Measuring core inflation for South Africa: a trimmed means approach

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Introduction …

- this paper represents a first attempt at measuring a trimmed mean core inflation rate for South Africa.
- the role of measures of core inflation under IT
- idea that central banks "must develop their ability to research inflation, dissecting data to distinguish between 'one-off', or transitory, factors affecting inflation and more permanent changes, and removing volatile items or those independent of central bank action in order to determine appropriate policy responses" (Carson et al, 2002: 5)
- essentially, look to distinguish "the signal from the noise" (Blinder, 1997: 157).

Theoretical background

- The overall inflation rate Π_t may be viewed as consisting of an underlying component Π_t^U and a transitory component Π_t^{Tr}
- that is, $\Pi_t = \Pi_t^U + \Pi_t^{Tr}$
- While there is agreement on what core inflation should depict – namely the underlying inflationary pressures Π_t^U – there is no consensus regarding a single measure that consistently and accurately captures this

Theoretical background (cont.)

Criteria for choosing a measure of core inflation: (Roger, 1997)

- timely
- robust and unbiased
- verifiable

Also, (Wynne, 1999)

- computable in real time
- forward looking
- track record
- understandable to the general public
- history invariant to new data
- sound theoretical basis

Theoretical background (cont.)

Three main approaches to measuring core inflation:

- the behavioural or exclusion-based approach (eg CPI ex food and energy, CPI ex energy, Stats SA Core, …)
- the model-based set of methods (eg Quah and Vahey)
- and statistical methods which attempt to eliminate the impact of short-term fluctuations in inflation by computing limited influence estimators (e.g. using trimmed means, etc.).

Trimmed mean approach

- proposed eg by Bryan and Cecchetti (1993)
- The approach is based on the finding that when the data are not drawn from a normal distribution, the sample mean is not the most efficient (minimum variance) estimator of the first moment.
- calculation of the trimmed mean involves computing the weighted mean of price movements in the central core of the ranked distribution
- in effect cutting off the tail at each end of the distribution of price movements and averaging what is left.

Analysis of SA consumer price changes

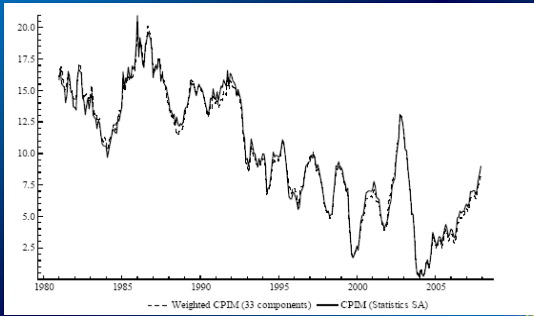
Data:

- We use monthly price indices and weights from Stats SA for 33 components of the CPI (metropolitan areas)
- Sample runs from Jan 1980 – Dec 2007 (336 observations generating 324 12-month changes)
- Weighted CPIM inflation rate obtained by applying the price changes π_{it} to the weights w_{it} according to:

$$\pi_{it} = \sum_{i=1}^{n} w_{it}\pi_{it}$$

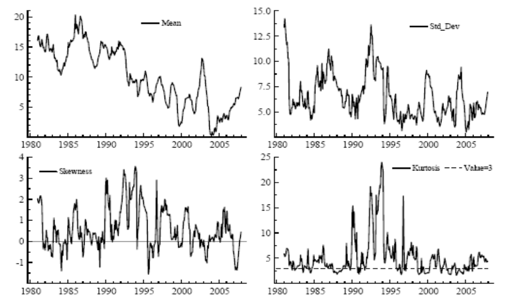
Analysis of SA consumer price changes

Figure 1 Consumer price index (metropolitan areas)



Analysis of SA consumer price changes

Figure 2 The moments of inflation



Calculation of trimmed mean estimators

For each month trimmed mean inflation rates which trim t_1 per cent from the lower tail and t_2 per cent from the upper tail were calculated:

- the price changes and their associated weights were ranked in ascending order;
- the cumulative sum of the ranked weights were formed (e.g. the third ranked price change π_3 would have a cumulative weight equal to $w_1+w_2+w_3$);
- the trimmed weight assigned to those ranked price changes which have a cumulative weight less than t_1 per cent or greater than $(100-t_2)$ per cent were set to zero
- For example:

Example: January 1981 CPI data (t_1=10, t_2=10)

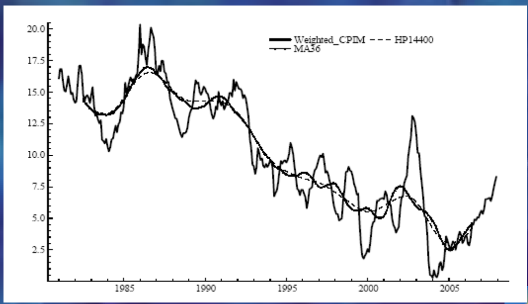
Sector code	Inflation	Weight	Cum weight	Trimw	New weight
25.000	3.9063	6.1988	6.1988	0.00000	0.00000
12.000	4.0000	1.6897	7.8884	0.00000	0.00000
21.000	4.9180	2.3895	10.278	0.27794	0.34743
8.0000	6.8627	0.77984	11.058	0.77984	0.97481
22.000	6.9930	1.0198	12.078	1.0198	1.2747
26.000	7.8431	3.1694	15.247	3.1694	3.9617
11.000	7.9545	2.0796	17.327	2.0796	2.5995
13.000	9.2025	7.3085	24.635	7.3085	9.1357
5.0000	9.4118	1.4297	26.065	1.4297	1.7871
18.000	10.106	1.3297	27.395	1.3297	1.6622
7.0000	10.345	0.53989	27.934	0.53989	0.67487
28.000	10.490	3.0494	30.984	3.0494	3.8117
2.0000	10.784	0.93981	31.924	0.93981	1.1748
19.000	10.870	1.5097	33.433	1.5097	1.8871
15.000	10.897	17.596	51.030	17.596	21.996
23.000	11.111	2.0796	53.109	2.0796	2.5995
24.000	12.690	5.5689	58.678	5.5689	6.9611
3.0000	12.903	2.7495	61.428	2.7495	3.4368
27.000	12.903	0.98980	62.418	0.98980	1.2373
30.000	12.903	0.81984	63.237	0.81984	1.0248
14.000	13.014	1.4697	64.707	1.4697	1.8371
20.000	13.333	1.5597	66.267	1.5597	1.9496
16.000	13.445	2.0696	68.336	2.0696	2.5870
31.000	13.684	2.9494	71.286	2.9494	3.6868
4.0000	13.821	1.1998	72.486	1.1998	1.4997
9.0000	15.190	1.3197	73.805	1.3197	1.6497
32.000	16.667	5.4089	79.214	5.4089	6.7611
0.00000	16.667	3.4093	82.623	3.4093	4.2616
10.000	17.143	0.51990	83.143	0.51990	0.64987
17.000	17.986	3.1294	86.273	3.1294	3.9117
6.0000	32.308	3.4993	89.772	3.4993	4.3741
1.0000	52.113	9.1182	98.890	0.22795	0.28494
29.000	56.061	1.1098	100.00	0.00000	0.00000

Choosing an "optimal" trimmed mean estimator

- How much should we trim?
- potentially a relatively large number of trimmed mean inflation rate series generated (asymmetric trim => 2500)
- to facilitate choice, a benchmark is required which serves to proxy the trend or underlying component in inflation
- Following Bryan, Cecchetti and Wiggins (1997), one option is to choose a centred 36-month moving average (MA36) of the overall CPI inflation rate.
- Comparisons were undertaken using a range of benchmarks, although results are reported only for the Hodrick-Prescott (λ = 14400) benchmark. [Various centered moving-average benchmarks were used, as well as Hodrick-Prescott filters (λ = 14400 and λ=129000)].

Choosing an “optimal” trimmed mean estimator

Figure 3 Alternative benchmark for the optimal trim

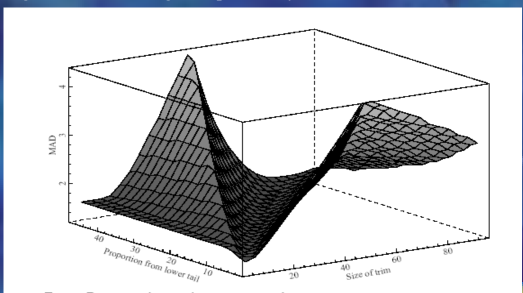


Choosing an “optimal” trimmed mean estimator

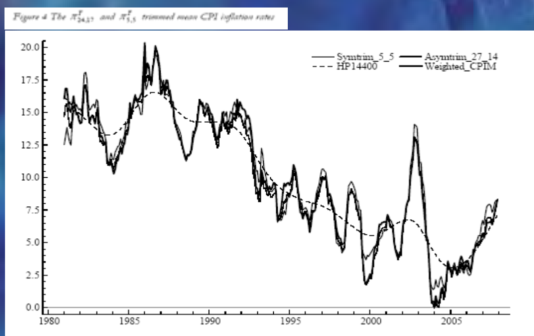
- trimmed mean estimators were therefore computed and then compared using the mean absolute deviations (MADs) between the trimmed series and trend inflation proxied by the Hodrick-Prescott (λ = 14400) benchmark.
- comparison was undertaken for both the case where only symmetric trimming was undertaken and for the case where asymmetric trimming was permitted
- the minimum MAD trims were $\Pi_{5,5}$ (symmetric) and $\Pi_{24,17}$ (asymmetric, ie achieved with 24 per cent trimmed from the lower tail and 17 per cent trimmed from the upper tail)

Choosing an “optimal” trimmed mean estimator

Figure 5 Determining the optimal asymmetric trimmed mean



Choosing an “optimal” trimmed mean estimator



Analysis of the “optimal” trimmed mean estimators

- In the case of the 5 per cent symmetric trim, the MAD from the benchmark was 1,421 percentage points.
- the MAD of this symmetric trim is 1,7 per cent lower than that of the overall CPI inflation rate.
- with the $\Pi_{24,17}$ asymmetric trim, the MAD from the benchmark was 1,368 percentage points
- this MAD is 5,37 per cent lower than that of the overall CPI inflation rate

An analysis of the tails of the $\Pi_{24,17}$ trimmed mean estimator

- one of the major benefits of the trimmed mean is that it helps to identify the most volatile price elements over a period of time
- and allows us to look at whether these are in fact excluded from the standard exclusion-based core inflation measures
- we provide an analysis of the tails of the trimmed mean estimator over various periods, and a comparison of the tails with those of Statistics South Africa’s core inflation measure

Table 2. Analysis of the $\Pi_{24,17}$ trimmed mean estimator , 1980:1-2007:12

Number of months (out of total sample of 324) and per cent

Code	# months in tails	%	# months in lower tail	%	# months in upper tail	%
0	117	36.11	49	15.12	68	20.99
1	194	59.88	81	25.00	113	34.88
2	127	39.20	56	17.28	71	21.91
3	120	37.04	38	11.73	82	25.31
4	128	39.51	69	21.30	59	18.21
5	181	55.86	91	28.09	90	27.78
6	221	68.21	102	31.48	119	36.73
7	91	28.09	42	12.96	49	15.12
8	139	42.90	78	24.07	61	18.83
9	43	13.27	4	1.23	39	12.04
10	83	25.62	15	4.63	68	20.99
11	97	29.94	26	8.02	71	21.91
12	187	57.72	36	11.11	151	46.60
13	148	45.68	145	44.75	3	0.93
14	161	49.69	157	48.46	4	1.23
15	222	68.52	142	43.83	80	24.69
16	85	26.23	56	17.28	29	8.95
17	110	33.95	96	29.63	14	4.32
18	169	52.16	159	49.07	10	3.09
19	167	51.54	167	51.54	0	0.00
20	94	29.01	25	7.72	69	21.30
21	171	52.78	53	16.36	118	36.42
22	113	34.88	96	29.63	17	5.25
23	154	47.53	17	5.25	137	42.28
24	143	44.14	67	20.68	76	23.46
25	202	62.35	103	31.79	99	30.56
26	176	54.32	146	45.06	30	9.26
27	168	51.85	106	32.72	62	19.14
28	149	45.99	129	39.81	20	6.17
29	113	34.88	49	15.12	64	19.75
30	163	50.31	9	2.78	154	47.53
31	14	4.32	8	2.47	6	1.85
32	133	41.05	104	32.10	29	8.95

An analysis of the tails of the $\Pi_{24,17}$ trimmed mean estimator : results summary

- the most volatile elements are scattered across a variety of product sub-groups and are not necessarily confined to any particular main group(s)
- The product categories excluded in the calculation of core inflation have not necessarily experienced the most volatile price movements in practice.
- The products excluded in the calculation of Statistics SA's core CPI make up around 22 per cent of the overall CPI. This is less than half the weight excluded by our chosen trimmed mean estimator
- An analysis of more disaggregated data would provide additional insight in this regard.

Example: Oct 2005 CPIX data (t_1=20, t_2=20)

Sorted sectors

Sector code	Inflation	Weight	Cum weight	Trims	New weight
14.000	-5.9978	1.5300	1.5300	0.00000	0.00000
18.000	-2.6338	0.94000	2.4700	0.00000	0.00000
13.000	-1.8730	2.5300	5.0000	0.00000	0.00000
19.000	-1.8587	1.0000	6.0000	0.00000	0.00000
4.0000	-1.4674	0.93000	6.9300	0.00000	0.00000
28.000	-1.4418	3.3900	10.320	0.00000	0.00000
24.000	-0.77187	5.6900	16.010	0.00000	0.00000
27.000	0.00000	3.1900	19.200	0.00000	0.00000
32.000	0.00000	3.6300	22.830	2.8300	4.7167
26.000	0.27778	2.2900	25.120	2.2900	3.8167
8.0000	0.90535	1.2700	26.390	1.2700	2.1167
17.000	1.1447	1.2100	27.600	1.2100	2.0167
9.0000	1.2730	4.1700	31.770	4.1700	6.9500
0.00000	1.5480	4.8400	36.610	4.8400	8.0667
1.0000	1.9691	6.9500	43.560	6.9500	11.583
22.000	2.4390	0.13000	43.690	0.13000	0.21667
31.000	2.5994	4.3700	48.060	4.3700	7.2833
16.000	3.1891	4.2800	52.340	4.2800	7.1333
20.000	3.7234	1.5000	53.840	1.5000	2.5000
3.0000	3.8173	2.3400	56.180	2.3400	3.9000
7.0000	4.2702	0.69000	56.870	0.69000	1.1500
29.000	4.4601	0.40000	57.270	0.40000	0.66667
15.000	4.5362	11.570	68.840	11.570	19.283
10.000	4.6019	1.2600	70.100	1.2600	2.1000
5.0000	4.6332	1.2600	71.360	1.2600	2.1000
6.0000	5.0440	2.4300	73.790	2.4300	4.0500
2.0000	6.0720	0.78000	74.570	0.78000	1.3000
11.000	6.0942	1.7000	76.270	1.7000	2.8333
23.000	7.2425	7.7000	83.970	3.7300	6.2167
30.000	8.1025	3.7700	87.740	0.00000	0.00000
12.000	9.3350	1.3500	89.090	0.00000	0.00000
21.000	10.203	3.5900	92.680	0.00000	0.00000
25.000	18.283	7.3200	100.00	0.00000	0.00000

Table 3. Analysis of tails of the $\pi^{I}_{24,17}$ trimmed mean estimator for 1981-2007 and 2000-200

	Sub-product group	Main product group	1981-2007	2000-2007
0	Grain Products	Food		
1	Meat	Food	X	
2	Fish and Other Sea Food	Food		
3	Milk, Cheese & Eggs	Food		
4	Fats and Oils	Food		X
5	Fruit and Nuts	Food	X	
6	Vegetables	Food	X	X
7	Sugar	Food		
8	Coffee, Tea & Cocoa	Food		
9	Other food	Food		
10	Non-alcoholic Beverages	Non-alcoholic Beverages		
11	Alcoholic Beverages	Alcoholic Beverages		
12	Cigarettes, Cigars, and Tobacco	Cigarettes, Cigars, and Tobacco	X	X
13	Clothing	clothing & footwear		X
14	Footwear	clothing & footwear	X	X
15	Housing	Housing	X	X
16	Fuel and Power	Fuel and Power		
17	Furniture	Furniture & equipment		
18	Appliances	Furniture & equipment	X	X
19	Other Household equipment and Textiles	Furniture & equipment	X	X
20	Household Consumables	Household operation		
21	Domestic Workers	Household operation	X	X
22	Other Household Services	Household operation		
23	Medical Care and Health Expenses	Medical Care and Health Expenses		X
24	Vehicles	Transport		
25	Running Cost	Transport	X	X
26	Public and Hired Transport	Transport	X	X
27	Communication	Communication	X	
28	Recreation and Entertainment	Recreation and Entertainment		X
29	Reading Matter	Reading Matter		
30	Education	Education	X	X
31	Personal Care	Personal Care		
32	Other	Other		X

Table 4. Comparison between products contained in the tails of the $\pi^{I}_{24,17}$ trimmed mean estimator and those excluded in the calculation of official core CPI

no	Product or sub-product category	CPI	Core inflation	% exclusion**	1981-2007	2000-2007
[a]	[b]	[c]	[d]	[e]	[f]	[g]
0	GRAIN PRODUCTS	3.81	4.9	0		
1	MEAT	5.66	0.07	91	X	
2	FISH AND OTHER SEAFOOD	0.69	0.19	78		
3	MILK. CHEESE AND EGGS	1.96	2.52	0		
4	FATS AND OILS	0.76	0.98	0		X
5	FRUIT AND NUTS	1.09	0.44	65	X	
6	VEGETABLES	2.00	0.21	79	X	X
7	SUGAR	0.50	0.65	0		
8	COFFEE. TEA AND COCOA	1.07	1.38	0		
9	OTHER FOOD PRODUCTS	3.45	4.44	0		
10	NON-ALCOHOLIC BEVERAGES	1.10	1.41	0		
11	ALCOHOLIC BEVERAGES	1.40	1.80	0		
12	CIGARETTES. CIGARS AND TOBACCO	1.14	1.47	0	X	X
13	CLOTHING	2.04	2.63	1		X
14	FOOTWEAR	1.21	1.55	0	X	X
15	HOUSING	22.14	11.76	59	X	X
16	FUEL AND POWER	3.49	4.49	0		
17	FURNITURE	0.95	1.23	0		
18	APPLIANCES	0.80	1.03	0	X	X
19	OTHER HOUSEHOLD EQUIPMENT AND TEXTILES	0.78	1.00	0	X	X
20	HOUSEHOLD CONSUMABLES	1.25	1.61	0		
21	DOMESTIC WORKERS	3.48	4.48	0	X	X
22	OTHER HOUSEHOLD SERVICES	0.09	0.12	0		
23	MEDICAL CARE AND HEALTH EXPENSES	7.15	9.20	0		X
24	VEHICLES	5.95	7.66	0		
25	RUNNING COSTS	7.05	9.08	0	X	X
26	PUBLIC AND HIRED TRANSPORT	1.84	2.36	0	X	X
27	COMMUNICATION	2.98	3.83	0	X	
28	RECREATION AND ENTERTAINMENT	3.31	4.26	0		X
29	READING MATTER	0.39	0.50	0		
30	EDUCATION	3.48	4.48	0	X	X
31	PERSONAL CARE	3.67	4.72	0		
32	OTHER GOODS AND SERVICES	3.32	3.55	0		X
	TOTAL	100	100			

*Note: **sum of weights of products excluded in the calculation of core CPI expressed as percentage of overall CPI.*
Source: own calculations with data from StatsSA

Table 5. Analysis of tails of the $\pi^{I}_{24,17}$ trimmed mean estimator for a specific month over the sample period 1981 to 2007 (more than 50 per cent of time in tails)

Products		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grain Products	0												
Meat	*1*	X	X	X	X	X	X	X	X	X	X	X	X
Fish and Other Sea Food	2												
Milk, Cheese & Eggs	3												
Fats and Oils	4												
Fruit and Nuts	*5*	X	X	X	X	X	X		X	X			X
Vegetables	*6*	X	X	X	X	X	X	X	X	X	X	X	X
Sugar	7												
Coffee, Tea & Cocoa	8							X		X			
Other food	9												
Non-alcoholic Beverages	10												
Alcoholic Beverages	11												
Cigarettes, Cigars, and Tobacco	*12*		X	X	X	X	X	X	X	X	X	X	X
Clothing	13	X		X				X					
Footwear	*14*				X	X	X		X	X			
Housing	*15*	X	X	X	X	X	X	X	X	X	X	X	X
Fuel and Power	16												
Furniture	17												
Appliances	*18*			X	X		X	X	X	X			X
Other Household equipment and Textiles	*19*				X		X	X	X	X	X	X	X
Household Consumables	20												
Domestic Workers	*21*			X	X	X	X	X	X		X		
Other Household Services	22												
Medical Care and Health Expenses	23		X	X		X	X						
Vehicles	24												
Running Cost	*25*	X	X	X	X	X	X	X	X	X	X	X	X
Public and Hired Transport	*26*	X	X	X	X	X	X	X	X				
Communication	*27*		X		X	X	X	X	X	X	X	X	
Recreation and Entertainment	28									X		X	
Reading Matter	29												
Education	*30*		X	X	X				X	X	X	X	
Personal Care	31												
Other	32					X							

Source: own calculations with data from StatsSA

Concluding comments

- The analysis presented in the paper has significant potential usefulness for policy-makers, in that it improves the ability to dissect inflation data and distinguish the signal from the noise in these data
- the performance of the measure in this regard and in the forecasting of inflation can and should be compared with that of alternative measures

Appendix 1 The 33 components of CPI

Own code	Stats SA code	Component
0	VPI30101	Grain products
1	VPI30102	Meat
2	VPI30103	Fish and other sea food
3	VPI30104	Milk, cheese & eggs
4	VPI30105	Fats and oils
5	VPI30106	Fruit and nuts
6	VPI30107	Vegetables
7	VPI30108	Sugar
8	VPI30109	Coffee, tea & cocoa
9	VPI30110	Other food
10	VPI30200	Non-alcoholic beverages
11	VPI30300	Alcoholic beverages
12	VPI30400	Cigarettes, cigars, and tobacco
13	VPI30501	Clothing
14	VPI30502	Footwear
15	VPI30600	Housing
16	VPI30700	Fuel and power
17	VPI30801	Furniture
18	VPI30802	Appliances
19	VPI30803	Other household equipment and textiles
20	VPI30901	Household consumables
21	VPI30902	Domestic workers
22	VPI30903	Other household services
23	VPI31000	Medical care and health expenses
24	VPI31101	Vehicles
25	VPI31102	Running cost
26	VPI31103	Public and hired transport
27	VPI31200	Communication
28	VPI31300	Recreation and entertainment
29	VPI31400	Reading matter
30	VPI31500	Education
31	VPI31600	Personal care
32	VPI31700	Other

Source: Stats SA

Thank You!