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Jonung, Lars; Lindén, Staffan

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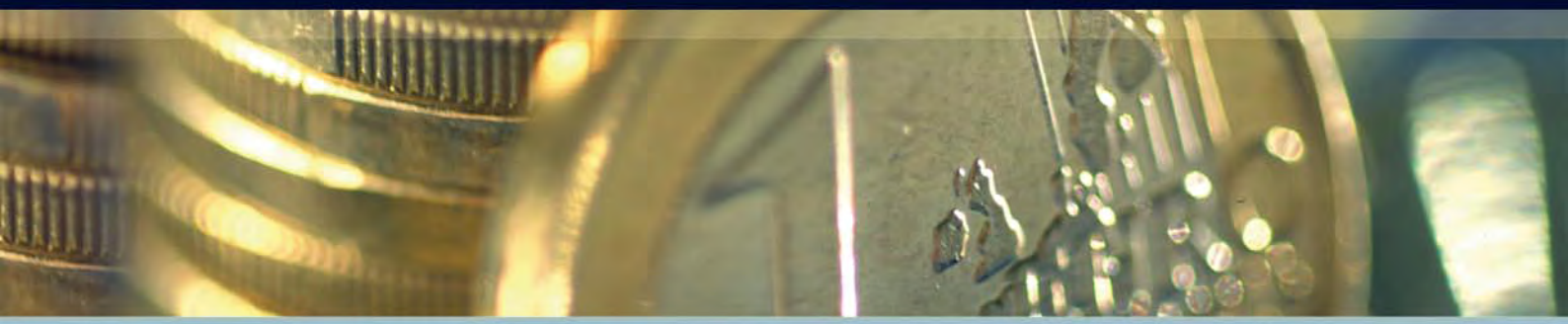

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The forecasting horizon of inflationary expectations and perceptions in the EU

Is it really 12 months?

November 2010

Lars Jonung[*] and Staffan Lindén[**]

* Lund University, Swedish Fiscal Policy Council, Stockholm
** European Commission, Directorate-General for Economic and Financial Affairs, Brussels[†]

Abstract

The standard way today to obtain measures of inflationary expectations is to use questionnaires to ask a representative group of respondents about their beliefs of the future rate of inflation during the coming 12 months. This type of data on inflationary expectations as well as on inflationary perceptions has been collected in a unified way on an EU-wide basis for several years. By now, probably the largest database on inflationary expectations has been built up in this way.

We use this database to explore the forecasting horizons implicitly used by the respondents to questions about the expected rate of inflation during the coming 12 months. The analysis covers all EU member states that have relevant data. We examine the forecast errors, the mean error and the RMSEs, to study if the forecast horizon is truly 12 months as implied by the questionnaires. Our working hypothesis is that the forecast error has a U-shaped pattern, reaching its lowest value on the 12-month horizon. We also study the "backcast" error for inflationary perceptions in a similar way.

Our exploratory study reveals large differences across countries. For most countries, we get the expected U-shaped outcome for the forecast errors. The horizon implicitly used by respondents when answering the questions is not related to the explicit time horizon of the questionnaire. On average respondents use the same horizon when answering both questions, e.g. when respondents use a 12-month forecast horizon answering to the question on future inflation, they use the same forward looking horizon when answering to the question on past inflation. We suggest possible explanations for the differences observed.

Key Words: Inflationary expectations, inflationary perceptions, forecasting error, forecasting horizon, EU, euro.

JEL Classification: C33, E31, E32, E37, and E58

[†] We have received constructive comments from participants at the European Commission Workshop on Developments in Business and Consumer Surveys, Brussels, 2007 and the CIRET conference, Santiago, 2008. We greatly acknowledge valuable comments and assistance from Christian Buelens, Björn Döhring, Roberta Friz, Andreas Jonsson, Lourdes Acedo Montoya and István P. Székely. The views expressed here represent only those of the authors, not of the European Commission.

1. Introduction

Inflationary expectations held by the public are important for macroeconomic policy-making. According to the present approach to monetary policy-making based on inflation targeting, central banks should be forward-looking, framing the policy today on the basis of forecasts of the rate of inflation one to two years ahead. This approach requires access to reliable and frequently reported data on a wide range of variables, including inflationary expectations of the public. The latter information, however, is lacking for the simple reason that inflationary expectations are not directly measurable in a way similar to aggregates such as interest rates, money supplies, rates of unemployment, consumer and producer prices etc.

An important method – and today the standard method – to construct measures of inflationary expectations is to use questionnaires and ask a representative group of respondents about their beliefs of the future rate of inflation. This type of data on inflationary expectations and perceptions are collected in a unified way on an EU-wide basis allowing for the build up of the largest database on inflationary expectations (see Lindén (2008) for a recent survey). More recently, a set of quantitative questions have been introduced in the EU-survey; the resulting database now contains more than 1.5 million replies concerning the expected rate of inflation 12 months ahead in time.

The characteristics of inflationary expectations as measured by interviews have been examined in a large number of studies concerning issues like rationality, distribution, differences across socio-economic groups, uncertainty etc.[1] Here we exploit the new EU database with quantitative replies gathered within the Joint Harmonised EU Programme of Consumer Survey to examine an issue that to our knowledge does not appear to have been studied: the forecasting horizon implicitly used by the respondents. In short, respondents are asked about a forecast for 12 months ahead. It is an open question, however, for which horizon they actually give the best forecast, i.e. the forecast with the smallest forecast error. This issue is explored in this paper. We do the same type of test for the properties concerning the perceived rate of inflation, i.e. the rate of inflation perceived by the respondents during the past 12 months.

Our study is organized in the following way. First we describe the methodology applied, second the data used. Then we present our results in a set of tables and figures, before considering factors that potentially could explain our empirical results. A sixth section concludes.

2. Methodology

We explore the forecasting horizons implicitly used by the respondents when answering to questions about the expected rate of inflation during the coming 12 months in the EU Consumer

[1] For a few examples see Jonung (1981), Jonung and Laidler (1988) and Jonung (1986).

Survey. The study covers all EU member states that have supplied DG ECFIN with relevant data, which have been processed in a unified way. As respondents are asked to give their expectations for a forecast horizon of 12 months ahead, all econometric work using such data assumes implicitly that this is also the relevant or "true" horizon to use. It remains, however, an empirical issue to explore the extent to which respondents actually have a forecast horizon of 12 months in their minds when responding to the questions about the future rate of inflation. We examine this issue by comparing the forecast error for varying forecasting horizons, starting from zero going up to 24 months. We examine the time profile of the forecast errors in different ways, using the mean error and the root mean squared error (RMSE).

Leaving aside for the moment how we measure the forecast error, if the forecast horizon is truly 12 months, we expect a minimum for the forecast error at that horizon. We do not expect to find the forecast error to be zero at the 12-month horizon; we only expect it to be at a minimum at this horizon. At least for the RMSEs, we would expect a U-shaped pattern for the forecast error like the solid stylised curve in Figure 1. Our first null hypothesis is therefore that the forecast error takes a minimum at the 12-month horizon.

For the "backcast" error, that is the difference between the actual rate of inflation and the perceived rate, we expect in a similar way a minimum for contemporaneous observations. Thus, we expect a stylised curve like the dashed one in Figure 1. Our second null hypothesis is therefore that the "backcast" error takes a minimum on the contemporaneous month, i.e. in the same month as the surveys are conducted.

We can see several reasons why these two hypotheses might be rejected. In a context where it is easier to produce inflation forecasts for the more near future than for the 12-months ahead, respondents might use an inflation forecast for a shorter horizon to extrapolate or approximate the 12-month horizon. Thus the minimum for the forecast error will not be registered at the 12-month horizon.

Another reason could be that the timing of the release of official data is important for respondents when forming their opinions. If inflation opinions are significantly influenced by official data, which usually are released after the surveys are conducted, respondents could systematically be forecasting inflation with a minimum error at a shorter horizon than 12 months. In this respect, even the perceived past inflation rate could be lagging if perceptions are updated with the release of new official inflation rates. Faulty interpretations of the survey questions by the respondents could also affect the results.

The RMSEs for any specific country and specific lag k is calculated in the following way:

$$RMSE_k = \sqrt{\sum_{t=1}^{T-|k|} \left(p_{t-k}^{e} - p_t^{HICP}\right)^2 \Big/ \left(T - |k|\right)},$$

where the expected (perceived) inflation rate is p^e and the actual inflation rate is p^{HICP}. The t represent any particular month in the sample considered. To create Figure 2 to Figure 5, the lag operator k takes the integer values 0 to 24 for expectations and -12 to 12 for perceptions. A k equal to zero produces the contemporaneous RMSE and using a positive (negative) k produces a RMSE for which consumers' expectations are leading (lagging) actual inflation. Furthermore, the sample is adjusted such that all RMSEs used in a figure contain the same number of observations (errors) independent of the specific lead or lag considered.

Similarly, the mean error (ME) is calculated as:

$$ME_k = \sum_{t=1}^{T-|k|} \left(p_{t-k}^{e} - p_t^{HICP} \right) \Big/ \left(T - |k| \right).$$

We carry out our empirical investigations for every country for which data are currently available. We also pool the data. As the physical introduction of the single currency in 2002, the euro notes and coins, influenced perceptions of inflation to a significant degree[2], we make a distinction between countries that have adopted the euro and those who have not (see Column 7 in Table 1). We want to stress that our approach is an "impressionistic" one. For this reason statistical tests are not performed.

3. Data used

The data used are taken from the Joint Harmonised Programme of Consumer Surveys for the European Union. National institutes in each of the 27 participating countries conduct these surveys. The harmonised questionnaire contains questions on the economic situation of the household and the country where the respondent resides. Parallel with two qualitative questions on price developments, two additional price questions were introduced in 2003 on an experimental basis. These two questions ask respondents to quantify past and future inflation and give their responses in percent. A more comprehensive description of the harmonised EU survey programme can be found in the European Economy, No 6, 1997 and the European Economy, No 5, 2006.

The quantitative formulation of the price questions are currently implemented in 25 out of 27 national questionnaires. In most cases, the questions were introduced from May 2003, but some countries began already in January 2003. France and the UK started asking the questions from January 2004. The only two countries for which the surveys do not include the questions are the Netherlands, who stopped asking the questions in May 2005, and Hungary that has not yet included the questions in their survey. As of May 2005, also Estonia partly stopped asking the experimental questions as they excluded the backward looking question. The considered period run between May 2003 and December 2007, during which 12 countries were members of the

euro area, and 13 have yet to fulfil the conditions for adopting the euro or have chosen not to participate.[3]

The quantitative price questions (labelled Q51 and Q61 in the harmonised questionnaire) are based on the individual responses to the qualitative price questions (labelled Q5 and Q6 in the harmonised questionnaire). The exact phrasing of these questions and their respective possible responses are as follows:

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) don't know

Q51 If question 5 was answered by 1, 2, 3, or 5: by how many percent do you think that consumer prices have gone up/down over the past 12 months? (Please give a single figure estimate): Consumer prices have increased by……,…% / decreased by……,…%.

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) don't know

Q61 If question 5 was answered by 1, 2, 3, or 5: by how many percent do you expect consumer prices to go up/down in the next 12 months? (Please give a single figure estimate): Consumer prices will increase by……,…% / decreased by……,…%.

The individual responses are aggregated into weighted monthly country averages, which in turn have been used to form a euro-area aggregate. The weights used, supplied by the institutes conducting the surveys, correct for possible selection biases stemming from differences in the probability of selecting a specific consumer (see European Commission (1997, 2006, and 2007)).

As the data contains numerous extreme values[4], they are trimmed applying the same procedure as implemented in the University of Michigan survey of consumer attitudes (see Curtin (1996)). Responses above +95 percent or below -95 percent are truncated to +/-95 percent. This truncation affects less than 0.3 percent of all forecasted inflation rates and about 0.8 percent of all

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2 See for example Döhring and Mordonu (2007) and Ehrmann (2006).

3 Data available for the following euro-area members: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Portugal, Slovenia, and Spain. Data available for the following non-euro area members: Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, Sweden, and the United Kingdom.

4 See Lindén (2008) and European Commission (2006) for a brief description.

the perceived inflation rates. This trimming only marginally changes the monthly country averages, and does not influence the results in any way.

There are eight months of missing data in the beginning of the sample for France and the UK, and a five-month period of missing data in 2005 for Spain. In addition, the French institute does not conduct surveys in August, so this month is missing. To bridge these periods of missing data, a linear equation is estimated for each country by regressing the available quantitative responses on the qualitative ones, as summarised by the balance statistic. The equation is then used to rescale the balance series to form a quantitative inflation sentiment for the missing months.

4. Empirical results

4.1 Expectations

Calculations for 25 EU Member States indicate that the expected pattern for inflationary expectations roughly holds for a small set of countries. In total ten countries show a U–shaped pattern for the forecast errors (see Table 2, Column 7, and Figures 2 and 3), seven that are euro-area members and three that are not part of the euro area. The average forecast horizon for respondents in these countries is around 8 to 9 months, that is a few months shorter than the 12 months that Figure 1 hypothesis (Table 2, Columns 2 and 5, shows at what lead or lag the minimum forecast error is reached).

If we expand the search for a minimum forecast error outside the pre-specified window of leading forecasts (0 to +24 months, see Figures 2a-2c and 3a-3c) to a lead-lag window between -12 and +12 months, two more countries show a U-shaped pattern: Denmark and Slovakia. For these countries the minimum forecast error is reached at a lag of 0 and -3 months. This suggests that inflation forecasts are actually not forecasts, but contemporaneous estimates of past inflation. Changing the window further towards lagging expectations, covering the interval between -18 to +6 months also Sweden shows a U-shaped pattern with a minimum forecast error at a lag of -4 months. In addition, Cyprus and Bulgaria can be judged to exhibit U-shapes within the pre-specified window of leading forecasts, with minimum forecast errors at a lead of +12 and +8, respectively. In total, 15 out of 24 countries show the expected shape, but not at the expected lead of 12 months.

In order to quantify the forecast improvement, or the change in the RMSE, we calculate the difference between the maximum and the minimum error within the 25 month interval (Table 2, Column 3 and 6). For the 12 countries with U-shapes with a minimum within the lead-lag interval 0 to +24 months, the inflation forecasts improve by an average 0.5 of a percentage point. The average increases slightly to 0.6 of a percentage point when we include the other three countries as well.

4.2 Perceptions

Inflation perceptions are a different matter. First, there are big differences between the two different measures of the forecast error. As the mean error does not actually have to produce a U-shaped pattern, because negative and positive errors can either offset each other or dominate in any direction, we only consider the RMSEs in the analysis of perceptions. Second, within the pre-specified lead-lag window of -12 to +12 months (see Figures 4 and 5), we find much fewer U-shapes for the backcast errors. In total, there are four countries with U-shapes, but only one that is a member of the euro area, France (see Table 3, column 7). At an average lag of -2 months, thus almost in line with our presumption, the perceived inflation rate for these four countries more or less coincides with the contemporaneous actual inflation rate.

If the lead-lag window is changed to incorporate a contemporaneous forecast to a lead of 24 months for the perceived inflation rate, another six euro-area member states and four non-member (Czech Republic) show a U-shaped pattern for the RMSEs. The euro-area members that become U-shaped are the same as those for expected inflation (Austria, Belgium, Luxembourg, Portugal, Spain, and Greece). The minimum error is reached at an average lead of +12 months for these six countries, and thus the perceived inflation rate is rather a forecast than a recollection of past price developments. Sweden can also be added to the list when the window is changed to incorporate the lagging months -24 to 0, but in this case perceived inflation is lagging by 10 months.

5. Possible factors influencing the results

5.1 Inflation history

One possible factor influencing the results is the inflation history of each country. Table 1 presents the inflation history of all EU countries divided into two groups, euro-area members and non euro-area members, ranked in an order of increasing average inflation between 2003 and 2007. Inflation rates range from 1.1 percent in Finland to 9.0 percent in Romania, but several countries have a recent history of much higher inflation (Column 1). In general euro-area members and countries that joined the EU before 2004 have a history of lower inflation than countries that joined after 2004.

There seems to be no relationship between the number of countries that show a U-shaped forecast error and the historical inflation rate. The results in Table 2 and 3 are also presented in the same order as Table 1. For inflation expectations, using all 15 countries for which forecast errors have been judged to show a U-shaped pattern for the forecast errors, i.e. allowing the

lead-lag window to vary outside the 0 to +24 months, there are as many U-shapes for high-inflation countries (7) as there are for low-inflation countries (8). [5]

As for expectations, there is no systematic relationship between the historical inflation rates and the shape of the errors of perceived inflation, and the magnitudes of the changes in the RMSEs are similar to those for expectations. In fact, it is the same countries that show U-shaped errors for perceptions as for expectations.

We do, however, observe that the forecast error is in general an increasing function of the historical inflation rate. Respondents in countries with relatively high historical inflation rates, make bigger forecast errors than people in countries with low past rates of inflation. When the sample is divided into two groups of equal size, based on their past inflation, the group of high inflation countries has an average RMSE of 8.4 percentage points in their expectations, while that of the low inflation group is 3.3 percentage points. The corresponding figures for perceptions are higher, especially for the low inflation group, for which the RMSE is 6.3 percentage points. The high inflation group has an average RMSE of 9.7 percentage points. In terms of rank correlation, the coefficient between historical inflation rates and consumers' expectation and perception errors are as high as 0.74 and 0.53, respectively.

5.2 Euro membership

In January 2002, 12 EU member states converted their national currencies to the euro. This historical event had several positive consequences for the functioning of the internal market by, for example, securing macroeconomic stability and boosting cross-border trade, financial integration and investment. Another effect, however, was the dramatic increase in the perceived inflation rate as measured by the qualitative questions in the surveys (at the time of the cash changeover the experimental questions had not yet been introduced).[6] This could potentially influence our results.

Yet again, however, there does not seem to be a systematic relationship between the number of countries that show U-shaped errors and membership of the euro area in 2002. For expectations, seven euro-area members and eight non-members show U-shaped errors (see Table 2). In Table 3, for perceptions, the distribution of countries with U-shapes is the same as that of expectations. Thus the same number of countries exhibit U-shapes in the two categories of countries, members and non-members.

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5 The median country (Luxembourg with an average inflation rate of 2.5%) is used as the divider between the high and the low (including the median country) inflation group.

6 This is an issue studied by many; see for example Döhring and Mordonu (2007) and Ehrmann (2006).

5.3 Forecast difficulty

Differences in the degree of difficulty to forecast inflation could also influence expected and perceived inflation. In times of high and volatile inflation rates forecasting becomes more difficult. This might influence both the size of the errors and the forecast horizon. To check whether such forecasting difficulty influences the results, we establish a set of benchmark inflation forecasts by estimating simple autoregressive (AR) models of order twelve for each individual country. These AR(12) models are used to forecast inflation at the 12-month horizon, and we calculate RMSEs of the forecast errors obtained with these naïve models. The RMSEs serve as our benchmark measure for how difficult or complex it is to forecast each countries inflation rate.

The model based inflation forecasts are in general much better than consumers' expectations and perceptions (see Table 4). This contradicts results found with US data, where consumers' inflation forecasts outperform model based forecasts.[7] For countries that are members of the euro area, the introduction of the euro is one factor that affects the results. However, the forecasts from the models are in general much better than those of the consumers also for the non-euro-area Member States. The only exceptions are Romania, where consumers are better than the naïve model, and Denmark, where consumers' forecast errors are in line with the model projections.

There is no systematic association between the number of countries with U-shaped errors and the difficulty to forecast inflation. There are marginally more U-shapes for that half of countries that is easier to forecast than that half that is more difficult, 8 versus 7. Furthermore, the results are the same for both expected and perceived inflation.

One result that emerges from the analysis is that consumers' forecast errors are greater in countries where it is more difficult to project inflation. Consumers' forecast errors are positively correlated with the difficulty to forecast inflation; the rank correlation between consumers' expectation errors and the models' forecast errors is 0.59.[8] This correlation coefficient increases to 0.77 if two outliers are excluded from the sample.[9] Although this result does not explain why consumers systematically over estimate the future rate of inflation, it provides one explanation for the large errors in high-inflation countries.

Initially, there is no significant correlation between perceived errors and the difficulty to project future inflation. By excluding a few outliers, however, the correlation for perceptions also

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7 See for example Ang, Bekaert, and Wei (2005).

8 The number in the text refers to Spearman's rank correlation, but Kendall's rank correlation provides a similar results.

9 For the case of expectations the outlier countries are and Cyprus and Greece.

becomes significantly positive with a coefficient of 0.41[10], showing that also perceived rate of past inflation is affected by the same factors that make it difficult for consumers to form expectations regarding inflation. However, the correlation coefficient between perceived errors and forecasting difficulty is highly influenced by the very high errors made by consumers in the euro-area, which is due to the previously discussed euro cash changeover.

To separate the two effects arising from the difficulty to forecast and the euro introduction the sample is split in two groups, euro-area members and non-euro-area members. The correlation persists in the non-euro-area sample, but fades away to insignificance in the euro-area sample. This suggests that in the euro area the main factor behind the misperceptions is the euro introduction, while in countries outside the euro area the inherent difficulty to forecast is an important factor explaining expectation errors.

Overall, these results suggest that respondents' forecast horizon is independent from the framing of the questions. On average respondents use the same horizon when answering both questions, regardless whether the question concerns past or future inflation, i.e. either respondent are 12-month forward looking for both questions or 12-month backward looking for both questions. The lead-lag behaviour of the errors when determining past or future inflation is thus more related to in which country the survey is conducted. In countries where respondents form expectations with a 12-month horizon in mind, they also use a forward looking approach answering to the question on past inflation. Similarly, in countries where respondents use a 12-month backward looking horizon when forming their perceptions about past inflation, they also form backward looking expectations.

6. Conclusions

The standard way used by economists today to construct measures of inflationary expectations is to use questionnaires and ask a representative group of respondents about their beliefs of the rate of inflation during the coming 12 months. This type of data on inflationary expectations as well as on inflationary perceptions has been collected in a unified way on an EU-wide basis for several years.

We use this database to explore the forecast horizons implicitly used by EU respondents to questions about the expected rate of inflation during the coming 12 months in all EU member states that have supplied DG ECFIN with relevant data. We examine the forecast error using mean errors and RMSE. If the forecast horizon is truly 12 months, we expect a U-shaped pattern for the forecast error reaching its lowest value at the 12-month horizon. We also study the backcast error for inflationary perceptions in a similar way. This is the first time – as we are aware of – someone is examining the implicit forecast horizon of the public.

[10] For the case of perceptions the outlier countries are considered to be Italy, Spain, and Greece. By

We establish a mixed picture, finding large differences across countries. For most countries, we get the expected outcome, for others this is not the case. In addition, the horizon implicitly used by respondents when answering the questions is not related to the explicit time horizon of the questionnaire. On average, respondents use the same horizon to answer to both questions, e.g. when respondents use a 12-month forecast horizon answering to the question on future inflation, they use the same forward looking horizon when replying to the question on past inflation. Another result of our analysis is that the forecast errors are higher for countries with a history of relatively high inflation, and lower for countries that have experienced relatively lower inflation.

Our explorative study raises important questions concerning the interpretation and use of data obtained with surveys. It also points at the value of having our tests applied to data bases on inflationary expectations gathered outside the EU. We leave it to others to develop the implications of our findings for policy use and use in econometric testing.

excluding Cyprus and Ireland the coefficient increases to 0.60.

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Figure 1 Stylised illustration of expected results

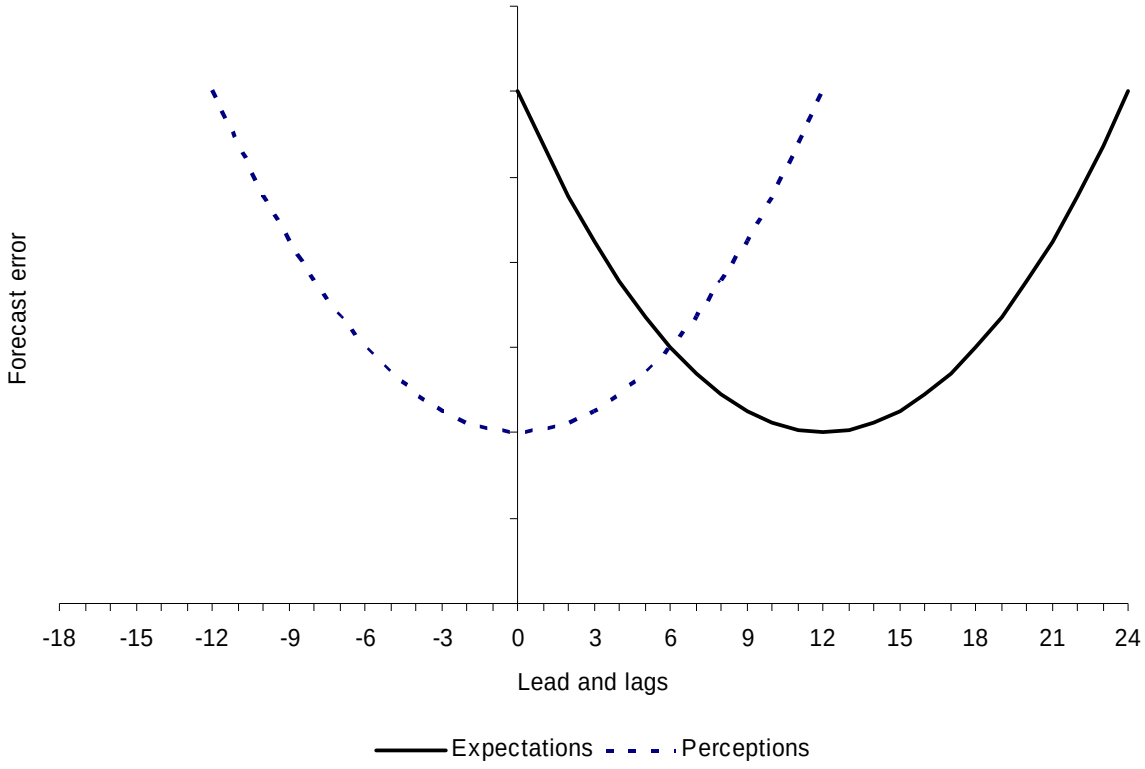

Table 1 Inflation history 1987-2007 and year for adopting the euro. Countries are ordered according to average inflation 2003 – 07

	Inflation History						
	Jan 1988 – Dec 1997		Jan 1998 – Dec 2007		May 2003 – Dec 2007		Member
EA members	Mean (1)	Std (2)	Mean (3)	Std (4)	Mean (5)	Std (6)	Year (7)
Finland	3.1	2.23	1.6	0.96	1.1	0.92	1999
The Netherlands	2.2	1.01	2.2	0.91	1.5	0.35	1999
Germany	2.8	1.38	1.4	0.59	1.7	0.54	1999
France	2.4	0.80	1.6	0.61	1.8	0.40	1999
Austria	2.7	0.88	1.8	0.76	1.9	0.62	1999
Belgium	2.4	0.81	1.9	0.73	2.1	0.61	1999
Italy	4.5	1.36	2.3	0.40	2.3	0.31	1999
Luxembourg	1.2	0.30	2.3	0.74	2.5	0.45	1999
Portugal	7.7	3.89	2.9	0.80	2.6	0.50	1999
Spain	5.0	1.46	3.0	0.75	3.1	0.60	2001
Greece	13.1	4.78	3.4	0.71	3.2	0.43	1999
Ireland	2.5	0.94	3.6	1.44	3.3	1.15	1999
Slovenia	-	-	5.7	2.50	3.4	1.17	2007
Euro area	2.4	0.59	2.0	0.52	2.1	0.30	

	Jan 1988 – Dec 1997		Jan 1998 – Dec 2007		May 2003 – Dec 2007	
Non EA members	Mean (1)	Std (2)	Mean (3)	Std (4)	Mean (5)	Std (6)
Sweden	4.5	3.43	1.2	1.00	1.2	0.81
Denmark	2.6	1.13	2.1	0.58	1.7	0.43
United Kingdom	3.9	2.18	1.6	0.56	1.9	0.54
Poland	142.4	279.06	4.7	3.87	2.1	1.27
Malta	3.9	0.36	2.5	1.07	2.1	1.16
Czech Republic	-	-	3.3	2.95	2.2	1.13
Cyprus	4.2	1.49	2.7	1.12	2.6	0.92
Lithuania	98.1	166.63	2.1	2.37	2.7	2.42
Estonia	21.3	8.57	4.4	2.26	4.0	2.10
Slovakia	-	-	6.6	3.57	5.0	2.53
Hungary	22.3	4.14	7.5	3.40	5.4	2.02
Bulgaria	307.6	469.52	9.5	31.15	6.2	2.62
Latvia	21.8	10.60	4.7	2.78	6.8	2.42
Romania	143.9	91.07	26.1	21.44	9.0	3.61
European Union	-	-	1.9	0.45	2.1	0.30

Table 2 Expected inflation May 2003 – Dec 2007, lead 0 to +24 months

	Mean Error			Root Mean Square Error				
EA members	Min (1)	Lead/Lag (2)	Change (3)	Min (4)	Lead/Lag (5)	Change (6)	Shape (7)	Obs (8)
Finland	1.0	24	0.7	1.0	24	0.7	\	32
The Netherlands								32
Germany	4.1	24	0.4	4.3	24	0.5	\	32
France	1.1	2	0.4	1.2	4	0.4	U	32
Austria	3.6	9	0.2	3.6	8	0.2	U	32
Belgium	1.3	12	0.3	1.5	8	0.4	U	32
Italy	3.5	0	0.3	3.6	0	0.3	/	32
Luxembourg	1.5	8	0.5	1.7	8	0.7	U	32
Portugal	5.8	13	0.2	6.0	10	0.1	U	32
Spain	9.6	12	0.3	9.7	12	0.3	U	32
Greece	9.9	12	0.1	10.1	11	0.1	U	32
Ireland	6.0	24	0.3	6.2	24	0.3	∩	32
Slovenia	4.1	0	1.0	4.2	0	1.1	/	32
Euro area	4.2	8	0.1	4.3	8	0.1	U	32
	Mean Error			Root Mean Square Error				
Non EA members	Min	Lead/Lag	Change	Min	Lead/Lag	Change	Shape	Obs
Sweden[4]	0.7	24	0.3	1.0	0	0.2	∩	32
Denmark[3]	-0.1	24	0.4	0.5	22	0.3	∩	32
United Kingdom	2.9	24	0.7	3.0	24	0.7	\	32
Poland	8.9	6	0.7	9.2	5	1.0	U	32
Malta	4.1	9	0.9	4.9	9	1.3	U	32
Czech Republic	6.6	24	0.7	7.2	8	0.6	U	32
Cyprus[1]	13.6	0	0.3	14.1	0	0.3	/	32
Lithuania	7.7	24	3.0	7.9	24	3.1	\	32
Estonia	7.2	24	2.2	8.1	24	2.0	\	32
Slovakia[3]	8.8	0	3.1	9.0	0	3.5	/	32
Hungary								32
Bulgaria[2]	6.9	24	2.0	7.2	24	1.9	\	32
Latvia	8.6	24	2.2	9.4	24	1.9	\	32
Romania	10.1	0	5.0	10.3	0	4.9	/	32
European Union	4.1	24	0.2	4.1	24	0.2	\	32

1) Cyprus is U-shaped in the leading interval +3 - +24, with minimum RMSE at lead +12

2) Bulgaria is U-shaped in the leading interval 0 - +18, with minimum RMSE at lead +8

3) Denmark and Slovakia are U-shaped in the lead-lag interval -12 - +12, with minimum RMSEs at lags 0 and -3, respectively.

4) Sweden is U-shaped in the lead-lag interval -18 - +6, with minimum RMSEs at lag -4.

Table 3 Perceived inflation May 2003 – Dec 2007, lead-lag -12 to +12 months

	Mean Error			Root Mean Square Error				
EA members	Min (1)	Lead/Lag (2)	Change (3)	Min (4)	Lead/Lag (5)	Change (6)	Shape (7)	Obs (8)
Finland	2.1	12	0.2	2.2	12	0.2	∩	44
The Netherlands								44
Germany	8.5	12	0.5	9.4	12	0.6	\	44
France	5.1	-5	0.2	5.1	-5	0.2	U	44
Austria[1]	7.7	12	0.3	7.7	12	0.3	\	44
Belgium[1]	5.9	12	0.4	6.0	12	0.3	\	44
Italy	21.5	-12	0.3	22.5	-9	0.3	/	44
Luxembourg[1]	5.3	-4	0.3	5.4	12	0.3	\	44
Portugal[1]	6.6	-12	0.3	6.7	-12	0.4	/	44
Spain[1]	19.5	-5	0.2	19.7	-7	0.1	∩	44
Greece[1]	16.1	-12	0.2	16.5	-12	0.3	/	44
Ireland	10.4	-12	0.7	10.5	-12	0.8	/	43
Slovenia	4.3	-12	1.6	4.4	-12	1.7	/	44
Euro area	11.5	12	0.1	11.9	12	0.1	—	44
	Mean Error			Root Mean Square Error				
Non EA members	Min	Lead/Lag	Error	Min	Lead/Lag	Change	Shape	Obs
Sweden[2]	0.4	-4	0.3	0.7	-10	0.2	/	44
Denmark	-0.1	-11	0.2	0.4	0	0.3	U	44
United Kingdom	3.9	12	0.6	4.2	12	0.5	\	44
Poland	8.8	12	0.5	9.5	1	0.4	U	44
Malta[1]	5.6	-3	0.5	6.2	-3	0.8	/	44
Czech Republic[1]	2.6	12	1.1	3.1	12	1.0	\	44
Cyprus[1]	13.7	-12	0.7	14.4	-11	0.8	/	44
Lithuania	5.7	12	3.1	6.1	12	2.9	\	44
Estonia								
Slovakia	7.3	-4	2.2	7.5	-4	2.3	U	44
Hungary								44
Bulgaria[1]	8.4	12	2.1	9.1	12	1.8	\	44
Latvia	5.7	12	3.1	6.1	12	2.9	\	44
Romania	10.3	-12	6.0	10.6	-12	5.9	/	44
European Union	9.7	12	0.2	10.0	12	0.2	\	44

1) Austria (+12), Belgium (+12), Luxembourg (+9), Portugal (+13), Spain (+12), Greece (+14), Malta (+9), Czech Republic (+8), Cyprus (+14), Bulgaria (+7), and the euro area as a whole are U-shaped in the leading interval 0 - +24, with minimum RMSEs within parentheses.

2) Sweden is U-shaped between lags -18 – +6 with minimum RMSEs at lag -10.

Figure 2a: Mean error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

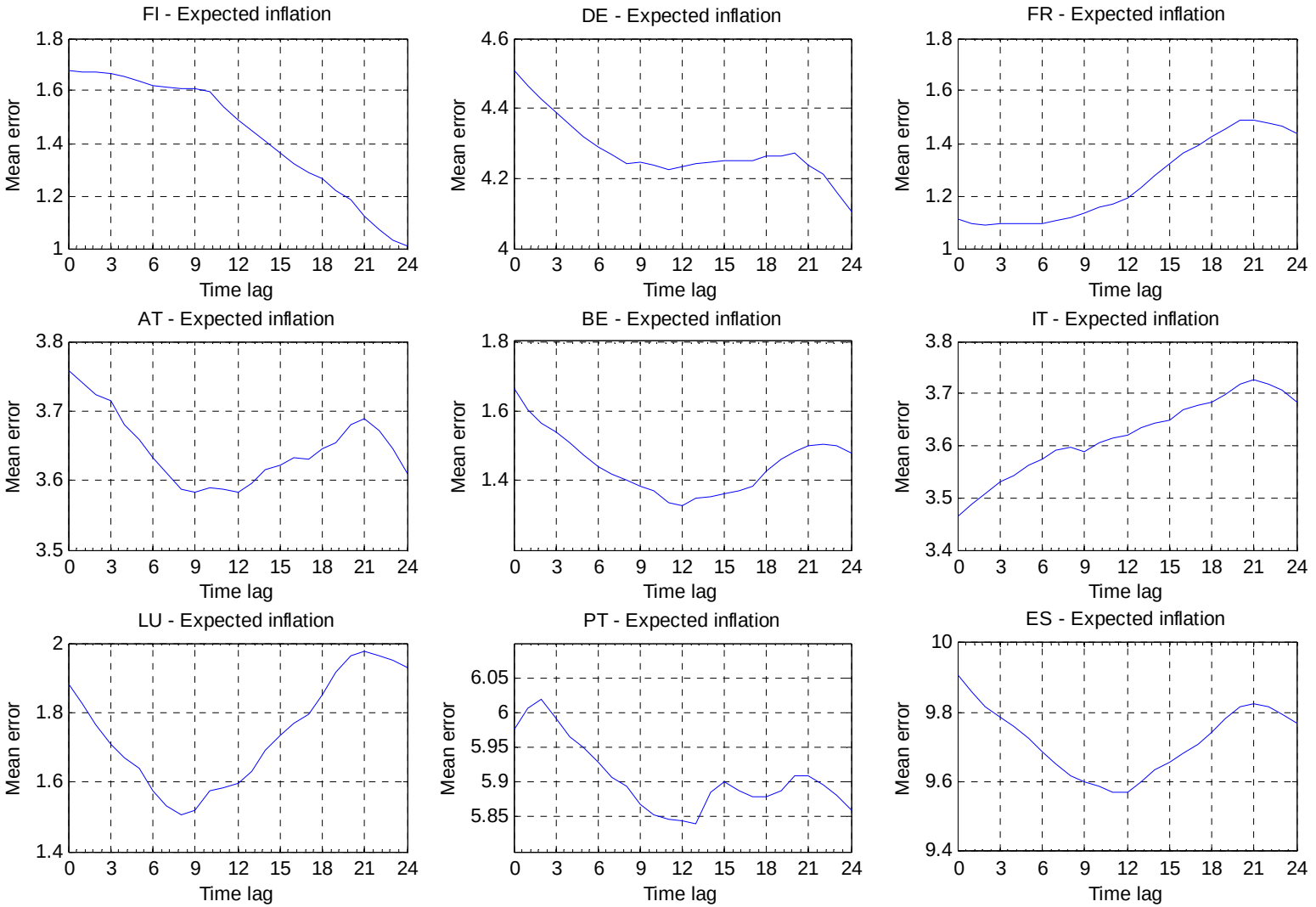

Figure 2b: Mean error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

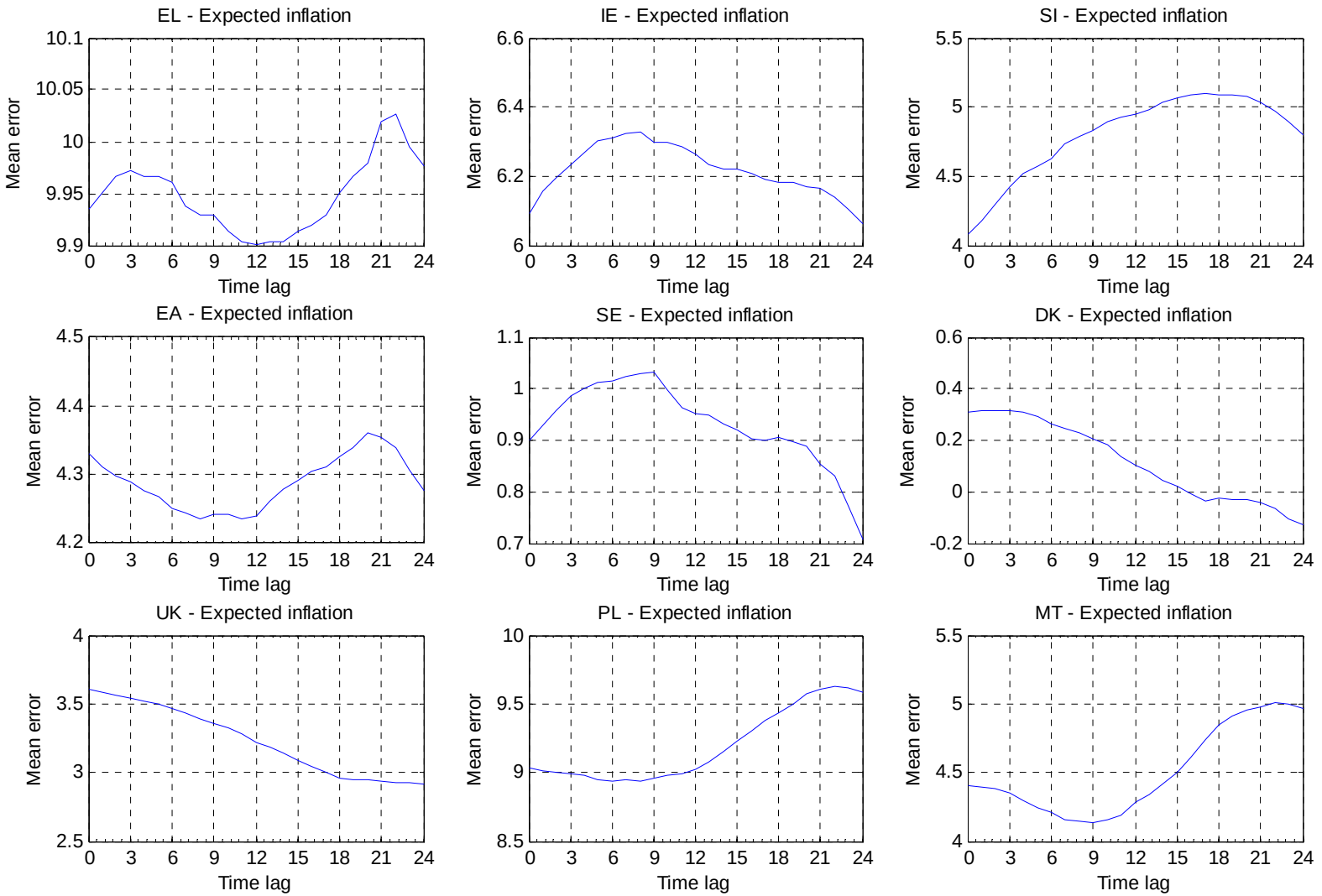

Figure 2c: Mean error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

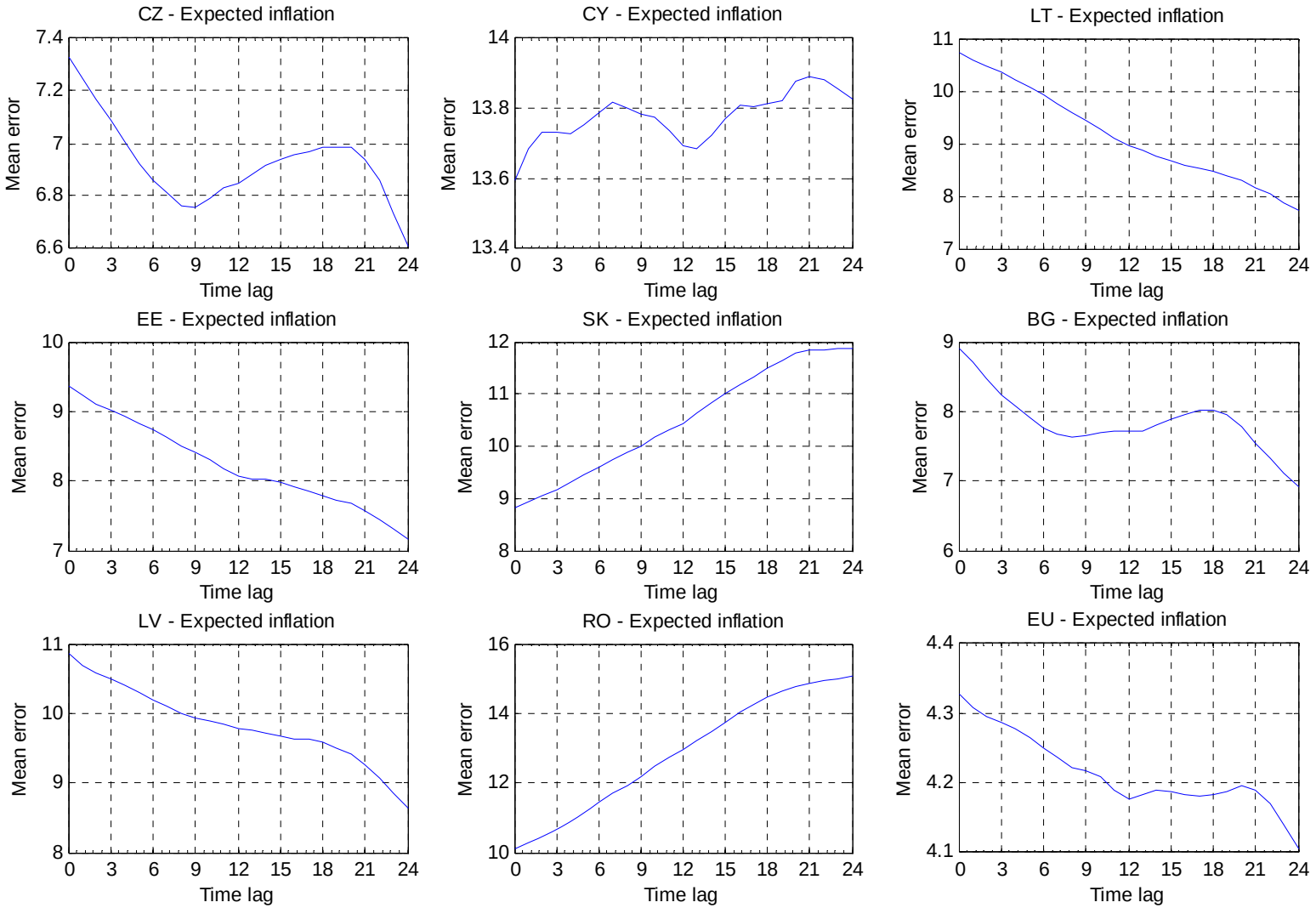

Figure 3a: Root mean square error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

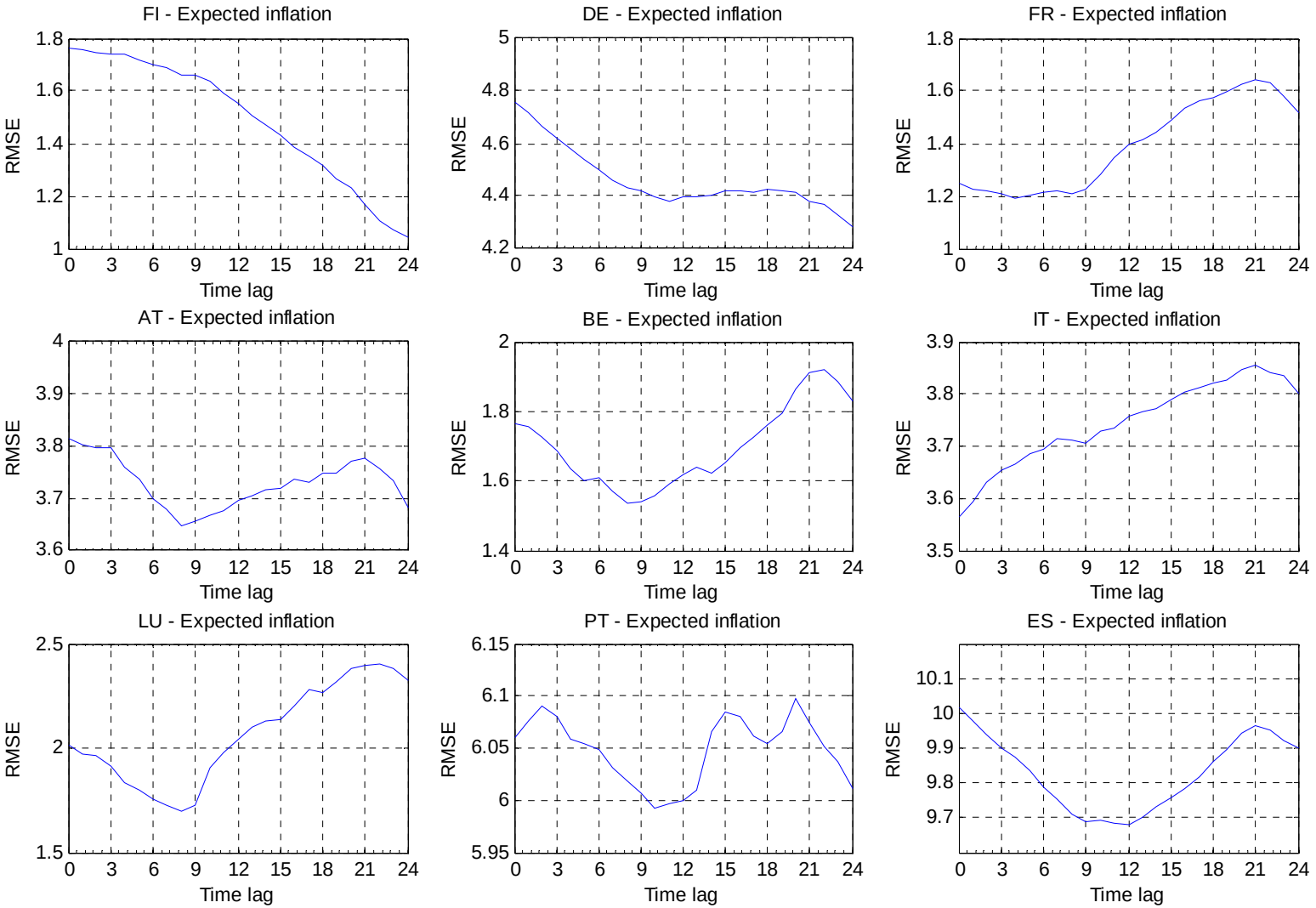

Figure 3b: Root mean square error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

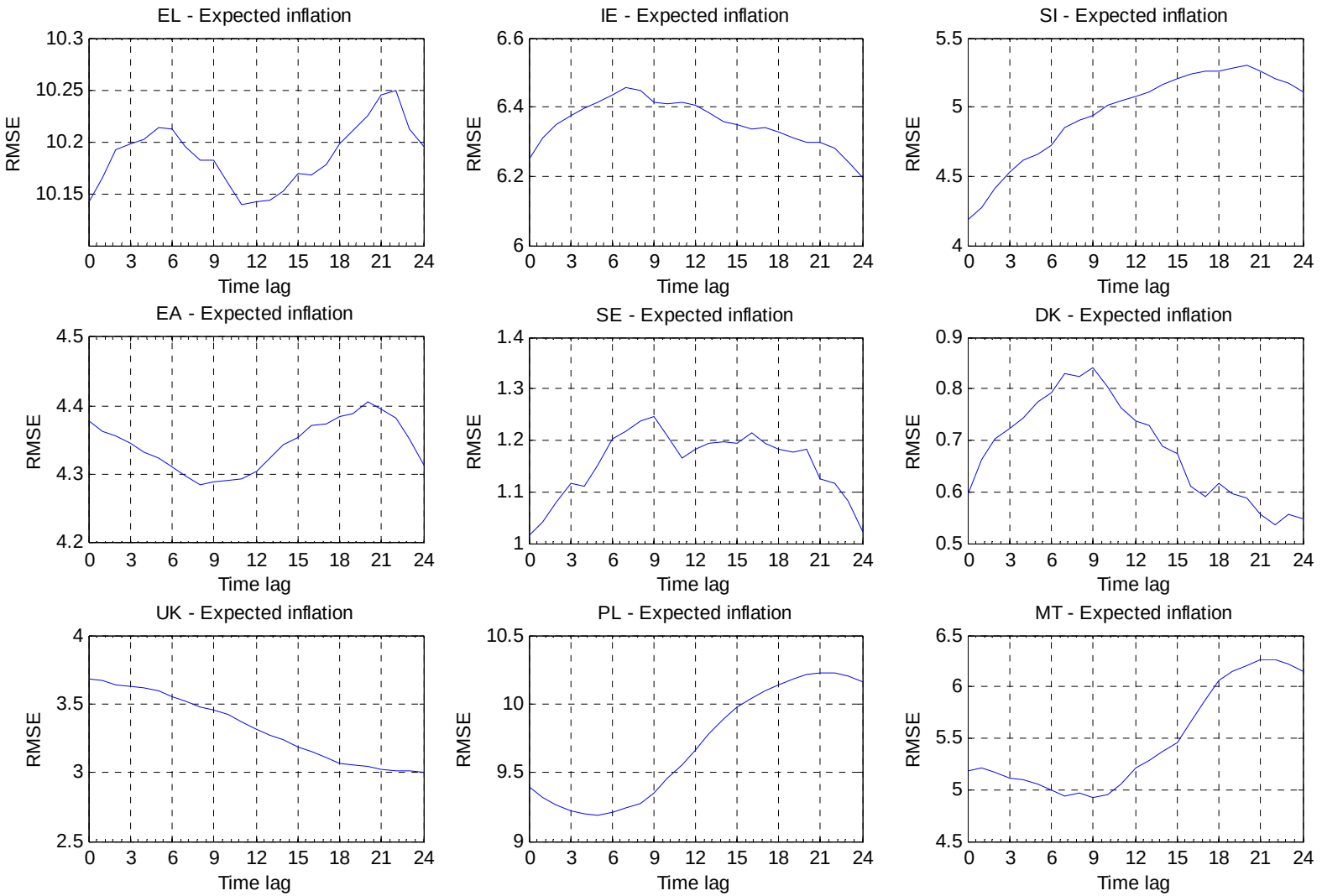

Figure 3c: Root mean square error for the expected inflation rate in relation to the actual inflation rate, series are shifted between 0 months (contemporaneous) and +24 months (leading)

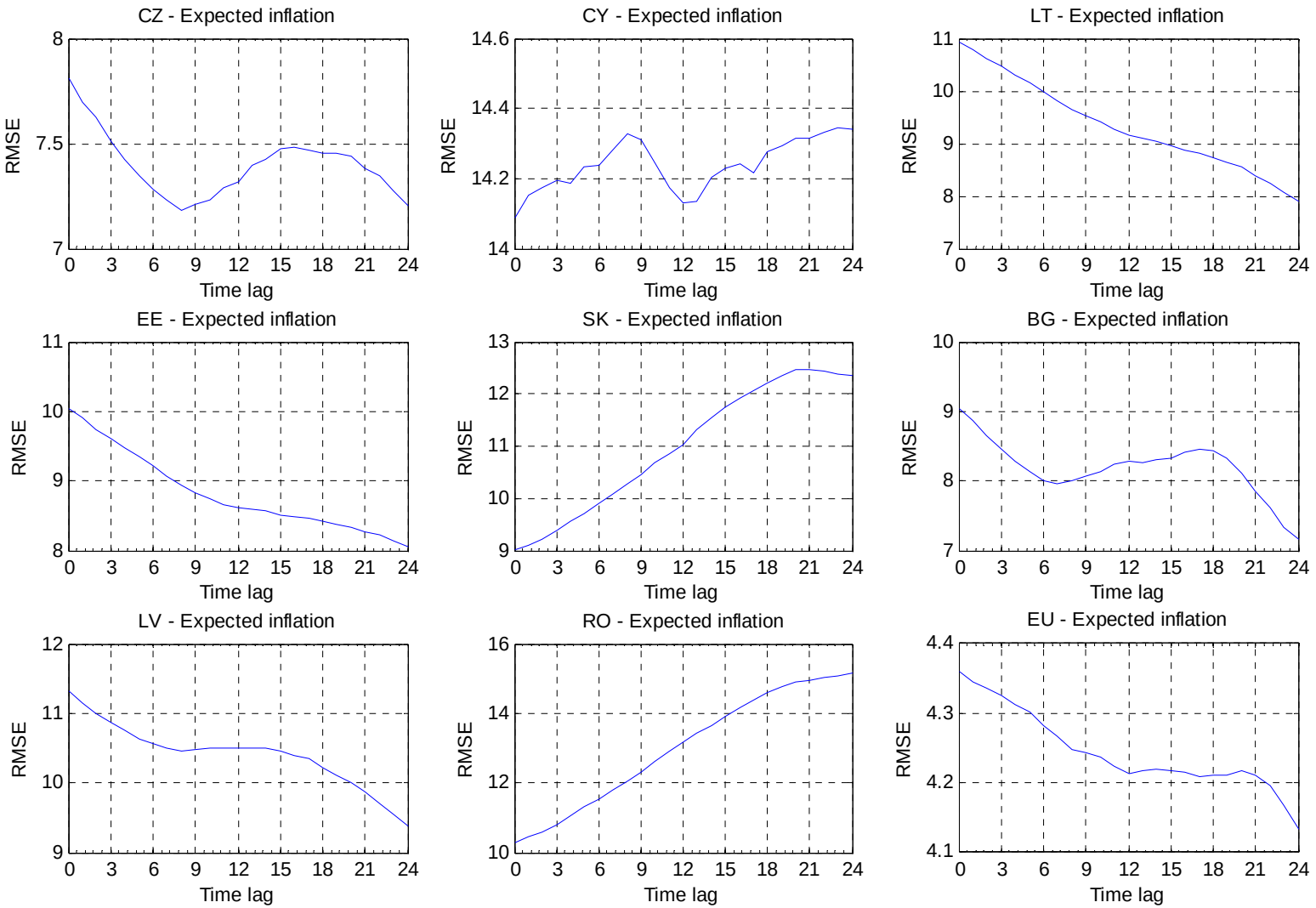

Figure 4a: Mean error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

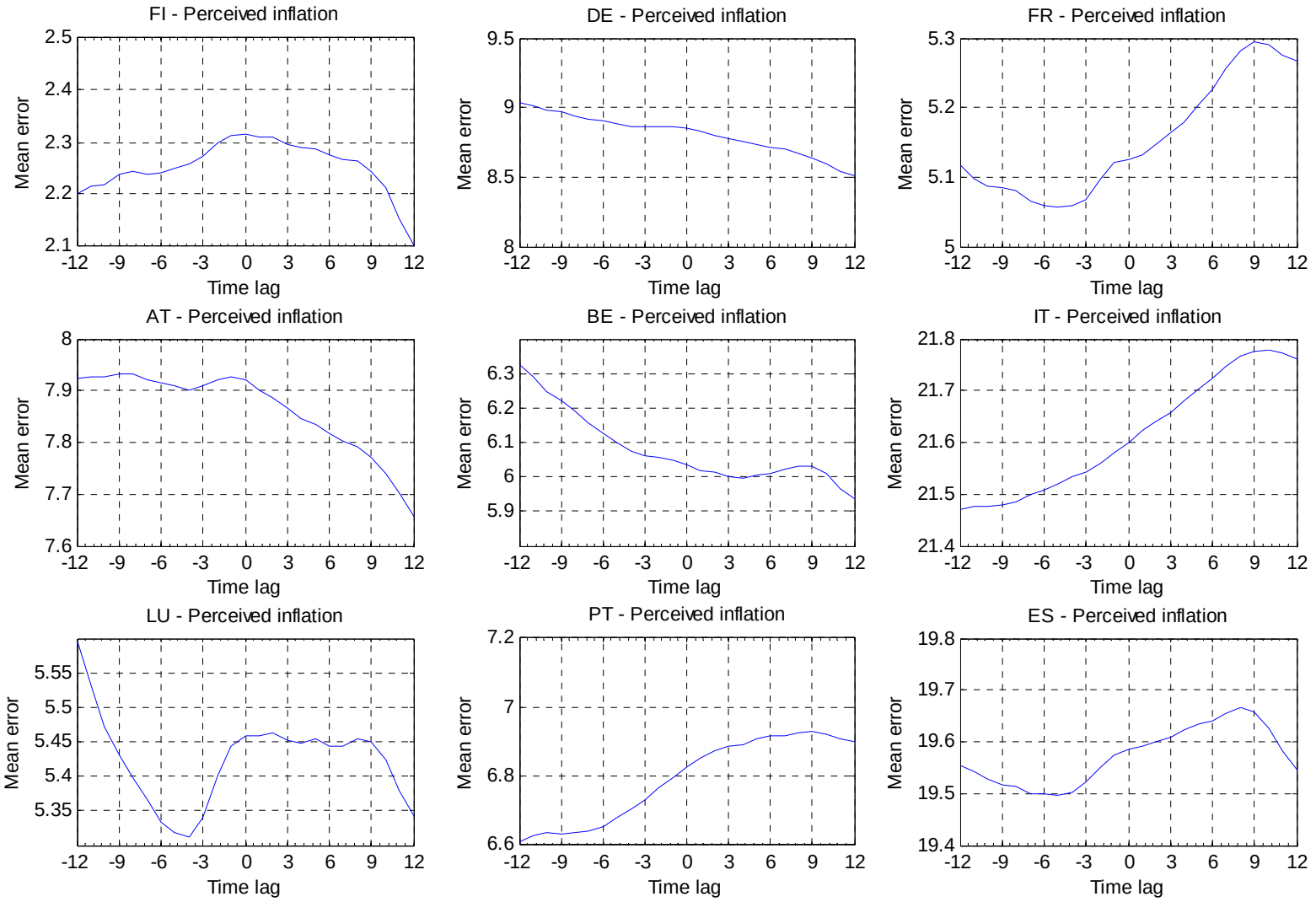

Figure 4b: Mean error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

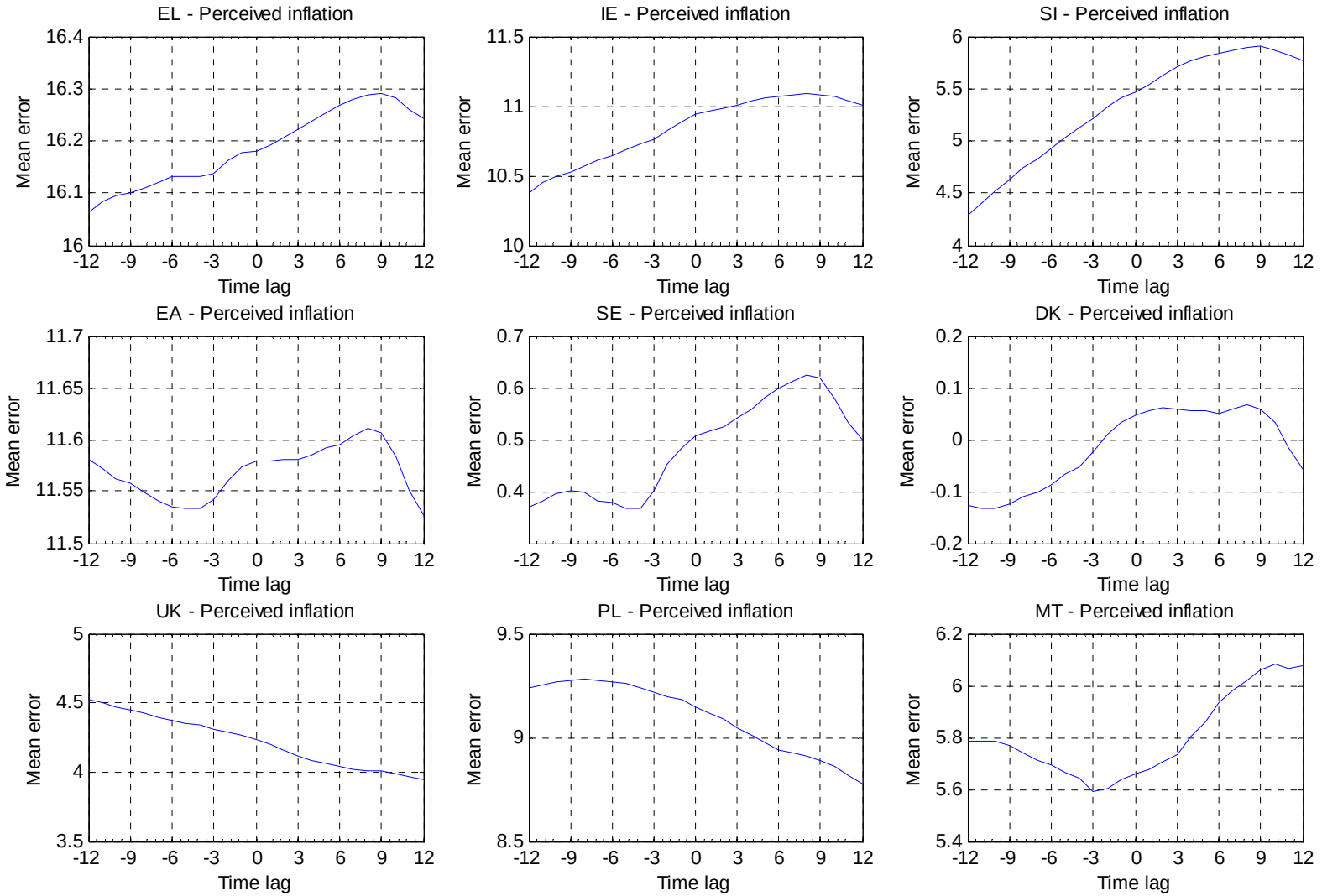

Figure 4c: Mean error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

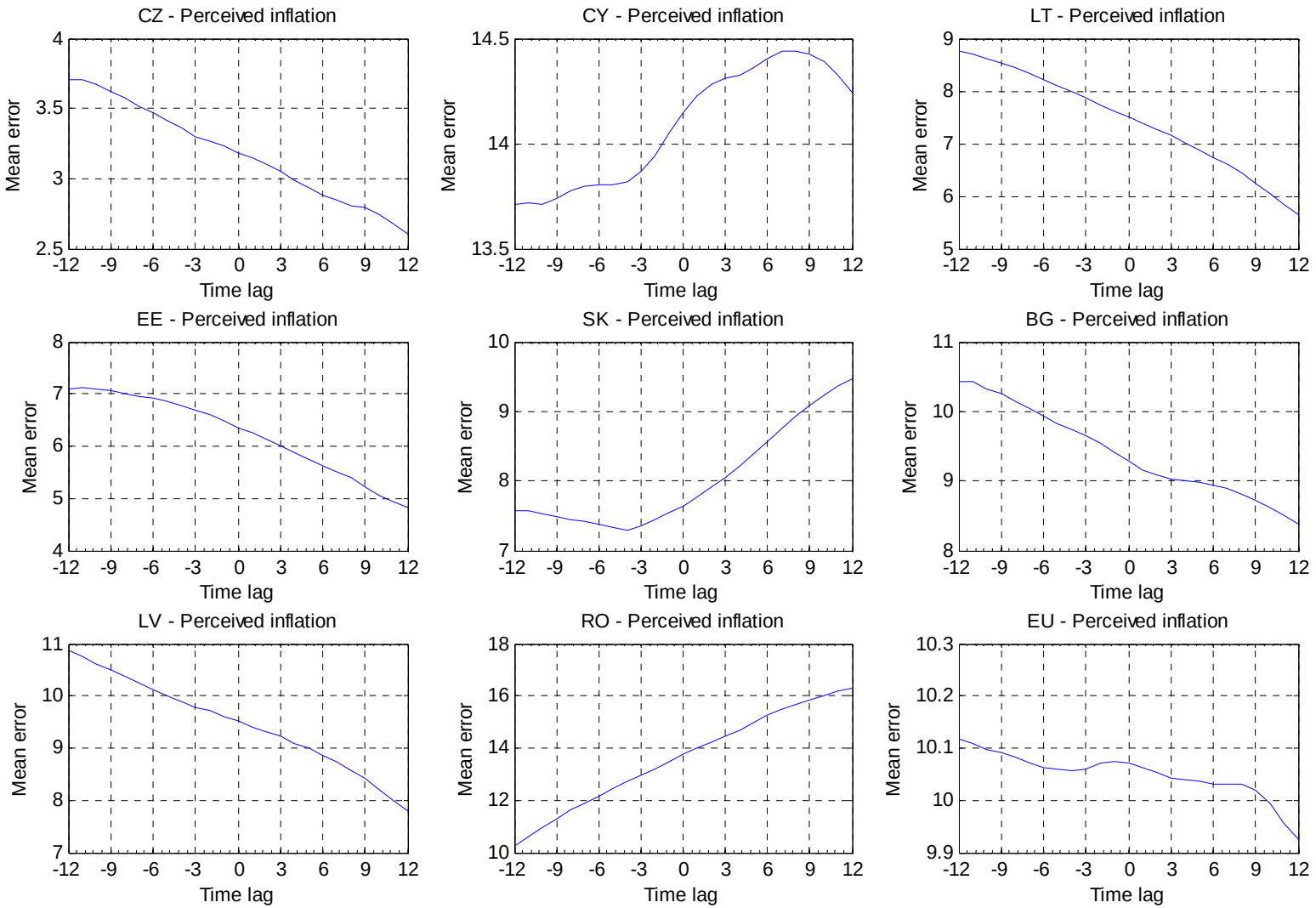

Figure 5a: Root mean square error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

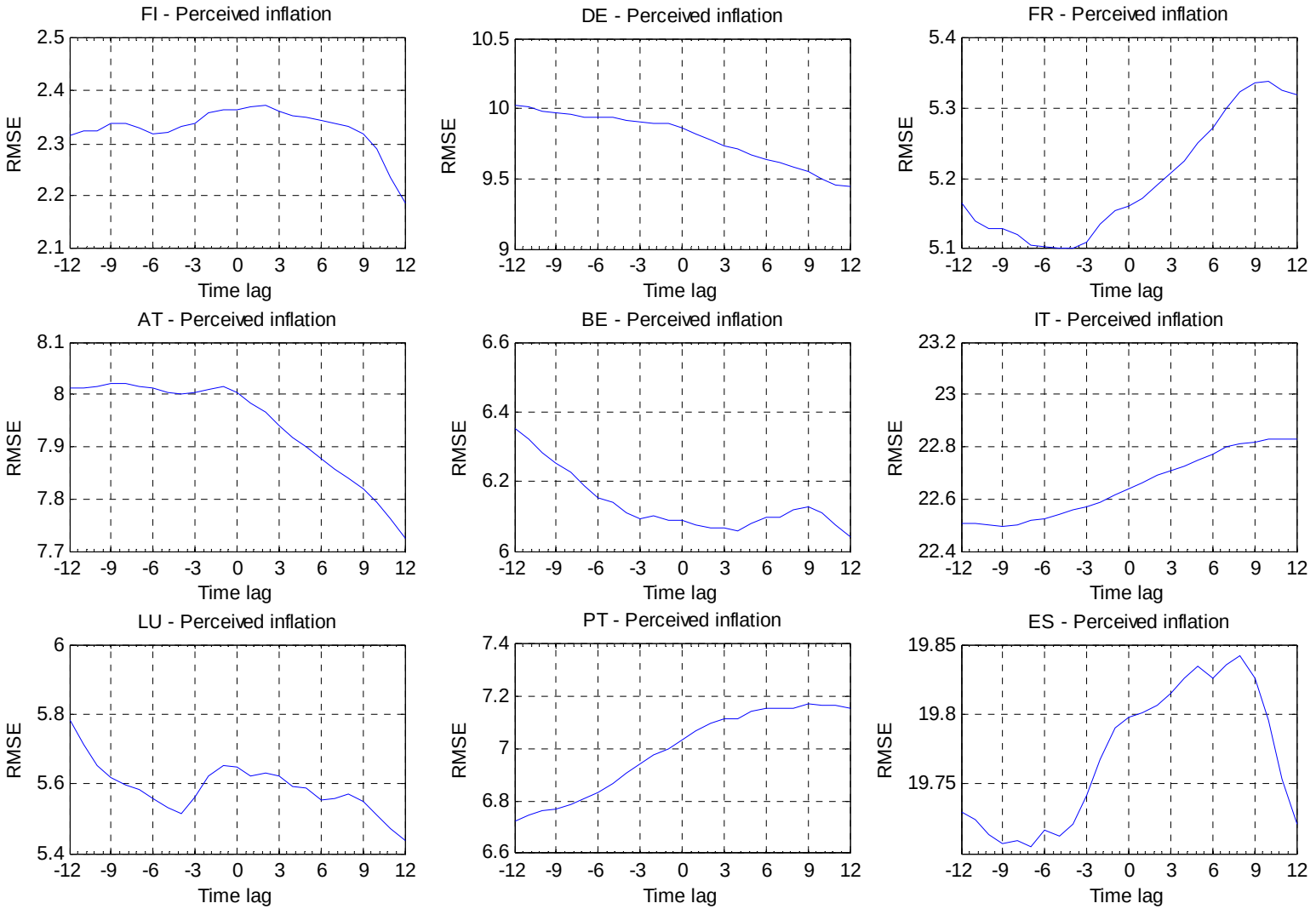

Figure 5b: Root mean square error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

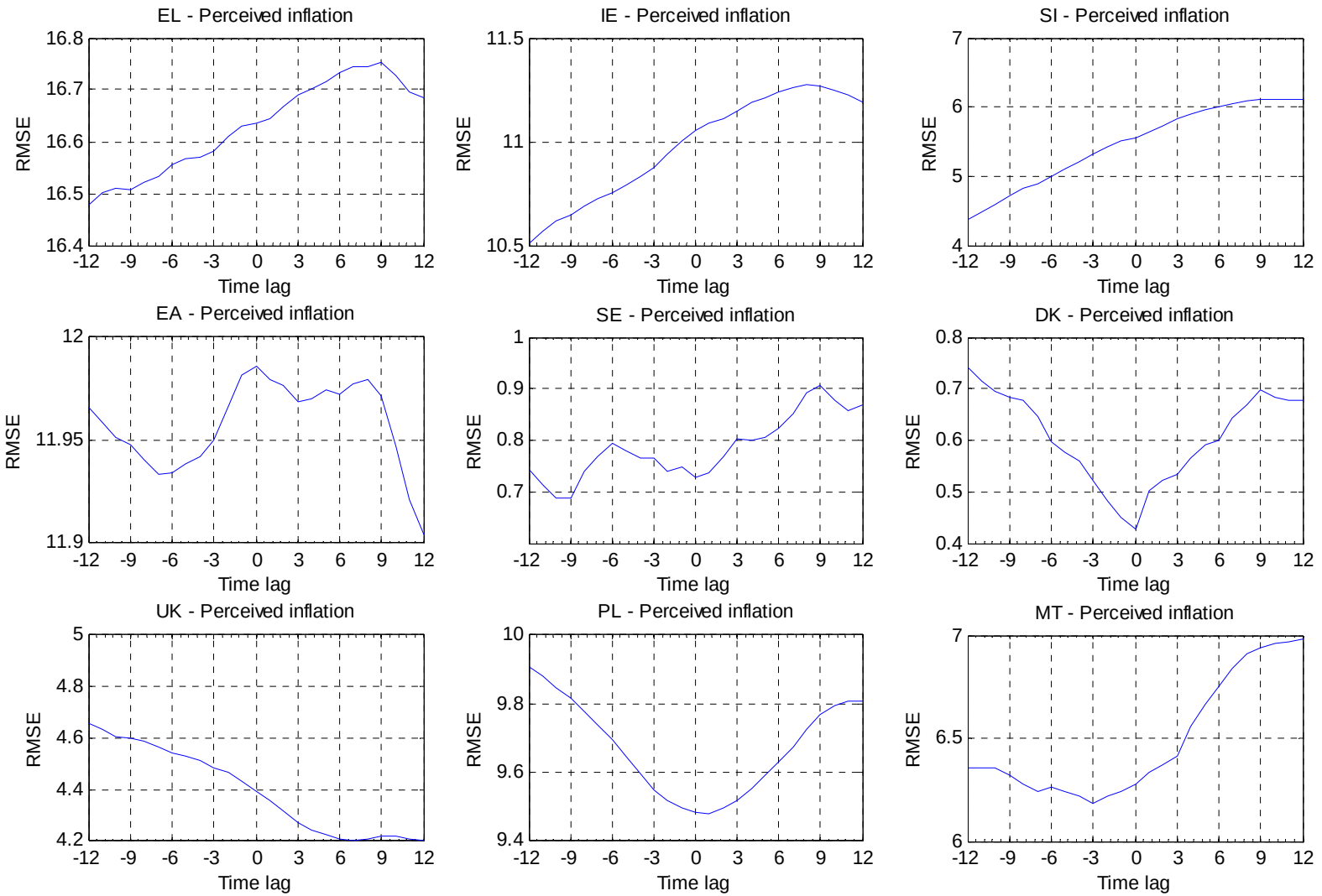

Figure 5c: Root mean square error for the perceived inflation rate in relation to the actual inflation rate, series are shifted between -12 months (lagging) and +12 months (leading)

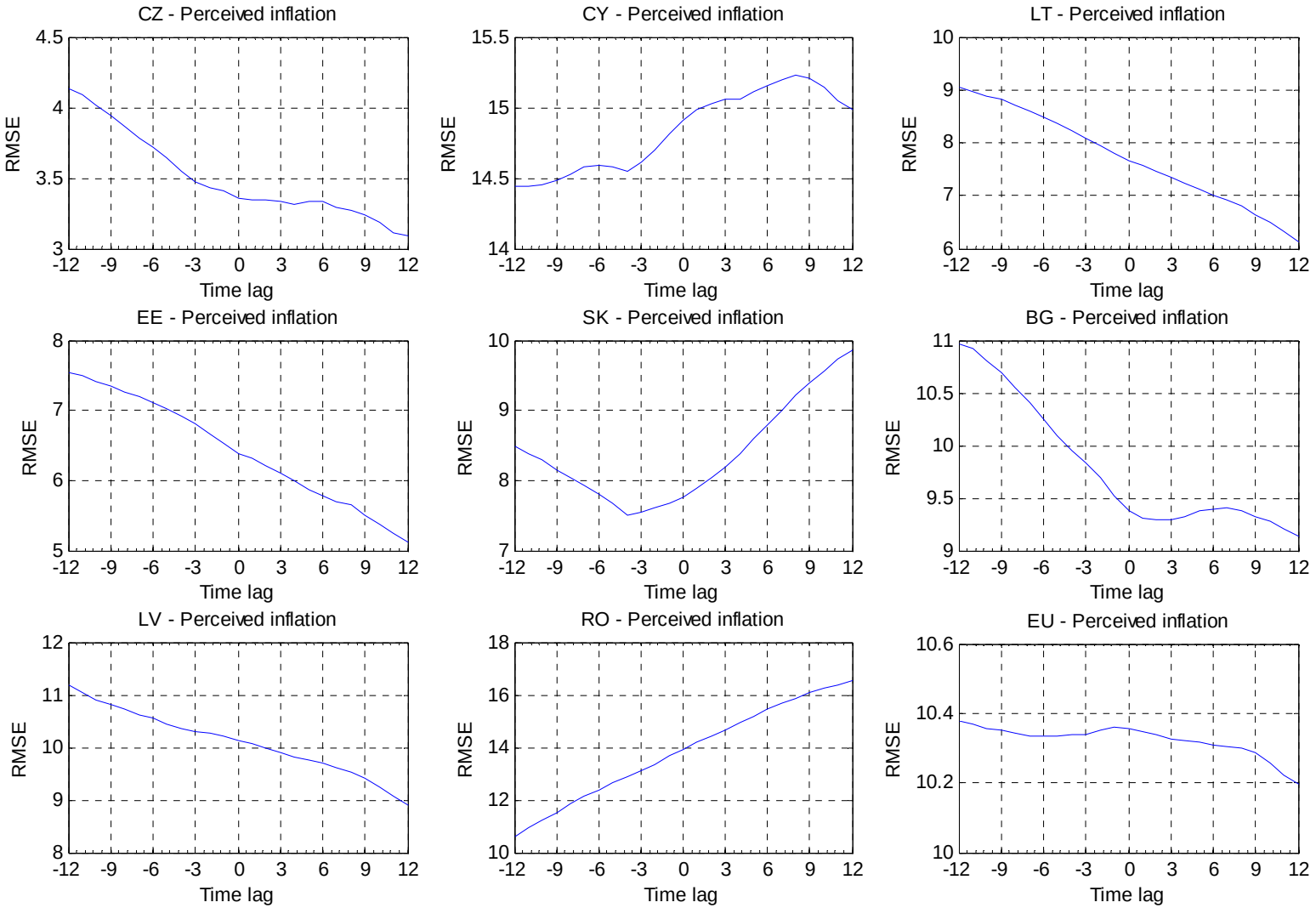

Table 4 Difficulty to forecast inflation: RMSEs from using estimated AR(12) models to forecast inflation on a 12 month horizon

	Root mean Square Error		
EA members	AR(12) model of inflation (1)	Expected inflation (2)	Perceived inflation (3)
Italy	0.33	3.6	22.5
Finland	0.34	1.0	2.2
Greece	0.45	10.1	16.5
Ireland	0.48	6.2	10.5
France	0.57	1.2	5.1
The Netherlands	0.58	-	-
Belgium	0.59	1.5	6.0
Portugal	0.60	6.0	6.7
Austria	0.64	3.6	7.7
Germany	0.85	4.3	9.4
Spain	0.86	9.7	19.7
Luxembourg	1.04	1.7	5.4
Slovenia	1.21	4.2	4.4
Euro area	0.51	4.3	11.9
	Root mean Square Error		
Non EA members	AR(12) model of inflation	Expected inflation	Perceived inflation
Sweden	0.38	1.0	0.7
Denmark	0.41	0.5	0.4
Cyprus	0.99	14.1	14.4
United Kingdom	1.02	3.0	4.2
Czech Republic	1.15	7.2	3.1
Poland	1.24	9.2	9.5
Malta	1.72	4.9	6.2
Estonia	2.23	8.1	-
Bulgaria	2.78	7.2	9.1
Hungary	3.10	-	-
Lithuania	3.25	7.9	6.1
Latvia	4.47	9.4	6.1
Slovakia	4.83	9.0	7.5
Romania	13.45	10.3	10.6
European Union	0.46	4.1	10.0