EVALUATING CORE INFLATION INDICATORS[1]

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ABSTRACT

This paper proposes testable conditions that core inflation measures should satisfy. Trend inflation indicators calculated by Banco de Portugal are tested against this background. The major conclusion is that the so-called “underlying inflation”, the “10% trimmed mean”, and the “25% trimmed mean” do not meet the proposed conditions. However, they are satisfied by the “37-month centred moving average”, the “first principal component” and the “standard deviation weighted CPI” indicators. Yet, only the last two indicators can be used as useful core inflation measures, as the first one is not computable in real time.

Keywords: core inflation measures, trimmed mean

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1 INTRODUCTION

When assessing price developments, Central Banks generally make a distinction between permanent and transitory changes of inflation. Since the recorded consumer price index (CPI) may be subject to the volatility of some (few) items, Central Banks developed alternative inflation indicators, which intend to identify the "permanent" component of inflation, by eliminating the so-called temporary price fluctuations. Such indicators are usually referred to in the literature as trend or core inflation indicators. Cecchetti (1999), Coimbra and Neves (1997), Lafléche (1997), Bakhsi and Yates (1999), Álvarez and Matea (1999) and Wynne (1999) provide a reasonably updated summary of this type of measures.

The conventional approach for the calculation of these measures of core inflation usually consists in excluding from the CPI the components with the largest volatility, in a somewhat discretionary manner. The so-called "underlying inflation" (also called the "excluding food and energy" inflation) is obtained by excluding the prices of "non-manufactured foodstuffs" and "energy products". In turn, the "10% trimmed mean" for a given month is obtained by excluding the items with a price change standing amongst the 10% largest or the 10% smallest changes.

A common feature of this type of indicators is that they are based on a set of explicit or implicit assumptions, which never, or almost never, are tested and that, in most cases, do not hold. For instance, the "underlying inflation" indicator calculated by Banco de Portugal (and by other Central Banks) since the beginning of the nineties and originally introduced as a trend inflation indicator was not tested against well-defined criteria. This lack of evaluation does not permit to assess the kind of information contained in this indicator and, therefore, the type of conclusions that can be drawn from its behaviour. After having been introduced with paramount expectations, the "underlying inflation" indicator gradually begun to be regarded as an uninteresting variable, since in the course of time it has not proven to be suitable to be used as a core inflation indicator. Obviously, this conclusion should (and could) have been drawn before starting to use it in the analysis of inflation.

To our knowledge, there has not been in the literature a consistent attempt to introduce testable conditions to evaluate potential measures of core inflation. The papers on this issue spend a lot of time explaining how to build new trend inflation indicators, but the evaluation of the new or existing indicators is generally overlooked, if not completely disregarded.

Therefore, the first aim of this paper is to introduce testable conditions for a core inflation indicator and to use these conditions to evaluate the trend inflation indicators usually calculated by Banco de Portugal.

It should be stressed that the proposed conditions may be met by more than one indicator. In this case, additional criteria could be envisaged (i.e., volatility, persistency) in order to further rank these indictors.

This article is organised as follows. Section 2 presents the necessary conditions that must be met by any potential core inflation measure. Section 3 analyses the core inflation indicators usually calculated by the Banco de Portugal vis-à-vis the conditions introduced in section 2 and section 4 presents the major conclusions.

2 CONDITIONS FOR A CORE INFLATION MEASURE

This section introduces and discusses necessary conditions that a trend or core inflation measure should verify. To some extent, this issue has been overlooked in the literature. Sometimes, the potential trend inflation measures are analysed by comparing their behaviour with the trajectory of a so-called “reference measure” for inflation [see, for instance, Bryan and Cecchetti (1994), Coimbra and Neves (1997), Bryan, Cecchetti and Wiggins II (1997), Bakhshi and Yates (1999)]. Coimbra and Neves (1997) use as “reference measure” the median of the CPI´s year-on-year change rates, for a 19-month time span, whereas Bryan, Cecchetti and Wiggins II (1997) use a 36-month centred moving average and Bakhshi and Yates (1999) a 37-month centred moving average.

In these papers the optimal indicator is the one that best approximates the “reference measure”, and so, as a general rule, the selected indicator is the one that minimises the mean square error (MSE) calculated with respect to the “reference measure”, i.e., $\sum (p_t^* - \hat{p}_t)^2 / n$ where p_t^* represents the core inflation indicator and $\hat{p}_t$ the inflation ”reference measure”.

Needless to say, the use of such an approach may be highly misleading. On one hand, the introduction of these so-called “reference measures” for inflation, on the basis of which the other indicators are evaluated, is never duly justified and so there is no guarantee that these indicators are useful references for the assessment of core inflation measures.

On the other hand, if it is the case the “reference measure” is not the best proxy for the (unknown) “true trend” of inflation, then this approach does not guarantee that the best indicator is selected, as the core inflation indicator that best approximates the “reference measure” is not necessarily the one that best approximates the “true” trend of inflation. This may be so even when a centred moving average is used as the “reference measure” for inflation. Centred moving averages are known to preserve linearity, that is, they are optimal trend estimators when the trend of the series is a linear function of time. On the other hand it is possible to show that centred moving averages also exhibit nice properties when the original series is an integrated variable[2]. However, the question of how close the empirical centred moving average tracks the trend of a time series depend on the statistical properties of the series and on the number of periods used in the computation of the centred moving average[3]

Laflèche (1997) evaluates the different core inflation indicators by "measuring" the information content of each indicator in the forecast of future values of recorded inflation. For that purpose, she estimates an auto-regressive model for each indicator and looks at the fit of the corresponding models. For a model with a fixed number of lags, the indicator supplying the highest R^2 is chosen as the best core inflation measure. Of course, this evaluation is made in relative rather than absolute terms, and so no conclusion can be drawn on the properties of the selected indicator(s).

Roger (1997) suggests that a core inflation measure should verify three properties. Ideally this measure should be timely (if it is not available for use in a timely manner its practical value will be severely impaired), robust and unbiased (otherwise it will provide false signals, leading to policy bias and fail to gain public credibility) and verifiable (otherwise it is unlikely to have great credibility). More recently, Wynne (1999) presented the following six criteria which, in his opinion, should be used to select a core inflation measure: 1) to be computable in real time; 2) to be forward-looking in

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[2] To see that consider first the trend stationary variable $Y_t = a + bt + u_t$ where u_t is stationary and $E[u_t] = 0$. For this time series the trend function is given by $Y_t^* = a + bt$. Now, it is easy to see that if $\overline{Y}_t$ represents the moving average with 2m+1 terms centred in period t, then

$$\overline{Y}_t = \frac{1}{2m+1}\sum_{i=-m}^{m} Y_{t+i} = a + bt + \overline{u}_t \qquad \text{with} \qquad \overline{u}_t = \frac{1}{2m+1}\sum_{i=-m}^{m} u_{t+i}$$

i.e., the centred moving average is also a trend stationary variable and we have $E\left[\overline{Y}_t\right] = Y_t^*$. However the degree of accuracy of $\overline{Y}_t$ depends on how close to zero is the $\overline{u}_t$ series. This means that the optimal number of periods to be used depend on the properties of u_t.

On the other hand it is easy to show that whatever the assumed data generating process for Y_t the centred moving average may be written as

$$\overline{Y}_t = \overline{Y}_{t-1} + \frac{1}{2m+1}\left[\Delta Y_{t-m} + \Delta Y_{t+m}\right] = \overline{Y}_{t-1} + e_t$$

Now, if Y_t is integrated of order one, i.e, $Y_t = Y_{t-1} + u_t$ then $e_t = \frac{1}{2m+1}\left[u_{t-m} + u_{t+m}\right]$ is a stationary variable and so $\overline{Y}_t$ is also integrated of order one. However the properties of $\overline{Y}_t$ vis-a-avis Y_t will depend on the number of periods (m) as well as on the time series properties of u_t.

[3] Bakhshi and Yates (1999) also discuss some theoretical reasons that may explain why the centred moving average may not be a good benchmark against which to judge core inflation indicators.

some sense; 3) to have a track record of some sort; 4) to be understandable by the public; 5) to be such that history does not change each time we obtain a new observation; 6) to have some theoretical basis, ideally in monetary theory.

There are two main comments that can be made about these conditions. Some of them, however important, have the only purpose of previously excluding some candidates and so strictly speaking are more a pre-requisite than a specific property of any indicator (this is the case, for instance, of the conditions for the indicator to be timely and computable once and for all). Some other conditions, eventhough important to characterise the remaining candidates, are rather vague and little selective, and the form of their practical implementation is not addressed (this is the case, for instance, of the requirement for the indicator to be "robust and unbiased" or to be "forward-looking in some sense"). For this reason, they also allow little progress as to the properties of the selected indicators.

To overcome these difficulties, we first introduce a set of *a priori* conditions that have to be met by any core inflation indicator. Obviously, in the discussion that follows, we implicitly assume that any candidate to be a core inflation measure does meet the pre-requisites of being timely and computable once and for all. This would exclude from the candidates the symmetric filters (centred moving averages or the Hodrick-Prescott filter).

Let us assume that for any given period t, the inflation rate, say p_t, is broken down into the sum of two components: a permanent component, named core or trend inflation, say, p_t^*, and a temporary component represented by u_t. By definition, in each period of time, we have:

$$p_t = p_t^* + u_t \tag{1}$$

In equation (1) we assume that the temporary disturbances in the inflation rate, u_t, are caused by developments such as changes in weather conditions, disturbances in the demand or supply of goods, etc. By definition u_t is expected to have zero mean and finite variance, and therefore, non-stationary is excluded on theoretical grounds. Notice for instance that if u_t were allowed to exhibit a non-zero mean that would mean that the core inflation measure, p_t^*, would not be capturing all the systematic component of p_t.

The problem of the degree of integration of inflation is an empirical issue. In some countries, the inflation rate may be represented by a stationary process, while in others, such as Portugal, the inflation rate is better characterised as an integrated process of order 1, i.e., an I(1) variable.

In what follows it is assumed that p_t, the inflation rate, is I(1). It then results from equation (1), given the hypothesis on u_t, that the core inflation measure, p_t^*, shall also be I(1) and, in addition, must be cointegrated with the inflation rate, p_t, so that $z_t = p_t - p_t^*$ is stationary with zero mean.

It should be noted that if $z_t = p_t - p_t^*$ does not have zero mean, then p_t^* is not capturing all the systematic component of p_t, i.e., there is a non vanishing difference between p_t and p_t^*. In other words the core inflation measure does not capture the true level of the permanent component of inflation and may give false signals to monetary authorities if they do not take this into account.

Something similar happens if $z_t = p_t - bp_t^*$ is stationary, but $b \neq 1$. Also in this case, p_t^* does not account for all the permanent component of p_t. The net result shall correspond to either a faster (if $b < 1$) or slower (if $b > 1$) systematic growth of p_t^* vis-à-vis p_t and therefore the two variables tend to drift apart.

We are now able to introduce a set of necessary conditions for a core inflation measure. When inflation, p_t, is I(1), we say that p_t^* is a core inflation measure if:

i) p_t^* is I(1) and p_t and p_t^* are cointegrated with unitary coefficient, i.e., p_t-p_t^* is a stationary variable with zero mean[4];

ii) There is an error correction mechanism given by $z_{t-1} = (p_{t-1} - p_{t-1}^*)$ for Δp_t, i.e., Δp_t may be written as

$$\Delta p_t = \sum_{j=1}^{m} a_j \Delta p_{t-j} + \sum_{j=1}^{n} b_j \Delta p_{t-j}^* - g\,(p_{t-1} - p_{t-1}^*) + e_t \qquad (2)$$

iii) p_t^* is strongly exogenous for the parameters of equation (2).

The rationale behind condition i) was already presented. It implies that inflation and the core inflation measure cannot exhibit a systematically diverging trend, in which case the latter will probably give

[4] Freeman (1998) first proposed this condition.

false signals to the monetary authority. Note that the condition $E\left[p - p^*_t\right] = 0$ is not restrictive. In fact, if relations of the form: $p_t = a + p^*_t + u_t$ are to be considered it is always possible to define a trend measure $\overline{p}_t = a + p^*_t$ and resume, without loss of generality, the condition $E\left[p_t - \overline{p}_t\right] = 0$

The remaining conditions should be further analysed. From Granger's representation theorem (Engle and Granger, 1987), we know that if condition i) holds then there is an error correction representation for at least one of the variables p_t or p^*_t. Condition ii) requires that that representation exists specifically for p_t, i.e., that the term z_{t-1} appears in the equation of Δp_t. The logical behind this requirement is rather simple: if the variable p^*_t is to be classified as a trend measure of p_t, then p^*_t shall behave as an attractor for p_t, i.e., in the long run, p_t must converge to p^*_t. In fact, if the variable p^*_t does not exhibit this property, its interpretation as a core inflation measure is not useful in any sense. If there is no reason to expect that p_t will converge to p^*_t, there is no point in knowing whether in a given period p^*_t is above or below p_t. However, if condition ii) holds, we can ensure that if in a given period p_t is above (below) p^*_t, there is a reason to expect that, sooner or later, p_t will start to decrease (increase) and converge to p^*_t.

Note that condition ii) includes as a special case the requirement of Granger causality. In particular, this condition requires that p^*_t Granger causes p_t, i.e., that p^*_t is a leading indicator of p_t. However, condition ii) goes beyond this requirement by requiring the existence not only of the "short-term" causality, reflected in equation (2) by the term $\sum_{j=1}^{n} b_j \Delta p^*_{t-j}$, but also (and mainly) of a "long-run" causality reflected in equation (2) by the error correction term.

Let us now consider condition iii). This condition aims at preventing that condition ii) does occur the other way around, i.e., that p_t is not an attractor for p^*_t and also that p^*_t is not sensitive to observed outliers in p_t. Otherwise it will be very difficult, if not impossible, to anticipate the future path of inflation by looking at p^*_t. The fact, for instance, that in a given period p^*_t is above p_t, allow us to anticipate the future path of p_t only if p^*_t is not a function of p_t. By requiring the strong exogeneity of p^*_t this condition implies simultaneously that the error correction term does not appear in the equation for p^*_t (i.e., that p^*_t is weakly exogenous for the parameters of the cointegrating vector) and also that p_t does not Granger cause p^*_t. In other words, condition iii) implies that in the error correction model for p^*_t

$$\Delta p_t^* = \sum_{j=1}^{r} d_j \Delta p_{t-j}^* + \sum_{j=1}^{s} q_j \Delta p_{t-j} - l\,(p_{t-1}^* - p_{t-1}) + h_t \qquad (3)$$

we must have $l = q_1 = \ldots = q_s = 0$. Under these conditions, the model for p_t^* shall simply be written as follows

$$\Delta p_t^* = \sum_{j=1}^{m} d_j \Delta p_{t-1}^* + h_t \qquad (4)$$

The test of condition i) may be carried out in different manners. One of them consists in testing the hypothesis $(a, b) = (0,1)$ in the static regression $p_t = a + bp_t^* + v_t$. For that, we may, for instance, resort to the Johansen approach (see Johansen (1995)). In alternative, condition i) may be tested using unit root tests on the series $z_t = (p_t - p_t^*)$, with a view to establishing that this is a zero mean stationary variable.

Condition i) having been established the verification of ii) is relatively simple, just requiring the specification of a model of type (2) and the testing of the hypothesis $g = 0$ using the conventional t-ratio of $\hat{g}$.

The test of condition iii) is also easy, and simply consists in testing the hypothesis $l = q_1 = \ldots = q_s = 0$ in model (3). In the next section the test of this condition is carried out in two steps. In the first step we simply test the condition $l = 0$ (weak exogeneity). The second part ($q_1 = q_2 = \ldots = q_s = 0$) is carried out only for the weakly exogenous indicators[5].

[5] Notice that the condition $l = 0$ jointly with condition i) imply condition ii). In this sense the three conditions are not independent.

3 EVALUATING THE CORE INFLATION INDICATORS

In Portugal, according to the ADF test, the inflation rate, measured by the year-on-year growth rate, appears to be I(1) without a drift[6]. In this case, any core inflation indicator must meet conditions i), ii) and iii) introduced in section 2. This section evaluates the core inflation indicators usually computed by Banco de Portugal, using a single equation approach based on the ADF statistic.

It must be recognised that the Johansen approach is specially designed to test the conditions set up above. However according to some preliminary results the conclusions appeared to be quite sensitive to the number of lags used in the estimated VAR, much in line with the existing evidence that suggests that the Johansen approach may be very misleading when the number of observations is small. In fact, due to major changes introduced in the VAT rates in the middle of 1992, which strongly affected the year-on-year inflation rate during one year, we had to reduce our sample to the period 1993/7-1999/11.

The single equation approach used in this section to evaluate the core inflation indicators includes as a first step the ADF unit root test on the series (p_t-p^*_t). Notice that if we consider the following cointegrating regression

$$(p_t - p^*_t) = a + (b-1)p^*_t + u_t \tag{5}$$

one readily concludes that (p_t-p^*_t) is stationary if and only if u_t is stationary and $b = 1$. Notice also that as the ADF test has not much power, the null of a unit root on (p_t-p^*_t) will only be rejected if in fact u_t in (6) is stationary and $\hat{b}$ is very close to one. Furthermore if we conclude for the stationary of (p_t-p^*_t) then we may proceed to testing the hypothesis $a = 0$ by allowing the ADF test to account for a nonzero constant. If non-stationarity of (p_t-p^*_t) is rejected we may then test condition ii) using equation (2) and condition iii) using equations (3) and (4).

This approach was applied to the following 8 core inflation indicators: (1) the 37-term centred moving

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[6] For the sample period: 1993/7 to 1999/11 we get

$$\Delta p_t = \underset{(1.04)}{0.093} + \underset{(2.47)}{0.277}\Delta p_{t-1} - \underset{(-1.56)}{0.037}p_{t-1}$$

and so the null that the coefficient of p_{t-1} is zero is not rejected.

average (MA37), (2) the 25-term centred moving average (MA25), (3) the 13-term centred moving average (MA13), (4) the 10% symmetric trimmed mean (TM10), (5) the 25% symmetric trimmed mean (TM25), (6) the underlying inflation (UNI), (7) the first principal component (FPC) and (8) the standard deviation weighted CPI (SDI). Banco de Portugal usually computes all these indicators with the exception of the first three (MA37, MA25 and MA13) and the last one (SDI).

It is apparent that the centred moving averages (MA37, MA25 and MA13), in practice, cannot be used as core inflation indicators, as they are not computable in real time. But, as referred to above, the MA37 is commonly used as a "reference measure" for inflation and, therefore, it seems interesting to test whether these type of indicators exhibit the properties that one would expect in an appropriate core inflation measure, no matter the number of terms.

The SDI indicator was obtained by re-weighting CPI, using as weights the inverse of the standard deviations of the difference between inflation rate of each item and the year-on-year inflation rate computed from the CPI itself. Therefore we have

$$SDI_t = \frac{\sum_{i=1}^{N} w_{it} P_{i,t}}{\sum_{i=1}^{N} w_{it} P_{i,t-12}} \qquad \text{with} \quad w_{it} = \frac{\frac{1}{s_{it}}}{\sum_{j=1}^{N} \frac{1}{s_{jt}}}$$

where

$$s_{it} = \sqrt{\frac{\sum_{j=t-m+1}^{t} \left[\left(p_{i,j} - p_j \right) - \left(\overline{p_{it} - p_t} \right) \right]^2}{m}} \qquad \text{for } i = 1, 2, \ldots N$$

and

$$\left(\overline{p_{it} - p_t} \right) = \sum_{j=t-m+1}^{t} \frac{\left(p_{ij} - p_j \right)}{m}$$

with p_{it} standing for the year-on-year inflation rate of item i in period t and p_t for the year-on-year inflation rate of the CPI in period t. This indicator is a slight modification of the so-called neo-Edgeworthian index whose weights are the inverse of the variances instead of the inverse of the standard deviations.

The empirical results are presented in Table 1. With the exception of MA37, MA25 and MA13 whose sample periods are 1993/7-1998/5, 1993/7-1998/11 and 1997/3-1999/5, respectively, all the indicators where analysed for the period 1993/7-1999/11.

The first column in Table 1 reports the results of the ADF unit root test on the series $(p_t - p^*_t)$. In order to test separately the conditions $a = 0$ and $b = 1$, the ADF regression always included a constant. The number of lags was set such that the estimated regression do not exhibit autocorrelation in the residuals. According to this test we were able to reject the null of a unit root for every series $(p_t - p^*_t)$. So we conclude that all the indicators, p^*_t, are cointegrated with p_t and that the hypothesis $b = 1$ is not rejected.

In the second column we present the test of the condition $a = 0$. This condition is tested conditional on the results of the previous column, i.e., we are testing $a = 0$ conditional on $(p_t - p^*_t)$ being stationary. To test $a = 0$ we just test whether the constant term on the ADF regression is significantly different from zero. So it is a simple t-test. Figures in this column just report the "p-values" of this test. By looking at the Table we conclude that the null of $a = 0$ is rejected for the two trimmed means (TM10 and TM25) and so these two indicators do exhibit some systematic biases[7]. Notice however that in case of the UNI and SDI indicators the "p-values" of the test $a = 0$, even though larger than 5%, are in fact quite small revealing also some "residual" biases.

One possible explanation for the fact that the two symmetric trimmed means indicators do not meet the first condition is that they are calculated without taking into account some of the features of the price changes distributions of the CPI items. Computations carried out by several authors[8] showed that, in general, the distributions of price changes are not normal, but rather appear to be leptokurtic (heavy tails) and asymmetric. The use of symmetric or centred trimmed means, in principle, shall be appropriate for the cases in which the distributions of price changes are, on average, not skewed. The calculations made for Portugal (see Coimbra and Neves (1997)) suggest the existence of relatively long positive and negative asymmetry periods. The result $a \neq 0$ reflects the fact that these positive and negative asymmetry periods do not cancel out exactly during the sample period.

The third column presents the results of the test for condition ii). The test was carried out by estimating equation (2) (both with and without a constant term) and testing whether the null $g = 0$ was rejected. This is also a simple t-test. For all the indicators with the exception of the UNI the null of

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[7] This limitation was previously pointed out by Coimbra and Neves (1997).

[8] See, for instance, Coimbra and Neves (1997), Bryan, Cecchetti and Wiggins II (1997) and Roger (1997).

$g = 0$ was rejected (figures in the table report the "p-values" of the corresponding t-statistic). So, we conclude that with the exception of the "underlying inflation indicator" all the other indicators meet condition ii). This conclusion obtains whether or not the estimated equation (2) allows for a constant term and whatever the number of lags used in the estimation.

In the fourth column we test for the first part of condition iii), i.e, whether $l = 0$ in equation (3). This test is similar to the test of condition ii) and figures in the table are the "p-values" for the "t-statistics" of $\hat{l}$. Now with the exception of MA25 and again of UNI all the other indicators meet the first part of condition iii). With the exception of TM10 this conclusion does not depend on whether or not the estimated model includes a constant term.

So all the indicators but MA25 and UNI are leading indicators of the inflation rate. For the underlying inflation indicator one concludes that it is not an attractor for CPI. Instead it works the other way around, i.e., it does not attract, but is attracted by the CPI ($g = 0$ and $l \neq 0$). In other words, the test confirms the suspicion raised in Coimbra and Neves (1997) that UNI is a lagged indicator rather than a leading indicator of inflation.

As regards the MA25 indicator we just note by now that the result in column four shows that the "centred moving average" of the inflation rate is not necessarily an appropriate measure of core inflation thus confirming our suspicion that using these sort of indicators as the "reference measure" for inflation may be very misleading.

Finally the fifth column of Table 1 reports the results of the tests of the second part of condition iii), i.e., whether $q_1 = q_2 = ... = q_s = 0$ in equation (3). This test is carried out only for those indicators that meet the first part of condition iii). It is a conditional test in the sense that it is carried out after re-estimating equation (3) with the restriction $l = 0$. In the table we present the "p-values" for the corresponding F-test. It is readily seen that all the remaining indicators with the exception of MA13 do meet the second part of condition iii).

All in all we conclude that from the 8 indicators analysed in this section only three of them meet all the conditions laid down in section 2. These are the "37-month centred moving average", (MA37), the "First principal component", (FPC), and the "Standard deviation weighted CPI", (SDI). The "37-month centred moving average" is obviously not utilisable in practice, as it is not computable in real time. As to the FPC indicator it seems worth notice that it meets condition iii) with some difficulty as strong exogeneity is close to being rejected. In what concerns the SDI indicator it seems also worthwhile remembering that it is close to a biased indicator as it meets condition i) ($a = 0$) with a very low “P-value”.

One must then conclude that from the core inflation indicators computed on a regular basis by Banco de Portugal only the “First principal component” meets all the conditions, with condition iii) being close to be rejected. The SDI indicator, proposed in this paper, also meets all the conditions even though condition i) is borderline.

In what concerns the two trimmed mean indicators (TM10 and TM25) also computed by Banco de Portugal on a regular basis it must be stressed that despite being biased ($a \neq 0$) they meet all the remaining conditions. As explained above this biasedness is due to the fact that the symmetric trimmed means do not account for possible asymmetries of the underlying price changes distribution. It seems however that will be possible in the near future to build some sort of “asymmetric trimmed mean” to account for the main features of the price change distribution so that it meets the three conditions proposed in this paper. Some research on this issue is already taking place at Banco de Portugal in the line of Roger (1997).

4 CONCLUSIONS

Most Central banks compute various core inflation indicators on a regular basis. These indicators aim at identifying the "permanent" component of inflation by eliminating the so-called temporary price fluctuations. By looking at core inflation indicators monetary authorities are supposed to prevent themselves of being misguided by the effects of temporary shocks on the evolution of the Consumer Price Index.

Most of the literature on this subject focuses on the development of new core inflation indicators, but their evaluation is generally overlooked. As a rule, core inflation indicators are evaluated against a so-called "reference measure" of inflation. This approach may be misleading, as the properties of the "reference measure" are themselves unknown.

To our knowledge, there has not been in the literature a consistent attempt to introduce testable conditions to evaluate potential core inflation indicators. In this paper we propose a set of testable conditions that core inflation measures should meet and evaluate some commonly used indicators of trend inflation. As "centred moving averages" have been used in the literature as a benchmark against which the other core inflation indicators are checked we also evaluate three different "centred moving averages", in order to see whether these measures are by themselves appropriate core inflation indicators.

The tests carried out show that amongst the trend inflation indicators computed by Banco de Portugal on a regular basis, only the "First principal component" does meet all the conditions proposed in this paper. However these conditions are also met by the "standard deviation weighted CPI" indicator computed for the first time for Portuguese data.
The "underlying inflation" indicator, one of the most used core inflation indicators does not meet the conditions. This measure is not a leading indicator of inflation. Rather, it works the other way around. It is the inflation rate itself that appears as a leading indicator of this "core inflation measure".

The "10% and 25% symmetric trimmed means" appear to be biased estimators. However these two measures meet all the remaining conditions and so it appears advisable to develop in the near future some sort of "asymmetric trimmed means" in order to account for the asymmetry properties of the underlying distribution of price changes.

As to the "centred moving average" indicators it is seen that the "37-month centred moving average" meets the theoretical conditions, but that this is not so with the "25-month centred moving average" and with the "13-month centred moving average". This shows that using these indicators as "reference measures" against which the other indicators are evaluated may be very misleading as one may select an indicator that does not exhibit the properties one should expect in a core inflation measure.

Finally, it is worth mentioning that the results are conditional on the sample period selected. However, given the important structural changes suffered by the Portuguese CPI over time, we found it more adequate to work with a smaller but more homogeneous period.

5 REFERENCES

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TABLE 1
Evaluating core inflation measures

Variable	ADF test on $(p - p^*)$ [(a)]	$a = 0$ given $b = 1$	$g = 0$	$l = 0$	Strong exogeneity $q_1 = \ldots = q_s = 0$ given $l = 0$	Conclusion
Column	(1)	(2)	(3)	(4)	(5)	(6)
MA37	Yes ADF(1)=-3.82	Yes P=0.24	No P=0.00	Yes P=0.84	Yes F(4,45)=1.01 P=0.41	OK
MA25	Yes ADF(1)=-3.94	Yes P=0.96	No P=0.04	No P=0.00	—	Fails condition iii)
MA13	Yes ADF(1)=-3.95	Yes P=0.97	No P=0.00	Yes P=0.36	No F(3,60)=2.79 P=0.048	Fails condition iii)
TM10	Yes ADF(1)=-3.57	No P=0.01	No P=0.01	Yes[(b)] P=0.42	Yes F(4,63)=0.12 P=0.97	Fails condition i)
TM25	Yes ADF(1)=-3.30	No P=0.01	No P=0.01	Yes P=0.76	Yes F(2,69)=0.14 P=0.87	Fails condition i)
UNI	Yes ADF(1)=-3.65	Yes P=0.09	Yes P=0.44	No P=0.02	—	Fails conditions ii) and iii)
FPC	Yes ADF(1)=-2.82	Yes P=0.75	No P=0.00	Yes P=0.15	Yes F(1,72)=3.40 P=0.07	OK
SDI	Yes ADF(1)=-3.62	Yes P=0.08	No P=0.02	Yes P=0.58	Yes F(4,63)=0.44 P=0.78	OK

[(a)] The critical values for the ADF test with 75 observations (model with nonzero constant) are: -3.52 for a 1% test, -2.90 for a 5% test and –2.59 for a 10% test.

[(b)] We have $l \neq 0$ in the model with no constant term.

MA36 = 36 months centred Moving Average;

TM10 = 10 per cent Trimmed Mean

TM25 = 25 per cent Trimmed Mean

UNI = Underlying Inflation

FPC = First Principal Component

SDI = Weighted standard deviation CPI