A Measure of Core Inflation in the UK

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Abstract

We develop a measure of core inflation in the UK over the period January1987 - December 1998, following the work of Bryan and Cecchetti (1996),Bryan, Cecchetti and Wiggins (1997) and Roger (1997). Disaggregation is into85 price categories. Given the high kurtosis of the price change distribution over this period, a trimmed mean is a more robust estimator of core inflation than other published measures such as the RPIX widely used in the UK, in particular by the Bank of England when targeting inflation. We discuss the relative advantages of our measure of core inflation, with emphasis on the determination of an optimal trimming point and on the analysis of the products whose price changes are excluded from our measure in each time period. The resulting measure appears well behaved, but differs noticeably from a number of published measures.

1. Introduction

The aim of this paper is to develop a measure of core inflation in the UK over the period January 1987 to December 1998, following the work of Bryan and Cecchetti (1996), Bryan, Cecchetti and Wiggins (1997) and Roger (1997). Disaggregation is into 85 price categories, as published by the ONS from January 1987. Given the high kurtosis of the price change distribution over this period (see Table 1 below), a trimmed mean is a more robust estimator of core, or underlying, inflation than other published measures such as the RPIX widely used in the UK, in particular by the Bank of England when targeting inflation.

Statistical offices and central banks in many countries construct and publish measures of core, or underlying, inflation that aim at representing more accurately the general trend of prices than the official, or headline, measure of inflation. For example, in the UK, the ONS publishes the Retail Price Index ('RPI all items' here-after denoted as RPI) and ten other price indices that exclude, i.e., give zero weight to, some of the RPI components. In some issues of the Bank of England's *Inflation Report*, a 15% trimmed mean inflation[1] is also reported. The usage of alternative measures of inflation based on these indices has increased in recent years as in many countries the main objective of monetary policy has become the control of inflation with the adoption of specific targets for inflation by the central bank. This is the case, for example, in Australia, Canada, Finland, New Zealand, Spain, Sweden and the UK (see Haldane 1995, 1998, for example).

"Measuring inflation is a surprisingly difficult task" (Cecchetti (1997), p.143), in particular when the objective is to produce a measure of price changes appropriate for monetary policy formulation. Defining and measuring core inflation is even more difficult. A good survey of the issues surrounding the concept of core inflation is Roger (1998). In this paper we are concerned with what Roger describes as 'generalised inflation measures based on stochastic methods'. In this case, the core or generalised inflation component of inflation, which is associated with expected inflation and monetary expansion, is blurred by a non-core, relative price shocks or noise component associated with supply shocks which only have a temporary impact on inflation.

The distinction between the two components is based on the analysis of price changes at a disaggregated level, removing from the inflation measure those price changes that reflect more transient price shocks. There are alternative ways of doing this[2], but we are concerned with measures based on stochastic methods, where inflation categories are zero weighted in a systematic way because their price changes are outliers with respect to the general price change in the time period. One thus re-weights the price changes of the basket of goods and services included in the measure of inflation on a period by period basis. Given the non-normality of price changes and in particular the high kurtosis, the use of robust or limited influence estimators such as trimmed means (see, for example, Stuart and Ord (1994)) appears desirable.

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[1] That is, excluding the largest and smallest 15% of price changes, adding up to 30%. The selection is based on % annual increases in 81 components of (seasonally adjusted) RPIX; see, for example, *Inflation Report* of May 1997, p.6, footnote 1.

[2] Alternative generalised inflation measures can have either a 'specific adjustment', when components reflecting one-off price shocks, like those associated with changes in indirect taxes and government subsidies, are zero weighted, as in inflation measures based on the UK Tax and Price Index (TPI); or have a 'systematic re-weighting of price series', when price series that are believed to be primarily determined by supply conditions are zero weighted, like food and energy components in the Canadian and the US CPI excluding food and energy, or mortgage interest payments in the UK (RPIX).

The intuition behind this definition of core inflation and the use of trimmed means is based on Ball and Mankiw's (1995) menu cost model as discussed in, for example, Bryan and Cecchetti (1996) and (critically) in Bakhshi and Yates (1999).

The paper is organised as follows: in section 2 we present the data and moments of the distribution of the price distribution; in section 3 we calculate trimmed means inflation and the optimal trimming point; in section 4 we conclude the paper.

2. Data description and moments of its distribution

We use monthly data on the RPI for the UK divided into $m = 85$ categories as published by the ONS since 1987, the date of the last major revision and re-basing of the RPI (for a list of the categories and some descriptive statistics see Appendix I). The ONS published data on 82 categories between January 1987 and December 1992, then in January 1993 included a new category 'Foreign holidays', followed by 'UK holidays' in January 1994, and 'Housing depreciation' in January 1995, thus completing the 85 categories[3]. The RPI index is a Laspeyres annual chain index with weights revised each January (see Andrade (1998) and Baxter (1998) for detailed descriptions of the RPI methodology). The ONS publishes other indices which give zero weight to some categories of the RPI. These indices include RPIX (RPI minus mortgage interest payments (here-after MIPS)), RPIY (RPI minus MIPS and indirect taxes), RPI excluding either food, or seasonal food, or housing, or MIPS and depreciation, or MIPS and council tax. Also available are TPI (defined above), RPI all goods and RPI all services.

Definition of Inflation and moments

We define the price changes or inflation rate in component *i*, *i=1,...,m*, at time (month) *t*, over horizon *k*, dp_{it}^{k}, as

$$dp_{it}^{k} = \ln\left(\frac{p_{it}}{p_{it-k}}\right) \times 100 \approx \frac{p_{it} - p_{it-k}}{p_{it-k}} \times 100$$

where p_{it} is the price index for component *i* at time *t*. We then define aggregate inflation over *k*, dp_{t}^{k}, as

$$dp_{t}^{k} = \sum_{i=1}^{m} w_{it} \ln\left(\frac{p_{it}}{p_{it-k}}\right) \times 100 \qquad (1)$$

where w_{it} is the weight of category *i* at time *t* (and fixed within each year). The general level of inflation, I_{t}^{k}, is defined as

$$I_{t}^{k} = \ln\left(\frac{p_{t}}{p_{t-k}}\right) \times 100 \qquad (2)$$

where $p_{t} = \sum w_{it} p_{it}$ is the published RPI all items. The difference between these two definitions of inflation, aggregate inflation calculated from the components of the RPI (1) and the general level of inflation calculated from the RPI all items (2), averages –0.026 over the period of analysis, with a standard deviation of 0.191. Its minimum is –0.592 in November 1991 and its maximum is 0.607 in January 1992. Since April 1992, the difference between the two definitions became much smaller, between –0.154 in December 1997 and 0.174 in March 1993. Here-after 'inflation' will mean aggregate inflation as defined in (1).

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[3] See, for example, *Business Monitor MM23*, July 1993, July 1994 and December 1994, respectively, for details

The higher order weighted cross sectional moments of price changes are given by

$$m_r^k(t) = \sum_i w_i \left(dp_{it}^k - dp_t^k \right)^r$$

and skewness and kurtosis are defined respectively as

$$skew_t^k = \frac{m_3^k(t)}{\left(m_2^k(t) \right)^{3/2}}$$

$$kurt_t^k = \frac{m_4^k(t)}{\left(m_2^k(t) \right)^2}$$

Moments of the distribution of price changes

In Table 1 we report the average moments of the distribution of the *k*–month price changes of 85 components RPI over the period January 1987 - December 1998 (144 observations) for values of *k* between 1 (monthly inflation) and 24 months (two yearly inflation).

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on the motivation and methodology used in the calculation of the price indices of the new categories (or *BPP*, Cmnd.9848 (1986), Cm.1156 (1990), Cm.2142 (1993) and Cm.2717 (1994), all quoted in Andrade (1998)).

Table 1 : Average moments of the distribution of the *k*–month price changes of 85 components RPI (annualised rates)

k	dp^k	$st\ dev^k$	$skew^k$	$kurt^k$	k	dp^k	$st\ dev^k$	$skew^k$	$kurt^k$
1	4.012	20.85	0.162	37.81	13	4.263	6.50	0.143	13.16
2	4.030	15.77	0.255	23.74	14	4.283	6.47	0.095	12.44
3	4.059	13.03	0.033	19.27	15	4.302	6.40	0.086	11.52
4	4.070	11.13	0.019	18.28	16	4.314	6.32	0.090	11.36
5	4.083	9.88	–0.025	19.13	17	4.324	6.24	0.072	11.30
6	4.100	8.96	0.023	18.83	18	4.332	6.16	0.046	10.99
7	4.130	8.36	0.135	16.46	19	4.344	6.09	0.034	10.07
8	4.160	7.89	0.134	14.85	20	4.350	6.02	–0.002	9.56
9	4.182	7.48	0.124	14.34	21	4.354	5.94	–0.033	9.20
10	4.203	7.10	0.146	13.51	22	4.354	5.87	–0.051	8.90
11	4.222	6.77	0.134	13.60	23	4.353	5.80	–0.079	8.65
12	4.240	6.51	0.135	12.64	24	4.352	5.74	–0.080	7.88

The sample moments in Table 1 indicate that the distribution of price changes is non-normal, skewed and highly leptokurtic. This result was also found by Bryan and Cecchetti (1996, 1999) and Roger (1997) in US, Japan, and New Zealand inflation data respectively, but with a difference. In their case they found positive skewness whereas we find a varying (and lower) skewness. An important factor here maybe that their datasets cover longer periods of time and include the 1970s whereas our dataset does not. The kurtosis of these distributions is very high and decreases considerably with *k*, varying from 37.81 for monthly inflation to 12.63 for annual inflation and to 7.88 for two yearly inflation. Some of the variations in skewness and kurtosis are attributable to taking non seasonal differences in price series with seasonal components.

We will use *k=12*, annual inflation rate, as in many other studies and official publications, thus avoiding the issue of (fixed) seasonal adjustment and decreasing transitory noise (as discussed in Cecchetti (1997))[4]. Considering *k=12*, the distribution of annual inflation changes is negatively skewed in the periods April 1991 to March 1994, December 1995 to June 1997, and from October 1998 (see Figure 1), with an absolute minimum of −6.399 in December 1996. In these periods, the number of large price decreases was greater than the number of large price increases. The absolute maximum was 4.376 in March 1995. Kurtosis was particularly high over two periods (August 1994 to June 1995 and October 1996 to June 1997) and again from November 1998 (see Figure 2) with an absolute maximum of 79.79 in January 1997. Some idea of the appropriate scale for these measures is given by their properties in samples from a normal distribution, where $skew^k$ would have mean 0 and variance 6, while $kurt^k$ would have mean 3 and variance 24.

Given these characteristics of the sample distribution, a more robust estimator of the central tendency is the weighted sample median, or 50% percentile, (see Figure 3). The median of the annual inflation rate is (tends to be) lower than the inflation rate when there is positive skew and higher when there is negative skew in the sample distribution. This happens because when the distribution is positively skewed, there are more large price increases than price decreases and the size of the former is not taken into account in the calculations of the median. Whereas other investigators often find positive skewness in the price changes distribution and therefore a median that tends to be lower than the inflation rate, we find a mixed situation: the median is above the rate of inflation over the periods April 1991 to March 1994, December 1995 to June 1997, and from October 1998, when the sample distribution is negatively skewed, and

[4] See, for example, Shiratsuka (1997) who calculates Japanese trimmed inflation using both annual and monthly (seasonally adjusted) inflation data, and discusses their relative advantages. Bryan and Cecchetti prefer to use

below it at all other times. One can consider the median as a particular case of a trimmed mean.

3. Trimmed mean inflation

We consider a class of robust location measures known as α–trimmed means defined as (indices *t* and *k* (=12) omitted)

$$\bar{x} = \frac{1}{1-2\left(\alpha/100\right)} \sum_{i \in I_\alpha} w_{(i)} dp_{(i)}$$

where the sample of price changes was first sorted into order and relabelled so that $dp_{(1)} < dp_{(2)} < \ldots < dp_{(m)}$ together with their associated weights $w_{(i)}$. The set of observations to be averaged, I_α, is the set of price changes $dp_{(i)}$ corresponding to the cumulative weight $W_j = \sum_{i=1}^{j} w_{(i)} dp_{(i)}$, centred between $\alpha/100$ and $1-\left(\alpha/100\right)$ with renormalised weights. Two important particular cases are given by $\alpha = 0\%, \bar{x}_0 \equiv dp$, the weighted sample mean, and $\alpha = 50\%, \bar{x}_{50}$, the weighted sample median. Note that the trimming is done in cross-section for each month of the sample and therefore, potentially, the categories trimmed in a given month will be different from those trimmed in any other month of the sample.

Following Bryan and Cecchetti (1996,1999) and Bryan *et al.* (1997), we use bootstrap methods to determine the trimming point. The optimal trimming point α^* is the trim that minimises either of the two measures of efficiency used, MAD (mean absolute deviation) and RMSE (root mean square error). As a benchmark to judge efficiency, we follow Cecchetti

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monthly US and Japanese inflation data, as do Bakhshi and Yates (1999) who study UK inflation data based on RPIX.

(1997) and the references above and use the 36 month centred moving average inflation[5] as the point about which to measure MAD and RMSE. Bryan and Cecchetti (1999) and Mio and Higo (1999), for example, have concluded that the procedure is quite robust to the choice of number of months in the moving average which we also find. We then calculate the relative price changes of each category with respect to the 36 month moving average of inflation (or the deviations of each category inflation from the 36 month moving average of inflation), meaning that we have a matrix of 132 observations on 85 categories for relative price changes together with their weights, which are updated every year[6]. In Appendix II we describe in detail the bootstrap procedure used. In Figure 4 we plot the two measures of efficiency used, MAD and RMSE, against α to determine the optimal trim and in Table 2, columns 2 and 3, we report their values for selected values of α between 5% and 30% together with inflation and median. The optimal trimming point is $\alpha^* = 21\%$ chosen by both measures (minimises both MAD and RMSE).

[5] Implicit in this choice of benchmark is the assumption by Cecchetti (1997) that the 36 month centred moving average of inflation is a good approximation to the movements in the long-term trend in inflation, but as a low frequency trend it may not have the timeliness required by policy makers.

[6] Using US data, Bryan *et al.* (1997) use the 1985 weights throughout their period of analysis 1967 to 1997, and using Japanese data, Bryan and Cecchetti (1999) use the average of the weights over the whole period 1970 to 1997.

Table 2 : Optimal trimming point for inflation and inflation excluding MIPS

	Inflation		Inflation	exc. MIPS
α	MAD	RMSE	MAD	RMSE
5	0.839	1.093	0.413	0.514
10	0.509	0.633	0.382	0.477
11	0.491	0.612	0.380	0.473
15	0.476	0.590	0.384	0.480
20	0.465	0.578	0.393	0.489
21	0.455	0.568	0.393	0.493
25	0.461	0.574	0.406	0.506
30	0.470	0.585	0.420	0.522
dp	1.037	1.289	0.659	0.867
median	0.523	0.643	0.460	0.571

NB: Rows for intermediate values of α calculated, but not shown.

Trimming improves considerably the efficiency of the inflation estimators. Even trimming 5% off each tail reduces the MAD from 1.037 to 0.839 and the RMSE from 1.289 to 1.093, gains of 19.1% and 15.2%, respectively. At the optimal 21%, the gains in efficiency are respectively 56.1% and 55.9%. (Using the median (α = 50%) as the central measure improves the efficiency by 49.6% and 50.1%, respectively. Of course, 50% trimming about the median gives MAD = RMSE = 0).

Some caution is needed in interpreting the location of the minima. Bootstrapping is random re-sampling, and different experiments will produce different curves. One can estimate this variability by a double bootstrapping, calculating the MAD and RMSE for 1000 replications, then repeating the process 1000 times. The results are shown in Figure 5a and b, the bands being provided by the 5% and 95% percentiles of the distribution of MAD and RMSE, the centre being the median and mean, which are coincidental for practical purposes. To take the MAD, while the minimum is at α=22%, here the interval is 0.44080 to 0.47572, which overlaps with the interval at α=14%. Thus we cannot clearly distinguish α=22% and α=14%. One can attempt to reduce this variability by smoothing the MAD and RMSE curves. One way of doing this is to render adjacent observations correlated by re-using the same random numbers for different α values when re-sampling. The results are shown in Figures 6a and b. There is similar uncertainty as to the precise location of the optimal trimming point.

In Figure 7 we plot $\alpha-$trimmed inflation rates for α =10% and 15%, together with the optimal trim 21% and inflation. The categories that were trimmed for each α are given in Figure 8. The most trimmed categories were 'processed potatoes' (category No.24), MIPS (No.41) and 'audio-visual equipment' (No.76), which were trimmed 91.7%, 95.5% and 99.2% of the months respectively at the 21% optimal trim. The least trimmed components were 'restaurant meals' (No.31), 'take-aways and snacks' (No.33), 'DIY materials' (No.45), 'domestic services' (No.59), 'other clothing' (No.64), and 'UK holidays' (No.84), which were all trimmed less 5% of the months (minimum of 0.8% for Nos. 33 and 84) at the 21% optimal trim.

This optimal trimming point of 21% (meaning 21% trimmed off each tail to a total of 42% excluded from the index) is quite high, perhaps reflecting the very high kurtosis of the annual UK inflation series as discussed above. Using a different definition for UK inflation (annualised monthly inflation excluding MIPS), sample period (1974-1997), and methodology to calculate the optimal trimming point, Bakhshi and Yates (1999) estimate trimming points of 17% using MAD and 47% using RMSE. Bryan *et al.* (1997) using monthly annualised seasonally adjusted US inflation estimate an optimal trimming point of 7% and Bryan and Cecchetti (1999) using monthly annualised Japanese inflation 34% and 39%. On the other hand, Mio and Higo (1999) using annual Japanese inflation estimate 15%. One factor could be the kurtosis of the distribution of category inflation. Bryan *et al.* (1997) show that "the efficient trim increases with the kurtosis of the data generating process". Indeed, they report a kurtosis of 12.64 for the monthly annualised US inflation whereas Bryan and Cecchetti (1999) report a kurtosis of 31.25 for the monthly annualised Japanese inflation.

Unlike other studies, when we used the actual data to determine the optimal trim, i.e., calculate the minimum of MAD and RMSE of trimmed mean inflation for different values of α with respect to the 36 month centred moving average of actual inflation (what Bryan and Cecchetti (1999) call 'historical experiments'), we obtained a different and much smaller optimal trim of 8% using the same benchmark (36 month moving average) and criteria (MAD and RMSE).

We repeated the whole process for UK inflation excluding MIPS, i.e., inflation based on the RPIX index. As shown in Table 2, columns 4 and 5, the optimal trimming point decreases to 11%. At the optimal 11%, the gains in efficiency are respectively 42.3% and 45.4%. Using the median (α = 50%) improves the efficiency by 30.2% and 34.1%, respectively, where the gains are smaller than when we use all the inflation components, as above. This trim should be more comparable to the 15% trim used in some issues of the Bank of England's *Inflation Report* (see footnote 1), but based on seasonally adjusted inflation data. The most trimmed categories at the optimal 11% trim are still 'processed potatoes' (No.24), and 'audio-visual equipment' (No.76), now trimmed only 85.6% and 91.7% of the months, respectively. Twelve categories were never trimmed at the optimal 11% : 'sweets and chocolates' (No.23), 'restaurant meals' (No.31), 'take-aways and snacks' (No.33), 'DIY materials' (No.45), 'other household equipment' (No.54), 'pet care' (No.56), 'domestic services' (No.59), 'other clothing'

(No.64), 'chemist goods' (No.67), 'maintenance of motor vehicles' (No.70), 'other travel costs' (No.75), and 'UK holidays' (No.84). Using the historical method, the optimal trim is reduced to 4%. Exclusion of MIPS in the analysis excludes a volatile category which is usually trimmed. This also induces (larger) fluctuations in the moving average, and thus decreases MAD and RMSE. Given the flatness of much of these functions, it is not surprising that the optimal trimming point moves considerably. It is not clear why it should be decreased.

In the above we follow Bryan and Cecchetti (1996,1999) and Bryan *et al.* (1997) and trim symmetrically. However, we can allocate the total trim of 2α unequally to the two tails, choosing the allocation which minimises the MAD and RMSE. Searching for an optimal allocation from 0.5α, through 0.6α, ... up to 1.5α gives a minimum MAD of 0.458 at α=17% (with a 22.1% / 11.9% split) and a minimum RMSE of 0.566 at α=16% (with a 20.8% / 11.2% split). The slight increase arises because we are re-using random deviates to smooth the curves.

4. Conclusion

Using monthly data on the UK RPI we estimate a measure of core inflation based on a trimmed mean with optimal trimming point $\alpha^* = 21\%$. This means that every month we trim 2×21% = 42% of the published index. The resulting measure diverges quite considerably from the published inflation (see Figure 7) and, as discussed in text, is a more robust measure of UK core inflation than the published inflation or other aggregates published by ONS. If we base our calculations on the RPIX (RPI excluding MIPS) the optimal measure of core inflation excludes a smaller proportion of the index : 2×11%=22%. However, problems persist. The trimming point seems unduly sensitive to the exact method used, as is clear for example when we compare our results with those obtained by Bakhshi and Yates (1999) for the UK and with the results of investigators using data from other countries. It would appear that we are some way from a clear and undisputed measure of core inflation.

It can be argued that trimming biases the index if a volatile and much excluded category exhibits a significant trend: 'audio-visual equipment' (category No.76) is a candidate, with consistent negative inflation throughout the period of analysis. Re-weighting schemes have been used (see Lafleche (1997) and Wynne (1997,1999)), but these can also bias the index, and suffer from aggregation problems. We have yet to find an appealing solution to this problem.

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6. Appendices

6.1. Appendix I

In Table A1 we list the 85 categories of the UK RPI, together with their 1998 weights. In Table A2 we list the descriptive statistics of the annual inflation of each of the 85 categories (average mean and standard deviation) for the period January 1988 to December 1998.

Table A1: RPI Categories description and 1998 weights

No	Category	w_i98	No	Category	w_i98
	Food:	*130*	29	Processed fruit	1
1	Bread	5	30	Other foods	14
2	Cereals	4		*Catering:*	*48*
3	Biscuits and cakes	9	31	Restaurant meals	24
4	Beef	4	32	Canteen meals	7
5	Home killed lamb	1	33	Take-aways and snacks	17
6	Imported lamb	1		*Alcoholic drink:*	*71*
7	Pork	2		Beer	
8	Bacon	3	34	on licence sales	33
9	Poultry	6	35	off licence sales	10
10	Other meat	8		Wines and spirits	
11	Fresh fish	2	36	on licence sales	10
12	Processed fish	2	37	off licence sales	18
13	Butter	1		*Tobacco:*	*34*
14	Oil and fats	2	38	Cigarettes	32
15	Cheese	4	39	Tobacco	2
16	Eggs	1		*Housing:*	*197*
17	Milk fresh	7	40	Rent	47
18	Milk products	4	41	Mortgage Interest Payments	45
19	Tea	2	85	Depreciation	32
20	Coffee & other hot drinks	2	42	Community charge and rates /	
21	Soft drinks	10		council tax	30
22	Sugar and preserves	2	43	Water and other payments	12
23	Sweets and chocolates	12	44	Repairs & maintenance charge	10
24	Unprocessed potatoes	2	45	DIY materials	14
25	Processed potatoes	4	46	Dwelling insurance and	
26	Fresh vegetables	6		ground rent	7
27	Processed vegetables	3		*Fuel and light:*	*36*
28	Fresh fruit	6	47	Coal and solid fuels	1

No	Category	w_i98	No	Category	w_i98
48	Electricity	18		*Fares and other travel costs:*	*20*
49	Gas	16	73	Rail fares	4
50	Oil and other fuels	1	74	Bus and coach fares	5
	Household goods:	*72*	75	Other travel costs	11
51	Furniture	20		*Leisure goods:*	*46*
52	Furnishings	13	76	Audio-visual equipment	10
53	Electrical appliances	9	77	Tapes and discs	*6*
54	Other household equipment	7	78	Toys, photographic and	
55	Household consumables	15		sport goods	11
56	Pet care	8	79	Books and newspapers	12
	Household services:	*54*	80	Gardening products	7
57	Postage	2		*Leisure services:*	*61*
58	Telephones, telemessages, etc.	16	81	TV licences and rentals	10
59	Domestic services	9	82	Entertainment and other	
60	Fees and subscriptions	27		recreation	18
	Clothing and footwear:	*55*	83	Foreign holidays	25
61	Men's outwear	11	84	UK holidays	8
62	Women's outwear	18			
63	Children's outwear	6			
64	Other clothing	10		*Total*	*1000*
65	Footwear	10			
	Personal goods and services	*40*			
66	Personal articles	11			
67	Chemists goods	19			
68	Personal services	10			
	Motoring expenditure:	*136*			
69	Purchase of motor vehicles	53			
70	Maintenance of motor vehicles	24			
71	Petrol and oil	39			
72	Vehicles tax and insurance	20			

Notes:

'w_i*98*' are the 1998 weights for the 85 categories expressed out of 1000. The total weight for each of the 14 main categories is given in italics next to its title.

The ONS has published price indices for all these categories since 1987 (January 1987=100) except for categories 83 ('Foreign holidays') which started in January 1993 (January 1993=100), 84 ('UK holidays') in January 1994 (January 1994=100) and 85 ('Depreciation') in January 1995 (January 1995=100).

Adjustments were made to five categories in *Food* and two in *Alcoholic drink*:

– ONS subdivides 'Lamb', 'Fish', 'Potatoes', 'Vegetables' and 'Fruit' into two different categories (typically 'fresh' and 'processed') with two different weights, but publishes price indices only for the aggregate and for the 'fresh' category. In each case we calculated the price index for each 'processed' category out of the aggregate category, and used only the 'fresh' and 'processed' categories in our dataset;

– In *Alcoholic drink*, the ONS publishes price indices for total 'Beer' and 'Wine and spirits' sales, together with price indices for those sales disaggregated in 'on' and 'off' licence sales. We used only the latter and deleted the total from our dataset.

Table 2A : Average mean and stand deviation of annual category inflation rate

No	dp_i	std_i	No	dp_i	std_i	No	dp_i	std_i	No	dp_i	std_i
1	2.64	3.50	23	3.75	1.62	44	5.77	2.49	66	1.80	1.85
2	3.00	3.16	24	3.10	25.91	45	3.84	3.15	67	5.54	2.03
3	3.83	2.51	25	3.57	7.69	46	5.22	9.15	68	7.58	2.68
4	2.27	4.62	26	0.28	10.09	47	2.49	2.69	69	2.60	2.80
5	3.22	8.70	27	3.15	4.38	48	2.63	5.22	70	5.79	2.70
6	3.19	8.14	28	2.33	8.61	49	1.73	4.36	71	5.76	4.71
7	2.54	9.04	29	3.56	4.29	50	0.28	15.02	72	6.40	5.97
8	3.68	6.49	30	3.57	2.76	51	3.19	1.87	73	6.03	2.60
9	0.73	4.67	31	5.41	1.90	52	3.19	2.20	74	5.50	3.11
10	2.57	3.73	32	6.47	1.88	53	–0.33	2.64	75	3.69	2.27
11	2.76	7.10	33	5.37	2.19	54	3.15	2.33	76	–4.99	3.51
12	2.46	4.06	34	6.05	2.87	55	4.03	3.19	77	1.62	2.40
13	4.79	5.40	35	3.88	3.00	56	3.57	1.55	78	1.47	2.15
14	3.22	2.80	36	5.48	2.80	57	3.89	3.78	79	5.32	2.55
15	4.28	3.86	37	3.59	3.38	58	0.21	4.30	80	3.23	3.08
16	3.07	6.18	38	7.43	3.30	59	5.66	2.35	81	2.34	2.04
17	3.79	3.01	39	6.04	3.01	60	4.66	2.82	82	7.45	2.77
18	3.07	3.81	40	6.97	2.93	61	1.39	2.29	83	2.14	0.19
19	4.69	6.15	41	7.04	18.79	62	0.34	2.19	84	1.85	0.29
20	2.80	8.30	85	5.90	2.51	63	1.52	2.69			
21	5.35	3.78	42	4.10	15.13	64	3.97	2.08			
22	3.32	5.00	43	8.61	3.56	65	1.44	3.07	dp	4.24	6.51

6.2. Appendix II

Bootstrap Methodology

Following Bryan and Cecchetti (1996,1999) and Bryan *et al.*(1997) we set up a matrix of relative prices (log price deviations) with respect to the 36 month centred moving average inflation for each category of inflation. The matrix has 132 rows (monthly observations) and 85 columns (categories) and general element $\bar{x}^j$ of log price deviations from the 36 month centred moving average for that column. In each experiment we draw randomly one observation from each category, i.e., one draw from each column of the matrix, weighted by the column (category) weight for that year, (the weights are re-normalised in each draw to sum to 1000). We use n = 10,000 replications, thus generating 10,000 "observations", and calculate trimmed inflation for a given α. Then we compute two measures of efficiency about zero: the MAD (mean absolute deviation)

$$MAD_{\alpha} = \frac{\sum_{t=1}^{n} \left| \tilde{x}_{\alpha}^{j} \right|}{n}$$

and the RMSE (root mean square error)

$$RMSE_{\alpha} = \sqrt{\frac{\sum_{t=1}^{n} \left(\tilde{x}_{\alpha}^{j} \right)^2}{n}}$$

The process is repeated for each value of α from 5% to 30%, enabling us to plot MAD_{α} and $RMSE_{\alpha}$ against α.

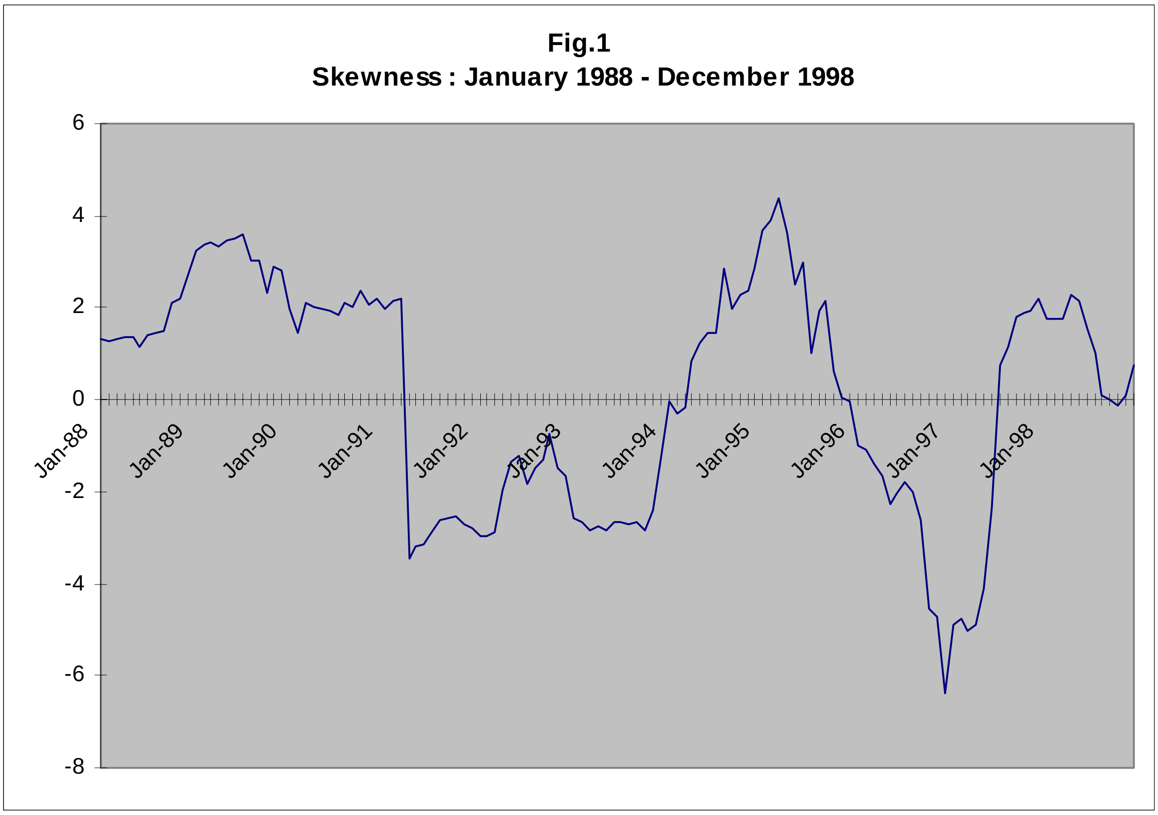


Fig.1
Skewness : January 1988 - December 1998
6
4
2
0
-2
-4
-6
-8
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

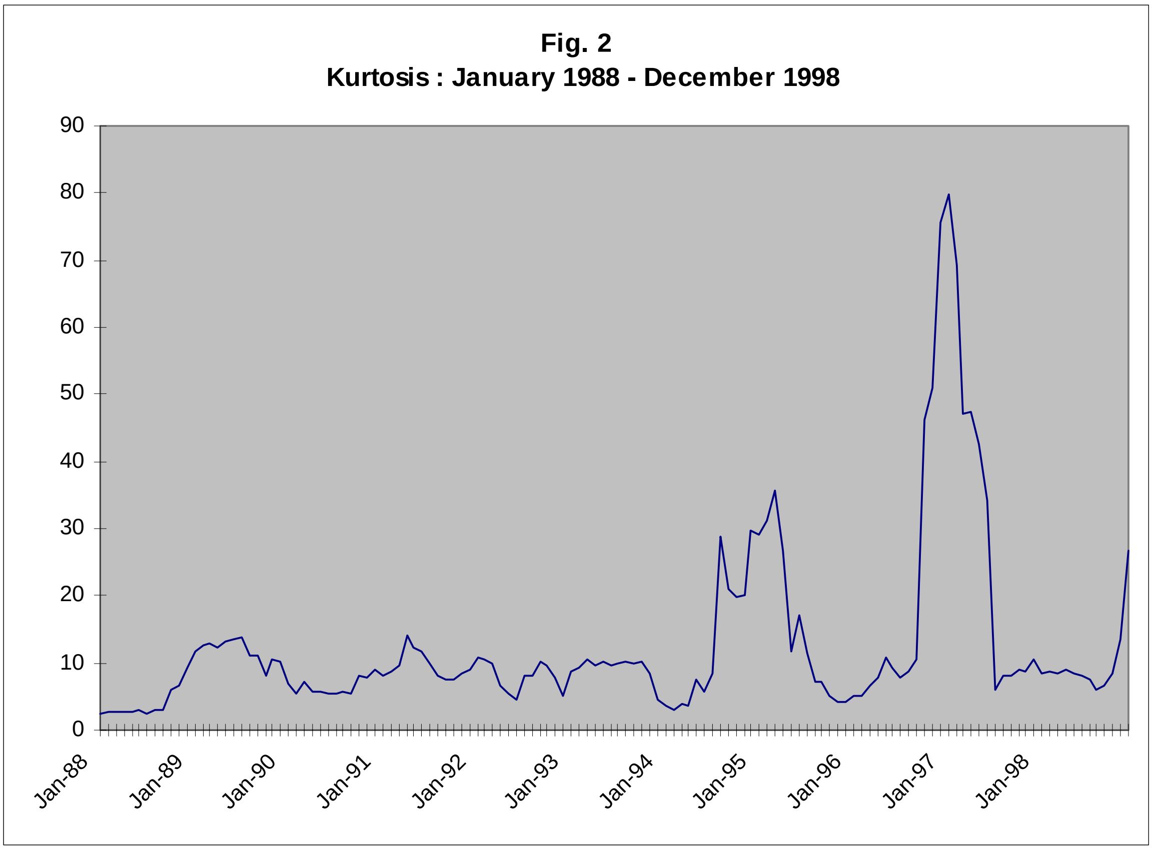


Fig. 2
Kurtosis : January 1988 - December 1998
90
80
70
60
50
40
30
20
10
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98

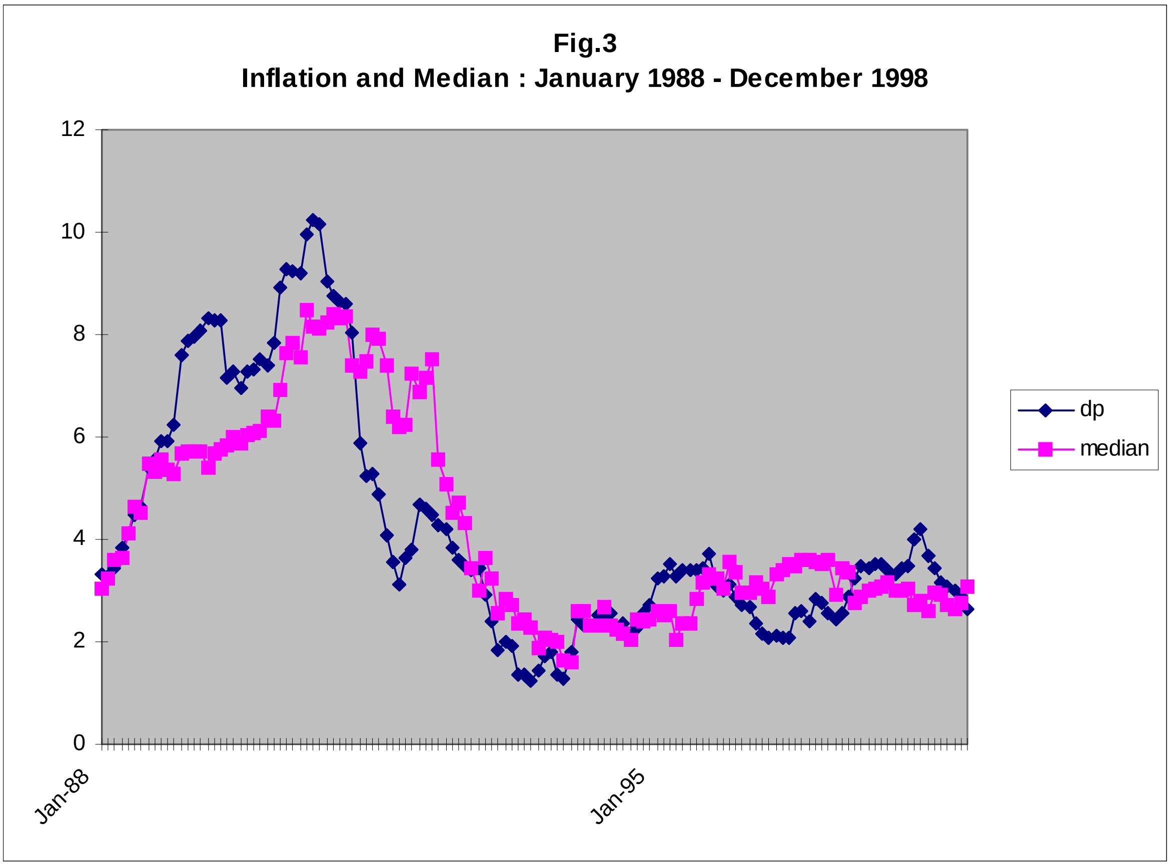


Fig.3
Inflation and Median : January 1988 - December 1998
12
10
8
6
4
2
0
Jan-88
Jan-95
dp
median

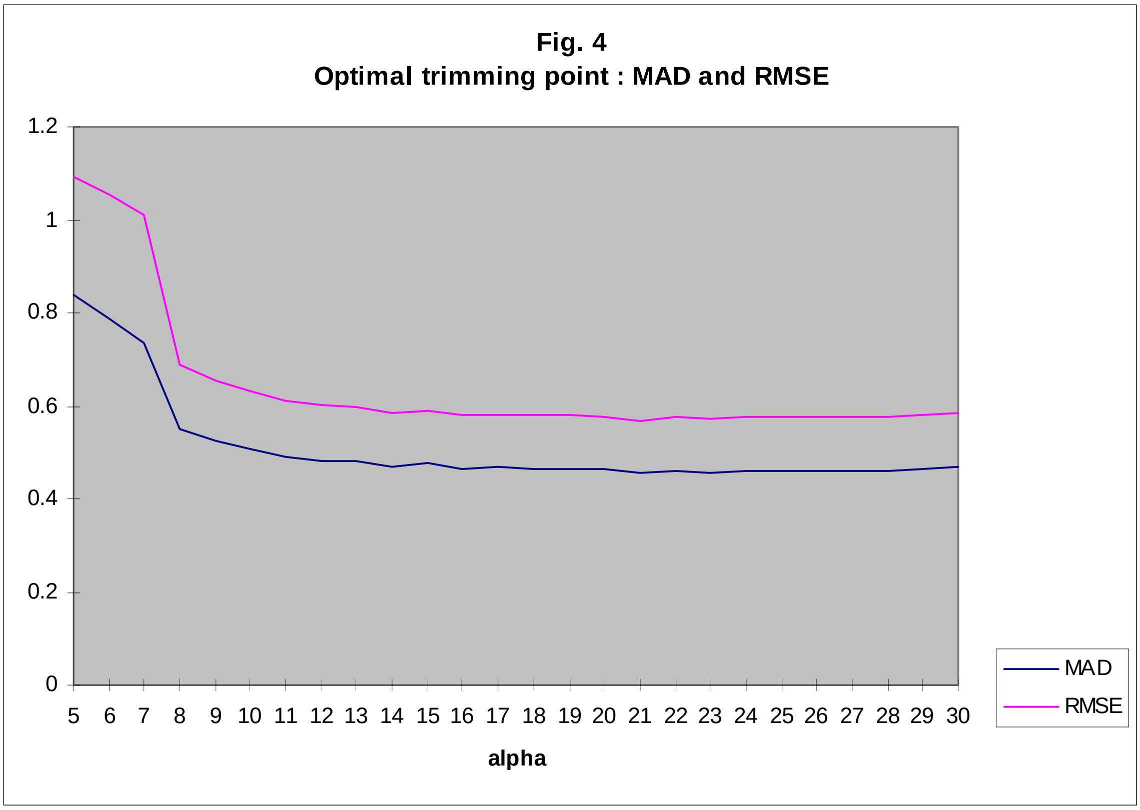


Fig. 4
Optimal trimming point : MAD and RMSE
1.2
1
0.8
0.6
0.4
0.2
0
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
alpha
MAD
RMSE

Fig. 5a
MAD : 5% and 95% doublebootstrap confidence bands

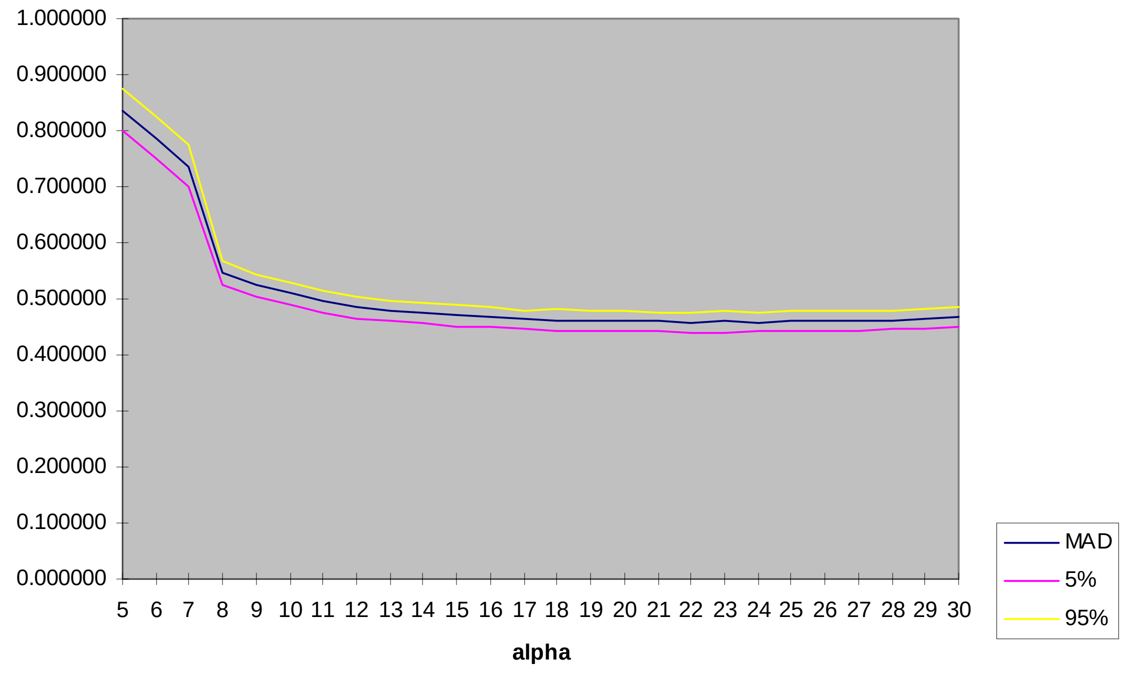
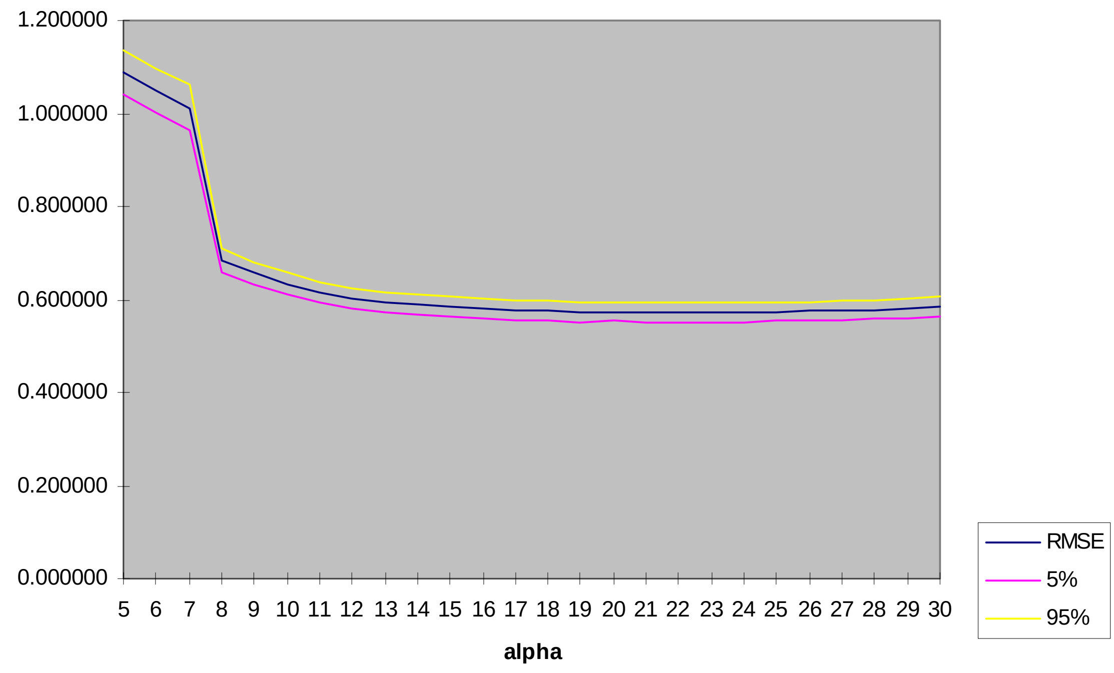


Fig. 5b
RMSE : 5% and 95% doublebootstrap confidence bands



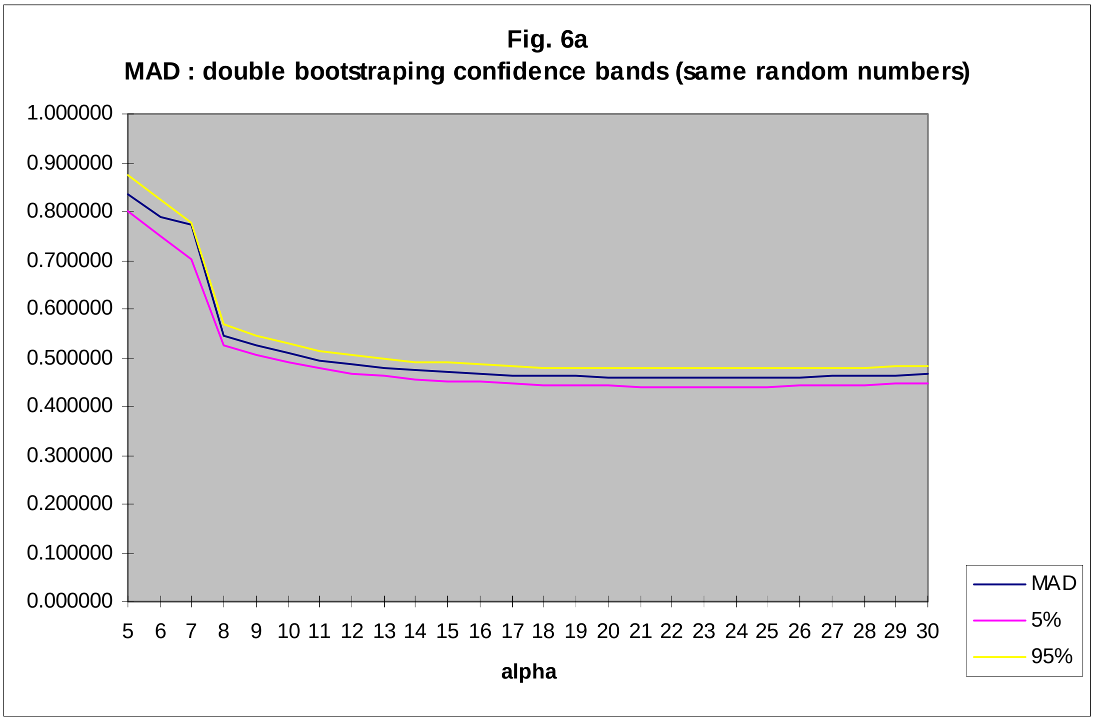


Fig. 6a
MAD : double bootstraping confidence bands (same random numbers)
1.000000
0.900000
0.800000
0.700000
0.600000
0.500000
0.400000
0.300000
0.200000
0.100000
0.000000
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
alpha
MAD
5%
95%

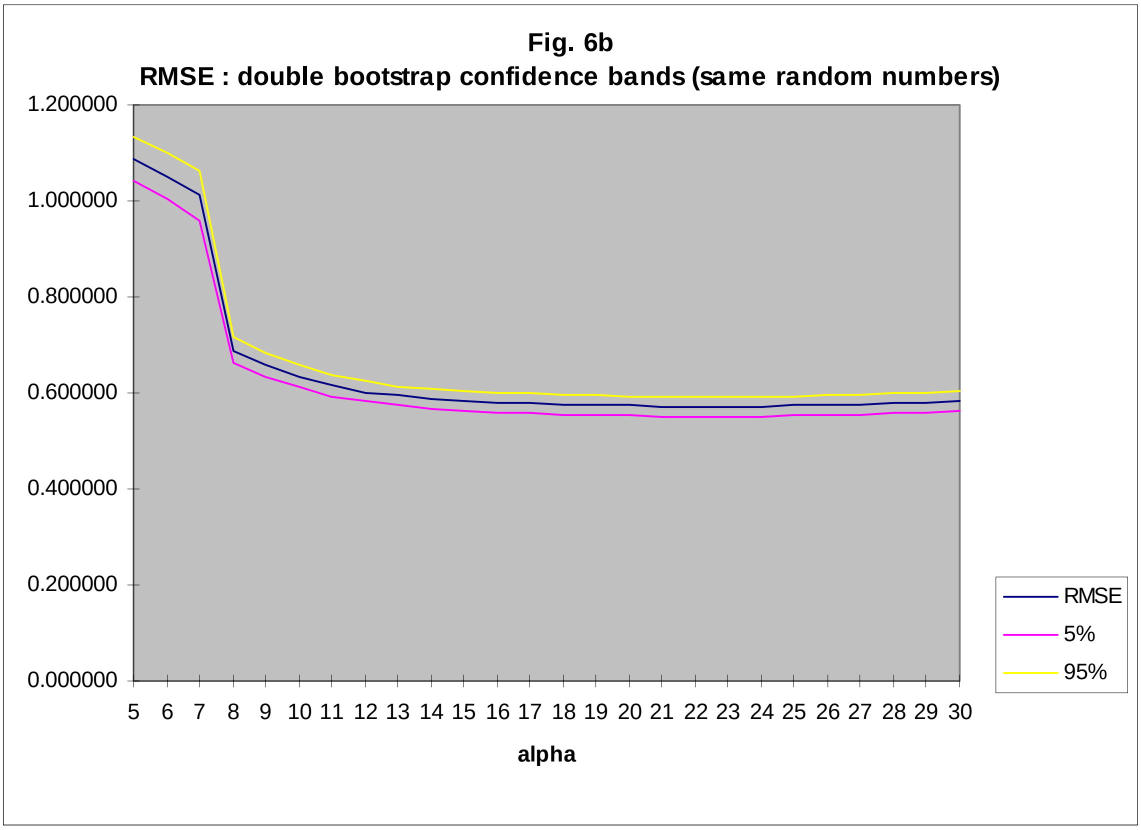


Fig. 6b
RMSE : double bootstrap confidence bands (same random numbers)
1.200000
1.000000
0.800000
0.600000
0.400000
0.200000
0.000000
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
alpha
RMSE
5%
95%

Fig. 7
Trimmed Mean Inflation : January 1988 - December 1998

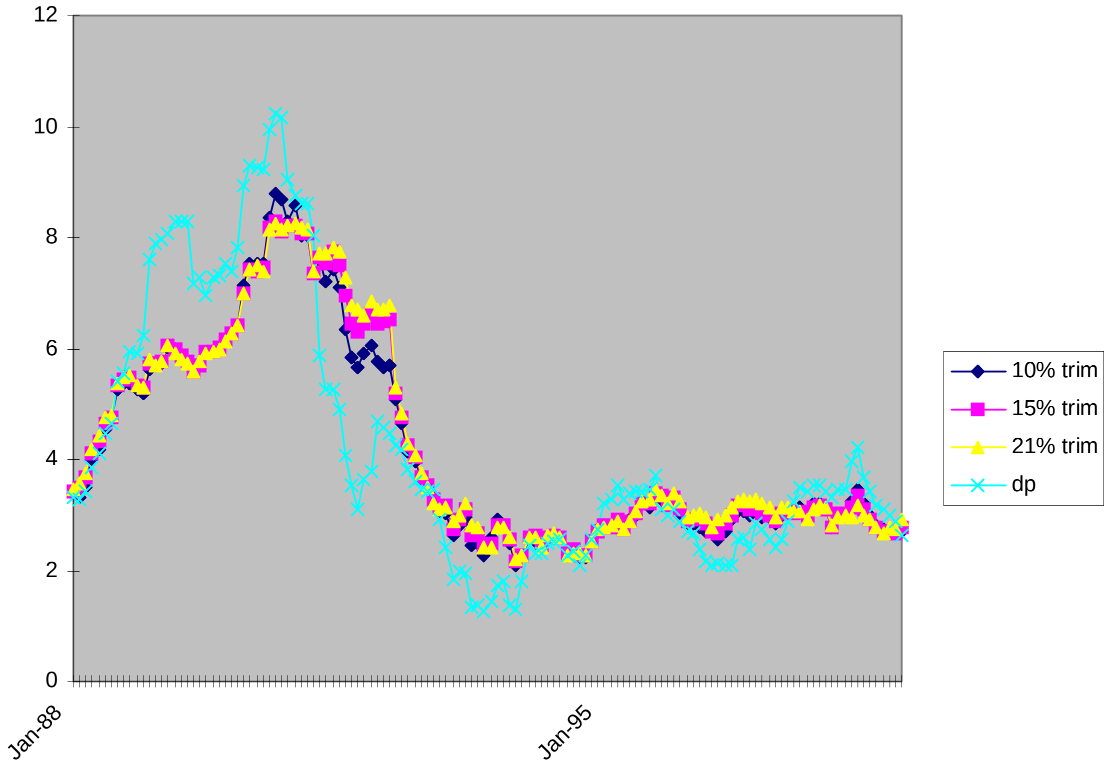
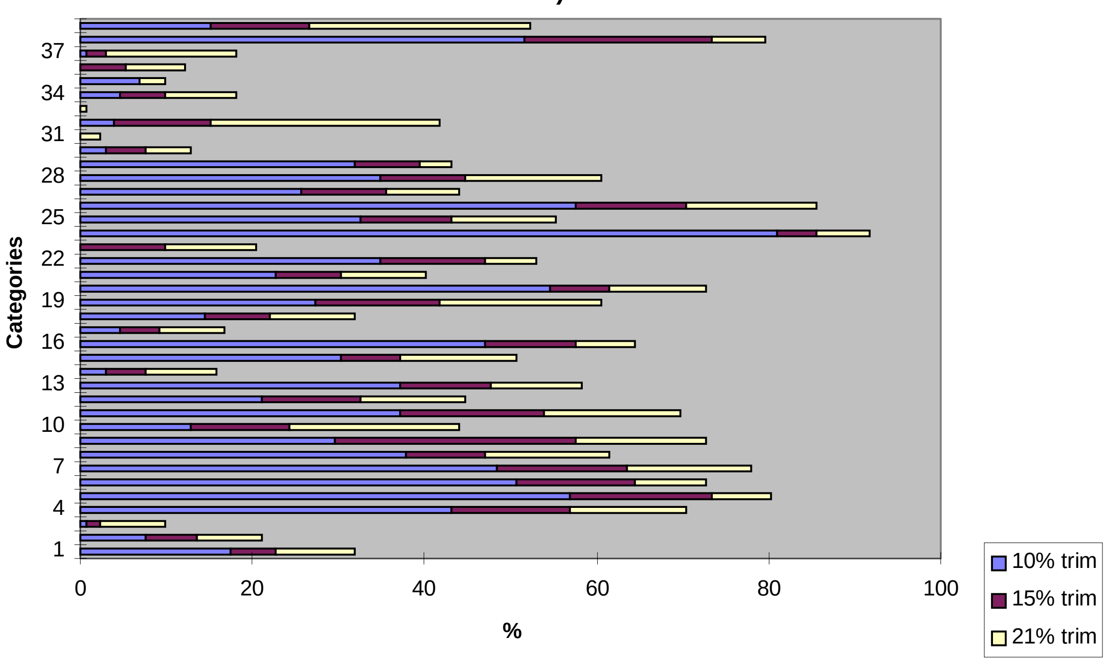


Fig. 8a
Trimmed Categories : Food, Catering, Alcoholic drink and Tobacco (in %)



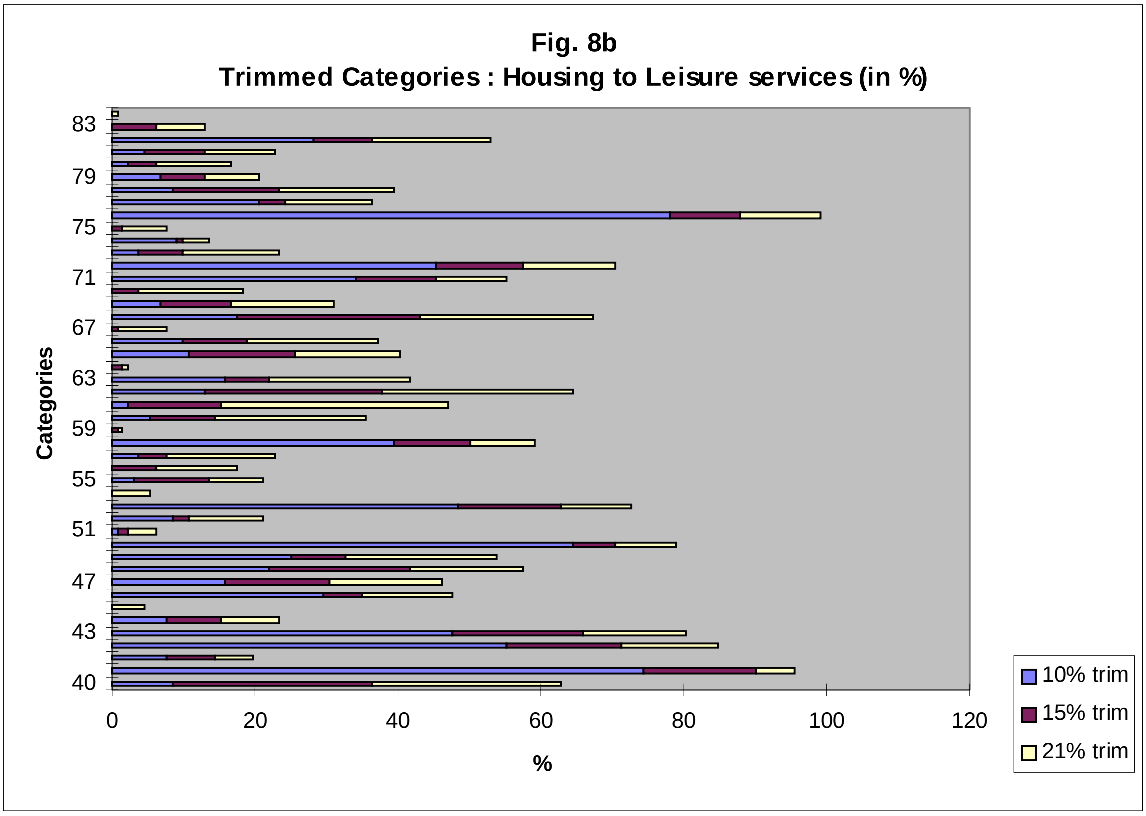


Fig. 8b
Trimmed Categories : Housing to Leisure services (in %)
Categories
83
79
75
71
67
63
59
55
51
47
43
40
0
20
40
60
80
100
120
%
10% trim
15% trim
21% trim