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A New Measure of Core Inflation in Pakistan

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Abstract

We propose a new method of permanently excluding relatively volatile commodities from CPI basket in Pakistan. This is achieved by making use of trimming approach on past data on monthly CPI changes to isolate a Relatively Stable Component of CPI (RSC-CPI) as a new measure of core inflation. This method ensures inclusion of both food and non-food commodities that show persistent price behavior in Pakistan. Three alternative core inflation series based on this new approach and four other core measures based on existing methodology have been evaluated. RSC-CPI based measures of core inflation are found to be the best in terms of desirable properties proposed by Marques et al (2003) for a core inflation measure and various relative performance indicators.

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I. Overview

The concept of core inflation has gained wide acceptance in general public, academia and central banks since it was coined by Gordon (1975) and Eckstein (1981). It has become more important in the aftermath of 2008 global financial crisis that was followed by extraordinary quantitative easing in advanced countries, without triggering excessive inflation. Core inflation measures are used as important supplements to headline inflation in order to distinguish between the 'permanent' (underlying) signal of inflation from the 'transient' noise contained in inflation data that can potentially mislead central banks towards taking an undesirable monetary policy action.

Among the various methods of estimating core inflation, two approaches have gained particular importance. The first is known as the exclusion-based approach and the other as the trimming approach. Non-food non-energy (NFNE) part of Consumer Price Index (CPI) is the most prominent core inflation measure in Pakistan, perhaps, because of its simplicity and transparency. Twenty percent weighted trim of CPI is an example of core inflation measure based on the second approach. While the core trim measure was found to be clearly superior to NFNE measure (Lodhi, 2007), it has failed to gain as much acceptance as NFNE. This phenomenon is not confined to Pakistan. Several studies, including Detmeister (2011 and 2012), Meyer and Pasaogullari (2010) and Smith (2004) have found that exclusion-based core measures perform poorly compared to trim-based or other measures.

Walsh (2011) shows that exclusion of food misspecifies inflation that can lead to higher inflationary expectations, especially in developing countries where food inflation is relatively more persistent and food price shocks carry higher risks of transmission to non-food inflation. Despite these and several other studies, ex food and energy based measures continue to be preferred by policy makers and the public at large.

To overcome the shortcomings of exclusion based core inflation measures, we propose a new method of permanently excluding relatively volatile commodities from CPI basket in Pakistan. This is achieved by making use of trimming approach on past data on monthly CPI changes to isolate a relatively stable component of commodities in CPI. This component is then used as an exclusion-based core inflation measure for Pakistan. We call this the Relatively Stable Component of the Consumer Price Index (RSC - CPI). This component includes a mix of both food and non-food commodities that show persistent price behavior.

We compare RSC-CPI inflation with alternative core inflation measures in Pakistan and find it to be the best in terms of desirable properties of a core inflation measure (Marques et al, 2003) and various relative performance indicators.

II. Measures of Core Inflation in Pakistan

Non-food non-energy and twenty percent weighted trimmed mean measures are officially used definitions of core inflation in Pakistan. Pakistan Bureau of Statistics (PBS) publishes data of the two series on monthly basis as part of its publication on "Monthly Review on Price Indices". SBP also uses the same data in all of its official communications. However, for an internal analysis SBP also considers few other measures of core inflation that include non-perishable food and non-energy (NPFNE) and weighted median of CPI inflation. All these measures of core inflations are worked out using 89 composite consumer price indices monthly data published by PBS.

NFNE measure in Pakistan is currently being worked out by permanently excluding all food items and selected energy items from the CPI basket. Specifically, all items from three food related sub-groups, i.e. *food and non-alcoholic beverages*, *alcoholic beverages and tobacco*, and *restaurants and hotels*; three items, i.e. electricity, gas and kerosene oil from *housing, water, electricity, gas and others* sub-group; and one item, i.e. motor fuel from *transport* sub-group are excluded for computing NFNE measure. Items that are included in the NFNE measure share a combined weight of around 54 percent of total CPI basket.

NFNE is an exclusion-based definition of core inflation and alternative measures can easily be defined. For example, core inflation can be measured by "stripping food, energy and transportation components of the CPI" (IMF, 2013). This definition is being used by the IMF to monitor core inflation in Pakistan. We have included this as NFNE2 in this paper for the purpose of comparison with our new and other select measures of core inflation in current practice.

As mentioned earlier, internally SBP also monitors NPFNE, which is computed by excluding same energy prices, as in the case of NFNE, and prices of perishable food items only. Excluding only perishable food prices is primarily based on the argument that not all the food price changes reflect noise in the data; rather these prices may contain important indications about underlying inflation trends. Since prices of perishable food items are usually most volatile in nature, probability of getting more noise than information in their case is quite high and therefore these are excluded. Items in NPFNE measure comprise around 86 percent of the overall CPI basket.

In computing the 20 percent trimmed mean measure of core inflation, 10 percent of items showing extreme price changes each from top and bottom are excluded. Unlike the aforementioned exclusion-based approaches, in the case of trimmed mean, uniform basket is not used overtime; as different items may usually be excluded at different points in time. Similarly, even in a given month, inflation for different time periods, such as monthly, yearly, period average, etc, may not necessarily be worked out on a common basket. This implies that point to point and average inflation based

on trimmed mean measure are not integrated with each other and therefore may not portray a coherent inflationary picture all the time.

It is, however, the simplicity in understanding and ease in computing permanent exclusion-based measures such as NFNE that explain its widespread acceptability in Pakistan and in many other countries. This is despite the fact that NFNE measure does not fulfill desired properties generally recommended for a core inflation estimator. For instance, NFNE measure does not co-integrate with headline inflation and it has shown a significantly different mean than CPI inflation during July 2003 to February 2013 (see following section for more detail).[1]

In this backdrop, this study has designed alternative measures of core inflation for Pakistan that: (a) are based on exclusion criteria, (b) are relatively easy to understand and communicate, (c) address some of the procedural weakness of trimmed mean measure, and (d) also meet the desirable properties of core inflation measures.

Relatively Stable Component of CPI – A New Core Inflation Measure

Relatively Stable Component of CPI (RSC-CPI) is based on a permanent exclusion criteria. The basic idea is to exclude those items from CPI basket that usually show higher volatility in prices. A common approach to classify such volatile prices is to select a benchmark for a measure of volatility (such as standard deviation or coefficient of variation) in prices. Items showing higher volatility than the benchmark over a long period of time are identified for permanently excluding from the CPI basket to achieve a stable component or a measure of core inflation. Based on this approach, Tahir (2003) has computed a core inflation series for Pakistan. As found by Lodhi (2007), this measure, however, does not fulfill the desirable properties of a core inflation measure.

Our new technique for estimating core inflation is essentially a hybrid method that combines exclusion and trim-based approaches. Volatile price items, to be excluded in the newly proposed measure RSC-CPI, are identified by analyzing the list and frequency of commodities that have been trimmed out over time while computing monthly weighted trimmed mean measure. Commodities that were more frequently trimmed out July 2008 to February 2013 are selected for permanently excluding from the CPI basket. Given there is no unique or preferred way of choosing cut-off for frequency of exclusion, following three series of RSC-CPI are worked out:

- RSC-CPI 1: by excluding commodities those were trimmed out 10 times or more
- RSC-CPI 2: by excluding commodities those were trimmed out 13 times or more

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[1] Similar results were also found by Lodhi (2007).

- RSC-CPI 3: by excluding commodities those were trimmed out 16 times or more

Commodities identified for exclusion or inclusion in each of these exercises are listed down in **Annexure 1**. Commodities included comprise relatively stable component (RSC-CPI) and items excluded comprise relatively volatile component (RVC-CPI). Their group-wise composition is shown in **Annexure 2**. Complete CPI (2007-08 base year) basket of 89 commodities along with their weights is shown in **Annexure 3**.

III. Evaluating Core inflation Measures

The three alternative relatively stable components of CPI inflation series along with NFNE, trimmed mean, and Non-perishable food and non-energy (NPFNE) measures of core inflation on YoY basis are evaluated against desirable properties of a core inflation and on a relative performance criteria. Core inflation series worked out on IMF's definition of exclusion-based core CPI (NFNE2) for Pakistan is also evaluated.

Tests of Desirable Properties

Marques et al. (2003) defined desirable prosperities for a core inflation estimator. The basic idea is to ensure a compulsory feature, i.e. headline inflation should converge to core inflation in the long run, but not vice versa. For this purpose, the study proposed the following three testable conditions:

- Measure of YoY core inflation and CPI (headline) inflation must be co-integrated with same mean.
- Headline inflation must converge toward core inflation in the long-run.
- Core inflation must not converge towards headline inflation.

At any point in time, the relationship between headline (π_t) and core inflation (π_t^*) can be expressed as:

$$\pi_t = \pi_t^* + \mu_t \tag{1}$$

Where, μ_t represents a transitory component and reflects deviation in core and CPI inflation due to factors such as seasonal price movements; one-off increases in administrative prices; temporary supply side shocks, etc.

Given headline and all the core inflation series under review are integrated of order 1, i.e. I (1) (see **Table 1**), the co-integration between core and headline inflation condition can be tested by applying standard Augmented Dickey Fuller (ADF) stationarity test on (π_t - π_t^*), i.e.:

$$\Delta(\pi - \pi^*)_t = \alpha + \rho \, (\pi - \pi^*)_{t-1} + \sum_{j=1}^{n} \varphi_j \Delta(\pi - \pi^*)_{t-j} + \xi_t \qquad (2)$$

So if the $(\pi_t - \pi_t^*)$ series is stationary, this implies that headline and core inflation are co-integrated. However, as explained by Lodhi (2007), stationarity of $(\pi_t - \pi_t^*)$ is, though necessary, not a sufficient condition to ensure that headline inflation will converge to the estimated core inflation series (in the long run). It is possible that any two series are co-integrated and move parallel to each other. Therefore, it is also preferable that the constant term α should be zero.

Given the first condition is met, the second property that the headline inflation must converge towards the core inflation can be checked by estimating following error-correction model for equation 1, i.e.:

$$\Delta\pi_t = \delta + \sum_{j=1}^{m} \beta_j \Delta\pi_{t-j} + \sum_{j=1}^{n} X_j \Delta\pi_{t-j}^* - \gamma(\pi_{t-1} - \pi_{t-1}^*) + \varepsilon_t \qquad (3)$$

In the above expression if the parameter γ is statistically different from zero, then it implies that π^* is an attractor of π. In other words, if there is deviation in the two inflation series owing to temporary shocks, headline inflation would converge towards the estimated core inflation in the long-run. On the other hand, if $\gamma = 0$, then the estimated core inflation series does not satisfy this desirable criteria.

The third desirable property for a core inflation measure is to ensure that in case of short-term deviations in the headline and core inflation trends, only the former should move towards the latter. If this is not the case, then core inflation at a point in time may not correctly predict future path of the headline inflation. This condition can be checked by estimating following error-correction model:

$$\Delta\pi_t^* = \omega + \sum_{j=1}^{m} \sigma_j \Delta\pi_{t-j}^* + \sum_{j=1}^{n} \theta_j \Delta\pi_{t-j} - \lambda(\pi_{t-1} - \pi_{t-1}^*) + \nu_t \qquad (4)$$

In the above expression λ should be equal to zero to ensure that the estimated core inflation will not coverage towards headline inflation in the case of any deviation in the two series. Also if $\theta_1 = \theta_2 = \ldots \theta_j = 0$ in equation 4, then this implies that estimated core inflation series is strongly exogenous, which means that headline inflation does not granger-cause core inflation. In case this condition is not met, while $\lambda = 0$, then π^* is termed as weakly exogenous. Or in this case, headline inflation does contain predictive contents for the estimated core inflation measure, though the latter would not converge toward the former.

Equations 2 to 4 are estimated for the seven alternative series of core inflation measures and results are summarized in **Table 2**. Both non-food non-energy methods failed to satisfy the desirable properties. Results of equation 2 for NFNE measure suggest that it is not co-integrated with headline inflation. Since the other two properties are contingent upon this long-run (co-integration) relationship, equation 3 and 4 are not estimated for NFNE. NFNE2 measure failed to satisfy the third

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property; as it also converges towards headline inflation and makes it difficult to predict the future paths of both headline and core inflation.

The other measures of core inflation, including NPFNE, twenty percent trimmed mean, and the three alternative RSC-CPI based measure, satisfy all the three desirable properties.

Only NPFNE is, however, found to be strongly exogenous, while the others are found as weakly exogenous. A variable, such as monetary policy rate that affects both the core and headline inflation in a similar manner, may explain this weak exogeneity of core inflation measures.

Relative Performance

Findings from the previous section suggest that except NFNE and NFNE2, all the other measures under review can potentially be used as an estimator of core inflation in Pakistan. This section compares performance of each of these core inflation measures in relative terms by testing following characteristics or conditions:

- Long-term average of the core inflation should not be statistically different from that of headline inflation.
- Core inflation should be less volatile than headline inflation
- Core inflation measure should match the movements in the trend rate of inflation overtime.

Performance of the core inflation measures against these characteristics and other statistical properties are compared and summarized in **Table 3** and **Table 4**. Consistent with the findings of previous section, only long-term averages of NFNE and NFNE2 are statistically different from that of headline inflation. For all the other measures, we failed to reject the null hypothesis that means of core and headline inflations are equal.

Statistical comparison of standard deviation of headline inflation and core inflation suggests that all the measures, except NPFNE, are significantly less volatile then headline inflation. Standard deviation of NPFNE measure is not statistically different from that of headline inflation. Coefficient of variation and mean absolute change measure also suggest that NPFNE measure is the most volatile. Stable component based measures show lower volatility than the other measures.

In order to test the third characteristic, root mean squared error (RMSE) of the differences between trend headline and core inflation are computed. Measure that is associated with lower RMSE is considered as a better estimator of core inflation. Two measures of trend headline inflation are derived by applying HP and Baxter-King filters on YoY CPI inflation series. In both the cases, RSC-CPI 2 shows the lowest and NFNE2 shows highest RMSE.

Figure 1 and **Figure 2** that plot headline and various core inflation series also depict that trimmed mean and RSC-CPI based measures are relatively more stable and more closely follow the trends in headline inflation than the other measures. Figure 3 depicts the price behavior of relatively volatile components and compares it with CPI trends. Volatility of these components is visually apparent.

Robustness

Our new core inflation measure was isolated from a trimming (weighted) exercise carried out on past monthly data of CPI. We were restricted to use monthly data starting from July 2008 because the earlier CPI basket was based on the consumer expenditure patterns of 2000-2001, in contrast with the new basket based on 2007-2008. A natural question arises as to how 'robust' is the composition of our RSC-CPI. Does it differ significantly from the component that would have obtained if trimming was applied on old basket? To answer this question, we repeated our method on past CPI basket monthly data running from July 2001 to June 2008.

Since the old basket had 92 composite commodities compared with 89 in new CPI basket, and the old monthly series entailed 83 monthly trims as opposed to 55 monthly trims in new series, it is better to look at the percentage of times that various commodities got trimmed out in these two trimming exercises. These percentages were quite close to each other. For example, 'onion' got trimmed out in 55 out of 55 trims (100%) in the new basket, whereas it got trimmed out in 80 out of 83 trims (96.4%) in the old basket. Percentage point difference in this instance is 3.6. These percentage point differences were within 10 for the 23 out of 29 identical commodities excluded from both the old and new baskets as shown in **Table 5**.

While it is difficult to establish the extent of 'permanence' of the volatile items in temporally-apart non-identical baskets, above illustrations indicate that volatile items identified through trimming are similar in both baskets. Since new CPI basket will always have some new items, it is desirable that this method should be repeated every five years or so to isolate a more relatively stable component from CPI. This will help the new core inflation measure to continue exhibiting desirable properties in terms of Marques et al.

IV. Conclusions

We have proposed a new way for estimating core inflation measure and applied it on Pakistan CPI. This technique essentially combines trimming with exclusion-based approach. A relatively stable component of CPI (RSC-CPI) is identified by excluding those items that were trimmed out the most number of times in past monthly CPI data. Three alternative measures were estimated in this way based on excluding items that were trimmed out at least 10, 13 or 16 times in past 55 monthly weighted trims of CPI during July 2008 to February 2013.

We compare these three alternative RSC-CPI measures with four other measures of core inflation. We found RSC-CPI 2 (based on permanently excluding those items that were trimmed at least 13 times) to be the best performing in terms of desirable properties of a core inflation measure specified by Marques et al (2003) and various relative performance indicators.

This new measure is also largely free of weaknesses pointed out by Walsh (2011) as RSC-CPI includes the persistent component of food as well as non-food portions of CPI. In our view, this new measure can provide a useful input in monetary policy decision-making in Pakistan. It also has the potential to replace NFNE-CPI as the core inflation measure in terms of transparency and acceptability, if adopted officially by SBP for monthly communication through its website and Monthly Inflation Monitor.

An incidental, but important finding of our comparison exercise is that the core inflation monitored by IMF for Pakistan (based on stripping food, energy and transportation components) is the worst performing among exclusion-based and our proposed measures of core inflation.

References

Clark, Todd E. 2001. "Comparing Measures of Core Inflation", Federal Reserve Bank of Economic Review, second quarter.
http://www.kansascityfed.org/PUBLICAT/ECONREV/PDF/2q01clar.pdf

Detmeister, Alan K. June 2012. *"What Should Core Inflation Exclude?"*, Finance and Economics Discussion Series, Federal Reserve Board, Washington, D.C.
http://ssrn.com/abstract=2191268

Gupta, Souvik and Magnus Saxegaard. August 2009, *"Measures of Underlying Inflation in Sri Lanka"*, IMF working paper no 167.
http://www.imf.org/external/pubs/ft/wp/2009/wp09167.pdf

Laflèche, Thérèse and Jamie Armour. 2006, "*Evaluating Measures of Core Inflation*", Bank of Canada review, summer.

International Monetary Fund (IMF). September 2013. Pakistan: IMF Country Report No.13/287

Lodhi, Muhammad Amin Khan. June 2007, *"Evaluating Core Inflation Measures in Pakistan"*, SBP Working Paper No 18.
http://www.sbp.org.pk/publications/wpapers/2008/wp18.pdf

Marques, C., P. Neves, and L. Sarmento. 2000. *"Evaluating Core Inflation Indicators."* Bank of Portugal Working Paper No. 3.

Marques, C., P. Neves, and L. Sarmento. 2003. *"Evaluating Core Inflation Indicators."* Economic Modeling, 20, pp 765-775

Pakistan Bureau of Statistics (PBS). *"Monthly Review on Price Indices"*, various issues.

Pedersen, Michael. 2005, *"An Alternative Measure of Core Inflation"*, Danmarks National Bank Working Paper No 33.
http://www.nationalbanken.dk/C1256BE9004F6416/side/FAF465DB9DD84F3AC12570D60032991A/$file/wp33_samlet.pdf

Rich, Robert and Charles Steindel. December 2007. *"A Comparison of Measures of Core Inflation"*, Federal Reserve Bank of New York Economic Policy Review.

Tahir, Sadia. September 2003. *"Core Inflation Measures for Pakistan"*, SBP Working Paper No 4. http://www.sbp.org.pk/publications/wpapers/2008/wp04.pdf

Walsh, James P. April 2011. "*Reconsidering the Role of Food Prices in Inflation*", IMF Working Paper WP/11/71.

Table 1: Results of Stationarity Tests on YoY Inflation Series

	level		First difference	
	ADF test statistics	Prob.	ADF test statistics	Prob.
CPI	-0.11	0.64	-5.71	0.00
NFNE	-0.59	0.46	-5.07	0.00
NFNE2	0.15	0.73	-11.48	0.00
NPFNE	-0.03	0.67	-3.86	0.00
20% Trimmed	0.03	0.69	-4.62	0.00
RSC - CPI 1	-0.83	0.36	-3.35	0.00
RSC - CPI 2	-0.87	0.34	-3.77	0.00
RSC - CPI 3	-0.71	0.41	-4.52	0.00

Table 2: Results of Test Applied on Various Measures of Core Inflation

	Condition 1		Condition 2	Condition 3		Conclusion
	(a) $(\pi - \pi^*)$ is Stationary	(b) $\alpha = 0$; given (a) holds	π^* is an attractor of π ($\Upsilon = 0$)	π is an attractor of π^* ($\lambda = 0$)	Strong exogeneity ($\theta_1 = \theta_2 \dots \theta_s = 0$)	
NFNE	No ADF = -2.14	n.a	n.a	n.a	n.a	Failed
NFNE2	Yes ADF = -3.46	Yes P-val = 0.13	Yes P-val = 0.00	Yes P-val = 0.05	n.a	Failed on condition 3
NPFNE	Yes ADF = -2.70	Yes P-val = 0.92	Yes P-val = 0.01	No P-val = 0.14	Yes $F(3,114) = 1.77$	Ok (strong exogneity)
20% Trimmed	Yes[#] ADF = -2.56	Yes P-val = 0.41	Yes P-val = 0.03	No P-val = 0.78	No $F(4,113) = 3.95$	Ok (weak exogneity)
RSC - CPI 1	Yes[#] ADF = -2.56	Yes P-val = 0.63	Yes P-val = 0.00	No P-val = 0.72	No $F(3,114) = 2.28$	Ok (weak exogneity)
RSC - CPI 2	Yes ADF = -3.10	Yes P-val = 0.25	Yes P-val = 0.00	No P-val = 0.23	No $F(4,114) = 3.61$	Ok (weak exogneity)
RSC - CPI 3	Yes ADF = -3.05	Yes P-val = 0.27	Yes P-val = 0.00	No P-val = 0.24	No $F(4,115) = 5.09$	Ok (weak exogneity)

n.a. : not applicable;   #: at 10% level of significance

Note: **RSC - CPI 1:** by excluding items that were trimmed out 10 times or more during July 2008 to February 2013.

   RSC - CPI 2: by excluding items that were trimmed out 13 times and more during July 2008 to February 2013.

   RSC - CPI 3: by excluding items that were trimmed out 16 times and more during July 2008 to February 2013.

Table 3: Relative Performance of Core Inflation Measures

	Mean		Standard deviation			Coefficient of variation	Mean absolute change	RMSE	
	Value	T-test for equality[1]	Value	F-test for equality[2]				HP filter	Baxter-King filter
CPI	9.92	-	5.14	-		51.78	0.89	-	-
NFNE	8.18	P-val = 0.00	3.97	F = 1.67	*	48.59	0.39	977	331
NFNE2	7.71	P-val = 0.00	3.44	F = 2.23	*	44.58	0.70	1534	1529
NPFNE	9.80	P-val = 0.85	5.10	F = 1.02	#	52.02	0.69	1300	290
20% Trimmed	9.26	P-val = 0.28	4.59	F = 1.25	**	49.56	0.55	918	296
RSC - CPI 1	9.27	P-val = 0.27	4.10	F = 1.57	*	44.21	0.38	765	267
RSC - CPI 2	9.16	P-val = 0.19	4.13	F = 1.55	*	45.11	0.42	753	220
RSC - CPI 3	9.16	P-val = 0.20	4.33	F = 1.41	*	47.28	0.46	770	268

[1]: Null hypothesis is that long-term mean of YoY core inflation measure is equal to that of CPI inflation.

[2]: Null hypothesis is that variance of YoY core inflation measure is equal to that of CPI inflation, with alternate hypothesis that variance of the CPI inflation is higher.

#: failed to reject the null hypothesis at 10 percent level of significance

*: null hypothesis rejected at 5 percent level of significance

**: null hypothesis rejected at 10 percent level of significance

Table 4 Summary Statistics

	CPI	NFNE	NFNE2	NPFNE	20% TRIMMED	RSC – CPI option 1	option 2	option 3
Mean	9.9	8.2	7.7	9.8	9.3	9.3	9.2	9.2
Median	8.9	7.8	7.6	9.0	8.6	8.6	8.4	8.0
Maximum	25.3	19.0	14.9	26.0	21.7	20.5	20.6	21.9
Minimum	1.4	2.0	1.5	2.5	2.3	2.3	2.3	2.9
Std. Dev.	5.1	4.0	3.4	5.1	4.6	4.1	4.1	4.3
Skewness	1.1	0.9	0.1	1.3	0.9	0.7	0.8	0.9
Kurtosis	4.4	4.0	2.2	4.8	3.8	3.6	3.7	3.7
Jarque-Bera	37.1	23.8	3.4	51.9	19.4	12.2	15.9	19.6
Probability	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Sum	1270	1046	987	1254	1185	1187	1172	1172
Sum Sq. Dev.	3351	2004	1500	3300	2673	2134	2167	2381
Observations	128	128	128	128	128	128	128	128
Memorandum items								
Weight in CPI	**100**	**54**	**26**	**86**	**80**	**55**	**68**	**77**

Table 5 (a): Comparison of Identical Commodities of Volatile Baskets from Old and New base

	No. of months covered	83	55					
		Weight		No. of times excluded		% change of being excluded		Percentage point difference
Sr.No.	Items	Base 2000-01	Base 2007-08	Base 2000-01	Base 2007-08	Base 2000-01	Base 2007-08	
1	Onion	0.6362	0.5417	80	55	96.4	100.0	3.6
2	Tomatoes	0.4958	0.4496	78	53	94.0	96.4	2.4
3	Fresh Fruits	1.6156	1.8649	66	50	79.5	90.9	11.4
4	Eggs	0.4119	0.4555	75	47	90.4	85.5	-4.9
5	Fresh Vegetable	1.7998	1.6571	74	47	89.2	85.5	-3.7
6	Potatoes	0.5931	0.4776	73	46	88.0	83.6	-4.3
7	Chicken	0.9158	1.3596	75	46	90.4	83.6	-6.7
8	Sugar	1.9467	1.0445	58	34	69.9	61.8	-8.1
9	Gur	0.0735	0.0220	54	31	65.1	56.4	-8.7
10	Pulse Moong	0.2230	0.2336	51	29	61.4	52.7	-8.7
11	Pulse Masoor	0.2214	0.2712	41	29	49.4	52.7	3.3
12	Pulse Mash (Washed)	0.2017	0.2098	46	28	55.4	50.9	-4.5
13	Fish	0.2703	0.2970	33	26	39.8	47.3	7.5
14	Pulse Gram	0.4272	0.2361	50	26	60.2	47.3	-13.0
15	Kerosene Oil	0.1366	0.0057	44	24	53.0	43.6	-9.4
16	Vegetable Ghee	2.6672	2.0714	35	23	42.2	41.8	-0.4
17	Besan	0.1320	0.1500	46	22	55.4	40.0	-15.4
18	Wheat Flour	5.1122	4.1648	32	20	38.6	36.4	-2.2
19	Cooking Oil	0.6858	1.7538	23	19	27.7	34.5	6.8
20	Gram Whole	0.1491	0.1616	43	19	51.8	34.5	-17.3
21	Spices	0.6008	0.5441	26	19	31.3	34.5	3.2
22	Wheat	0.4830	0.3477	47	18	56.6	32.7	-23.9
23	Mustard Oil	0.0456	0.0952	31	17	37.3	30.9	-6.4
24	Dry Fruits	0.2760	0.2543	25	17	30.1	30.9	0.8
25	Wheat Product	0.1059	0.0959	19	14	22.9	25.5	2.6
26	Electricity	4.3698	4.3985	21	13	25.3	23.6	-1.7
27	Tea	1.2559	0.8377	19	13	22.9	23.6	0.7
28	Betel Leaves & Nuts	0.1851	0.0229	41	13	49.4	23.6	-25.8
29	Woolen Readymade Garments	0.1485	0.3964	24	13	28.9	23.6	-5.3

Table 5 (b): Comparison of Non-Identical Commodities of Volatile Baskets from Old and New base

	Base 2000-01			Base 2007-08		
Sr.No.	Items	Weight	No. of times excluded	Items	Weight	No. of times excluded
1	Jewellery	0.3936	44	Motor Fuel	3.0269	28
2	Diesel	0.2070	37	Personal Equipments	0.8440	23
3	Computer & Allied Products	0.0525	36	Honey	0.0446	22
4	Natural Gas	2.0458	35	Water Supply	0.4971	21
5	Petrol	1.7253	33	Fire Wood Whole	0.2277	19
6	Condiments	0.3392	33	Medical Equipment	0.0080	17
7	Beverages	0.7286	32	Beans	0.0269	16
8	Bulb & Tube	0.1311	23	Rice	1.5821	15
9	Refrigerator & Airconditioner	0.1756	21	Doctor (MBBS) Clinic Fee	0.5904	14
10	Cigarettes	0.9527	19	Household Servent	1.0432	14

Note: The items which have been excluded 13 or more times while calculating 20% trimmed mean inflation (MoM) for the period Jul08 - Feb13 is said to be volatile items while the rest of these are named as stable items.

Figure 1: Comparative Trends of YoY Headline and Existing Core Inflation Measures (in percent)
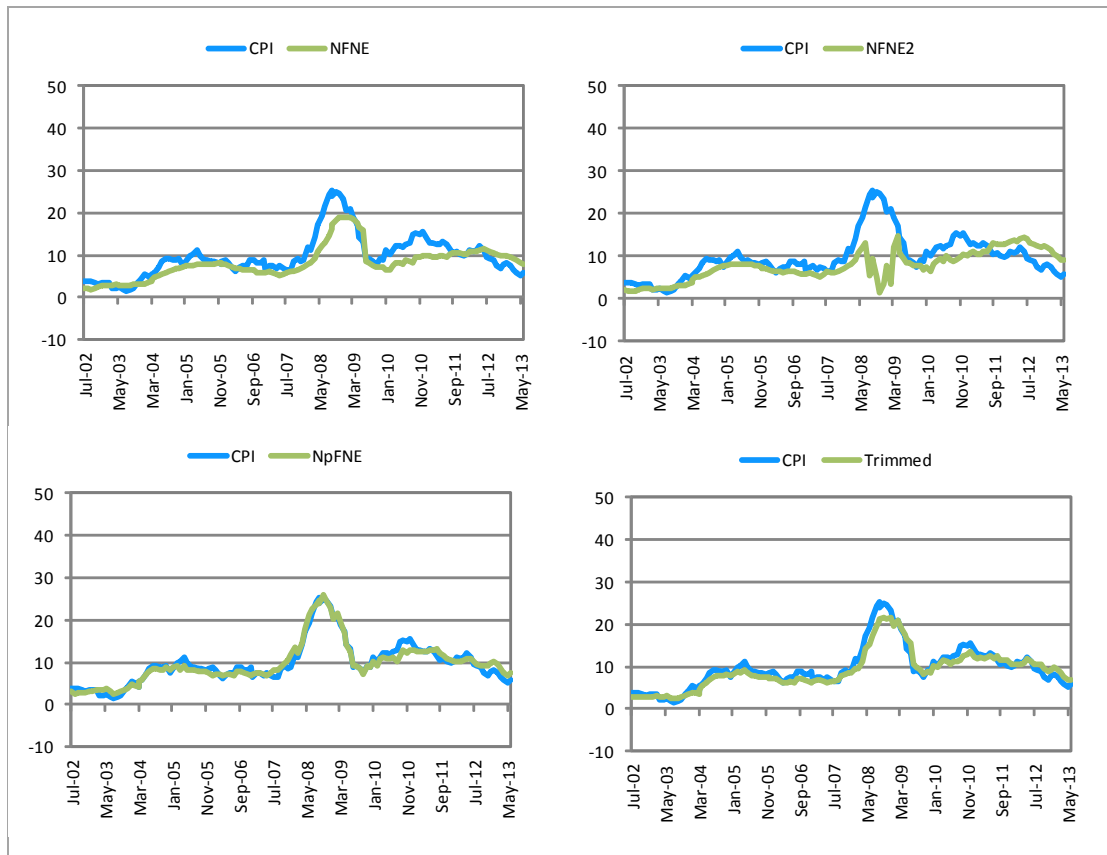
Figure 2: Comparative Trends of YoY Headline and Relative Stable Components of VPI (in percent)
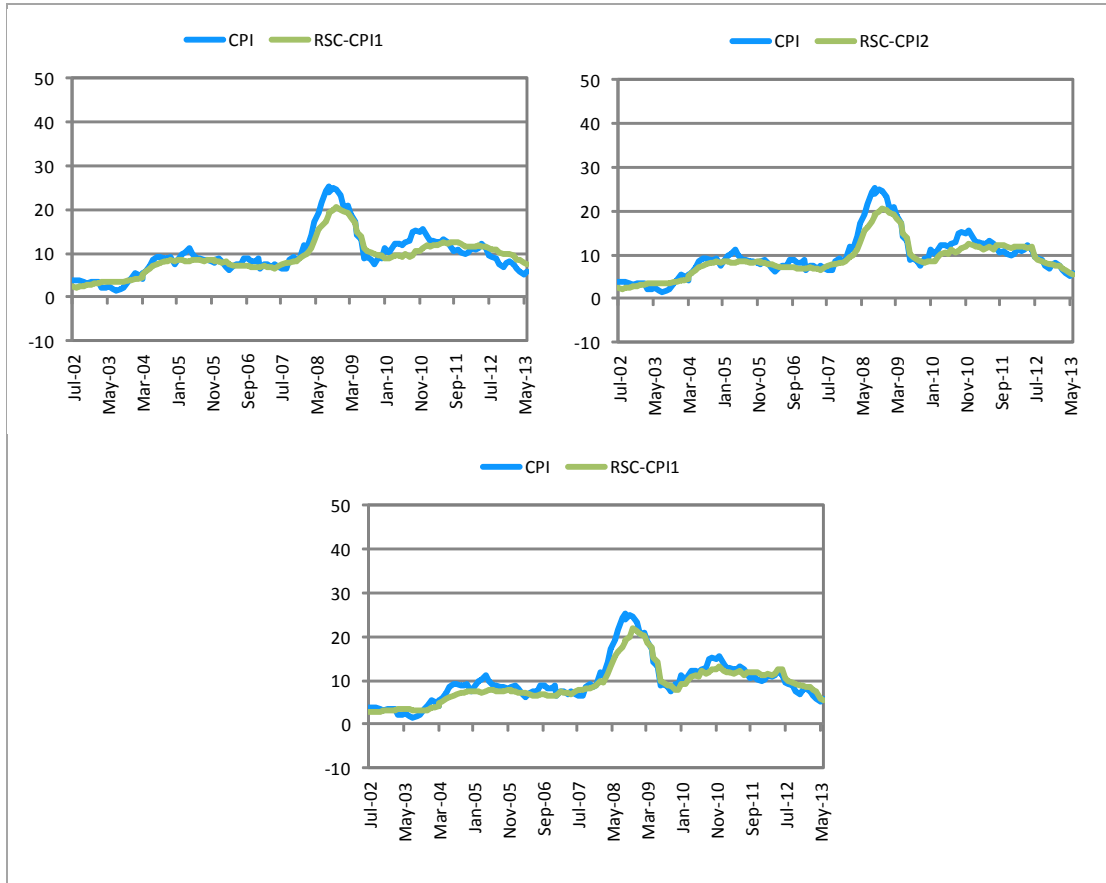
Figure 3: **Comparative Trends of YoY Headline and Relatively Volatile Components of CPI** (in percent)

Annexure 1: Commodities Identified to be excluded from CPI Basket for Computing RSC-CPI

RSC-CPI 1

CPI Group	Commodities Excluded	Commodities Included
Food & Non-Alcoholic Beverages	Beans, Besan, Beverages, Chicken, Cooking Oil, Dry Fruits, Egg, Fish, Fresh Fruits, Fresh Vegetable, Gram Whole, Gur, Honey, Mustard Oil, Onion, Potatoes, Pulse Gram, Pulse Mash (Washed), Pulse Masoor, Pulse Moong, Rice, Spices, Sugar, Tea, Tomatoes, Vegetable Ghee, Wheat, Wheat Flour, Wheat Product (29)	Bakery & Confectionary, Cereals, Condiments, Jam, Tomato Ketchup & Pickle, Meat, Milk Fresh, Milk Powder, Milk Product, Nimco, Sweet Meat (10)
Alcoholic Beverages, Tobacco	Betel Leaves & Nuts, Cigarette (2)	(0)
Clothing & Footwear	Cleaning & Laundering, Cotton Cloth, Woolen Readymade Garments (3)	Dopatta, Footwear, Hosiery, Ready Made Garment, Tailoring, Woolen Cloth (6)
Housing,Water,Elect,Gas & Other Fuel	Electricity, Fire Wood Whole, Gas, Kerosene Oil, Water Supply (5)	Construction Input Item, Construction Wage Rate, House Rent (3)
Furnished H.Hold Equip.& Mant Etc	Household Servant, Marriage Hall Charges, Washing Soap & Detergent (3)	Furniture, Household Equipment, Household Textile, Plastic Products, Sewing Needle & Dry Cell, Utensils (6)
Health	Doctor (MBBS) Clinic Fee, Medical Equipment (2)	Drug Medicine, Medical Test (2)
Transport	Motor Fuel, Transport Services (2)	Mechanical Service, Motor Vehicle Tax, Motor Vehicle, Motor Vehicle Accessories (4)
Communication	Communication & Apparatus (1)	Postal Services (1)
Recreation & Culture	(0)	News Papers, Recreation & Culture, Stationery, Text Books (4)
Education	(0)	Education (1)
Restaurants and Hotels	(0)	Ready Made Food (1)
Miscellaneous Goods and Services	Personal Equipments (1)	Blades, Cosmetics, Personal Care (3)
Total	**48**	**41**

RSC-CPI 2

CPI Group	Commodities Excluded	Commodities Included
Food & Non-Alcoholic Beverages	Beans, Besan, Chicken, Cooking Oil, Dry Fruits, Egg, Fish, Fresh Fruits, Fresh Vegetable, Gram Whole, Gur, Honey, Mustard Oil, Onion, Potatoes, Pulse Gram, Pulse Mash (Washed), Pulse Masoor, Pulse Moong, Rice, Spices, Sugar, Tea, Tomatoes, Vegetable Ghee, Wheat, Wheat Flour, Wheat Product (28)	Bakery & Confectionary, Beverages, Cereals, Condiments, Jam, Tomato Ketchup & Pickle, Meat, Milk Fresh, Milk Powder, Milk Product, Nimco, Sweet Meat (11)
Alcoholic Beverages, Tobacco	Betel Leaves & Nuts (1)	Cigarette (1)
Clothing & Footwear	Woolen Readymade Garments (1)	Cleaning & Laundering, Cotton Cloth, Dopatta, Footwear, Hosiery, Ready Made Garment, Tailoring, Woolen Cloth (8)
Housing,Water,Elect,Gas & Other Fuel	Electricity, Fire Wood Whole, Kerosene Oil, Water Supply (4)	Construction Input Item, Construction Wage Rate, Gas, House Rent (4)
Furnished H.Hold Equip.& Mant Etc	Household Servant (1)	Furniture, Household Equipment, Household Textile, Marriage Hall Charges, Plastic Products, Sewing Needle & Dry Cell, Utensils, Washing Soap & Detergent (8)
Health	Doctor (MBBS) Clinic Fee, Medical Equipment (2)	Drug Medicine, Medical Test (2)
Transport	Motor Fuel (1)	Mechanical Service, Motor Vehicle Tax, Motor Vehicle, Motor Vehicle Accessories, Transport Services (5)
Communication	(0)	Communication & Apparatus, Postal Services (2)
Recreation & Culture	(0)	News Papers, Recreation & Culture, Stationery, Text Books (4)
Education	(0)	Education (1)
Restaurants and Hotels	(0)	Ready Made Food (1)
Miscellaneous Goods and Services	Personal Equipments (1)	Blades, Cosmetics, Personal Care (3)
Total	**39**	**50**

RSC-CPI 3

CPI Group	Commodities Excluded	Commodities Included
Food & Non-Alcoholic Beverages	Beans, Besan, Chicken, Cooking Oil, Dry Fruits, Egg, Fish, Fresh Fruits, Fresh Vegetable, Gram Whole, Gur, Honey, Mustard Oil, Onion, Potatoes, Pulse Gram, Pulse Mash (Washed), Pulse Masoor, Pulse Moong, Spices, Sugar, Tomatoes, Vegetable Ghee, Wheat, Wheat Flour (25)	Bakery & Confectionary, Beverages, Cereals, Condiments, Jam, Tomato Ketchup & Pickle, Meat, Milk Fresh, Milk Powder, Milk Product, Nimco, Rice, Sweet Meat, Tea, Wheat Product (14)
Alcoholic Beverages and Tobacco	(0)	Betel Leaves & Nuts, Cigarette (2)
Clothing and Footwear	(0)	Cleaning & Laundering, Cotton Cloth, Dopatta, Footwear, Hosiery, Ready Made ,Garment Tailoring, Woolen Cloth, Woolen Readymade Garments (9)
Housing,Water,Elect,Gas & Other Fuel	Fire Wood Whole, Kerosene Oil, Water Supply (3)	Construction Input Item, Construction Wage Rate, Electricity, Gas, House Rent (5)
Furnished Household Equip & Maint	(0)	Furniture, Household Equipment, Household Servant, Household Textile, Marriage Hall Charges, Plastic Products, Sewing Needle & Dry Cell, Utensils, Washing Soap & Detergent (9)
Health	Medical Equipment (1)	Doctor (MBBS) Clinic Fee, Drug Medicine, Medical Test (3)
Transport	Motor Fuel (1)	Mechanical Service, Motor Vehicle Tax, Motor Vehicle, Motor Vehicle Accessories, Transport Services (5)
Communication	(0)	Communication & Apparatus, Postal Services (2)
Recreation & Culture	(0)	News Papers, Recreation & Culture, Stationery, Text Books (4)
Education	(0)	Education (1)
Restaurants and Hotels	(0)	Ready Made Food (1)
Miscellaneous Goods and Services	Personal Equipments (1)	Blades, Cosmetics, Personal Care (3)
Total	**31**	**58**

Annexure 2

Sr. No.	Consumer Price Index (CPI) Groups	Weight	RSC-CPI1 NC	RSC-CPI1 Weight	RSC-CPI2 NC	RSC-CPI2 Weight	RSC-CPI3 NC	RSC-CPI3 Weight	RVC-CPI1 NC	RVC-CPI1 Weight	RVC-CPI2 NC	RVC-CPI2 Weight	RVC-CPI3 NC	RVC-CPI3 Weight
	General													
1	Food & Non-Alcoholic Beverages	34.83	10	12.39	11	13.58	14	16.10	29	22.45	28	21.25	25	18.73
2	Alcoholic Beverages & Tobacco	1.41	-	-	1	1.39	2	1.41	2	1.41	1	0.02	-	-
3	Clothing & Footwear	7.57	6	5.23	8	7.17	9	7.57	3	2.34	1	0.40	-	-
4	Housing, Water, Elect, Gas & other Fuels	29.41	3	22.71	4	24.29	5	28.68	5	6.70	4	5.13	3	0.73
5	Furnishing & Household Equip. Maintenance etc	4.21	6	2.30	8	3.17	9	4.21	3	1.91	1	1.04	-	-
6	Health	2.19	2	1.59	2	1.59	3	2.18	2	0.60	2	0.60	1	0.01
7	Transport	7.20	4	1.47	5	4.18	5	4.18	2	5.73	1	3.03	1	3.03
8	Communication	3.22	1	0.07	2	3.22	2	3.22	1	3.15	-	-	-	-
9	Recreation & Culture	2.02	4	2.02	4	2.02	4	2.02	-	-	-	-	-	-
10	Education	3.94	1	3.94	1	3.94	1	3.94	-	-	-	-	-	-
11	Restaurant & Hotels	1.23	1	1.23	1	1.23	1	1.23	-	-	-	-	-	-
12	Miscellaneous	2.76	3	1.91	3	1.91	3	1.91	1	0.84	1	0.84	1	0.84
	Total	**100.00**	**41**	**54.86**	**50**	**67.69**	**58**	**76.66**	**48**	**45.14**	**39**	**32.31**	**31**	**23.34**

Annexure 3
Commodity Groups and 89 Commodities of CPI (Base year: 2007-08)

Group	Items	Weight	Group	Items	Weight
Food & Non-Alcoholic Beverages.		**34.8343**		Tailoring	0.8840
	Wheat	0.3477		Footwear	1.5504
	Wheat Flour	4.1648	**Housing,Water,Elect,Gas & Other Fuel**		**29.4149**
	Wheat Product	0.0959		House Rent	21.8149
	Besan	0.1500		Construction Input Item	0.5623
	Rice	1.5821		Construction Wage Rate	0.3331
	Cereals	0.1563		Water Supply	0.4971
	Bakery & Confectionary	1.1550		Electricity	4.3985
	Nimco	0.4574		Gas	1.5756
	Meat	2.4303		Kerosene Oil	0.0057
	Chicken	1.3596		Fire Wood Whole	0.2277
	Fish	0.2970	**Furnished H.Hold Equip.& Mant Etc**		**4.2082**
	Milk Fresh	6.6800		Furniture	0.3315
	Milk Product	0.6338		Household Textile	0.6489
	Milk Powder	0.1129		Household Equipment	0.5936
	Egg	0.4555		Utensils	0.3212
	Mustard Oil	0.0952		Plastic Products	0.2547
	Cooking Oil	1.7538		Washing Soap & Detergent	0.7893
	Vegetable Ghee	2.0714		Sewing Needle & Dry Cell	0.1496
	Dry Fruits	0.2543		Household Servant	1.0432
	Fresh Fruits	1.8649		Marriage Hall Charges	0.0762
	Pulse Masoor	0.2712	**Health**		**2.1868**
	Pulse Moong	0.2336		Drug Medicine	1.2667
	Pulse Mash (Washed)	0.2098		Medical Equipment	0.0080
	Pulse Gram	0.2361		Doctor (MBBS) Clinic Fee	0.5904
	Gram Whole	0.1616		Medical Test	0.3217
	Beans	0.0269	**Transport**		**7.2023**
	Potatoes	0.4776		Motor Vehicle	0.6630
	Onion	0.5417		Motor Vehicle Accessories	0.2439
	Tomatoes	0.4496		Motor Fuel	3.0269
	Fresh Vegetable	1.6571		Mechanical Service	0.4552
	Sugar	1.0445		Motor Vehicle Tax	0.1099
	Gur	0.0220		Transport Services	2.7034
	Honey	0.0446	**Communication**		**3.2198**
	Sweet Meat	0.2483		Postal Services	0.0662
	Beverages	1.1990		Communication & Apparatus	3.1536
	Jam, Tomato Ketchup & Pickle	0.2454	**Recreation & Culture**		**2.0227**
	Condiments	0.2656		Recreation & Culture	0.8634
	Spices	0.5441		Text Books	0.5706
	Tea	0.8377		News Papers	0.1934
Alcoholic Beverages, Tobacco		**1.4135**		Stationery	0.3953
	Cigarette	1.3906	**Education**		**3.9431**
	Betel Leaves & Nuts	0.0229		Education	3.9431
Clothing & Footwear		**7.5708**	**Restaurants and Hotels**		**1.2286**
	Cotton Cloth	1.7286		Ready Made Food	1.2286
	Woolen Cloth	0.8759	**Miscellaneous Goods and Services**		**2.7550**
	Ready Made Garment	0.9739		Personal Care	1.4935
	Woolen Readymade Garments	0.3964		Cosmetics	0.3853
	Hosiery	0.5094		Blades	0.0322
	Dopatta	0.4412		Personal Equipments	0.8440
	Cleaning & Laundering	0.2110			

Source: Pakistan Bureau of Statistics