INFLATION PERCEPTIONS AND EXPECTATIONS IN THE EURO AREA AND PORTUGAL[1][*]

Francisco Dias[**]

Cláudia Duarte[**]

António Rua[**]

1. INTRODUCTION

In the last few decades, the increasing interest of economists in agents' perceptions and expectations, in a context of improving data collection and statistical techniques, is associated with a surge in business and consumer surveys. Within the euro area, as well as in several other countries, various business and consumer surveys are conducted on a monthly basis.

Business and consumer surveys inquire individual firms and consumers directly about their assessment of the present and future short-term movements referring to a large number of variables. Since the answers only refer to the agents' opinion on the direction of change of a specific variable, the information gathered from these surveys is naturally of a qualitative nature. However, in order to use this information in economic models and econometric analysis, a great amount of effort has been put into converting this qualitative information into quantitative measures, so as to be comparable with the benchmark quantitative variables associated with each specific question.

Although several different variables have been investigated throughout the years (see, for example, Smith and McAleer (1995) or Driver and Urga (2004)), amongst all the questions of the surveys, the ones that have received more attention are those related to prices (see, among others, Carlson and Parkin (1975), Berk (1999), or Thomas Jr. (1999)). One example of a survey with questions on price developments is the European Commission's (EC) consumer survey, which inquires 23000 consumers each month in the euro area about their perceptions and expectations of price developments (see European Commission (2007)).

In order to quantify the qualitative data several methods have been put forward (see Nardo (2003) for a survey). One of these methods is the Carlson and Parkin (1975) (CP hereafter) probabilistic method. This method assumes that each consumer answers the questionnaire based on a subjective probability density function associated with the variable under question. This allows one to interpret the share of respondents that provide a particular answer as a specific area under the aggregate probability density function. The application of the CP method to the price questions is commonly found in the literature (see, for example, Forsells and Kenny (2002), Łiziak (2003) or Mestre (2007)).

The aim of this article is to provide a quantitative measure of perceived and expected inflation, for the euro area and Portugal, considering the qualitative data from the European Commission consumer survey and using the CP method, which can be directly compared with the observed inflation.[2] As a by-product, one can assess the issue of the impact of the euro cash changeover on inflation perceptions and test the rationality of inflation expectations.

2. INFLATION PERCEPTIONS

2.1. Measurement

Inflation perceived by consumers does not have to be equal to observed inflation. As Berk (1999) points out, individual agents may not be able to perceive accurately the overall rate of inflation, due to the signal extraction problem (see Lucas (1972, 1976)). Since at the end of the day what really influences agents decisions are their perceptions, assessing price perceptions and comparing their evolution with observed inflation is becoming more and more important, not only for economic researchers but also for policymakers.

In order to obtain a quantified measure of perceived inflation, from amongst the methods that have been put forward to convert qualitative data into quantitative variables, we rely on the CP method to quantify the qualitative information on inflation perceptions from the EC consumer survey. Though formal comparisons of the different methods are not always possible, there is some evidence in favour of using the method proposed by Carlson and Parkin (1975) as discussed in Nardo (2003).

The CP method assumes that each consumer, at each moment in time, responds to the questionnaire based on a subjective probability density function associated with the variable under question. This assumption allows one to associate the proportion of respondents that provide a particular answer as a specific area under the aggregate probability density function.

One of the key assumptions of CP method concerns the choice of the distribution for perceived inflation across the sample. Initially, and in most subsequent empirical applications, the choice fell on the Normal distribution. This choice can be justified based on statistical theory relying on the Central Limit Theorem. Nevertheless, the choice of the Normal distribution has been subjected to some criticism. For example, Carlson (1975) and Batchelor (1981) stress the fact that considering a symmetric distribution, as is the case of the Normal, may be a strong assumption. However, besides the analytical convenience of assuming a Normal distribution, there is also empirical evidence in favour of the use of this distribution. Balcombe (1996) and Berk (1999) did not find empirical evidence in favour of using asymmetric distributions. Moreover, the latter as well as Löffler (1999) conclude that results are similar with or without the normality assumption.

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[2] See Dias, Duarte and Rua (2007, 2008) for the same measures calculated for other countries, namely, Germany, France, Italy, Spain, Belgium, The Netherlands, Ireland and Greece.

The initial formulae of the CP methodology were developed for surveys which included only three possible answers. Batchelor and Orr (1988) and Berk (1999) adapted the CP method to take into account a richer set of survey responses, in which it is possible to choose between five alternative answers. One such example of these surveys is the EC consumer survey. In particular, the question and the corresponding possible answers, regarding the evaluation of current price developments, are the following (see European Commission (2007)):

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

In other words, consumers are asked if year-on-year inflation rate is: 1) above its moderate level; 2) at its moderate level; 3) below its moderate level; 4) nil or 5) negative.

Due to the way the question is posed, in addition to the zero inflation, there is another reference value for the evaluation of the evolution of perceived inflation, which is the moderate inflation rate. Therefore, any measure for perceived inflation should not only reflect the different allocation of answers but should also be a function of this moderate inflation rate.

Denote P_{it} as the proportion of the sample answers falling in the ith response category at time $t(i = 1, \ldots, 5)$.[3] The fractions of responses can be regarded as the maximum likelihood estimates of the areas under the perceptions' distribution delimited by the relevant thresholds (see Batchelor and Orr (1988)). Let F be the cumulative Normal standard distribution function and define the thresholds (Z_{it}) (Chart 1) as:

$$Z_{1t} = F_t^{-1}(1 - P_{1t})$$

$$Z_{2t} = F_t^{-1}(1 - P_{1t} - P_{2t})$$

$$Z_{3t} = F_t^{-1}(1 - P_{1t} - P_{2t} - P_{3t})$$

$$Z_{4t} = F_t^{-1}(P_{5t})$$

As shown by Batchelor and Orr (1988) and Berk (1999), the perceived inflation rate, π_t^p, is given as[4]

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(3) Note that, as stressed by Mestre (2007), the "don't know" answer is not informative. Hence, it has been a current practice to reallocate proportionally the corresponding fraction of answers to the other response categories (see, for example, Forsells and Kenny (2002)).

(4) For details, see Dias, Duarte and Rua (2007).

Chart 1

DISTRIBUTION OF RESPONSES UNDER THE
NORMAL ASSUMPTION
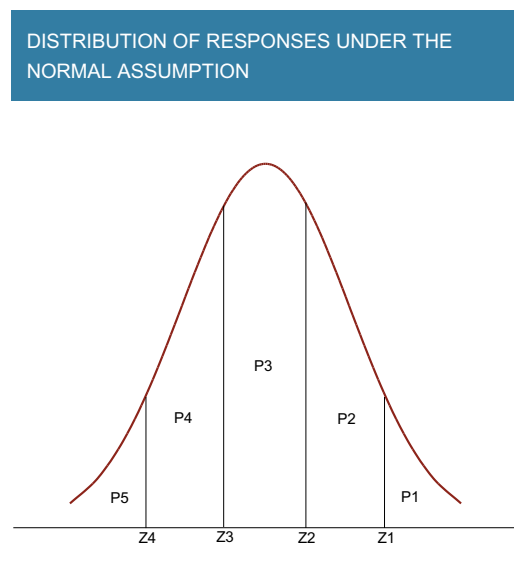
$$\pi_t^p = \frac{-Z_{3t} - Z_{4t}}{Z_{1t} + Z_{2t} - Z_{3t} - Z_{4t}} \pi_t^m$$

where π_t^m represents the moderate inflation rate. From the expression above one can see that the moderate inflation rate plays a scaling role in relation to the perceived inflation rate. Batchelor and Orr (1988) argue that the moderate inflation rate reflects the individual's best guess of the permanent or trend inflation rate. Hence, one possible proxy for the moderate inflation rate could be obtained by using a filtering method that allows one to extract the trend component of the inflation rate. Such filtering could be attained through the use, for example, of the Hodrick and Prescott (1997) (hereafter HP) filter. The HP filter is a well-known standard filtering procedure which provides a mean of obtaining a smooth trend component for a series (see, for example, King and Rebelo (1993)). In practice, the HP smoothing parameter is set to 14400, a standard value when working with monthly data, and as usual, the end of the sample problem of HP filtering can be tackled by extending the series with forecasts. One should note that the trend is extracted using the whole sample data and not only the data available at the time perceptions are formed. Hence, at each moment in time, moderate inflation reflects past, present and future values of observed inflation. In a relatively stable inflation environment (as is the case of the last two thirds of the sample) such an assumption is innocuous, whereas during the disinflation process (the first third of the sample) this hypothesis is also reasonable as the commitment of the authorities towards price stability was well known to the public.

In Chart 2, we present the proportion of answers falling in the ith response category regarding the question on current price developments, and Chart 3 shows the measure of inflation perceptions obtained, both for the euro area and Portugal. One can see that, in general, the perceived inflation rate follows closely the observed inflation rate.

Chart 2

PROPORTION OF ANSWERS FALLING IN THE ith RESPONSE CATEGORY REGARDING THE QUESTION ON CURRENT PRICE DEVELOPMENTS
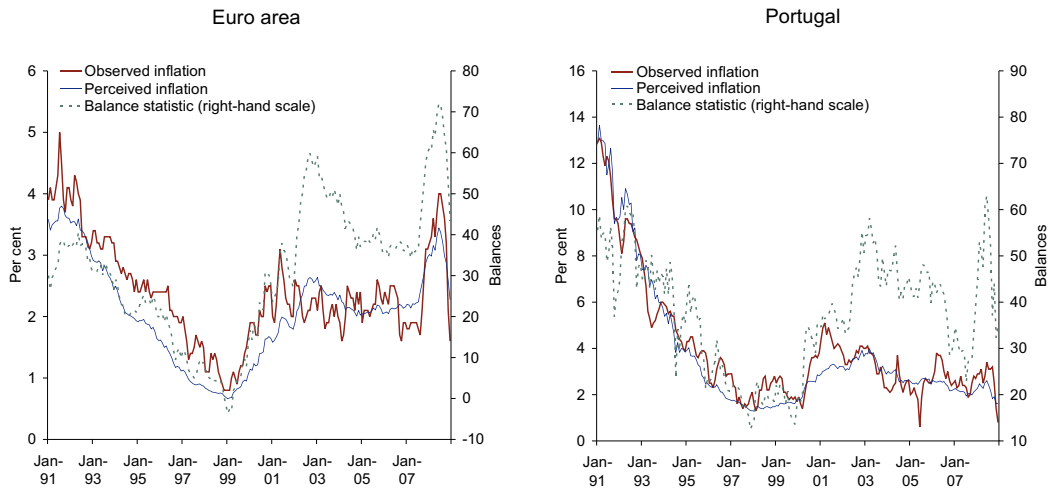
Euro area

Portugal
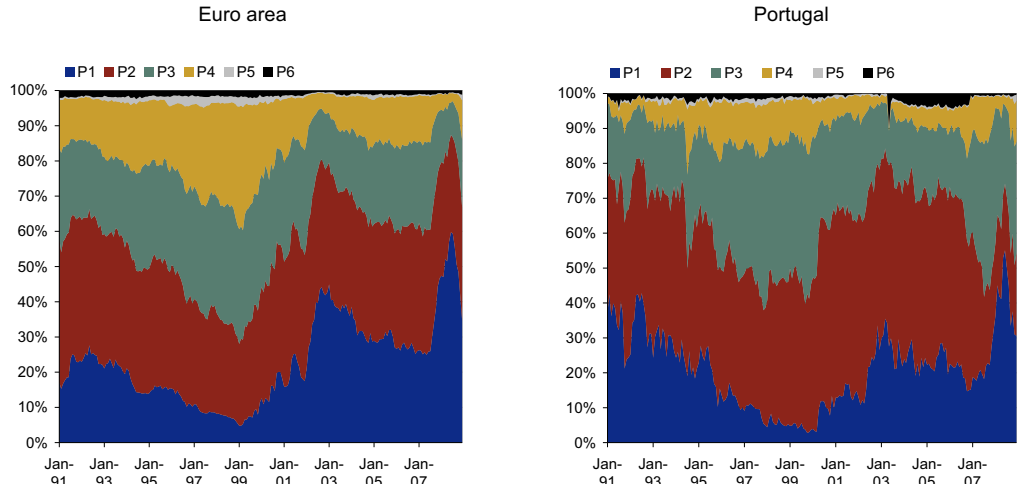
Source: European Commission.

Source: *INE.*

Chart 3

OBSERVED AND PERCEIVED INFLATION AND BALANCE STATISTIC

Euro area

Portugal

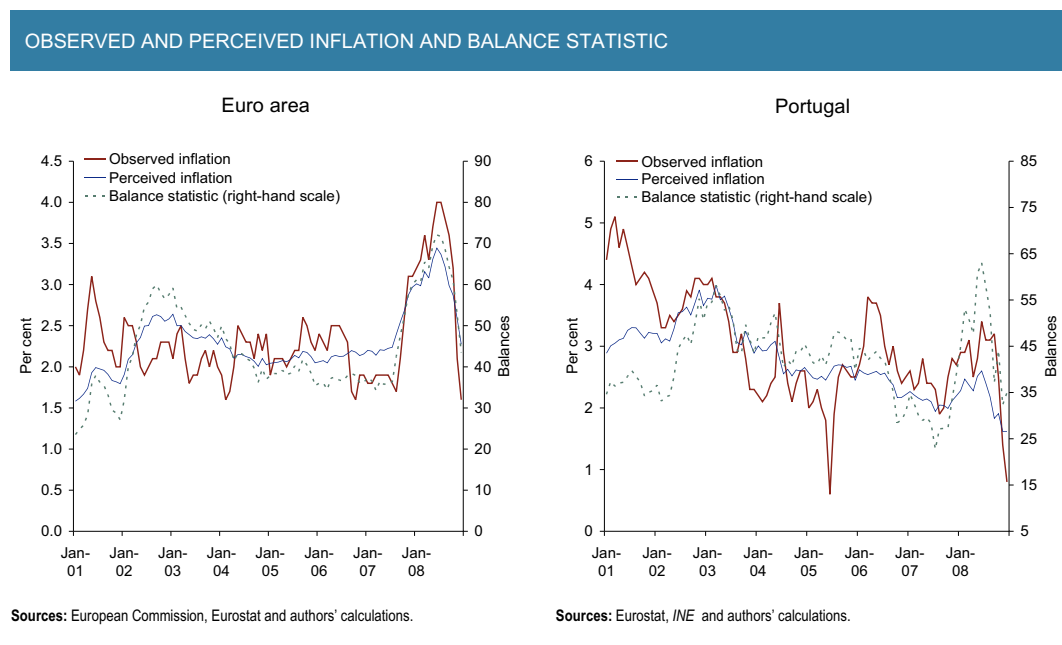**Sources:** European Commission, Eurostat and authors' calculations.

Sources: Eurostat, *INE* and authors' calculations.

Additionally, we also present in Chart 3 the corresponding balance statistics. The balance statistic is the measure used by the European Commission to summarise survey results and is simply a weighted average of the five response proportions

$$b = -P_5 - \frac{1}{2}P_4 + 0P_3 + \frac{1}{2}P_2 + P_1$$

with *ad hoc* weights attached to each answer. The balance statistic is a popular summary measure as it is quite straightforward to compute and is released each month by the European Commission. Apart from the scale, the balance statistic for the question on inflation perceptions has been widely used as a proxy for perceived inflation (see ECB (2003, 2005 and 2007) or Dörring and Mordonu (2007), amongst others). However, the balance statistic for this particular question is not always a reliable measure of perceived inflation (see Dias, Duarte and Rua (2007) for a discussion). In fact, the standard procedure of plotting the observed inflation rate and the balance statistic, allowing for different scales, to assess the evolution of inflation perceptions is reasonable only in a context of a relatively stable inflation environment. For instance, by plotting the observed and perceived inflation rate and the balance statistic over the last years (Chart 4), a period in which the inflation has been relatively stable, one can see that the balance statistic and the proposed perceived inflation measure are relatively similar.

Chart 4

OBSERVED AND PERCEIVED INFLATION AND BALANCE STATISTIC

Euro area

Portugal

Sources: European Commission, Eurostat and authors' calculations.

Sources: Eurostat, *INE* and authors' calculations.

2.2. The euro cash changeover

In the last few years, there has been a growing debate on the divergent evolution of observed inflation and the balance statistic, which is the most commonly used indicator for perceived inflation (see, for example, ECB (2007)). Notwithstanding the fact that observed inflation did not change significantly[5], the balance statistic increased substantially after the physical introduction of the euro banknotes and coins, clearly diverging from the observed measure of inflation. The resulting gap between the two

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(5) According to Eurostat (2003) the most significant impact of the euro changeover in the euro-zone observed inflation rate took place between December 2001 and January 2002 and is estimated to be within the range of 0.09 to 0.28 percentage points.

measures peaked somewhere at the beginning of 2003, and has been somewhat persistent since then (see Chart 3).

In the emerging literature on this subject (see, amongst others, ECB (2003, 2005, 2007), Aucremanne, Collin and Stragier (2007) and Dörring and Mordonu (2007)) the role of the euro cash changeover as the trigger for this gap has been presented in several ways. For example, it has been claimed that the euro cash changeover, and the extensive media coverage associated with it, may have drawn more attention to price increases, inducing an overreaction in inflation perception. Moreover, the rises in consumer prices that actually took place in the wake of the changeover appear to have been concentrated on the most frequently purchased goods, and that may have had a very significant effect on inflation perceptions. It has also been argued that a large number of European consumers still convert prices from euro to their former national currency, anchoring the relative prices to the pre-changeover levels.

As mentioned above, the balance statistic is not an appropriate measure to assess the evolution of perceived inflation over a sample period in which observed inflation is not stationary. Hence, this invalidates the use of the balance statistic to test the impact of euro cash changeover on inflation perceptions when the entire sample is considered, since in most countries it includes a pronounced disinflation period. In fact, the misuse of the balance statistic led wrongly to the conclusion that a divergence between observed and perceived inflation emerged, which could be associated with the introduction of the euro in January 2002. Furthermore, some of the explanations presented may be based on circumstantial evidence since, for example, some of the price increases that occurred at the time of the euro cash changeover, especially in frequently purchased goods, are not directly related with this event, in particular the increase in energy prices (related with the price of oil in international markets) and in unprocessed food prices (closely associated with the weather and harvest conditions) (see Eurostat (2003)).

From Chart 3, as opposed to what is perceptible when using the balance statistic, one can immediately suspect that such a breakdown does not seem to withstand when the measure of perceived inflation herein proposed is used. Dias, Duarte and Rua (2007) conduct a more formal test to assess whether there was a breakdown between perceived and observed inflation. In particular, after testing for unit roots, the existence of a cointegrating relationship between observed inflation and the proposed measure of perceived inflation is assessed. Resorting to the Johansen trace statistic, evidence was found in favour of cointegration. To test for a breakdown in the cointegrating relationship the authors used the test recently proposed by Andrews and Kim (2006) and no evidence of such a breakdown was found, for the euro area and Portugal, at the time of the euro cash changeover. Hence, using the proposed measure for inflation perceptions, for the whole sample, the evidence based on formal tests provides no support for the idea that a gap, motivated by the euro cash changeover, has emerged between observed and perceived inflation.

3. INFLATION EXPECTATIONS

3.1. Measurement

To obtain a quantitative measure for inflation expectations from qualitative data, namely the EC consumer survey, we apply the same CP method as discussed in section 2.1. In this case, the question and the corresponding set of answers, regarding the evaluation of future price developments, are the following (see European Commission (2007)):

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

They will

1) increase more rapidly

2) increase at the same rate

3) increase at a slower rate

4) stay about the same

5) fall

6) don't know

In other words, consumers are asked if the year-on-year expected inflation rate will be: 1) above their current inflation perceptions; 2) the same as the perceived inflation; 3) below the perceived inflation; 4) nil or 5) negative. Note that, as before, there are two reference values for the evaluation of the evolution of expected inflation: zero and the perceived inflation.

Similarly, as in the case of perceived inflation, it can be shown that the expected inflation rate, π_t^e, can be written as:

$$\pi_t^e = \frac{-Z_{3t} - Z_{4t}}{Z_{1t} + Z_{2t} - Z_{3t} - Z_{4t}} \, \pi_t^p$$

where, in this case, the perceived inflation rate plays a scaling role for the expected inflation rate. It seems natural to use the measure of perceived inflation proposed in Section 2.[6] In Chart 5, we present the proportion of answers falling in the ith response category regarding the question on future price developments, while in Chart 6 the resulting measures of expected inflation for the euro area and Portugal are presented.

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(6) One should mention that the overall results are qualitatively similar when the observed inflation rate is used as a proxy for the perceived inflation rate.

Chart 5

PROPORTION OF ANSWERS FALLING IN THE ith RESPONSE CATEGORY REGARDING THE QUESTION ON FUTURE PRICE DEVELOPMENTS
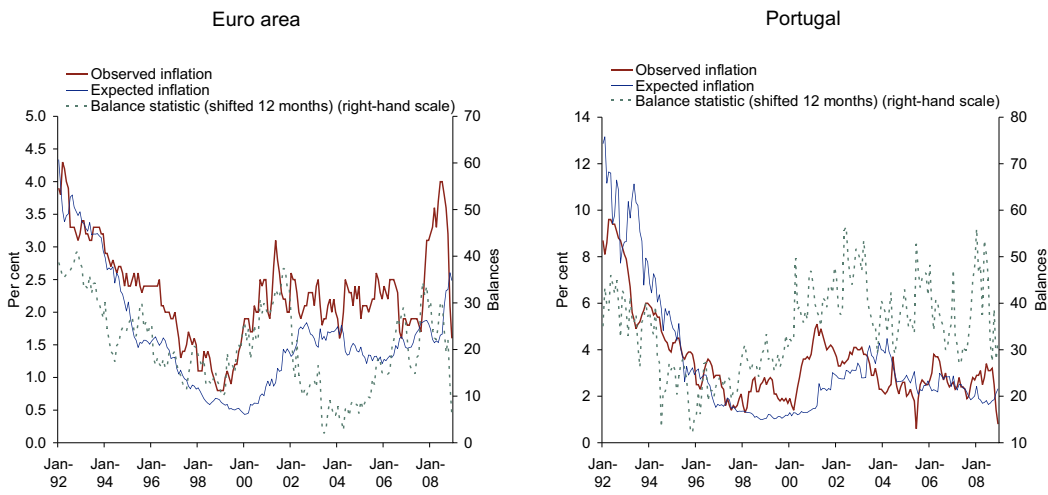
Euro area

Portugal
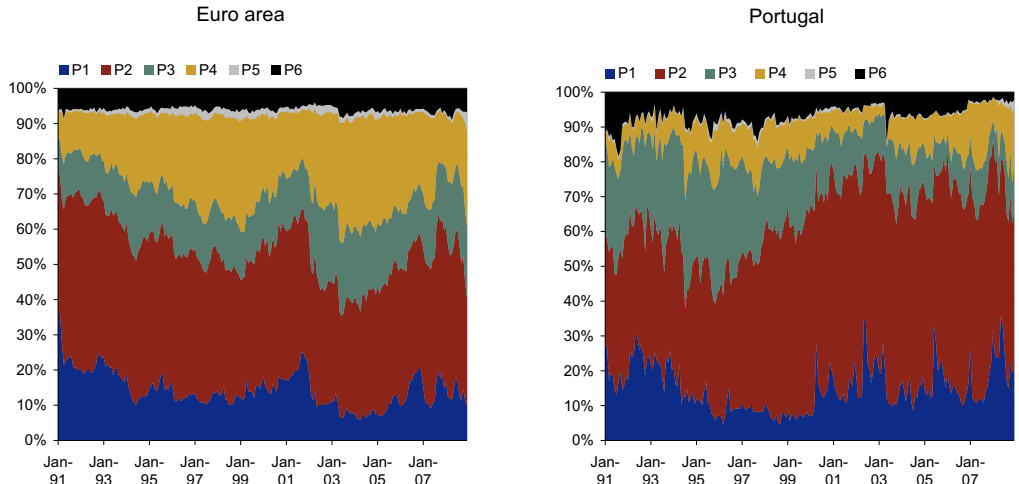
Source: European Commission.

Source: *INE.*

Chart 6

OBSERVED AND EXPECTED INFLATION AND BALANCE STATISTIC

Euro area

Portugal

Sources: European Commission, Eurostat and authors' calculations.

Sources: Eurostat, *INE* and authors' calculations.

3.2. Testing rational expectations

The concept of rational expectations was introduced by Muth (1961) and is based on the assumption that expectations are, in their essence, similar to the informed predictions derived from relevant economic theory. The predictions should exploit efficiently all available information in the dataset. In this section, the rational expectations hypothesis is tested for a particular kind of agents – consumers – regarding a specific variable – inflation.

In practice, for assessing the validity of the rational expectations hypothesis a set of formal tests has been proposed in the literature, namely tests for unbiasedness, lack of serial correlation, efficiency and orthogonality (see Pesaran (1989)). Unbiased expectations assume that rational agents do not commit systematic and persistent errors when forecasting inflation. This means that rational agents may over or under predict inflation at times, but that does not take place over a long time span. Considering the following testing equation for observed inflation:

$$\pi_t = \alpha + \beta \pi_t^e + u_t$$

where, π_t is the observed inflation rate, then a formal test for unbiasedness can be carried out by jointly testing $\alpha = 0$ and $\beta = 1$. In a non-stationary context, the unbiasedness restriction requires the existence of a cointegration relationship between the observed and the expected inflation and the cointegrating vector $[\alpha \ \beta]$ to be equal to $[0 \ 1]$.

Regarding efficiency and orthogonality, both tests are concerned with the use of information by agents to forecast inflation: in the first case, with the use of past inflation rates, while, in the second, with the use of a wider information set. The terminology used for these tests is not consensual among the different authors. For example, Forsells and Kenny (2002) use weak- and strong-efficiency to designate the efficiency and orthogonality tests, respectively. Testing weak-efficiency (or efficiency) consists in assessing the statistical significance of past observed inflation values in a regression with the forecast error, defined as the difference between observed and expected inflation, as the dependent variable. If the set of coefficients in this regression associated with past inflation is significant, then lagged observed inflation can be helpful to improve inflation forecast accuracy, *i.e.* reduce forecast errors.

For strong-efficiency (or orthogonality), a similar testing framework is considered but, in this case, the purpose is to check if a broader information set is orthogonal to the forecast errors. Consider the following equation,

$$e_t = \mu + \gamma \Omega_{t-12} + u_t$$

where $e_t = \pi_t - \pi_t^e$ and Ω_{t-12} denotes the information set available at the time (12-month ahead) expectations are formed. Formally, forecast errors are orthogonal to the economic variables considered relevant for predicting inflation if $\gamma = 0$. Since nowadays, due to data dissemination progress, agents have access to a wider information set at a progressively lower cost, the relevant information set can encompass an extremely large number of variables. Following the seminal work of Stock and Watson (1998), one can rely on the common factors extracted from the original dataset. In this way, it is possible to overcome the problem of the dimension of the information set at hand by reducing the number of regressors in a parsimonious way, without neglecting a significant amount of information. As in Łziak (2003), one can also control for lagged forecast errors and take into account data publication lags, by shifting the relative position of the series, so that at each moment in time the independent variables considered reflect the information available to the agents at the time of the survey (see, for example, Altissimo *et al.* (2007) and Barhoumi *et al.* (2008)). For this purpose, consider the following model:

$$e_t = \mu + \sum_{i=1}^{p} \rho_i e_{t-1} + \sum_{j=1}^{k} \Psi_j F_{j,t-12} + u_t$$

where p is the number of autoregressive terms included in order to cope for autocorrelation, F_j refers to the jth common factor extracted from the broad information set and k denotes the number of common factors considered in the regression.[7] One can rely on the criteria proposed by Bai and Ng (2002) to determine the number of factors to include in the model. Hence, agents' inflation expectations are orthogonal to the information set considered or, in other words, agents are strongly efficient, if the hypothesis $\Psi_1 = \Psi_2 = \ldots = \Psi_k = 0$ is not rejected.

Dias, Duarte and Rua (2008) performed the above analysis for the euro area as a whole as well as for several member countries (including Portugal). Concerning bias, the authors found no evidence in favour of unbiasedness (as in Berk (1999), Łiziak (2003) and Mestre (2007)). Although the Johansen test results point to the existence of cointegration between the observed and the expected inflation, though the hypothesis of the cointegrating vector $[\alpha \; \beta]$ being equal to $[0 \; 1]$ is clearly rejected for the euro area and Portugal (as well as for all the other countries covered in their analysis). Restricting the sample to the post-euro introduction period (*i.e.* since January 1999), the same result is found for the euro area, while for Portugal there are some signs of unbiasedness.

As the results of the unbiasedness test suggest that agents have, in general, biased inflation expectations, the hypothesis of rational expectations is ruled out, regardless the results of the efficiency and orthogonality tests. Nevertheless, even though agents incur in a systematic expectation error, Paquet (1992) argues that, in these cases, the existence of cointegration between the observed and expected inflation could also be interpreted as some sort of rationality, a so-called weak-form of rationality.

Concerning the weak-efficiency test, for the sample period as a whole, the results in Dias, Duarte and Rua (2008) suggest that one cannot reject weak-efficiency for the euro area. On the contrary, for Portugal, the authors found no evidence in favour of weak-efficiency. When the authors considered the post-euro introduction sample, the results remained qualitatively unchanged. As for strong-efficiency, the test results suggest that there is evidence in favour of strong-efficiency for the euro area. Focusing only on the post-euro introduction sample period, the same evidence holds.

Therefore, neither Portugal nor the euro area satisfies the whole set of conditions necessary to comply with the rational expectations hypothesis. This evidence holds not only for the full sample but also for the post-euro introduction period.

4. CONCLUSIONS

The aim of this article is twofold. First of all, we assess the quantification of inflation perceptions obtained from qualitative survey data. The measurement of inflation perceptions has gained a lot of attention in the last few years, particularly in the euro area. This renewed interest stems from the fact that

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(7) For a discussion on the existence of autocorrelation in the forecast errors under the rationality hypothesis, see Dias, Duarte e Rua (2008).

apparently the euro cash changeover in January 2002 had a substantial impact on inflation perceptions. Considering the commonly used balance statistic, released by the European Commission, as a proxy for perceived inflation, a gap between observed and perceived inflation emerged after the introduction of the euro notes and coins. However, one should be careful when drawing conclusions from the simple balance statistic since it is an adequate measure of the evolution of perceived inflation only under special circumstances. To circumvent the limitations of the balance statistic, in this article, we propose a more refined measure of perceived inflation, which was computed for the euro area and Portugal. This measure is based on the well-known generalised version of Carlson and Parkin method and exploits the information referring to the question on inflation perceptions from the European Commission's consumer survey. In sharp contrast with previous works, which rely on the balance statistic, no evidence of a breakdown between observed and perceived inflation after the euro cash changeover is found using the measure of inflation perceptions herein proposed.

Secondly, we also obtain a similar measure of expected inflation for the euro area and Portugal. Again, we resort to the rich consumer survey data released on a monthly basis by the European Commission and use the probabilistic method. Such a quantified measure allows one to test whether inflation expectations are rational or not. In this respect, the assumption of rationality does not seem to hold empirically for consumer inflation expectations in the euro area as a whole as well as in Portugal.

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