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A Measure of Core Inflation in Bangladesh

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Abstract
Core inflation refers to the persistent or general part of headline inflation that is free from temporary noise. The temporary noise parts are explained by the non-monetary events, such as sector specific shocks. It is argued that the trend in core inflation and not CPI should guide the formulation of monetary policy, and in providing policy accountability for the Central Banks. While it has now become a standard practice for most Central Banks around the world to monitor core inflation, no progress has so far been made in the Bangladesh context. This paper takes a pioneering look in measuring core inflation in Bangladesh, focusing on the popular exclusion and trimmed mean approaches. The performance criteria adopted in this study shows the superiority of trimmed mean measures over the exclusion measures of core inflation in Bangladesh.

Key words: *Core Inflation, Exclusion method, Trimmed mean*

JEL classification: E31

1.   Introduction

The central objective of monetary policy in Bangladesh is to maintain *price stability* while maintaining highest sustainable output growth. By tradition, the *price stability* objective of the Bangladesh Bank (BB) has been guided by developments (12-month moving average and point-to-point) in the consumer price index (CPI). However, focusing on the changes in total CPI as an operational guide to monetary policy requires qualifications because some volatile and non-trend components can rob the headline inflation of its credibility as a short or medium term guide to the operation of monetary policy (Berkmen, 2002, p. 2, Bagliano and Morana, 2003, p. 198). [1]

Sources of short-term fluctuations may be some components of CPI that are transitory and easily reversible. These components may be characterized by high volatility to the supply shocks like climatic conditions (e.g., drought, flood, and monsoon), external trade environment, and other transitory phenomena. Bryan and Cecchetti (1993) argued that transitory fluctuations in the price level caused by non-monetary events, such as sector specific shocks or measurement errors, should not reflect in the policy decisions of the monetary authority as these price changes do not constitute underlying monetary inflation. Hence, headline price inflation (e.g.., CPI) loses its credibility as a short or medium-run operational guide to monetary policy.

The concept of core inflation is thus to separate the persistent or general components of headline inflation, which contains the most relevant information regarding monetary policy operation. Here is the clear departure from the so-called headline inflation based on cost of living index to the core inflation based on monetary phenomena.[2] As for example, inflation that is caused by the non-monetary events such as sector specific shocks or measurement errors can have transitory impact on cost of living, but monetary authorities have little to do with it because these price changes do not constitute underlying monetary inflation. Monetary policy decisions need to be credible, and so that these are not subject to quick reversal because of such short-term fluctuations.

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[1] See Shahiduzzaman (2006) for an example.
[2] Wynne (1999) notes that "….for the purpose of monetary policy what is needed is not a microeconomic theory of the cost of living, but a macroeconomic theory of the cost of inflation".

In light of these policy considerations, it has now become a standard practice for central banks around the world to monitor the core inflation. As for example, while the Bank of Canada uses the changes in total CPI as the inflation-control target, core inflation is used as a shorter-term operational guide to its monetary policy formulation (Macklem, 2001). In the Philippines, the National Statistics Office (NSO) began publishing official core inflation, alongside the CPI headline inflation from February 2004. Other countries like Korea, Thailand and United States (US) also routinely publish and monitor core inflation measures.

Thus far, the Bangladesh Bank monitors the twelve-month moving average in defining the underlying trend that averages out the short-term or transitory components in total CPI. While the moving average or other smoothing measures tend to reduce the volatility, and may better reflect the persistent element, it affects the timeliness of the data. The average inflation series is dominated by past rather than the current inflation, and hence loses the relevance for the immediate policy stance of the monetary authority. The point-to-point inflation, which reflects the current price development better, however, is highly distorted by the short-term fluctuations that limit its accuracy as a short-term policy guide. Given this context, a suitable measure of core inflation is warranted in the Bangladesh context, which reflects both the current dynamics and underlying trend of price development.

A common approach in measuring core inflation is the exclusion method.[3] The exclusion method requires taking subjective decision of excluding particular prices from the aggregate price index. Other alternative approaches include statistical and model based approaches. The statistical approach includes the Limited Influence Estimators (LIEs) such as the trimmed mean proposed by Bryan and Cecchetti (1993) and the weighted median. Bryan and Cecchetti (1993) suggested the use of trimmed mean approach if the distribution of the sector specific shocks is skewed. The model-based approach is also

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[3] See for example, Clark (2001) for US, Guinigundo (2004) for Philippines, Macklem (2001) for Canada, Samanta (1999) for India and Tahir (2003) for Pakistan. A more detailed description about different methods of core inflation is incorporated in section 4.

called the economic approach that derives a measure of core inflation using the assumption of long-run neutrality of money.

This study employs the exclusion and trimmed mean approaches to construct the core inflation in Bangladesh. Because, both the exclusion and trimmed mean measures deal with price changes of individual components of CPI, this study gives a considerable space regarding the construction and the statistical characteristics of the price data in Bangladesh.

The outline of the paper is as follows. Following the introduction in section 1, section 2 reviews the literature on core inflation. Section 3 revisits the construction of CPI and statistical characteristics of price data in Bangladesh, while section 4 defines core inflation and estimates alternative measures of core inflation using exclusion and trimmed mean approaches. Finally section 5 offers the conclusion and recommendation.

2. Review of the Literature and Cross Country Official Measures of Core Inflation

Empirical study on the measurement of core inflation in Bangladesh is hitherto non-existent to the author's knowledge. However, studies on core inflation in some developing countries as well as developed countries provide useful lessons to explore the issue in the Bangladesh context. Some of these studies are reviewed below.

Bryan and Cecchetti (1993) examined various alternative methods of measuring core inflation, namely the CPI excluding food and energy, the 15-percent trimmed mean and the weighted median approaches using monthly data from February 1967 to December 1992 for the US economy. They preferred to use the limited-influence estimators to other methods as data shows substantial skewness in the distribution of the sample-a fact also noted by Berkmen (2002) for Turkey, Tahir (2003) for Pakistan and Roger (1998) for New Zealand, among others. The former study finds that the weighted median CPI fares best in comparison to other two measures, establishes the strongest relationships with past money growth and provides improved forecast of future inflation.

Berkmen (2002) compared three different core inflation measures, namely trimmed means, price index excluding food and energy prices, and median inflation for Turkey using monthly data for CPI and WPI from January 1988 to December 2000. Fifty components of CPI and twenty three components of WPI were covered in the analysis. While the sample median provides efficient results, the study reveals that trimmed means provide statistically better estimate in terms of cointegration or long run trend of inflation.

Quah and Vahey (1995) applied a bivariate structural vector autoregression (SVAR) framework consisting only of industrial production and inflation to identify the long run components of inflation for United Kingdom (UK). Bagliano and Morana (2003) extended the model to multivariate one to US inflation consisting four variables, namely oil price, industrial production, nominal M2, and CPI all item price index, and compared the results with two commonly used measures like median inflation and CPI excluding food and energy. The study concludes that the SVAR approach provides additional information regarding the trend behaviour of inflation that is useful for monetary policy

purposes. The core inflation is defined as the long-run forecast of inflation conditional on the information contained in nominal money growth and output fluctuation.

Guinigundo (2004) compared the statistical properties of the official core inflation measure in the Philippines (CPI excluding food and energy) with some other alternative methods namely, a centered 17-month moving average, 15 percent trimmed mean, weighted median and CPI excluding 7 volatile components and these are not limited to food and energy. The study concludes that while the official core measure is found as a stable indicator, alternative measures like LIEs have better predictive capacity of future inflation; hence, the alternative methods should be used as a complement of the official one. However, a recent study on core inflation in the Philippines by Bautista (2005) reveals that the official measure fares well and LIEs performs poorly in terms of statistical tests using cointegration and error correction model.

Durai and Ramachandran (undated) attempted to examine the relative merits of various alternative measures of core inflation for India: (i) exclusion, (ii) trimmed mean, (iii) weighted median, and (iii) common trends. Using monthly data of wholesale price index (WPI) for the period April 1994 to March 2005, the study concludes that the exclusion or limited influence estimators do not meet many empirical criteria like unbiasedness, less variability, close association with policy variables, long run relation etc.[4] The common trend model, however, satisfies all the desirable properties of core inflation and, can potentially be used as a measure of core inflation for policy purpose.

Tahir (2003) have applied exclusion and limited influence estimator approaches to develop measures of core indices. For the exclusion method, the study excluded some volatile components from total CPI, which exhibits coefficient of variation of over 250 percent retaining 90 percent of the weight of total CPI to the core measure where most of the food and energy items like wheat, rice, milk, petrol, natural gas charges were present. Items like seasonal fruits, vegetables, spices, tea etc are excluded. Trimmed mean method was also tried, and the analysis revealed that it provided a better picture than the traditional exclusion method.

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[4] This is to note that WPI serves as an official measure of inflation in India.

The literature review above suggests that there are also some common methods of measuring core inflation. The exclusion method, which is advocated in several papers and is used as an official measure in many countries of the world, is very simple and easy to compute as compared to trimmed mean or model based estimations. The most important characteristics of the exclusion method are that it is very transparent and easily understandable to the public. However, it poses a major limitation to exclude some components in an arbitrary way that may carry useful information regarding the trend inflation. Several authors suggested the use of trimmed mean approaches (e. g., Bryan and Cecchetti, 1993, Bryan, Cecchetti and Wiggins, 1997) if the distribution of the sector specific shocks is skewed. Authors who argue for the economic or model based approaches postulate that other methods (e.g. exclusion, trimmed mean) do not have any theoretical or forward-looking characteristics, which the economic approaches possess. Table 1 summarizes some cross-country measures of core inflation.

3. Revising the Construction of CPI and Statistical Characteristics of Price Data in Bangladesh

3.1: Revising the Construction of CPI in Bangladesh

Bangladesh Bureau of Statistics (BBS) regularly compiles and disseminates CPI at all three levels, national (CPI-N), rural (CPI-R) and urban (CPI-U). CPI-N is simply a weighted average of CPI-R and CPI-U giving 70.89 percent weight to rural and 29.11 percent weight to urban. The consumption pattern of the reference groups (rural and urban households) is determined from the results of the 1995-96 Household Expenditure Survey (HES).

There are 215 goods and services in the CPI-R, and 302 goods and services in the CPI-U. Table 2 notes the weight and number of items of broad commodity groups and subgroups in CPI-R and CPI-U. In the CPI-R, there are 106 items corresponding to the *food, beverage and tobacco* group, and 109 items corresponding to the *non-food* group. In the CPI-U, 113 items corresponding to the *food, beverage and tobacco* group and 189 items corresponding to the *non-food* group. The non-food group consists of a significantly higher number of items in CPI-U than in CPI-R (189 vs. 109).

As seen in the Table 2, the food, beverage and tobacco group holds the majority weight in both CPI-R and CPI-U: 62.96 percent and 48.80 percent respectively. Within the food basket *cereals (rice and other cereals)* comprise the majority (26.72 percent weight in CPI-R and 13.99 percent in CPI-U). *Rice* sub-group alone, which comprises of four items namely (1) r*ice parboiled-medium-aman, broadcast aman (b-aman) and biroi* (2) r*ice (parboiled-medium) aman/atap* (3) r*ice (parboiled-coarse)-aus/boro/IRRI* and (4) rice-*fine*, holds 23.79 percent weight in CPI-R and 11.28 percent weight in CPI-U.

The rice sub-group is followed by *fish (fresh) and dry fish* (9.81 percent weight in CPI-R and 8.14 percent weight in CPI-U), *vegetable* (6.12 percent weight in CPI-R and 4.24 percent weight in CPI-U), *eggs and meat* (3.15 percent weight in CPI-R and 5.15 percent weight in CPI-U), *spices* (2.98 percent weight in CPI-R and 2.23 percent weight in CPI-U) and some other sub-groups as noted in Table 2. Other cereals, which consists of *wheat (atta), muri, chira, and suji,* hold 2.93 percent weight in CPI-R and 3.39 percent weight in CPI-U.

The non-food basket for CPI-U and CPI-R is composed of 7 broad categories and 22 sub-categories. The seven broad categories are: (1) clothing and footwear (6.88 percent weight in CPI-R and 6.79 percent weight in CPI-U) (2) gross rent, fuel and lighting (14.69 percent weight in CPI-R and 22.17 percent in CPI-U) (3) furniture, furnishing, household equipments and operation (2.70 percent weight in CPI-R and 2.58 percent in CPI-U (4) medical care and health expenses (2.79 percent weight in CPI-R and 2.97 percent in CPI-U (5) transport and communication (2.98 percent weight in CPI-R and 7.07 percent in CPI-U (6) recreation, entertainment, education and cultural services (3.20 percent weight in CPI-R and 6.40 percent in CPI-U and (7) miscellaneous goods and services (3.80 percent weight in CPI-R and 3.22 percent in CPI-U).

Among the non-food categories, *gross rent, fuel and lighting* category holds a majority weight in both CPI-R and CPI-U, which is composed by *gross house rent* (5.99 percent weight in CPI-R and 17.21 percent in CPI-U) and *fuel and lighting* (8.70 percent weight in CPI-R and 4.96 percent in CPI-U *)*. The *transport and communication* is divided into three sub-categories, namely *public transport* (1.89 percent weight in CPI-R and 4.71 percent in CPI-U), *maintenance means of transport* (0.81 percent weight in CPI-R and 1.21 percent in CPI-U) and *miscellaneous services* (0.28 percent weight in CPI-R and 1.15 percent in CPI-U). The *miscellaneous goods and services* category is divided by three sub-categories, namely *servant's wage* (0.69 percent weight in CPI-R and 0.85 percent in CPI-U), *luxury* (2.28 percent weight in CPI-R and 1.75 percent in CPI-U) and *laundry and cleaning* (0.83 percent weight in CPI-R and 0.62 percent in CPI-U). Table 3 lists items in some non-food categories.

The sub-group wise composition of broad non-food categories in Table 2 demonstrates that *clothing and footwear* consists of 33 items in CPI-R as compared to 48 in CPI-U, *gross rent, fuel & lighting* consists of 6 items in CPI-R as compared to 13 in CPI-U, *furniture, furnishing, household equipment and operation* consists of 28 items in CPI-R as compared to 37 in CPI-U, *medical care & health expenses* consists of 5 items in CPI-R as compared to 16 in CPI-U, *transport & communication* consists of 11 items in CPI-R as compared to 22 in CPI-U, *recreation, entertainment, education & cultural services* consists of 11 items in CPI-R as compared to 19 in CPI-U, and *miscellaneous goods and services* consists of 15 items in CPI-R as compared to 34 in CPI-U.

The above analysis shows that there are a lot of item- and weight-wise differences in the composition of CPI-R and CPI-U. While the number of items in food group in CPI-R and CPI-U is more or less the same (99 and 104 items, respectively), a large difference is found in the non-food category (109 items in CPI-R vs. 189 items in CPI-U). This difference comes from inclusion of more varieties of a given product (as for example, three varieties of toothpaste are included in CPI-U instead of one in CPI-R, and non-consideration of some items like *natural gas charge, refrigerator, electric fan, sewing machine, diagnostic charges for medical care, auto-rickshaw fare, motor sprit (petrol), driver salary* etc in the rural index.

In terms of weight composition, a huge difference is evidenced between CPI-R and CPI-U. The food category comprises 60.48 percent weight in CPI-R, but only 44.53 percent weight in the CPI-U. The rice sub-category explains a major part of the difference in the relative weight of the food category: rice comprises 23.79 percent of CPI-R but only 11.28 percent of CPI-U. As mentioned above, a significant difference in relative weight in different sub-categories is also observed between the CPI-R and CPI-U. It is also evident from Table 2 that sub-categories like *luxury*, *laundry and cleaning*, *fuel and lighting, furniture and fixture, men's and boy's clothing, clothing and fabrics etc.* hold more weight in the CPI-R than in CPI-U.

Given the huge disparity in the items and weight between rural- and urban -CPI, it is logical to monitor the rural-urban prices separately for policy purpose, rather than looking at only the national average, which is simply a weighted average. However, considering more than two-thirds of total weight of CPI-R (70.89 percent) to CPI-N, the national price index in Bangladesh is largely explained by the rural prices.

3.2 Statistical Characteristics of Price Data in Bangladesh

The descriptive statistics for month-to-month price changes for national, rural and urban are presented in Table 3.1 for the period of 2000:07 to 2006:5. Mean, median, standard deviation, coefficient of variation, skewness and kurtosis are reported for national, rural and urban CPIs. The median for national and rural are lower than their mean value, and higher for urban indicating skewness in the price distribution.

The skewness measures the asymmetry of the distribution of the series and the kurtosis measures the peakedness or flatness of the distribution of the series. Figure 3.1 and 3.2 shows the histogram and kernel density for the national price changes. For a symmetric (normal) distribution, the skewness is zero and the kurtosis is three.[5] There is little skewness (0.5 for national) on average, which may lead to the proposition that the mean may be a good indicator of the general trend of inflation. The positive value of skewness implies that there is tendency of exceptional price rises than the exceptional price declines. The kurtosis is comparatively higher than 3 imply that for the national index, the distribution is leptokurtic. This indicates that the distribution of price changes has considerably flatter tail than the normal distribution. This implies that mean value would be subject to distortion by extreme price changes. So, contrary to what we found with skewness, the mean-CPI or headline inflation may not be a 'robust' indicator of the trend inflation.

Table 3.1
Descriptive statistics of price changes: National, Rural and Urban (1995-96=100):
Jul'00-May'06

	Monthly *(t=1)*		
	National	Rural	Urban
Mean	4.98	5.09	4.91
Median	4.55	4.75	4.38
Std. Dev.	5.57	5.56	5.54
Skewness	0.55	0.56	0.82
Kurtosis	5.61	5.99	4.08

Note: t- denotes the horizon over which inflation is measured, with t=1 denotes monthly changes in annualized rate. Figures are seasonally adjusted.

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[5] A positive skewness means that the distribution has long right tail and negative skewness means the distribution has a long left tail. In case of kurtosis, if the coefficient of kurtosis exceeds 3, the distribution is peaked relative to the normal and, if it is less than 3, the distribution is flat relative to the normal.

Figure 3.1:
**Distribution of Monthly Price Changes for CPI-N (2000:7-2006:5)**

Series: INFCPI_NATIONAL	
Sample 2000:07 2006:05	
Observations 71	
Mean	4.988803
Median	4.552189
Maximum	24.50682
Minimum	-9.569067
Std. Dev.	5.570207
Skewness	0.552612
Kurtosis	5.611930
Jarque-Bera	23.79594
Probability	0.000007
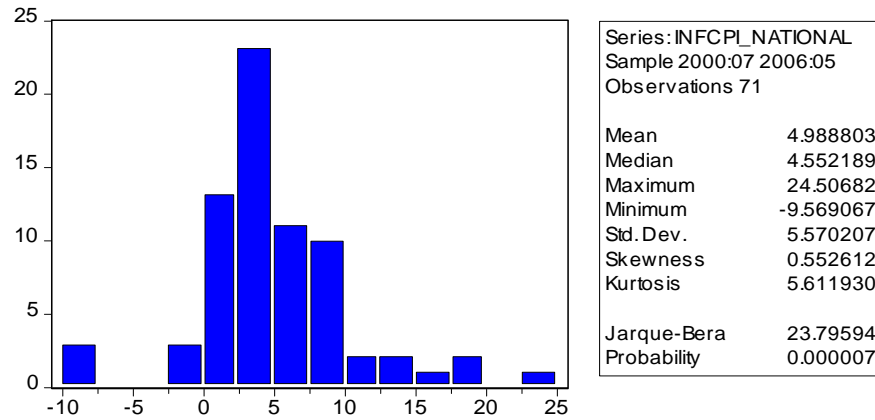
Figure 3.2:
Kernel Density of Monthly Price Changes for CPI-N (2000:7-2006:5)


Kernel Density (Normal, h = 1.5569)

INFCPI_NATIONAL
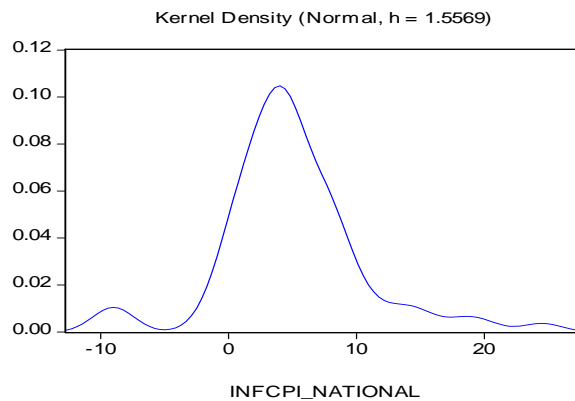
Table-3.2 notes the shape of distribution of the price changes during a financial year (FY)[6]. For both national and rural inflation, the mean value is lowest in FY01 and highest in FY05, but in case of urban inflation the mean value is lowest in FY00 and highest in FY06 (for 11 months). While both mean and median show a moderate inflation rates during FY00-FY02 (less than 4 percent) and a rising pattern in later years. The standard deviation, which measure the dispersion or spread in the series, is very high in some years reflecting the excessive volatility (FY05 for national, rural and urban) in the monthly price indices during the financial year.

From Table-3.2, we can see that the coefficient of skewness varies considerably from negative to positive and from year to year. The kurtosis of the distribution of the price

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[6] In Bangladesh July-June period is considered as the financial year.

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changes is lower or higher than 3 during the period of FY00-FY06. The coefficients also vary among national, rural and urban for FY01 the coefficient of skewness is -1.83 and -1.94 for national and rural respectively in comparison to only -0.31 for the urban inflation. In FY03, the national and urban price changes are positively skewed, whereas for the rural these are slightly negatively skewed.

Table 3.2:
Descriptive statistics of Month-to-Month Price Changes (annualized rate): National, Rural and Urban (1995-96=100)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06
National							
Mean	2.64	1.69	3.61	5.01	5.58	7.17	7.04
Median	3.54	2.46	3.66	4.12	5.04	6.61	7.75
Std. Dev.	4.86	3.68	2.35	3.11	1.72	8.24	9.02
Skewness	-0.66	-1.83	0.29	0.33	0.71	0.18	-0.24
Kurtosis	2.82	6.24	1.95	2.02	2.28	3.55	2.16
Rural							
Mean	3.10	1.59	3.50	5.36	5.64	7.34	7.33
Median	2.64	2.01	3.54	5.95	5.07	6.74	9.26
Std. Dev.	3.58	3.33	2.21	2.43	1.97	8.42	8.96
Skewness	-0.09	-1.94	0.15	-0.16	0.63	0.09	-0.29
Kurtosis	2.24	6.81	2.05	1.93	2.34	3.82	2.29
Urban							
Mean	1.24	2.03	4.05	4.27	5.46	6.73	7.09
Median	2.34	2.11	2.28	3.30	5.06	6.39	7.85
Std. Dev.	5.11	2.23	4.92	4.73	1.85	7.68	8.29
Skewness	-0.27	-0.31	0.52	0.69	0.39	0.10	0.26
Kurtosis	1.82	2.22	2.13	2.98	2.26	2.82	2.05
Observations	12	12	12	12	12	12	11*

Note: Data series are seasonally adjusted
* July-May, 2006

Figure 3.3 presents the monthly inflation rates together with 12-month moving average for the consumer prices during the period of 2001:07 to 2006:5 for national, rural and urban sectors respectively. The 12 -month moving average is used here to proxy the trend inflation.[7] It can be observed from the figure that the deviations from the trend inflation are quite large, and demonstrate quick reversal in all of the two cases. These kinds of

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[7] Berkmen, 2002 used 36-month moving average to proxy the long-term inflation trend. Because of smaller sample size (2001-2006), this study takes the 12-month moving average as a proxy of trend inflation, which is consistent with Tahir (2003).

deviations and quick reversals prove the presence of noise in the price data, a fact that necessitates the development of core inflation in Bangladesh.

Figure-3.3: Monthly CPI Inflation (annualized), Point to Point Inflation, and 12-Month Moving Average of National CPI
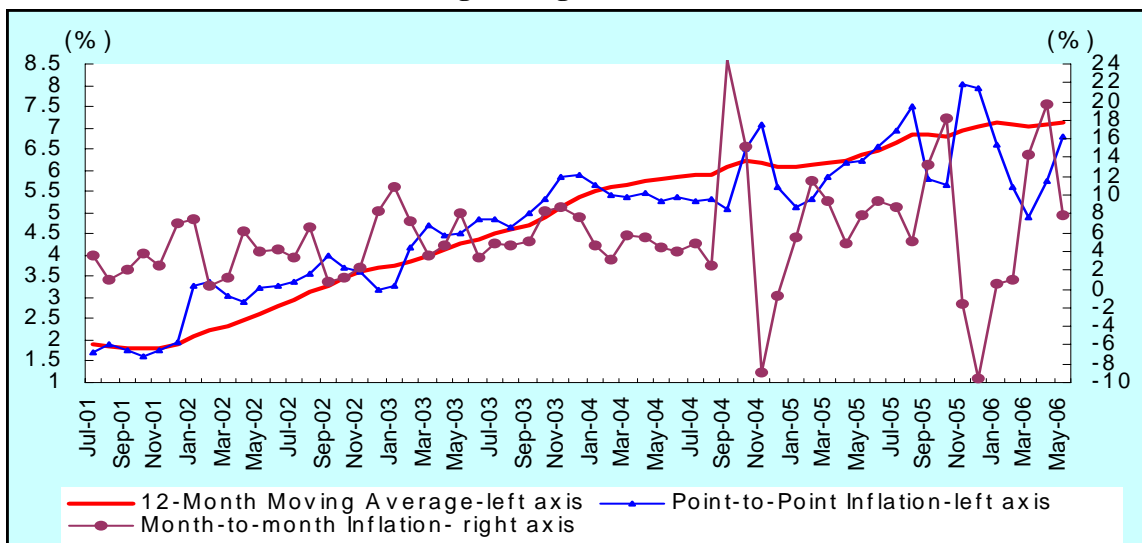
Note: Data series are seasonally adjusted

The above analysis has shown some general statistical characteristics of the price data in Bangladesh. From the whole series, a slight positive skewness and comparatively larger kurtosis than the normal distribution implies that the mean is affected by extreme observations, hence mean inflation loses it credibility as a measure of trend inflation. Descriptive statistics for the sub-samples show significant variation and is also consistent with the result of not to average out equally in all years. The standard deviation, which measures the variability of data, has risen significantly in the last two financial years. There has been a steady increase in both mean and median value from FY01 to FY06.

In measuring core inflation in Bangladesh, a few more things are investigated based on the particular needs of the method to be employed. A component wise analysis of the price data along the line of individual and combined volatility is performed while considering the exclusion method. Accordingly, monthly distribution of price changes is employed in case of statistical methods. The next section discusses these issues.

A higher level of aggregation of all items of CPI to total of 27 components of CPI-R and CPI-U for a period of 2001:7 to 2006: 5 are considered for the study. The choice of sample period and higher level of aggregation is particularly dependent on the availability of data from BBS. While sample period is relatively shorter for measuring core inflation,

it is consistent with earlier studies.[8] Data for some components was found missing in FY03 as provided by BBS. The author estimated the missing data. However, both the partially estimated series and actual data series are examined in order to gauge useful conclusion and to check the consistency of data.

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[8] In the literature there are instances of a focus with shorter sample period, e.g. Vega and Wynne (Euro area, 1996-2000) although larger sample is always better for estimation.

4. Measuring the Core Inflation in Bangladesh

4.1: Definition of Core Inflation

The general definition of core inflation is that the long run or persistent component of the measured price that is tied in some way to money growth (Bryan and Cecchetti, 1993). However, from the practical efforts in measuring core inflation, there are mainly two sets of definitions of core inflation: one considers core inflation as a persistent part and the other takes the generalized component of measured inflation (Berkmen, 2002, Roger, 1998). The Milton Friedman's definition of inflation as a "…steady and sustained increase in the general price level" is the basis of definition of core inflation as persistent inflation. Quah and Vahey (1995) have defined the core inflation as the persistent component. According to the both definitions, core inflation is the steady or persistent component of measured inflation, which is free from the disturbances having only transient impact on inflation. So, core inflation should exhibit more persistence or less variability than the aggregate measured inflation rate (Roger, 1998).

The second definition of core inflation by generalized components is the reflection of Arthur Okun's definition as "….a condition of generally rising prices". According to this definition, core inflation is that part of measured inflation that is free from relative price disturbances. The notion of relative price movements is often driven by supply side shocks. This is to note that, the widely practiced exclusion or statistical measures of core inflation are based on the concept of generalized inflation, where a variety of items of price index that seem to distort the general trend of other prices are removed.

4.2. Common methods

There are also some methods found in the literature to measure core inflation.[9] They are broadly categorized under three heads, namely, subjective approaches, e.g. the exclusion method, limited influence estimators, and model-based estimates.

Exclusion method: Exclusion method involves omitting some pre-specified components from the CPI basket at all dates that are believed to be highly volatile to supply shocks. A frequently applied approach is to exclude some food and energy prices, popularly known as "ex. food and energy measures". As for example, in case of US a typical measure of

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[9] See for example, Bryan and Cecchetti (1993), Clark (2001), Roger (1998), and Vega and Wynne (2003).

core inflation is that CPI excluding food and energy (Pedersen, 2006) and in case of Canada, CPI excluding food and energy and the effects of indirect taxes (Hogan et al., 1989). In case of Philippines, the components excluded are *rice, corn, fruits & vegetable, LPG, kerosene and oil, gasoline & diesel*. Most countries follow the exclusion approach to measuring core inflation. This is because the method is transparent, easy to understand for the public, and data for computation is easily available from the national statistical agency. The main criticism of this approach is that not all the components are volatile at every period. Therefore, excluding fixed set of items may lose some information that could be useful for predicting the trend inflation, i.e., part of the trend may be inadvertently thrown out along with volatility.

Limited Influence Estimators (LIEs): In order to solve the criticism of a fixed set exclusion, Bryan and Cecchetti (1993) propose the LIEs, e.g., trimmed mean, weighted median to measure core inflation. The approach attempts to eliminate the temporary noise components by computing limited influence estimators that averages out only central part of a distribution after truncating outlier points. The trimmed mean removes the large relative changes at each month based on statistical criteria.

Economic or Model Based Approach: The economic or model based approach proceeds on the assumption of long run neutrality of money. According to this approach, core inflation is that part of measured inflation which has no medium or long run effects on real output. The proponent of the approach is Quah & Vahey (1995), who measured core inflation for UK using the bivariate structural autoregression (VAR) approach. Claus (1997) and Gartner and Wehinger (1998) extended the model by including some other variables. The main advantage of this approach is that it has a clear economic interpretation. However, as argued by Roger (1998), the approach has limitations to satisfy most of the practical requirement as a measure of core inflation. One is that choices of the variables are at the discretion of modeller and as such different authors have incorporated different type of variables in the model. Given the complexity of the model, the method is not well followed by the central banks.

4.2: Measuring Core Inflation Using the Exclusion Method

As mentioned above, the CPI-N in Bangladesh is simply the weighted average of CPI-R and CPI-U, giving 70.89 and 29.11 percent weight respectively. In constructing the *core CPI* for national the same weighting is applied. Accordingly, separate core indexes are constructed for rural and urban consumers considering the composition of goods and their respective weight before finding the national core measure.

The exclusion method targets some components of CPI in an arbitrary way. All sub-groups of food group namely, *rice, other cereal, pulses, fish (fresh) & dry fish, eggs & meat, vegetable, fruits, spices, edible oils & fats, milk & milk products* and *miscellaneous food items*, as well as all sub-groups of some non-food groups namely "*gross rent, fuel and lighting*", "*transport and communication*", "*recreation, entertainment and educational services*" and *miscellaneous services* are taken into account. Non-food categories like "*clothing and footwear*", "*furniture, furnishing, H/H equipment and operation*" and *medical care & health expenses* have been included as broad heads.[10]

As mentioned above, a very typical example of exclusion method is CPI excluding food and energy. In case of Bangladesh, exclusion of whole food and energy component is made complex by the fact food constitutes a majority share of total CPIs (60.48 percent in case of CPI-R, 44.53 percent in case of CPI-U, and an average of 55.84 percent in CPI-N). Thus, excluding the whole food implies a re-weighting at a very high level and consequently excluding the all food prices from total CPI will not be representative of long-term inflationary trend because that will consistently ignore a major share of consumer expenditure.

One additional problem regarding the exclusion method is that the pattern of co-variability among the components of CPI. If the covariance of one volatile component is negative with the remaining components, there is a possibility that the variability of the constructed core index will increase after excluding the component. Table 5 reports the covariance among the components of CPI-R. It shows a significant number of negative covariance coefficients among the components of CPI. As for example, vegetable has

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[10] Since data for some components was found missing in CPI data in FY03, the author estimated the missing data. However, both the partially estimated series and actual data series are examined in order to gauge useful conclusion and to check the consistency of the constructed series.

negative covariance coefficients with 15 components in CPI-R out of 26. Thus, in this case, exclusion of vegetable from the basket, in fact, may increase the variance of the constructed index. The same kinds of circumstances are also possible in case of the exclusion of other volatile items.

Table 4 reports the weight and standard deviation of the 27 components of CPI-R and CPI-U. In Table 4 we can observe that the volatility across the components differs significantly as compared to headline CPI inflation for both rural and urban. Top ten volatile items include, mostly the food items like *vegetable, fruits, spices, edible oils and fat, pulses, rice* and *other cereal* etc. In the rural CPI, the components that are found variable twice as compared to the overall CPI are *rice, other cereal, pulses, vegetable, fruits, spices, edible oils and fat, miscellaneous food, beverages, miscellaneous services, recreation* and *educational services* consisting 48.68 percent of total weight. In the urban CPI, components that are more than twice as the overall CPI are *rice, other cereal, pulses, fish and dry fish, eggs and meat, vegetable, fruits, spices, edible oils and fat, miscellaneous food, beverages, fuel and lighting, public transport, maintenance means of transport and recreation* comprising 58.32 percent of total weight. Hence excluding the volatile components that pose variability more than double as compared to CPI will lead to a significant loss of information in the constructed index.

Keeping all of the above factors in mind, an initial attempt has been made to construct an index by excluding the components that are found more than three times as variable as compared to that of the overall CPI. According the criteria, seven components were excluded from CPI-R, namely *other cereal, vegetable fruits, spices, beverages, miscellaneous services,* and *recreation* accounting for 14.59 percent of total weight. A total of nine components namely, *pulses, vegetable, fruits, spices, edible oils and fat, beverage and maintenance means of transport* accounting for 15.69 percent of total weight were excluded from CPI-U. By this way, a total of 85.09 percent weight is retained in national CPI. The constructed index is denoted by CPIXV. However, as shown in the Figure 4.4, CPIXV does not perform well in tracking the headline CPI inflation; rather highly overstates and understates the headline inflation for most of the periods. The pattern of co-variability among the components as described above is the key to this explanation.

Figure 4.4
Point-to-point Inflation: CPI and CPIXV (Jun' 02-May 06)
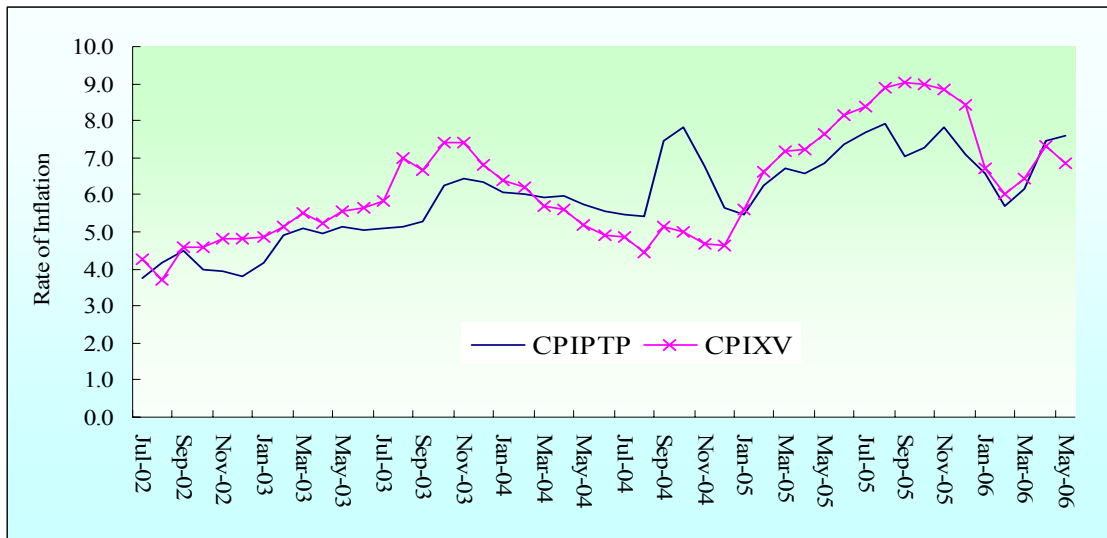
Figure 4.5
Point-to-point Inflation: CPI, CPIXR4 and CPIXC4 (Jun' 02-May 06)
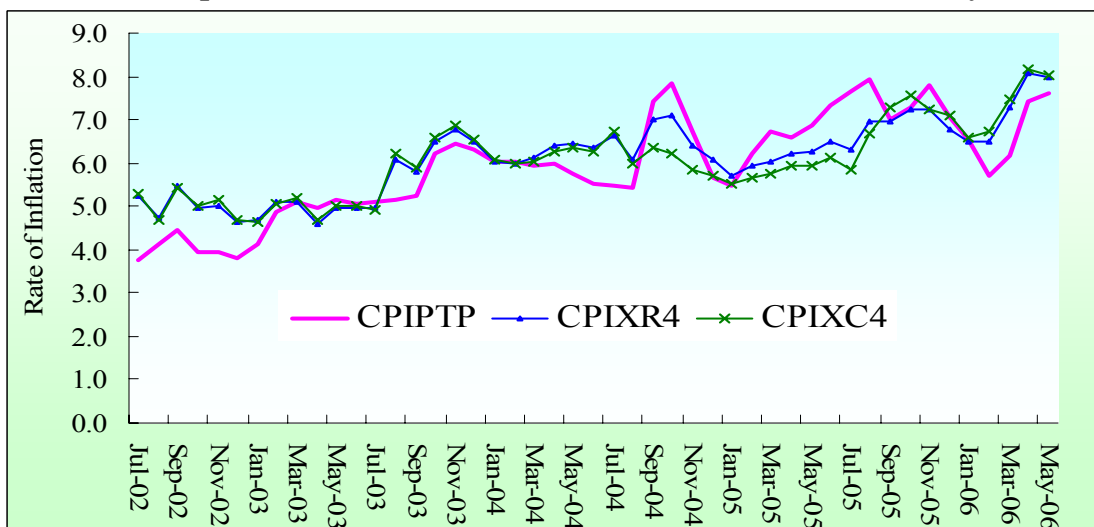
Given the backdrop, a number of alternative combinations can be made on an ad hoc basis to evaluate the comparative performance of various alternatives. Figure 4.5 plots two constructed indices namely CPI exc. *cereal and 4 most volatile items* (CPIXC4), and CPI exc. *rice and 4 most volatile items* (CPIXR4). CPIXC4 and CPIXR4 retained 65.92 and 68.78 percent of total weight of CPI. Notably, this degree of exclusion (i.e., a loss of about a third of total weight) is consistent with the literature, as for example 46 percent exclusion in Samanta (1999) for India, and as an extreme example, the Australian Treasury excludes roughly half of the components of CPI (Reserve Bank of Australia, 1994). In the Philippines, official core measure in constructed by excluding about 20

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percent of weight comprising rice, corn, fruits & vegetable, LPG, kerosene, oil, gas & diesel. A general look to Figure 4.4 and Figure 4.5 leads to the conclusion that CPIXC4 and CPIXR4 track the headline inflation better than the CPIXV. However, CPIXC4 and CPIXR4 retain some most volatile items and exclude some low volatile items that leave the measures very weak in terms of rule-based justification. Below we contrast these measures against the trend inflation in order to obtain a ranking among them.

4.3 Trimmed Mean

Although only a few countries have officially adopted the trimmed mean as a measure of core inflation, it has frequently been examined.[11] The main assumption behind the trimmed mean estimation is that volatility of CPI components varies from month-to-month, and hence subjective exclusion of some components for the whole series is not appropriate. Given this proposition, the trimmed mean removes the relatively large price changes in each month from the overall CPI for that month.

Figure 4.6: Cross Sectional Distribution of Monthly Price Changes-CPI -Rural
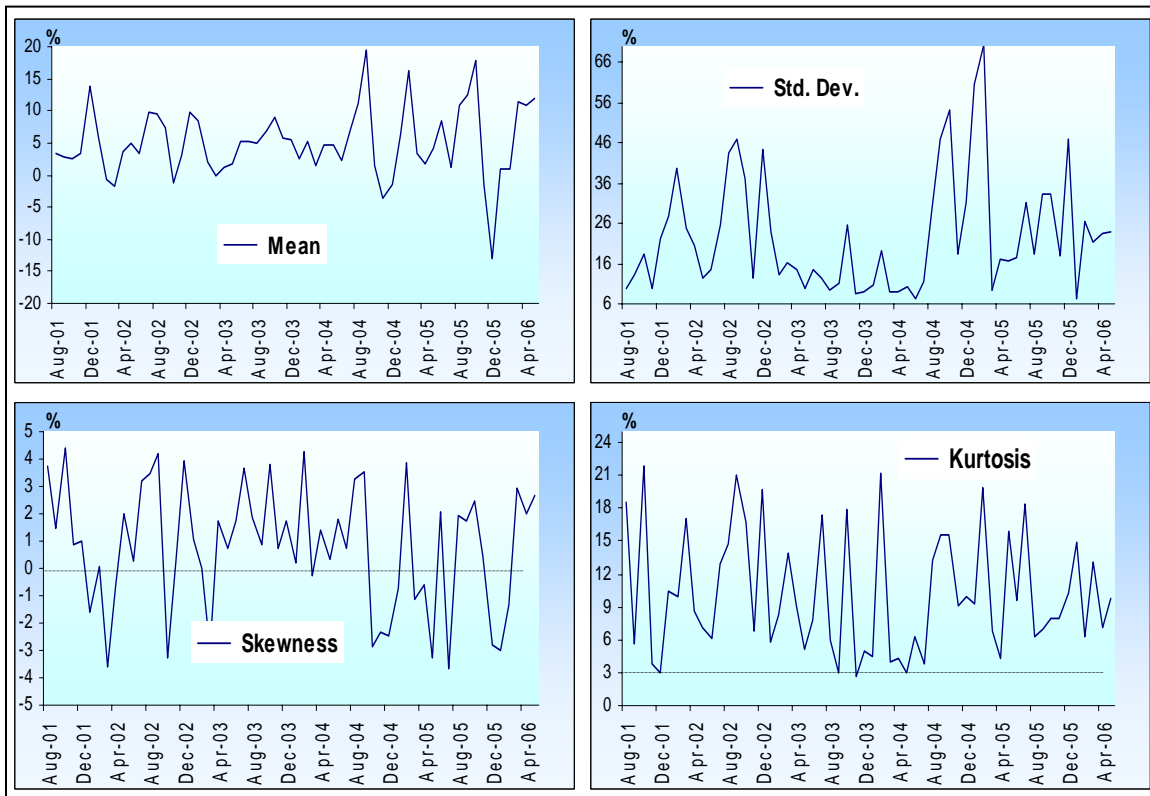
Note: Month-to-month price changes (annualized rate)

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[11] Studies include Australia (Kearns, 1998), Chile (Pedersen, 2006), Ireland (Meyler, 1999), New Zealand (Roger, 1998), Pakistan (Tahir, 2003), Turkey (Berkmen, 2002), and US (Bryan and Cecchetti, 1993).

The use of trimmed mean estimators is particularly recommended if the distribution of the sector specific shocks is skewed (Bryan and Cecchetti, 1993). Figure 4.6 shows the moments of distribution of monthly CPI-R. From the figure we can observe a significant amount of variation around mean, skewness and kurtosis in the price data in Bangladesh. The very high skewness relative to normal distribution motivates us to employ the trimmed mean approach in this study.

Trimming α-percent from the tail of the histogram, and then averaging the rest leads to trimmed means. The α-percent symmetric mean inflation is determined by

$$\pi_\alpha = \frac{1}{1 - 2(\frac{\alpha}{100})^{i \in I_\alpha}} \sum_{i=I_\alpha} w_i \pi_{it} \quad ,$$

where π_α are the estimators computed by ordering sorted price change. α is the trimmed mean estimators; if α=0, we obtain the weighted sample mean, at α=50, we obtain the weighted median. Note that, the "α" can be asymmetric, in this case, (α_1, α_2)-percent asymmetric trimming mean is applied.

After trying a number of trims, this study reports three asymmetric trimmed mean measures calculated using α=(0.20, 0.09), α=(0.20, 0.08) and α=(0.22, 0.08) that are found to possess lowest Root Mean Square Error (RMSE). The first one is denoted as CPI2009, the second one is denoted by CPIT2008 and the third one is denoted by CPIT2208. The RMSE is calculated from monthly changes in the constructed index and 12-month moving average inflation by using the following formula:

$$RMSE = \sqrt{\frac{1}{N} \sum_{t=1}^{N} (\pi_t^\alpha - \pi_t^T)^2}$$

Where π^α_t= trimmed inflation with α percent trim ratio at month t

π_t^T= trend inflation at month-t

T=number of periods

A 12-month centered moving average is considered here as trend inflation considering the shorter sample size, which is consistent with the literature (e.g., Tahir, 2003). Figure 4.6 plots the point-to-point inflation of headline inflation and the three trimmed mean measures.

Figure 4.6:
Point-to-point Inflation: Headline vs. Trimmed Means (Aug' 02-May 06)
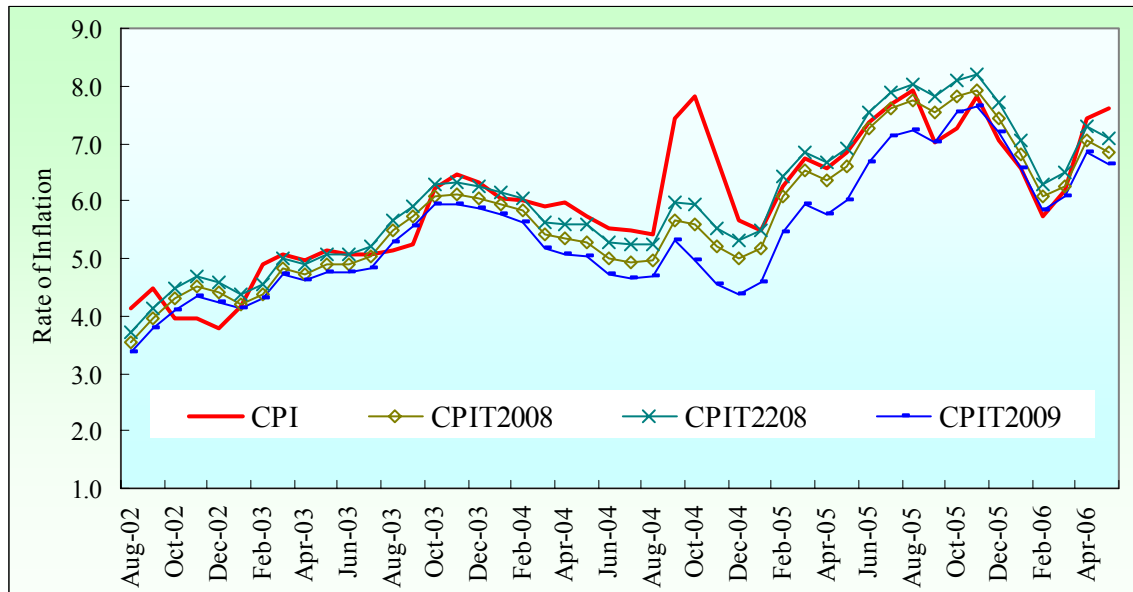
4.4: Performance of the Various Measures of Core Inflation

There is no well-articulated theoretical framework to evaluate the alternative measures of core inflation. However, most studies set the criteria to evaluate different measures to track trend inflation in two respects. One is that over a long horizon, the average rate of core inflation should match the headline CPI inflation, and the other is that, the core inflation will move closely with the trend inflation. Trend inflation is defined in the literature by 12 to 36 months moving average, or using well-known Hodrick-Prescott filter. In this study, three criteria are set to evaluate the comparative performance of core inflation. Firstly, the mean value of the core inflation should match the average rate of overall inflation for the sample period. Secondly, the standard deviation should be lower, and finally the core inflation should move closely with the trend rate of inflation as measured by the RMSE.

The mean and standard deviation for monthly inflation rates of 6 alternative measures of core inflation are shown in Table 4.3 along with headline inflation. It is found that, the mean value of CPIT2208 is closest to CPI for monthly inflation rates followed by CPIXV. In general, the core inflation measures using exclusion method remain above the mean of CPI inflation, and the mean core inflation measures using trimmed mean method remain below the mean of CPI inflation. The understatement and overstatement is probably because of shorter sample size. In terms of the absolute variability, all 6

alternative measures of core inflation show lower volatility. While the trimmed mean measures have the lower standard deviation than the exclusion-based measures, CPIT2009 has the lowest variability in terms of standard deviation. The standard deviation is highest in case of CPIXV.

Table 4.3:
Mean and Standard Deviation of Monthly Inflation Rates

	Mean	Std. Dev.	RMSE
CPI	5.69	5.88	5.73
CPIXV	5.78	4.30	4.31
CPIXR4	6.03	4.28	4.37
CPIXC4	5.98	3.96	4.09
CPIT2208	5.63	3.33	3.23
CPIT2009	5.13	3.26	3.15
CPIT2008	5.41	3.29	3.17

A core measure may be ranked superior if it moves more closely with the trend rate of inflation. In this study, tracking the trend inflation is measured in terms of RMSE as described in the previous section. As shown in 4.3, trimmed mean measures better track the trend inflation. Among the trimmed mean measures, CPIT2009 has the lowest RMSE.

The above analysis attests to the superiority of trimmed mean measures over the exclusion based measures in the case of Bangladesh price data over the sample period examined here. The weaker performance of the exclusion-based approaches according to criteria cited above is probably because of the lack of a coherent rule to exclude the volatile components. A compromise has to be made among the volatile components because of the pattern of co-variance among the components. Some rather volatile items still remained in CPIXR4 and CPIXC4. One the other hand, the trimmed measures have a strong statistical base to exclude the volatile items. Among the trimmed mean measures although CPIT2009 and CPIT2008 slightly understates the CPI inflation, these two measures show lower volatility and track the trend inflation better. The mean, standard deviation and RMSE of CPIT2008 remain in the middle of other two measures and it has the lowest "weight loss" for each month, hence CPIT2008 can be considered as most representative among the measures of core inflation examined here.

5. Conclusions and Recommendation

The concept of core inflation plays an important role in designing monetary policy and policy accountability. It is now well practiced by the central banks around the world. Many countries, such as Canada, the Philippines, Korea, Thailand, routinely publish and monitor core inflation measures. However, there is as yet no standard measure of core inflation used either by BB or the Bangladesh Bureau of Statistics (BBS). This is a serious shortcoming. It is therefore urgent in the Bangladesh context to come up with an official measure of core inflation that would be helpful in monetary policy formulation and in inflation forecasting. This study places the first endeavour to develop a measure of core inflation in Bangladesh, focusing on the popular exclusion and trimmed mean approaches.

This study employs both exclusion and trimmed mean to estimate the core inflation of Bangladesh with a limited data set (2001-2006). Both methods require extensive analysis regarding the moments of the distribution of price changes. The construction of core inflation measure using the exclusion method is made complex by the fact that food group holds the majority weight in both rural and urban. Within the food basket *cereals (rice and other cereals)* consists majority of 26.72 percent weight in CPI-R and 13.99 percent in CPI-U, and further, r*ice* sub-group alone holds 23.79 percent weight in CPI-R and 11.28 percent weight in CPI-U. In light of these facts, the traditional "excluding food and energy" approach has a major limitation in case of Bangladesh. Conversely, if only the most volatile components based on absolute dispersion criteria are excluded, the constructed index does not perform well because of the co-variance pattern among the components. Given this perspective, a number of combinations can be made among the volatile items to check which fit better the headline inflation. While CPI excluding cereal and 4 most volatile items (CPIXC4) and CPI excluding rice and 4 most volatile items (CPIXR4) fit better among the alternatives, these measures pose a major limitation due to the absence of a coherent rule for excluding the most volatile items.

This study also employs the trimmed mean estimation given the fact that a very high skewness relative to normal distribution is evidenced from the moments of distribution of monthly price data. Three asymmetric trimmed mean measures calculated using $\alpha = (0.22, 0.08)$, $\alpha = (0.20, 0.09)$ and $\alpha = (0.20, 0.08)$. The performance criteria utilized in

this study shows the superiority of trimmed mean measures over the exclusion measures of core inflation in Bangladesh. While the trimmed mean measures of inflation exhibit significant reduction in volatility and better track the headline inflation, they reflect the current inflationary picture. Therefore, the constructed core measure may be used as a short or medium term guide to monetary policy operation in Bangladesh.

In this study, the choice of sample period and higher level of aggregation is particularly dependent on the availability of data from BBS. Accordingly, a higher level of aggregation of all items of CPI to total of 27 components for rural and urban for a period of 2001:7 to 2006: 5 are considered for the study. A better construction can be made once the number of components and sample period can be extended. BBS is still computing CPI with 1995-96 as a base, which is rather old. The base and weight of CPI components should be revised to reflect the changing consumption pattern and the rural-urban population distribution. The component-wise data for the CPI should be made publicly available to encourage more research in this area.

References

Bagliano, Fabio C. and Claudio Morana (2003), "Measuring US core inflation: A common trends approach", *Journal of Macroeconomics* 25, 197-212.

Bautista, Carlos C. (2005), "Core Inflation in the Philippines: Measurement and Evaluation". Available at www.up.edu.ph/~cba/bautista.

Berkmen, Pelin (2002), "Measuring Core Inflation for Turkey-Trimmed Means Approach", *Central Bank Review* 2, The Central Bank of the Republic of Turkey, pp. 1-18.

Bryan, M., S. Cecchetti and R. Wiggins (1997), "Efficient Inflation Estimation", NBER Working Paper 6183.

Bryan, Michael F., and Stephen G Cecchetti (1993), "Measuring Core Inflation", NBER Working Paper No. 4303, Cambridge.

Clark, Todd E. (2001), "Comparing Measures of Core Inflation", *Federal Reserve Bank of Kansas City Economic Review*. Second Quarter, 2001.

Claus, I (1997), 'A measure of underlying inflation in the United States', Bank of Canada Working Paper 97-20.

Durai, S. R. Sethu and M Ramachandran (undated), "Core Inflation for India". Available at http://www.igidr.ac.in/money

Gartner, C. and D. Wehinger (1998), "Core Inflation in Selected European Union countries", Oesterreichische National Bank.

Guinigundo, Diwa C. (2004), "An official Core Inflation Measure for the Philippines", Bangko Sentral Review.

Hogan, Seamus, Marianne Johnson, and Thérèse Laflèche (2001), "Core Inflation", Technical Report No. 89, Bank of Canada.

Kearns, J. (1998), " The Distribution and Measurement of Inflation", Reserve Bank of Australia Research Discussion Paper.

Laflèche, T (1997), "Statistical measures of the trend rate of inflation", *Bank of Canada Review (Autumn)*, pp. 29-47.

Macklem, Tiff (2001), "A New Measure of Core Inflation", *Bank of Canada Review, Autumn* 2001.

Meyler, A. (1999), "A Statistical Measure of Core Inflation", *Central Bank of Ireland Technical Report*.

Pedersen, Michael (2006), "An Alternative Measure of Core Inflation", Central Bank of Chile, Working Paper No. 366.

Quah, D and S Vahey (1995), "Measuring Core Inflation", *The Economic Journal*, vol. 105, pp. 1130-44.

Roger, Scott (1998), "Core Inflation: concepts, uses and measurement", Reserve Bank of New Zealand Discussion Paper G98/9. July1998.

Samanta, G P (1999), "Core Inflation in India: Measurement and Policy Perspectives", Reserve Bank of India Occasional Papers, 20(1).

Shahiduzzaman, Md. (2006), "Towards a Measure of Core Inflation in Bangladesh: Conceptual Issues", Policy Note 0605, *Bangladesh Bank Quarterly*, Vol. III, Nos. 2 &3, pp. 25-30.

Tahir, Sadia (2003), "Core Inflation Measures for Pakistan", Working Paper 4, State Bank of Pakistan, September 2003.

Vega, J. L. and Wynne, M. A. (2003), "A first assessment of some measures of core inflation for the euro area", *German Economic Review*, 4 (3), 269-306.

Wynne, Mark A., (1999), "Core Inflation: A Review of Some Conceptual Issues", European Central Bank Working Paper No. 5.

Table 1:
Measures of Core Inflation Used in Selected Countries

Country	Measure of Core Measure
Canada	Excludes eight most volatile components from total CPI and then adjusts the remaining components for the effects of indirect taxes
Chile	CPI excluding 20% with higher (-) variations and 8% with higher (+) variations
Colombia	CPI excluding agricultural food, public services, and transport
Germany	CPI excluding indirect taxes
Japan	CPI excluding Fresh Food
Korea	CPI less energy and non-grain agriculture
Peru	CPI excluding 9 volatile items (food, fruits and vegetables, and urban transport, about 21.2%)
Philippines	Excluding selected food and energy items from headline CPI
Singapore	CPI excluding costs of private road transport and costs of accommodation
Spain	CPI excluding energy and unprocessed food
Thailand	CPI excluding Fresh Food and Energy (23%)
United States	CPI excluding food and energy

Source: Shahiduzzaman, Md. (2006)

Table 2:
Weight and number of components in CPI-rural and CPI-urban

Items and Specification	Rural -CPI		Urban -CPI	
	Weight (in percent)	No. of Items	Weight (in percent)	No. of Items
I. Food, beverage and tobacco	**62.96**	**106**	**48.80**	**113**
A. Food	**60.48**	**99**	**44.53**	**104**
a. Cereals	26.72	8	13.99	8
i. Rice	23.79	4	11.28	4
ii. Other cereals	2.93	4	2.71	4
b. Pulses	1.61	5	1.42	5
c. Fish (fresh) & Dry fish	9.81	14	8.14	12
d. Eggs and Meat	3.51	6	5.15	6
e. Vegetable	6.12	23	4.24	24
f. Fruits	1.20	11	1.71	14
g. Spices	2.98	11	2.23	11
h. Edible Oils & Fats	2.41	4	2.48	4
i. Milk & Milk Products	2.54	4	2.58	5
k. Misc. Food Items	3.58	13	2.59	15
B. Beverage	**0.96**	**3**	**2.40**	**3**
C. Tobacco and Products	**1.52**	**4**	**1.87**	**6**
II. Non-food	**37.04**	**109**	**51.20**	**189**
A. Clothing and Footwear.	**6.88**	**33**	**6.79**	**48**
a. Clothing and fabrics	1.24	6	1.02	12
b. Men's and Boy's clothing	2.12	9	1.85	15
c. Lady's and girl's clothing	2.43	13	2.61	11
...d. Other household fabrics	0.54	3	0.50	3
...e. Footwear	0.55	2	0.81	7
..B. Gross rent, fuel & lighting	**14.69**	**6**	**22.17**	**13**
a. Gross house rent	5.99	2	17.21	7
b. Fuel & Lighting	8.70	4	4.96	6
C. Fur. furn. h/h eq. & op.	**2.70**	**28**	**2.58**	**37**
...a. Furniture & Fixture	0.75	5	0.71	11
b. Kitchen Utensils	0.39	7	0.50	6
c. Household Articles	0.32	6	0.30	8
d. Personal effects	0.31	2	0.53	5
e. Household Repairing	0.93	8	0.54	7
D. Med. & health exp.	**2.79**	**5**	**2.97**	**16**
E. Transport and communication	**2.98**	**11**	**7.07**	**22**
a. Public transport	1.89	4	4.71	4
b. Maintenance Means of transport	0.81	3	1.21	13
c. Miscellaneous services	0.28	4	1.15	5
F. Rec., ent., edu., & cul. ser.	**3.20**	**11**	**6.40**	**19**
a. Recreation	0.12	2	0.51	10
b. Educational expenses	2.69	7	5.23	7
c. Radio and musical instruments	0.39	2	0.66	2
G. Miscellaneous goods & services	**3.80**	**15**	**3.22**	**34**
a. Servant's wage	0.69	1	0.85	1
b. Luxury	2.28	9	1.75	20
c. Laundry and cleaning	0.83	5	0.62	13

Table 3:
List of Items (or small item-group) of Some Non-food Categories

Name of the category	Name of sub-category	List of items	
		Rural	**Urban**
Gross Rent, Fuel & Lighting	Gross House Rent	H. R. without electricity 2- room Katcha house (3.24), H. R. electrified 2-room semi paka house (2.75)	H. R. 3- bed-attached bath (1.75), H. R. 2- bed-2 bath (2.78), H. R. 2- bed-1 bath (3.69), Semi-paca house (7.22), Katcha house (1.41), Water Expenses (0.36)
	Fuel & Lighting	Firewood local split dry mango (4.44),Kerosene -(2.89), Match (0.33), Electricity (1.04)	Firewood -Gazari, Goran (0.59), Firewood -Mango (0.94),Kerosene(0.33), Gas (0.94), Match (0.18), Electricity (1.98)
Transport & Communication	Public Transport	Richshaw fare (1.07), Boat fare (0.09), Train fare (0.18), Bus fare (0.55)	Richshaw fare (1.75), Auto-Rickshow fare (0.52), Train fare (0.86), Bus fare (1.58)
	Maintenance Means of Transport	Bi-cycle(0.41), Tire-bi-cycle (0.25), Tube-bi-cycle (0.15)	Motor Sprit-petrol (0.35), Bi-cycle-local (0.09), Bi-cycle-imported (0.03), Tire -bi-cycle local (0.05), Tire -bi-cycle -imported (0.02) Tube-bi-cycle-local (0.06), Tube-bi-cycle-imported (0.02), Bi-cycle oiling and cleaning (0.06), Car Servicing (0.02), Scooter oiling (0.05), Driver Salary (0.21), Garage Rent (0.08), Car Honda (0.17)
Miscellaneous Goods & Services	Servant's Wage	Servant's wages for cultivation (0.69)	Servant's wages for cultivation (0.85)
	Luxury	Toilet soap (0.55), Snow-(0.77), Talcum powder (0.20), Blade (0.10), Hair cut (0.35), Hair oil (0.55), Comb for lady (0.06), Tooth paste (0.07), Battery (0.13)	Toilet soap (0.39), Snow (0.19), Talcum powder (0.11), Tooth brush (0.07) Blade (0.05), saving cream (0.04), Hair cut (0.56), Comb for lady (0.03), Tooth paste (0.14), Shampoo (0.07), Lip Stick (0.05), Nail Polish (0.05)
	Laundry & Cleaning	Washing soap-local (0.64), Laundry charge-(0.1) washing soda (0.09)	Washing soap & Detergent -local (0.40), Laundry charge-(0.16),, washing soda/vim/finish (0.06)

Figure in the parenthesis describes weight in percent to total CPI

Table 4:
Volatility of CPI Components: Rural and Urban, 2001:7-2006:5

Components	Rural		Urban	
	Weight	Std. Dev.	*Weight*	Std. Dev.
CPI	*100*	6.13	*100*	6.22
Rice	*23.8*	14.17	*11.28*	16.76
Other cereal	*2.93*	20.15	*2.71*	16.41
Pulses	*1.61*	16.04	*1.42*	22.50
Fish and dry fish	*9.81*	11.65	*8.14*	12.15
Eggs and meat	*3.51*	11.30	*5.15*	14.78
Vegetable	*6.12*	48.57	*4.24*	50.33
Fruits	*1.2*	34.67	*1.71*	32.73
Spices	*2.98*	36.30	*2.23*	46.49
Edible oils and fat	*2.41*	14.29	*2.48*	29.31
Milk and milk products	*2.54*	10.90	*2.58*	8.64
Misc. food	*3.58*	17.73	*2.59*	17.86
Beverage	*0.96*	47.40	*2.4*	55.31
Tobacco & Products	*1.52*	5.71	*1.87*	3.18
Clothing & Footwear	*6.88*	5.10	*6.79*	3.80
Gross house rent	*5.99*	9.04	*17.21*	5.24
Fuel & Lighting	*8.7*	9.53	*4.96*	14.81
Furniture, Fur. and others	*2.7*	3.95	*2.58*	3.93
Medical & Health exp.	*2.79*	5.78	*2.97*	6.21
Public transport	*1.89*	11.64	*4.71*	12.62
Maintenance means of trans.	*0.81*	3.92	*1.21*	22.01
Miscellaneous service	*0.28*	27.27	*1.15*	10.44
Recreation	*0.12*	21.32	*0.51*	17.85
Educational expenses	*2.69*	13.92	*5.23*	9.87
Radio & musical inst.	*0.39*	10.43	*0.66*	0.49
Servant's wage	*0.69*	10.38	*0.85*	8.30
Luxury	*2.28*	8.66	*1.75*	8.68
Laundry & cleaning	*0.83*	4.00	*0.62*	7.34

Note: Standard deviations are calculated for annualized monthly inflation rates
Source: Data from Bangladesh Bureau of Statistics

Table 5: Variance-Covariance Matrix-Monthly Changes (annualized rate) of Rural CPI Components

	Rice	Other cereal	Pulses	Fish and dry fish	Eggs and meat	Vegetable	Fruits	Spices	Edible oils and fat	Milk & milk products	Misc. food	Beverage	Tobacco & Products
Rice	0.203												
Other cereal	0.062	0.314											
Pulses	0.015	0.045	0.220										
Fish and dry fish	-0.024	0.011	0.038	0.149									
Eggs and meat	-0.020	0.022	0.067	0.054	0.109								
Vegetable	-0.161	0.273	-0.021	-0.055	0.077	4.573							
Fruits	-0.053	0.096	0.039	0.012	0.020	0.082	1.379						
Spices	0.054	0.311	0.034	-0.042	0.013	2.161	0.120	2.148					
Edible oils and fat	0.041	-0.020	0.008	0.020	-0.042	-0.189	0.041	-0.427	1.991				
Milk & milk products	-0.015	-0.006	-0.016	0.007	-0.008	0.028	-0.054	-0.057	0.007	0.110			
Misc. food	-0.011	-0.010	0.012	0.002	0.023	-0.330	-0.119	-0.311	0.000	0.039	0.379		
Beverage	0.390	0.098	-0.035	-0.008	-0.052	-1.087	-0.011	-0.090	-0.045	-0.029	0.071	2.071	
Tobacco & Products	0.020	0.025	0.010	0.004	0.018	-0.047	0.050	-0.012	-0.016	-0.001	0.018	0.101	0.027
Clothing & Footwear	0.013	0.002	-0.006	0.002	0.002	0.031	-0.068	0.018	0.043	0.001	0.007	0.009	0.000
Gross house rent	-0.005	-0.022	-0.014	-0.003	-0.005	-0.021	-0.041	0.027	0.003	0.038	0.032	-0.028	0.000
Fuel & Lighting	0.021	0.003	0.019	-0.005	-0.006	-0.027	-0.026	0.094	-0.011	-0.009	0.001	0.103	0.013
Fur., Fur. & others	0.001	0.007	0.007	-0.004	-0.004	-0.031	0.010	-0.003	0.013	0.008	0.017	-0.011	0.001
Med. & Health exp.	-0.012	-0.006	0.005	0.004	0.012	-0.007	0.009	-0.003	-0.009	0.008	0.023	-0.009	0.002
Public transport	0.006	-0.007	0.012	-0.014	-0.016	-0.115	0.001	-0.023	0.020	0.010	0.061	-0.023	-0.006
Maintenance means of trans.	0.004	0.008	0.001	0.002	-0.002	0.020	0.000	-0.007	0.016	0.001	0.031	-0.002	0.000
Misc. service	0.036	-0.008	-0.024	-0.034	-0.018	0.116	0.015	0.042	-0.054	0.003	-0.055	-0.049	-0.010
Recreation	0.121	-0.032	-0.016	0.013	-0.014	-0.522	-0.089	-0.083	-0.026	0.062	0.046	0.243	0.011
Educational expenses	0.021	-0.013	0.010	-0.012	0.008	0.158	-0.064	0.159	-0.058	0.015	0.043	0.012	0.007
Radio & musical	-0.044	0.013	0.021	0.062	-0.022	-0.387	-0.072	-0.150	0.042	0.011	-0.051	0.017	-0.002
Servant's wage	0.006	-0.006	0.010	-0.016	0.004	-0.033	0.045	-0.035	-0.187	0.008	-0.033	-0.010	0.000
Luxury	-0.003	-0.009	0.032	-0.023	0.001	0.016	0.004	0.025	0.068	-0.004	0.021	-0.030	0.001
Laundry & cleaning	0.006	0.020	-0.012	0.001	-0.004	0.087	-0.008	0.013	0.001	0.012	0.006	-0.007	0.000

Continue Table 5: Covariance matrix-Rural

	Clothing & Footwear	Gross house rent	Fuel & Lighting	Fur., Fur. & others	Med. & Health exp.	Public transport	Maintenance means of trans.	Misc. service	Recreation	Educational expenses	Radio & musical	Servant's wage	Luxury	Laundry & cleaning
Rice														
Other cereal														
Pulses														
Fish and dry fish														
Eggs and meat														
Vegetable														
Fruits														
Spices														
Edible oils and fat														
Milk & milk products														
Misc. food														
Beverage														
Tobacco & Products														
Clothing & Footwear	0.023													
Gross house rent	0.010	0.078												
Fuel & Lighting	0.007	-0.004	0.085											
Fur., Fur. & others	0.001	0.013	0.006	0.013										
Med. & Health exp.	-0.001	0.008	-0.002	0.004	0.029									
Public transport	0.000	0.033	0.017	0.017	0.024	0.134								
Maintenance means of trans.	0.001	-0.001	0.002	0.000	-0.003	0.008	0.014							
Misc. service	0.003	0.007	-0.032	-0.015	-0.006	-0.031	-0.004	0.607						
Recreation	0.011	0.092	0.001	0.020	0.011	0.046	-0.002	-0.026	0.412					
Educational expenses	0.009	0.046	0.038	0.013	0.007	0.026	-0.004	-0.011	0.032	0.166				
Radio & musical	0.008	0.011	0.013	-0.002	0.021	0.012	-0.011	0.014	0.018	-0.217	0.857			
Servant's wage	-0.011	-0.010	-0.015	-0.002	-0.002	0.007	0.002	0.003	-0.026	-0.011	-0.009	0.091		
Luxury	0.000	0.004	0.003	0.003	0.004	0.009	0.001	-0.022	0.001	0.012	0.012	0.003	0.063	
Laundry & cleaning	0.007	0.005	-0.005	0.002	-0.002	0.001	0.002	-0.007	-0.001	-0.003	0.003	0.001	-0.006	0.017