1. INTRODUCTION

Recently Marques et al. (1999) have introduced new criteria to evaluate potential core inflation indicators and showed that the trimmed mean, that has been used by the Banco de Portugal as an instrument to analyse inflation, exhibits a systematic bias relative to the average level of inflation.

This paper discusses the use of trimmed means as core inflation indicators, when the price changes distribution is skewed, and shows that the trimmed mean bias results from the fact that the price changes distribution in Portugal is, on average, right skewed.

Using this finding the paper computes several trimmed means which meet all the conditions set out in Marques et al. (1999) and so, in particular, do not exhibit any systematic bias relative to the inflation rate.

Among these, the 10 per cent asymmetric trimmed mean centred on the 51.5th percentile, i.e., the one that trims 11.5 per cent of the left-hand tail and 8.5 per cent of the right-hand tail of the ordered price change distribution, is the least volatile. For this reason it is recommended as a core inflation indicator. It should however be noted that this indicator is not very smooth and so, it may be difficult to draw definite conclusions from its short run behaviour.

The remaining part of this paper is organised as follows: section 2 briefly reviews the theoretical arguments invoked to justify the use of trimmed means as core inflation indicators. Section 3 characterises the price changes distribution in the Portuguese case in terms of skewness and kurtosis. Section 4 discusses the calculation and the use of trimmed means in the context of asymmetric and fat-tailed distributions. Section 5 evaluates several asymmetric trimmed means, which do not exhibit any systematic bias relative to inflation, and finally, section 6 concludes.

2. THEORETICAL ARGUMENTS FOR USING THE TRIMMED MEAN AS A CORE INFLATION INDICATOR

This section briefly reviews the main arguments for using the trimmed mean as a measure of core inflation. Let $P_{it}$ stand for the price index of the $i$th basic item of the consumer price index (CPI) and $\alpha_i$, for its weight. By definition we have:

$$P_t = \sum_{i=1}^{N} \alpha_i P_{it}$$  \hspace{1cm} (1)

where $P_t$ represents the CPI and $N$ the number of basic items. It is easy to demonstrate that (1) can be written as:

$$\pi_t = \sum_{i=1}^{N} \omega_{it} \pi_{it}$$  \hspace{1cm} (2)

where

$$\pi_t = \left( \frac{P_t}{P_{t-12}} - 1 \right) \times 100$$
\[ \pi_{it} = \left( \frac{P_{i,t}}{P_{i,t-12}} - 1 \right) \times 100 \]  

(3)

\[ \omega_{it} = \alpha_i \times \frac{P_{i,t-12}}{P_{i,t-12}} \]

It should be noted that equation (2) presents the year-on-year inflation rate \( \pi_t \) as a weighted average of the year-on-year rates of change of all basic CPI items. However the weights \( \omega_{it} \), despite totalling 1, are time varying.

Economic literature generally sees inflation as the outcome of two effects. The first arises from changes in the overall price level and is connected with monetary factors. This is usually referred to as core inflation. The second effect stems from changes in the relative prices of one or more components included in CPI, as a result of phenomena, which are limited to restricted markets, triggered by short-term economic factors or measurement problems. On the basis of these effects, price changes of the \( i^{th} \) basic item of the CPI can be written as:

\[ \pi_{it} = \pi_t^* + v_{it} \]  

(4)

where \( \pi_t^* \) represents core inflation and \( v_{it} \) the deviations between price changes of item \( i \) and core inflation, in period \( t \). Multiplying (4) by, \( \omega_{it} \) summing and noting that \( \sum_{i=1}^{N} \omega_{it} = 1 \), we obtain the condition:

\[ \pi - \pi_t^* = \sum_{i=1}^{N} \omega_{it} v_{it} = u_t \]  

(5)

where \( u_t \) is, by assumption, a zero-mean stationary variable.

Monetary policy is supposed to be concerned with long run or core inflation \( \pi_t^* \) and not with current inflation. This fact explains the reason why the search for core inflation indicators has recently become an active research area in many central banks.

By definition, a core inflation indicator should disregard price changes resulting from short-lived phenomena, which give rise to erratic changes in recorded inflation. The calculation of trimmed means is one of the methods proposed in the literature for the construction of such indicators, which has attracted most attention, due to its simplicity and potential.

The trimmed mean can be computed from equation (2), by excluding a given percentage of the largest and smallest price changes. For example, the 10 per cent trimmed mean is obtained from (2) by excluding 10 per cent of the smallest price changes \( (\pi_{it}) \) and 10 per cent of the largest price changes, i.e. only 80 per cent (calculated taking into account the weights \( \omega_{it} \)) of the central price changes is taken into consideration.

The use of trimmed means as core inflation indicators is generally motivated both in economic and statistical terms. Economic arguments are generally based on theoretical models of price-setting behaviour, in the presence of adjustment costs(1).

The statistical arguments in favour of the trimmed means are built on the intuition that the kurtosis of the price changes distribution of the several CPI components is larger than the kurtosis of the normal distribution, i.e., it is leptokurtic. If the price changes distribution is leptokurtic it can be demonstrated that, in general, an estimator of the population mean that puts a greater weight on central price changes is more efficient than the sample mean. The reason is that in a leptokurtic distribution the probability of a large contribution to inflation of an extreme observation not being offset by an equally extreme observation on the other side of the distribution is larger than in the normal distribution(2).

In this case the most efficient estimator of the mean inflation (the mean of the price changes distribution) which is identified as core inflation is not likely to be the year-on-year CPI rate of change (the sample mean) but any estimator that attaches more weight to central observations. The trimmed mean and the median are the simplest of these estimators. Bryan et al. (1997) have shown that the more leptokurtic the distribution the less efficient the sample mean. They have also shown that, in general, the more leptokurtic the price changes distribution the larger the ideal trim (percentage of observations to be excluded or trimmed in the dis-

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(1) For a brief discussion of these models, see Marques and Mota (2000).

(2) See Bryan et al. (1997).
tribution tails). The idea is that the more leptokurtic the distribution the higher the proportion of unrepresentative price changes that must be eliminated in order to identify the trend of inflation.

These statistical arguments presented for instance in Cecchetti (1997) build on the idea that the underlying price changes distribution is symmetric. However, as we shall see in the following sections, these results cannot be immediately generalised when the price distribution is not only leptokurtic but also asymmetric, given that in this case, changes in the percentage of the trim alter the expected value of the estimator. Due to this fact, the trimmed means used in the following sections must be mainly seen as a statistical device which allows constructing core inflation indicators that potentially fulfil the evaluation criteria presented in section 5.

3. CHARACTERISTICS OF THE PRICE CHANGES DISTRIBUTIONS

This section analyses the main characteristics of the price changes distribution underlying the CPI, by resorting to the traditional kurtosis and skewness measures. A similar analysis was carried out in Coimbra and Neves (1997).

Representing the central moment of order \( k \) by \( m_{k1} \) we have

\[
m_{k1} = \sum_{i}^{N} w_i (\pi_{it} - \pi_t)^k
\]

and the skewness (\( S_t \)) and kurtosis (\( K_t \)) coefficients are given by

\[
S_t = \frac{m_{3t}}{(m_{2t})^{3/2}}
\]

\[
K_t = \frac{m_{4t}}{(m_{2t})^2} - 3
\]

Chart 1 presents the values obtained for the skewness and kurtosis coefficients in the period from July 1993 to May 2000. The skewness coefficient has varied over time, alternating positive and negative asymmetry periods. On average, the skewness coefficient was positive and equal to 0.83 (Sm line in Chart 1). This figure is higher than the one found for the US (0.2) by Bryan et al. (1997), but close to the figures found for New Zealand (0.7) by Kearns (1998), or for Ireland (0.8) by Meyler (1999). However we must bear in mind that these figures may be sensitive to the disaggregation level of the CPI as well as to the sample period.

Another skewness indicator is the so-called mean percentile (the percentile that corresponds to the sample mean of the distribution). In a symmetric and mesokurtic distribution (\( S_t = 0 \) in (7) and \( K_t = 0 \) (8)), the average mean percentile is expected to stand around the 50th percentile. This is not the case if the distribution is skewed. Chart 2 plots the empirical mean percentile for the price changes distribution (\( \beta_t \)) and the respective average value (\( \beta_{m} \)), obtained by averaging the monthly mean.
percentiles over the sample period. As it can be seen, the mean percentile happens virtually always above the 50th percentile, which is another strong piece of evidence of the chronic right skewness of the price changes distribution. For the sample period the average mean percentile (value of $\beta_m$) is 56. This figure is close to that obtained for other countries.

The second part of Chart 1 presents the kurtosis coefficient. It should be noted that $K_t$, in equation (8) measures the “excess” kurtosis relative to the normal distribution, so that any value above zero means that the distribution is leptokurtic. The value of $K_t$ along the sample period is always positive with an average value of 15.10, meaning that the distribution of the price changes is strongly leptokurtic. For this reason, in a typical month, a large proportion of the CPI items may experience price changes that are significantly different from the mean inflation rate.

Another important conclusion that can be drawn from the analysis of Chart 1 is that asymmetry and kurtosis are quite correlated. Periods of strong (positive or negative) asymmetry are in general linked with periods of higher kurtosis (or vice-versa). In other words, it seems that there is a strong link between the two indicators, which can be justified in two different ways. On the one hand, if the distribution is positively (negatively) skewed, the sample tends to be skewed to the right (left), meaning that the right (left) tail is the longest one. However, the kurtosis evaluates the relative importance of the distribution tails and therefore it will tend to be higher, the higher (in absolute value) the asymmetry. However, the relation can also work the other way around. According to Bryan et al. (1997), when the distribution is fat-tailed, there is a higher probability of obtaining a draw from one of the tails of the distribution, which is not balanced by an equally extreme observation from the other tail of the distribution. That is, the higher the kurtosis, the higher the probability of obtaining a skewed sample, even if the underlying distribution is symmetric. Therefore some proportion of the sample skewness may simply be generated by the kurtosis of the distribution.

This result has wide implications at the practical level, since it means that it is not possible to separate or correct separately the skewness and kurtosis of a given sequence of samples.

4. THE USE OF THE TRIMMED MEAN WHEN THE DISTRIBUTION IS SKEWED AND LEPTOKURTIC

As it has been stated in section 2, the use of the trimmed mean as a core inflation indicator stems from the fact that it is a more efficient estimator of the population mean than the sample mean, when the distribution is symmetric but leptokurtic.

The starting hypothesis is that, in each month, the price change of one of the items in the CPI basket, is a particular draw of a distribution whose unknown population mean is the core inflation prevailing in that month. However, given that the distribution is leptokurtic, recorded inflation (the sample mean) is an unbiased but relatively inefficient estimator of the core inflation (population mean), and this justifies the use of the trimmed mean as an estimator of the population mean.

In addition to the trimmed mean, the use of a (weighted) median has been suggested in the literature, as an indicator of core inflation (Bryan and Cecchetti (1994) and Cecchetti (1997)). When the distribution is symmetric, using the median (or even the mode) is probably a good thing to do. This is because recorded inflation — the variable of interest — corresponds to the sample mean of the price changes distribution. However, when the distribution is asymmetric, the mean differs from
the median or the mode\(^3\) and, therefore, in order to obtain an indicator that verifies condition (5) of section (2), i.e. to be an unbiased estimator of core inflation, we have to use an unbiased estimator of the population mean of the price changes distribution.

This conclusion suggests that the use of trimmed means may be warranted, even when the price changes distribution is asymmetric. However, it seems obvious that the trimmed mean must be calculated so as to be an unbiased estimator of the population mean. In fact, this condition helps to answer the question of whether (for instance) in a positive asymmetric distribution one should trim more from the right-hand tail or the left-hand tail of the distribution. The answer to this question is conditional on the relative weight attached to the bias and to the variance of the estimator. In fact, in a positive asymmetric distribution the draws with large price changes tend to emerge from the right-hand tail of the distribution and, hence, the minimisation of the variance of the resulting estimator would lead to a higher trim from the right-hand tail of the distribution. However it can easily be anticipated what happens to the trimmed mean if one trims more from the right-hand tail. When the distribution is right skewed, the largest, let us say, 10 per cent price changes have a greater contribution to the inflation rate (sample mean) than the 10 per cent smallest price changes. This means that if we trim more on the right-hand tail, the resulting trimmed mean will systematically underestimate the mean of the distribution. In other words, on average, the trimmed mean will be lower than recorded inflation and, hence, condition (5) of section (2) will not be verified, i.e. we are bound to have \(E[\mu_t] \neq 0\). Thus, in the case of a positive asymmetric distribution, if we want to obtain an estimator that does not systematically diverge from the recorded inflation rate, we must trim less from the right-hand tail of the distribution.

Chart 3 shows the 10 per cent symmetric trimmed mean, which has been calculated on a regular basis, by the Banco de Portugal for some years now. For the sake of harmonisation we shall call it TM \((50,10)\) (short form of 10 per cent trimmed mean, centred on the 50th percentile). It is obtained by trimming 10 per cent of the price changes on each tail of the distribution. As it can be seen, the series TM \((50,10)\) presents a lower average level than inflation along the sample period, which is reflected in the fact that the trimmed mean is most of the time below the inflation rate. This characteristic of the trimmed mean makes it obviously less interesting as a trend inflation indicator, since the series is unable to establish the correct level of core inflation itself. In other words, the variable TM \((50,10)\) does not meet condition (5) of section 2, as showed in Marques \textit{et al}. (1999). This clearly reduces the usefulness of TM \((50,10)\) as a core inflation indicator. However, the explanation for this result is now quite clear. The symmetric 10 per cent trimmed mean systematically

\(^3\) For instance, in a positive asymmetric distribution we have in general the inequality: mode < median < mean.
underestimates the inflation rate, because it trims too much from the right-hand tail of the distribution (or, equivalently because it trims too less from the left-hand tail).

In practical terms, the question of how to find an asymmetric trimmed mean, which does not exhibit a systematic bias relative to the recorded inflation, arises. Under the simple hypothesis (which is realistic in the Portuguese case) that the degree of asymmetry and kurtosis are constant over time, there is a relatively easy way of finding a trimmed mean that does not exhibit a systematic bias relative to the inflation rate. This can be translated into the following rule:

i) For a given trimming level, compute the trimmed mean centred on different percentiles of the distribution, starting at the 50th percentile and taking successively higher values (in the case of a positive asymmetric distribution);

ii) Stop whenever the resulting trimmed mean satisfies the condition \( \sum_{i} (\pi_i - \pi_i^*) = 0 \),

where \( \pi_i^* \) represents the trimmed mean.

Condition i) of this rule simply says that if the distribution is right skewed it is of no use to calculate trimmed means centred on percentiles below the 50th percentile, because it will never be possible to obtain an unbiased trimmed mean. Condition ii) in turn sets the upper limit of the research range relevant for a given level of trim, since any trimmed mean centred on a higher percentile, will exhibit a higher average level and so cannot be an unbiased estimator of core inflation.

For the Portuguese case, by applying this rule to the 5 per cent trimmed mean, we verify condition ii) for the 51st percentile. It should be noted that in this case the trimmed mean is obtained by trimming 4 per cent from the right-hand tail of the distribution and 6 per cent from the left-hand tail.

One might think that the solution obtained for the 5 per cent trimmed mean (51st percentile) would also be the optimal solution for the 10, 15 or 25 per cent trimmed mean, but this is not true. Indeed, in the asymmetric distributions, if we change the percentage of trimming the average value of the trimmed mean also changes. Chart 4 shows the 10 and 25 per cent trimmed means centred on the 52nd percentile. As it can be seen, by changing the degree of trimming we basically change the average level of the trimmed mean, which shifts downwards, when the percentage of trimming increases.

The explanation for this phenomenon is very simple. When we increase the percentage of trimming, we change the proportion trimmed from each side of the distribution. For instance, when we shift from a 10 per cent trimmed mean to a 25 per cent trimmed mean we have to trim more 15 per cent from each tail of the distribution. However, given the right skewness of the distribution, the 15 per cent excluded from the right-hand tail have a higher contribution to the resulting trimmed mean than the additional 15 per cent trimmed from the left-hand tail. The result is a trimmed mean with a lower average level. It should however be noted that this is not a parallel shift. As a general rule, the higher the degree of asymmetry of the distribution the larger the difference between the two series.

Let us now see how we can define the set of percentiles, in which it is relevant to carry out the search procedure described above. As we have seen, Chart 2 plots the mean percentile (\( \beta \)) as well as the average mean percentile (\( \beta_m \)). By definition, current inflation is the inflation rate corresponding to the mean percentile. Thus, the inflation rate corresponding to the average mean percentile (\( \beta_m \))
satisfies by construction equation (5) of section (2), i.e., it does not exhibit any systematic bias. Note that this series is the 50 per cent trimmed mean centred on \((\beta_m)\), and it appears as a natural candidate for a core inflation measure. In the Portuguese case we have \((\beta_m)\) equal to 56 and so, we know that the 56th percentile is the highest one for which there is an asymmetric trimmed mean with at least one interesting property. And we also know that it must be a 50 per cent trimmed mean. On the other hand, the percentile corresponding to the trimmed mean with the smallest percentage of trimming that we are willing to consider (5 per cent in our case) also gives us the lowest searching bound for \(\beta\). Let us exemplify. In our case the 5 per cent trimmed mean (the smallest percentage of trim for which it was decided to calculate the trimmed mean) occurred in the 51st percentile. This means that all other asymmetric trimmed means (for levels of trimming higher than 5 and lower than 50 per cent) must be searched for within the open interval (51,56).

In the following section, in addition to the 50 per cent trimmed mean centred on the 56th percentile, we shall also analyse other trimmed means that do not exhibit any systematic bias relative to the inflation rate: the 5, 10, 15, 20 and 25 per cent trimmed means centred on the 51st, 51.5th, 52.5th, 53rd and 54th percentile, respectively. It should be noted that the trimmed means presented in the following section have all been calculated under the assumption that the degree of asymmetry can be considered constant over the period under review(4).

5. THE ASYMMETRIC TRIMMED MEAN FOR THE PORTUGUESE DATA

This section analyses the different unbiased asymmetric trimmed means, computed in the previous section. We aim at establishing whether these variables are core inflation indicators with nice properties, assuming that inflation is measured by the year-on-year rate of change of the CPI.

The sample covers the period from July 1993 to May 2000. This was the period chosen in order not to include the effect of significant changes in indirect taxation occurred in the first half of 1992 and which increased significantly the year-on-year inflation rate during one year.

We analyse the following 7 trimmed means: i) the 10 per cent symmetric trimmed mean, which has been calculated by the Banco de Portugal on a regular basis and is represented by TM (50,10) and ii) the asymmetric trimmed means TM (51,05), TM (51.5,10), TM (52.5,15), TM (53,20), TM (54,25) and TM (56,50). It should be noted that the latter is just the sample inflation rate of the 56th percentile(5). These trimmed means have been calculated according to the rule suggested in the previous section and, therefore, they verify by construction the condition \( \frac{1}{T} \sum_{t=1}^{T} (\pi_t - \pi_t^*) = 0 \) in statistical terms.

The evaluation criteria of core inflation measures introduced in Marques et al. (2000) are also comprehensively explained in Marques et al. (1999). Therefore they are presented here without any further discussion. It should be recalled that the three criteria are the following:

i) The difference between recorded inflation and the core inflation indicator shall be a zero mean stationary variable;

ii) The core inflation indicator shall be an attractor of the inflation rate;

iii) Recorded inflation shall not be an attractor of the core inflation indicator.

The tests of these conditions can be carried out in several different manners. The verification of condition i) can be made by testing the existence of cointegration in the regression \( \pi_t = \alpha + \beta \pi_t^* + u_t \), where \( \beta = 1 \) and \( \alpha = 0 \). This test can be conducted in two stages. At the first stage, unit root tests are used in series \( z_t = (\pi_t - \pi_t^*) \), with the purpose of establishing that \( z_t \) is a stationary variable. In Table 1 this test corresponds to column 1. At the sec-

(4) For the discussion of this issue, see Marques and Mota (2000) who approach the way of dealing with time varying asymmetry.

(5) In practice this variable was calculated as the arithmetic average of the price changes of the following two central items: the one that immediately precedes the 56th percentile and the one that comes immediately after it.
ond stage, the hypothesis $\alpha = 0$ is tested conditioned on the fact that $z_t$ is a stationary variable. The result of this test is found in column 2(6).

To test the second and third conditions we need to specify dynamic models for $\pi_t$ and $\pi_t^*$. For a description of further technical details, see Marques et al. (2000).

Several conclusions can be drawn from Table 1. First, the result presented in Marques et al. (1999, 2000) is confirmed, i.e. the 10 per cent symmetric trimmed mean does not verify property i), wherefore it is not an unbiased estimator for the trend of inflation. Indeed, the 10 per cent symmetric trimmed mean systematically underestimates the trend of inflation ($\alpha = 0$ in column 2). The reasons for this behaviour have been presented in the previous section and stem from the fact that the distribution of price changes is on average right-skewed.

On the other hand, it can be verified that the 50 per cent trimmed mean centred on the 56th percentile, TM (56,50), does not meet condition iii), and so it depends on lagged inflation. The analysis of Chart 5 and Table 2 enables this finding to be explained: TM (56,50) is too volatile to be used as a core inflation indicator. It is even more volatile than inflation itself. This result is a clear sign that the degree of trim implicit in the calculation of this indicator is too high, leading to the exclusion of information, which is fundamental for the definition of a core inflation indicator.

Finally, it can be verified that the remaining trimmed means meet all the required properties and so they may be used as core inflation indicators. In particular, note that the result of the previous section is confirmed, i.e. the higher the trim the higher the percentile on which the asymmetric mean must be centred in order to get an unbiased estimator for the trend of inflation. For instance, for the 10 per cent trimmed mean the percentile that makes it possible to obtain an unbiased indicator is the 51.5th, whereas for the 15, 20 and 25 per

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**Table 1**

**EVALUATION OF TRIMMED MEANS AS CORE INFLATION INDICATORS**

<table>
<thead>
<tr>
<th>First condition</th>
<th>Second condition</th>
<th>Third condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta = 1$</td>
<td>$\alpha = 0$</td>
<td></td>
</tr>
<tr>
<td>TM(50,10)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(51,05)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(51,5,10)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(52,5,15)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(53,20)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(54,25)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>TM(56,50)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

(6) It should be noted that the unbiasedness property used in the previous section to identify the asymmetric trimmed means guarantees the verification of condition $\alpha = 0$. It does not however guarantee the stationarity of $z_t$.

**Table 2**

**RELATIVE VARIANCE OF INDICATORS**

<table>
<thead>
<tr>
<th>TM(50,10)</th>
<th>TM(51,05)</th>
<th>TM(51,5,10)</th>
<th>TM(52,5,15)</th>
<th>TM(53,20)</th>
<th>TM(54,25)</th>
<th>TM(56,50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.503</td>
<td>0.522</td>
<td>0.497</td>
<td>0.51</td>
<td>0.54</td>
<td>0.541</td>
<td>2.238</td>
</tr>
</tbody>
</table>
the corresponding percentiles are the 52.5th, the 53rd and the 54th respectively.

It should also be noted that the percentile that guarantees that the resulting trimmed mean is an unbiased estimator for core inflation is not truly unique. For instance, it is possible to compute a large number of 10 per cent trimmed means centred on a small neighbourhood of the 51.5th percentile, all of them being unbiased estimators of the trend of inflation. Of course all these 10 per cent trimmed means are statistically equivalent.

As might be expected, all these 5 indicators exhibit a very similar time profile, as illustrated in Chart 6 by TM (51.5,10) and TM (54,25). However, as all five indicators verify the three conditions required for a core inflation indicator, we need an additional criterion to be able to choose the best. A good criterion seems to be the degree of smoothness. Indeed, for two otherwise identical indicators we surely prefer the smoothest one, as it will exhibit a smaller short run volatility, and therefore will enable a clearer interpretation of the most recent inflation developments.

Table 2 presents the quotient between the variance of the first difference of each indicator and the variance of the first difference of recorded inflation\(^7\). This statistic is a good indicator of the relative smoothness of each indicator.

For all the five indicators that meet the three properties described above, it can be verified that their variance is lower than the variance of inflation, a fact that derives from conditions ii) and iii). Among these, the one with the smallest relative variance and, hence, the smoothest one, is the 10 per cent trimmed mean centred on the 51.5th percentile (TM (51.5,10)). This is thus the best core inflation indicator, in the class of the trimmed mean core inflation indicators.

Chart 7 shows the performance of TM (51.5,10). The evolution of this variable accords with what should be expected from a core inflation indicator. The indicator is below inflation in periods in which inflation is particularly high (over a large part of the period from 1993 to 1995, throughout 1998 and in early 1999) and is above inflation when this is particularly low (in early 1996, throughout 1997, at the end of 1999 and in early 2000). Additionally it turns out that in general, when TM (51.5,10) has been higher than inflation for some time, there is an increase in inflation, the reversal being the case when TM (51.5,10) has been lower than inflation for some time.

This said, and notwithstanding the fact that the indicator TM (51.5,10) meets all the required con-

\(^7\) It is interesting to note that the five indicators that meet the three conditions are well defined by pure random walks, i.e., their first difference behaves as a white noise.
ditions for a core inflation indicator and is the smoothest among the other indicators, it still presents some limitations. First, TM (51.5,10) is not as smooth as we would like it to be, as illustrated in Chart 7. There are several small changes in the inflation rate that are passed on to this indicator, giving rise to some noise, that makes its interpretation quite difficult in the short run.

Second, this indicator suffers from the limitation that affects all the indicators based on trimmed means. It is not able to deal with simultaneous temporary shocks on prices of all the basic items as, for instance, in the case of a VAT rate increase. In this case, the indicator will increase, by a value equivalent to the one exhibited by the year-on-year rate of change of the CPI. Indeed, this is the reason why the sample period of this paper starts in July 1993, given that in the first half of 1992 there were big changes in VAT rates.

6. CONCLUSIONS

This paper addresses the issue of how to define and compute trimmed means if they are to be core inflation indicators with nice properties, when the price changes distribution is leptokurtic and asymmetric.

It is demonstrated that when the price changes distribution is asymmetric, the conventional (symmetric) trimmed means are biased estimators of core inflation and also that simply changing the total amount of trimming in a symmetric way changes the expected value of the estimator. For this reason, we suggest practical rules for the process of finding an unbiased asymmetric trimmed mean.

Following the practical rules suggested in this paper, several unbiased trimmed means are calculated and subsequently tested according to the conditions stipulated in Marques et al. (2000). It can be verified that, with the exception of one case, all symmetric trimmed means meet these conditions. The exception is the symmetric trimmed mean that trims 100 per cent from the distribution around the average mean percentile. This fact is probably due to an excessive trim that makes the indicator too volatile.

Among the unbiased asymmetric trimmed means that meet the three conditions of Marques et al. (2000), it is verified that the 10 per cent trimmed mean centred on the 51.5th percentile is the smoothest one, and therefore its utilisation in the future, as a core inflation indicator is suggested. It should be noted that this trimmed mean is obtained by trimming 11.5 per cent from the left-hand tail and 8.5 per cent from the right-hand tail of the price changes distribution.

Despite all its properties, this core inflation indicator must be used with caution, not only because it exhibits some volatility, which may render its interpretation somewhat difficult in the short run, but also because trimmed means are not able of handling general price increases brought about, for instance, by changes in VAT rates, which have permanent effects on the price level, but only temporary effects on the inflation rate.

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