflation dynamics.

In order to circumvent this shortcoming, Theil (1952) and Batchelor (1986) simply calculate the difference between the share of consumers who expect the prices to rise in the following year ($U_t^e = a_t^e + b_t^e + c_t^e$) and the percentage of those expecting a deflation ($D_t^e = e_t^e$). Batchelor (1986) then scales that difference in order to obtain expected inflation.

$$\pi_t^e = \theta\left(U_t^e - D_t^e\right) \tag{2}$$

where θ is the scaling factor obtained by assuming the long-run unbiasedness of expectations.

$$\sum_t \pi_t^e = \sum_t \pi_t \tag{3}$$

where π_t is the actual inflation rate in period *t*. Thus the final expression for the population expected inflation is given by equation (4).

$$\pi_t^e = \frac{\sum_t \pi_t}{\sum_t \left(U_t^e - D_t^e\right)} \left(U_t^e - D_t^e\right) \tag{4}$$

Since CS questions aim to reflect consumers' attitudes towards their economic environment at the one year time horizon (see Q6), π_t is also analyzed as the year-on-year rate of change.

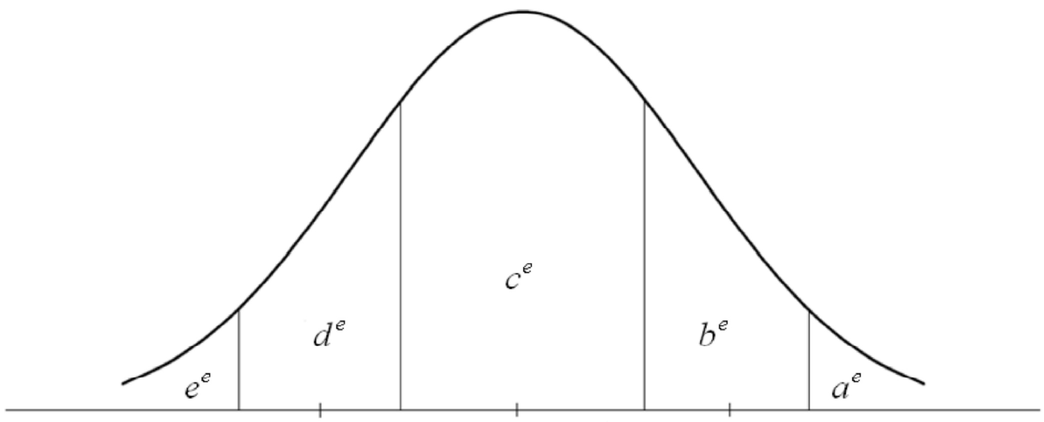
The most commonly used quantification method of expected inflation is the Carlson and Parkin (1975) (CP) approach. It is grounded on three basic assumptions:

1. Respondents form their inflation expectations on their own subjective probability density function (pdf)
2. Individual pdfs can be aggregated to a joint distribution $f(\pi_{t+12} \mid \Omega_t)$, where π_{t+12} is the inflation rate in the 12th future month and Ω_t is the information set available to the respondent at time *t*.
3. Respondents form their expectations according to two sensitivity intervals It is assumed that respondents declare a price growth/fall in time *t*+12 if their expected inflation π_{t+12}^e is at least ε_t above/below zero. It is also assumed that consumers base inflation expectations on their own perceptions of past inflation tendencies. In that sense, they expect the prices to increase at a slower rate/increase more rapidly only if their inflation expectations are at least δ_t units above/below their inflation perceptions for the previous year (π_t^p).

In order to assess inflation expectations as the expected valued of the aggregate distribution of responses ($E\left[\pi_{t+12} \mid \Omega_t\right] = \pi_{t+12}^e$), the latter has to be approximated by some kind of theoretical distribution. In the vast majority of empirical applications the choice comes down to the normal distribution (see Forsells and Kenny, 2004 or Arnold and Lemmen, 2008). This is strongly supported by the central limit theorem. Namely, if inflation expectations of respondents in time are random *i.i.d.* variables, then, no matter what form do the individual distributions have, the distribution of the mean of those variables is asimptotically normal (for a sufficiently large *N*).

Figure 1 summarizes all the above assumptions, presenting the aggregate probability distribution of inflation expectations.

Figure 1: Aggregate Probability Distribution of Inflation Expectations



Source: author. Note: Proportions of responses are measured in time.

Additionally, let $A^e = Nz^{-1}(1-a^e)$, $B^e = Nz^{-1}(1-a^e-b^e)$, $C^e = Nz^{-1}(1-a^e-b^e-c^e)$, $D^e = Nz^{-1}(e^e)$, while Nz is the cumulative standardized normal distribution function. Sabrowski (2008) shows that the final expression for expected inflation is given by the following relation.[1]

$$\pi^e_{t+12} = \pi^p_t \frac{C^e + D^e}{C^e + D^e - (A^e + B^e)} \tag{5}$$

It can also be found that the perceived inflation can be estimated through the following expression.

$$\pi^p = -s\frac{A^p + B^p}{A^p - B^p} \tag{6}$$

where $A^p = Nz^{-1}\left[1\text{-}(a^p + b^p + c^p)\right]$ and $B^p = Nz^{-1}(e^p)$. Also; a^p, b^p, c^p, d^p, e^p are the fractions of respondents declaring that prices have risen a lot, risen moderately, risen slightly or fallen in the last 12 months (respectively). Finally, s is the scaling factor.

$$s_t = \frac{-\sum_{i=1}^{T}\pi_t}{\sum_{i=1}^{T}\left(\frac{A_t^p + B_t^p}{A_t^p - B_t^p}\right)} \tag{7}$$

Third and the last quantification method analyzed here is the nonlinear regression approach (Pesaran, 1987; Smith and McAleer, 1995). It models the yearly inflation rate as the weighted combination of p respondents who expect an inflation rise ($\pi_{i,t}^{+}$) and consumers who expect a negative trend in inflation ($\pi_{i,t}^{-}$).

$$\pi_t = \sum_{i=1}^{p} w_{i,t}^{+}\pi_{i,t}^{+} + \sum_{i=1}^{m} w_{i,t}^{-}\pi_{i,t}^{-} \tag{8}$$

where $w_{i,t}^{+}$ and $w_{i,t}^{-}$ are the appropriate weights. Further on, Smith and McAleer (1995) define $\pi_{i,t}^{+}$ and $\pi_{i,t}^{-}$ as proportions of the actual inflation rate π_t:

$$\begin{aligned} \pi_{i,t}^{+} &= \alpha + \gamma_1\pi_t + v_{i,t}^{+} \qquad (\alpha \geq 0,\ 0 \leq \gamma_1 \leq 1) \\ \pi_{i,t}^{-} &= -\beta + \gamma_2\pi_t + v_{i,t}^{-} \qquad (\beta \geq 0,\ 0 \leq \gamma_2 \leq 1). \end{aligned} \tag{9}$$

Without presenting the full derivation (see Smith and McAleer (1995) for details), the final nonlinear regression model is defined as follows.

$$\pi_t = \frac{\alpha U_t^p - \beta D_t^p + U_t^p \sum_{j=1}^{k} \gamma_{1j}\pi_{t-j} + D_t^p \sum_{j=1}^{n} \gamma_{2j}\pi_{t-j}}{(1 - \gamma_{10}U_t^p - \gamma_{20}D_t^p)} + v_t \quad (-\gamma_{10}U_t^p - \gamma_{20}D_t^p \neq 1) \tag{10}$$

where U_t^p and D_t^p are the shares of consumers perceiving an inflation growth/decline in the past 12 months (Q5 in the CS questionnaire) and v_t is a white-noise process. This equation empirically estimates the economy-wide perceived inflation.

The Smith and McAleer (1995) method presumes that the same relationship given in equation (10) is also valid for inflation expectations (they assume that the economic agents perceive past and future (expected) changes of inflation in the exact same manner). Therefore, in order to empirically assess expected inflation, one has to insert the estimated coefficients from equation (10) into the equation (11).[2]

$$\pi_t^e = \frac{\hat{\alpha} U_t^e - \hat{\beta} D_t^e + U_t^p \sum_{j=1}^{k} \hat{\gamma}_{1j}\pi_{t-j} + D_t^e \sum_{j=1}^{n} \hat{\gamma}_{2j}\pi_{t-j}}{(1 - \hat{\gamma}_{10}U_t^e - \hat{\gamma}_{20}D_t^e)}, \quad (-\gamma_{10}U_t^p - \gamma_{20}D_t^p \neq 1) \tag{11}$$

3. LITERATURE REVIEW

The variety of expected inflation quantification methods is covered by a voluminous body of literature. The following section presents only the milestone papers, accentuating their vital findings.

Nardo (2003) has written one of the most influential paper dealing with the comparison of mainstream quantification methods. She presented the theoretical (technical) limitations of the CP and nonlinear regression method. As far as the CP method is concerned, Nardo (2003) highlights several situations in which it is technically impossible to employ it. Firstly, if none of the respondents declare an expected inflation hike or fall ($e^e = 0$ or $a^e + b^e + c^e = 0$). A similar situation occurs due to an unsubstantial share of respondents expecting a price growth; causing the CP inflation expectations to take unrealistically high values (see e.g. Łyziak and Stanisławska, 2006). Secondly, the CP method would also be disabled in the case of $d^e = 0$. Then the fractions of respondents declaring a rise/fall in inflation would be exactly equal ($a^e + b^e + c^e = e^e = 0.5$) and the denominator of relation (6) would be equal to zero.

Nardo (2003) also emphasizes the widely accepted unrealistic assumption of the nonlinear regression approach. Namely, it assumes that economic agents perceive past inflation figures in the identical way as they anticipate its future developments. To the best of the Nardo's knowledge, the only paper corroborating this *a priori* assumption is Wren-Lewis (1985).

All of the mentioned shortcomings might induce considerable inflation forecasting errors. This paper aims to explore which of the above disadvantages will prevail and which will be found to be negligible.

Several authors also question the arbitrary choice of normal distribution in the CP estimator.[3] However, several author make an attempt to employ distributions with asymmetry and non-normal peakedness. E.g. Berk (1999) analyzed the Dutch CS responses to show that the central and non-central *t*-distributions do not improve the forecasting accuracy of the CP estimator. A similar effort was made by Löffler (1999), who applied Monte-Carlo simulations to show that the CP estimator does not gain any added value (measured by correlation with the actual inflation) when fitted using the exponential or scaled *t*-distribution.

Terai (2009) also does not asses the forecasting accuracy of CS inflation expectations exploring actual survey data. On the contrary, he uses Monte-Carlo simulations and compares the Batchelor-type expectations indicator to the standard CP one. His results draw attention to several inferences. Firstly, the CP method outperforms the Batchelor-type inflation expectations. Secondly, it is found that CP performs reasonably well under normal economic conditions. On the other hand, the inflation forecasting error gets larger as U_t^e increases in the analyzed survey dataset (as the responses distribution gets skewed and deviates from the assumed normal distribution). Therefore this paper will aim to subject the harmonized EU CS to the rationality test in the presence of extreme economic conditions such as the recent financial crisis and turmoil. This will provide additional insights to the research on inflation expectations and question whether the recent global crisis had in any way changed the prevailing conclusions about consumers' (non) rationality. It is also worthwhile noticing that (except Berk (1999)), all above papers compare the quantification methods solely theoretically or on the basis of artificial (simulated) data. This paper adds to the literature by analyzing actual survey data from an extensive dataset of 24 individual EU countries.

The rational expectations hypothesis is a cornerstone of neoclassical economics. It is a priori assumed that economic agent (homo economicus) is perfectly rational and completely informed decision maker who basis his actions on all relevant economic information. However, some studies firmly disprove the concept of rationality regarding inflation expectations. Gramlich (1983) published the pioneer study in this area, finding that both the US consumers and professional forecasters overestimate inflation tendencies, which strongly contradicts rational expectations. Bakhshi and Yates (1988) corroborate his findings with UK data. Sabrowski (2008) also provides empirical evidence against the rationality of inflation expectations, this time by a study of various German socio-demographic groups (segregated by gender, age, education, and income). The exact same conclusion is brought forward by Kokoszczyński, Łyziak and Stanisławska (2006) for Polish and Czech consumers. Therefore it is evident that the concept of rational inflation expectations often tends to fail when empirically examined. To the best of the authors' knowledge, the only paper proving the existence of rational inflation expectations is Forsells and Kenny (2004). Relying on the CP quantification method, they find that the euro-zone consumers provide unbiased estimates of future inflation. This paper aims to shed some light on that issue, questioning the consumers' rationality in 24 different EU countries. This is so far the most extensive study of that kind.

4. DATA AND METHODOLOGY

The analyzed dataset comprises 24 EU member states.[4] For each of the observed countries three different inflation expectations measures are extracted: the CP-based indicator (*exp_cp*), a measure based on the nonlinear regression approach (*exp_reg*) and the Bachelor-type indicator (*exp_b*). All observed variables are in monthly frequencies. They span (at most, depending on the starting date for conducting CS in individual countries) from January 1997 to September 2013. All indicators of inflation expectations are put in relation to actual inflation series (expressed in year-on-year percentage changes of HICP). HICP data is obtained from Eurostat, while the source of CS responses data is the European Commission.

The first part of the analysis is to find the best performing inflation expectations indicator for each analyzed country. This is done by comparing their in-sample predictive performance with regards to actual inflation in terms of the mean square forecasting error. After that, the "optimal" expectations indicators and actual inflation series are tested for unit root presence. According to the ADF test results, the rationality tests are performed.

For every pair of stationary variables (π_t^e and π_t), the following OLS equation is estimated.

$$\pi_t^e = \alpha + \beta\pi_t + e_t \tag{12}$$

If the inflation expectations are rational, the following joint hypothesis cannot be rejected.

$$H_0 : (\alpha, \beta) = (0, 1) \tag{13}$$

Bakhshi and Yates (1998) were the first to test for rationality of nonstationary inflation expectations series. They argue that the inflation expectations can be characterized as rational if:

(i) π_t^e and π_t are cointegrated (without a constant in the cointegration relationship)

(ii) Their stationary combination involves equal and opposite coefficients of π_t^e and π_t

Namely, that would mean that the inflation forecasting error (the difference between actual and expected inflation) is stationary.

Hence for the nonstationary expected and actual inflations series, the Johansen cointegration test was conducted. When it was shown that the two series cointegrate, a lihelihood ratio test was performed to test whether the restriction holds that π_t^e and π_t coefficients in the cointegrating vector are equal and of the opposite sign.

5. EMPIRICAL RESULTS

The in-sample predictive performance of all three analyzed inflation expectations indicators are compared for each of the 24 observed countries. Firstly, the optimal inflation expectations measure (in terms of the mean square forecasting error (MSFE)) is found and marked by * in Table 1. For the other two models, their relative MSFEs (ratio of their MSFE and the optimal model's MSFE) are presented. This kind of presentation implies that numbers larger than one signify worse forecasting performance with regards to the optimal model (which minimizes the MSFE).

The presented results can be summarized in several important conclusions. Firstly, it is evident that the Batchelor (1986) method results in the relatively highest forecasting accuracy. To be specific, it is the chosen as the superior model in 13 countries (Austria, Belgium, Bulgaria, Croatia, France, Greece, Italy, Netherlands, Portugal, Slovenia, Spain, Sweden, and the UK). On the other hand, in the other 11 countries (Cyprus, Czech Republic, Estonia, Finland, Germany, Hungary, Latvia,

Table 1
Forecasting Accuracy of the Analyzed Inflation Expectations Indicators

Country	*Variable*	*MSFE*	*Country*	*Variable*	*MSFE*
Austria	*exp_cp*	2.2566	**Italy**	*exp_cp*	2.3394
	exp_b	*		*exp_b*	*
	exp_reg	1.5163		*exp_reg*	2.8040
Belgium	*exp_cp*	1.8153	**Latvia**	*exp_cp*	52.9688
	exp_b	*		*exp_b*	1.2262
	exp_reg	2.0250		*exp_reg*	*
Bulgaria	*exp_cp*	2.7195	**Lithuania**	*exp_cp*	27.8918
	exp_b	*		*exp_b*	1.2546
	exp_reg	1.1987		*exp_reg*	*
Croatia	*exp_cp*	1.9996	**Netherlands**	*exp_cp*	1.2898
	exp_b	*		*exp_b*	*
	exp_reg	1.5804		*exp_reg*	°
Cyprus	*exp_cp*	1.9360	**Poland**	*exp_cp*	1.3074
	exp_b	1.1072		*exp_b*	1.4249
	exp_reg	*		*exp_reg*	*
Czech Republic	*exp_cp*	2.3806	**Portugal**	*exp_cp*	1.9744
	exp_b	2.3421		*exp_b*	*
	exp_reg	*		*exp_reg*	1.3780
Estonia	*exp_cp*	3.2651	**Romania**	*exp_cp*	11.5842
	exp_b	1.0121		*exp_b*	7.7413
	exp_reg	*		*exp_reg*	*
Finland	*exp_cp*	1.4755	**Slovakia**	*exp_cp*	4.0711
	exp_b	1.0458		*exp_b*	3.9662
	exp_reg	*		*exp_reg*	*
France	*exp_cp*	1.6237	**Slovenia**	*exp_cp*	5.1685
	exp_b	*		*exp_b*	*
	exp_reg	2.0342		*exp_reg*	°
Germany	*exp_cp*	1.7199	**Spain**	*exp_cp*	2.0984
	exp_b	1.0025		*exp_b*	*
	exp_reg	*		*exp_reg*	1.9080
Greece	*exp_cp*	2.9104	**Sweden**	*exp_cp*	1.2994
	exp_b	*		*exp_b*	*
	exp_reg	1.3854		*exp_reg*	1.4212
Hungary	*exp_cp*	4.5203	**UK**	*exp_cp*	1.2783
	exp_b	3.9933		*exp_b*	*
	exp_reg	*		*exp_reg*	1.3418

Notes: * denotes the optimal indicator (lowest MSFE) for each analyzed country. ° denotes that the Gauss-Newton method for estimating nonlinear least squares did not converge to a unique solution.

Lithuania, Poland, Romania, and Slovakia) the nonlinear regression approach was found to be optimal. The CP method, however, seems to have the worst forecasting potential since it does not offer any "added value" in any of the analyzed countries.[5]

After choosing the "optimal" inflation expectations estimator, for each country, they are all tested for unit root presence along with the actual inflation series for each particular country.

Table 2
Unit Root Test Results

Country	*Variable*	*t-statistic*	*Country*	*Variable*	*t-statistic*
Austria	inf	-2.3478 (0)	**Italy**	Inf	-2.3151 (0)
	exp_b	-2.5001 (1)		Exp_reg	-3.5487 (0)***
Belgium	inf	-2.86445 (0)*	**Latvia**	Inf	-3.2326 (4)**
	exp_b	-3.7863 (0)**		Exp_reg	-0.8589 (1)
Bulgaria	inf	-1.1995 (1)	**Lithuania**	Inf	-1.004 (1)
	exp_b	-2.4819 (6)		Exp_reg	-2.1430 (1)
Croatia	inf	-2.2573 (1)	**Netherlands**	Inf	-1.9953 (0)
	exp_b	-3.7134 (0)**		Exp_b	-3.1564 (0)**
Cyprus	inf	-2.5911 (12)*	**Poland**	Inf	-2.1322 (1)
	exp_reg	-11.0682 (0)***		Exp_reg	-2.9047 (1)**
Czech Republic	Inf	-4.5760 (2)***	**Portugal**	inf	-2.6973 (1)
	Exp_reg	-5.3692 (0)***		Exp_reg	-2.0986 (1)
Estonia	Inf	-2.4726 (12)	**Romania**	Inf	-3.6895 (1)**
	Exp_reg	-4.3892 (0)***		Exp_reg	-4.1768 (0)***
Finland	Inf	-2.2236 (0)	**Slovakia**	Inf	-4.4783 (1)***
	Exp_reg	-1.8496 (2)		Exp_reg	-3.7406 (0)**
France	Inf	-3.2348 (12)**	**Slovenia**	Inf	-2.4034 (0)
	Exp_b	-3.8218 (0)**		Exp_b	-3.2188 (1)*
Germany	Inf	-2.9258 (0)**	**Spain**	Inf	-2.5530 (0)
	Exp_reg	-3.1181 (1)**		Exp_b	-1.2626 (1)
Greece	Inf	-1.3254 (0)	**Sweden**	Inf	-2.6489 (0)*
	Exp_b	-2.5581 (2)		Exp_b	-3.1068 (0)**
Hungary	Inf	-3.1853 (1)**	**UK**	Inf	-3.9275 (2)**
	Exp_reg	-2.6948 (0)*		Exp_b	-2.7103 (0)

Note: *** ($p<0.01$), ** ($p<0.05$), * ($p<0.1$). Optimal lag length (given in parentheses) is chosen using the Schwarz information criterion.

All variables are proven to be stationary in first differences. The obtained ADF results for differenced data are left out here for brevity purposes but can easily be obtained from the authors upon request.

Results from Table 2 clearly point out that both the actual and expected inflation are stationary for Belgium, Cyprus, Czech Republic, France, Germany, Hungary, Romania, Slovakia, and Sweden.

On the other hand, both analyzed variables are nonstationary in levels for Austria, Bulgaria, Finland, Greece, Lithuania, Portugal, and Spain.

Also, the results for Croatia, Estonia, Italy, Latvia, Netherlands, Poland, Slovenia, and the UK induce quite ambiguous conclusions: one of the observed variables is stationary and the other is not. Therefore, for the above mentioned countries it is not possible to perform the rationality test neither using the cointegration analysis nor in OLS framework. Namely, first-differencing the I(1) variable and then estimating a regression equation would disable the standard unbiasedness test since it would merely explore the relationship between the changes of one variable and the levels of the other one. However, the authors argue that the sole fact that the actual and expected inflation in the above stated countries diverge to such extent (one is I(0) and the other is I(1)) is sufficient to postulate that inflation expectations are not unbiased/rational.

For the countries with I(0) variables, the rationality test is performed by estimating OLS equation (12), while the same test for I(1) variables is carried out on the basis of Johansen's cointegration model.

The obtained empirical results are presented in the following two tables.

Table 3
OLS Rationality Test Results

Country	*χ^2 test statistic*	*p-value*
Belgium	857.7314	0.0000
Cyprus	211.4310	0.0000
Czech Republic	111.0370	0.0000
France	350.1171	0.0000
Germany	181.4633	0.0000
Hungary	22.3923	0.0000
Romania	38.6850	0.0000
Slovakia	67.9480	0.0000
Sweden	931.6033	0.0000

Table 4
Cointegration Rationality Test Results

Country	*χ^2 test statistic*	*p-value*
Austria	0.9459	0.3308
Bulgaria	12.7896	0.0003
Finland	2.5175	0.1126
Greece	0.0109	0.9170
Lithuania	11.5892	0.0007
Portugal	0.3098	0.5778
Spain	1.1686	0.2797

It is evident that the rational expectations hypothesis can be rejected for a vast majority of the analyzed countries. The only exceptions are Austria, Finland, Greece, Portugal and Spain.

CONCLUSIONS

One of the most important advantages of EU CS harmonization is the possibility of comparing the obtained results between various member states. Based on the analysis performed in this paper, there is no consensus in any of the raised research questions. Firstly, it is evident that (between the three competing approaches) the CP method is the worst performer in terms of predictive characteristics. It does not perform well in any of the analyzed countries. The reasons for such results can be found in the already stated technical pitfalls. The CP method is highly sensitive to extreme responses and situations in which none (or an extremely small fraction) of respondents declare price increases or price reductions. Due to the recent economic crisis, such findings are no exception in the observed dataset. Because of that, it is not surprising that the CP approach is ruled out here as a reliable quantification method for inflation expectations.

Regarding the proven non-rationality of consumers' inflation expectations in most observed countries; it is evident that economic agents are not able to produce unbiased estimates of future inflation tendencies. This finding, however, is not at all atypical with regards to other similar studies. Some author even go that far to hypothesize that the observed non-rationality can be put in relation to the general lack of macroeconomic literacy (Blanchflower and Kelly, 2008). This study provides no definite proof in favor of such hypothesis, but it can be noticed that the "rational" countries are either characterized by high overall educational levels (Austria and Finland) or that the recent turbulent economic situation dictates the consumers to thoroughly follow macroeconomic trends (Greece, Portugal, and Spain).

Also, one must take into account the differences in perceiving the price change between individuals/households and economic institutions (e.g. central banks) that undermines rational expectations when it comes to inflation measurement. Institutions consider the price change between the current and the base period, while individuals choose a point of reference for comparison with the current price (e.g. the price paid for the item when it was last bought or an average price of the product over a series of recent purchases). Further, as stated by the questions in *The Joint Harmonised EU Programme of Business and Consumer Surveys,* individuals only observe an increase or decrease of prices without the ability to state this price change in monetary value, which results in the divergence between the two measures. Also, individuals place more weight on price increases (e.g. food and oil price spikes before the 2008 Great Depression) than price decreases, which is further aggravated for frequently bought goods and services (Brachinger 20081, 2008b).

The observed non-rationality also highlights some caveats to the monetary policy holders. It is well known that the sole fact that the consumers expect the prices to rise can lead to an actual inflation boom (Eurostat, 2003; Traut-Mattausch *et al.*, 2004). Hence in order to suppress the observed non-rationality to result in an actual price boom, the economic policy holders must find a way to properly communicate the underlying changes in their economic system in a way that can „stabilize" inflation expectations and bring them closer to actual inflation. Since the European Central Bank and the central banks of all individual countries have the primary goal to keep inflation stable, this would also bring a rise in their credibility and diminish the psychological sources of inflation.

Notes

1. The technical details are neglected here for brevity purposes, but can easily be found e.g. in Sabrowski (2008).
2. In order to avoid potential multicollinearity and preserve valuable degrees of freedom, equations (10) and (11) are estimated using only the 12th lag of actual inflation instead of all 12 lags. The same approach has been suggested by Kokoszczyński, Łyziak and Stanisławska (2006), as well as by Łyziak and Stanisławska (2006).
3. This precise argument has lead Brachinger (2008a, 2008b) to compose an alternative indicator of perceived inflation based on the asymmetrical consumers' response to losses (price increases) in contrast to gains (price decreases).
4. This excludes Denmark, Ireland, Luxembourg and Malta, due to data unavailability and/or methodological breaks in the observed series.
5. The rationale for choosing the optimal expectations indicator according to the MSFE is somewhat in line with the methodology of the Chicago school of economics. Namely, the authors do not question the plausibility of the assumptions used by each of the quantification methods. They simply select the indicator that produces the most accurate forecasts, no matter how right or wrong its inherent assumptions are. The logic behind that is quite straightforward: if the most accurate expecations indicator does not yield unbiased expectations, then the other two indicators will not either.

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