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# Core Inflation Measures for Pakistan

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STATE BANK OF PAKISTAN

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**Abstract**

*An appropriate measure of monetary inflation is not only essential for taking prompt monetary policy decisions, but also in explaining them. Headline measure of inflation in terms of Consumer Price Index includes both monetary and short run non-monetary changes in prices. The concept of core inflation is to purge the components of transitory and non-monetary changes from the CPI basket. This is all the more desirable when distribution of price changes departs from normality, as is the case in Pakistan as well as in the other countries. Some of the alternative measures of core inflation are constructed in this paper and among these, it is found that trim-based measure compares favorably with those based on methods of excluding fixed items from the basket of CPI.*

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## Introduction

It is generally assumed that the ultimate goal for monetary policy is price stability. This is based on various individual and cross-country empirical studies[1] that a stable rate of inflation provides the best environment to promote economic growth. The State Bank of Pakistan has also committed to maintain price stability with a view to foster economic growth. Since money supply is the most important determinant of inflation, therefore a key element of the central bank's monetary strategy must be an assessment of outlook for price developments.

Given that the ultimate goal of most central banks is price stability, it is essential for any monetary authority to distinguish between movements in price trends and noisy shocks to inflation data. This means that a central banker should focus on price developments and decide as to what extent these movements are due to a persistent trend and what part constitutes a temporary fluctuation to this trend. A central bank's response to any transient non-monetary shock (e.g. a rise in price of onions due to a bad harvest) by decreasing money supply may aggravate the inflation in the short term. Hence, it is better for the central banks to accommodate such price changes if they represent only a transient change.

It is also recognized that monetary authorities cannot control all sources of inflation. Various economic developments, which are not controllable by the monetary authority, may generate short-run transitory changes in inflation rate. Sources of such changes include changing seasonal patterns, broad based resource shocks and exchange rate shocks that lead to asynchronous price adjustments. The concept of core inflation is an attempt to extract that part of headline inflation, which is persisting as a trend in the medium to long run.

The purpose of this paper is to introduce the concept of core inflation and to calculate alternative measures of core inflation for Pakistan. The aim is to develop a measure of inflation, which minimizes transitory shocks and extracts the generalized and persistent part of CPI price changes. The choice of any particular measure of core inflation based on the CPI basket depends partly upon the behavior and distribution of price changes, which, in turn, help isolate those items whose prices are most directly affected by transitory shocks.

Typically, national statistical agencies like the Federal Bureau of Statistics (FBS)[2], produce an array of different price indices, which aggregate prices over particular subsets of prices in the economy. Usually, this includes a consumer price index (CPI), a producer price index (PPI), a wholesale price index (WPI), or a GDP deflator. It is generally considered that the ultimate concern of the monetary policy is the welfare maximization of final consumers rather than producers, so it is most relevant to for monetary policy to focus on the CPI, and core inflation measures based on the CPI.

This paper uses simple statistical methods to develop alternative measures of core inflation based on the CPI basket. The organization of the paper is as follows: Section I discusses the concept of core inflation and its background. Section II examines the behavior and distribution of price changes, and the properties of the distribution of annual and monthly price changes in the CPI basket over the period July 1991 to June 2000. Section III considers different measures of core inflation using different techniques for minimizing the impact of large isolated price movements on the aggregate measure of inflation. . Section IV examines performance of the constructed measures of core inflation. Section V concludes the paper.

[1] Fischer (1993) and Barro (1995) presented evidence of a significant negative relationship between inflation and economic growth.

[2] The Federal Bureau of Statistics (FBS) is Pakistan's official statistical agency.

## I. The Concept of Core Inflation

Milton Friedman's (1970) dictum "Inflation is always and everywhere a monetary phenomena" provides room for the concept of core inflation.[3] Friedman further elaborated: [4]

> "Common to all disturbances, is that the price movements reflect changes in the quantity of money ...The other explanation has been in terms of some special circumstances of the particular occasion: good or bad harvest; disruption in international trade; and so on in great variety."

The different approaches to core inflation are surveyed in Roger (1998) and Wynne (1999). According to Roger (1998) " there are two broad concepts of core inflation. One concept views core inflation as the persistent component of measured inflation. The second concept views core inflation as the generalized component of measured inflation". [5]

Belonging to the first group are measures aimed at capturing directly the persistent component of inflation. Examples include univariate smoothing techniques and the multivariate structural VAR method first presented in Quah and Vahey (1995). A second group of approaches focuses on capturing the generalized component of inflation—which is also likely to be persistent—by excluding from measured inflation the effects of so-called non-core shocks. This approach consists of techniques that re-weight or exclude particular price series in a systematic way (for instance, measures of the well-known 'excluding energy and unprocessed food'-type) or make use of robust estimators such as the median or trimmed means, in order to down-weight outliers in the cross-section of price changes in a flexible way.

Starting from Friedman's view, first of the views was emphasized by Eckstein (1981), Quah &Vahey (1995)[6] with a common argument of association of supply shocks with short-lived inflation disturbances[7]. This concept of core inflation attempts to measure inflation essentially as a monetary phenomenon and exhibits more persistence or less variability than the aggregate measured inflation under the assumption of long run monetary neutrality[8].

The second approach views aggregate inflation comprising of generalized or core component associated with expected inflation and monetary expansion and a relative price change component exhibiting supply disturbances. These non-monetary factors such as changes in relative prices and measurement errors and omissions can produce noise and hence can temporarily cause the short-term inflation rate to deviate from its trend over the medium to long term. Such distortions can substantially affect the aggregate price indices at higher frequencies.

Measurement of inflation as a monetary phenomenon is a difficult task, because money growth is not necessarily an exogenous variable, and as such may respond to shocks themselves.[9] This suggests that measurement of core inflation requires identification of monetary shocks—exogenous money supply changes by the central bank-as well as shocks to which money is responding endogenously.

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[3] Friedman (1970), p 24.
[4] Friedman (1983), p 16.
[5] Roger (1998), p 1.
[6] Quah & Vahey (1995), p 1130.
[7] Both Eckstein (1981) and Quah & Vahey (1995) versions of core inflation have some variations about interpretation of non-core inflation, for details see Roger (1998) "Core Inflation: Concepts, Uses and Measurement", pp. 1-3.
[8] The neutrality of money is said to exist, if a once-for-all change in money supply does not affect the real value of the variables. This implies that an increase in money supply usually results in inflation and such inflation is bound to be wholly or mostly expected.
[9] Bryan & Cecchetti (1993), p 3.

The total or headline inflation rate, which is most commonly measured by the consumer price index, at a particular time could be decomposed into a permanent component and a non-permanent or transitory component, the permanent component; is viewed as core inflation, i.e.,

$$\prod_t = \prod_t p + \prod_t np$$

The core inflation being permanent component is influenced by the expectations of the economic agents about future inflation, which in turn affects policy decisions of the monetary authority and finally the developments in the monetary aggregates.

Concepts of core inflation share the general association of core inflation with the inflationary expectations and demand pressures component of measured inflation and excludes transient shocks. Therefore, central bankers tend to define core inflation, practically, by excluding a variety of items from aggregate inflation, whose price movement are considered likely to distort the more general trend of other prices.

## II. Distribution Of Price Changes in Pakistan

The moments of the cross-sectional distribution of price changes provide useful summary about the shape of distribution of price changes. For a symmetric distribution, the coefficient of skewness is zero. A positive coefficient of skewness indicates that the distribution is skewed to the right i.e., exceptional price rises are more common or more extreme than exceptional price declines. Conversely, a negative skewness coefficient indicates that sharp price declines are more common or more extreme than price increases. A skewed distribution (either negative or positive) signifies the predominance of outliers in terms of price changes, thereby giving a distorted impression of the general trend of inflation.

**Table 1: Moments of Price Changes**

| Sample Moments | FY93 | FY94 | FY95 | FY96 | FY97 | FY98 | FY99 | FY00 |
|---|---|---|---|---|---|---|---|---|
| **Mean** | 8.42 | 10.36 | 10.62 | 11.43 | 12.59 | 6.78 | 5.31 | 4.31 |
| **Median** | 7.31 | 7.78 | 9.28 | 10.46 | 12.28 | 5.59 | 3.95 | 3.35 |
| **Std. Dev.** | 9.28 | 12.55 | 9.9 | 10.29 | 9.91 | 9.03 | 7.9 | 10.12 |
| **Skewness** | 1.62 | 2.1 | 1.71 | 1.45 | 0.25 | 1.4 | 2.37 | -1.32 |
| **Kurtosis** | 8.66 | 10.92 | 10.66 | 9.06 | 7.42 | 8.69 | 16.33 | 37.85 |

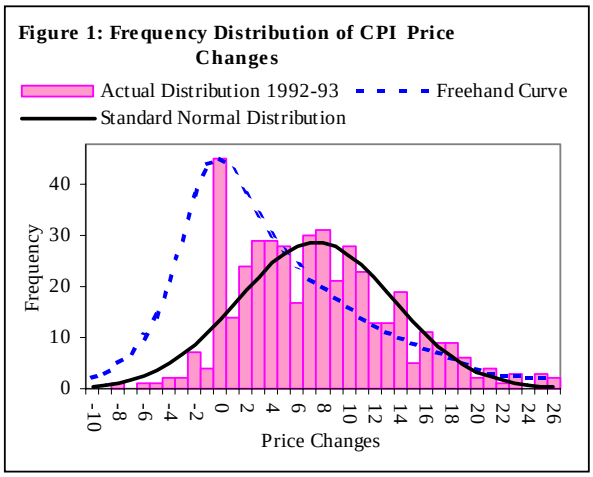
The coefficient of kurtosis[10] indicates the extent to whi ch the distribution is fat tailed (leptokurtosis $K_t > 3$) or thin tailed (Platykurtosis $K_t < 3$) relative to a normal distribution, which has a kurtosis coefficient of 3 (Mesokurtosis $K_t = 3$). A leptokurtic distribution indicates that exceptionally large price changes—positive or negative—are much more common than in a normal distribution. In this case the CPI would be frequently subject to distortion by extreme price changes. In statistical terms, this implies that the CPI mean, or 'headline' inflation rate may not be a 'robust' indicator of the general trend of inflation.[11]

[10] Kurtosis is a statistical measure that signifies the degree of 'peakedness' of a distribution relative to a standard normal probability distribution. Samples obtained from distributions with excess kurtosis have a higher probability of containing outliers than samples drawn from a normal density. Time series that exhibit a fat tail distribution are often referred to as leptokurtic.

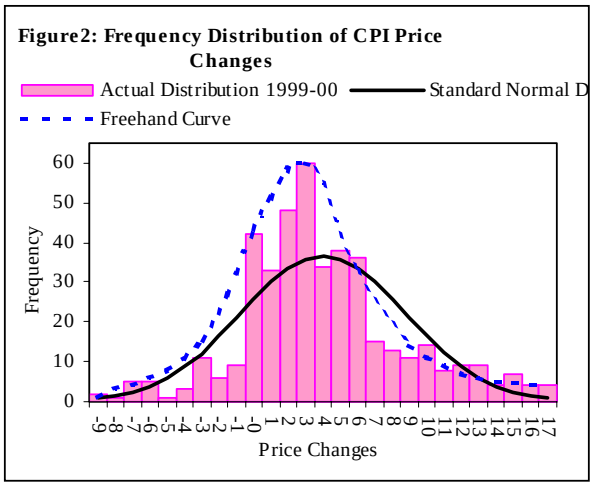
[11] A robust estimator of central tendency is defined to be one that is likely to be relatively unaffected by unusual or extreme values of a sample.

***Annual Distribution of Price changes***

**Table 1** shows the moments of annual average price changes from FY93 to FY00. It clearly reflects that mean price change was significantly higher during the period prior to FY98. The average rate of inflation declined from 10.74 percent for the period to 5.51 percent during FY98-00. Across all sub-periods median rate of price changes is below the mean rate indicating skewness in the price distribution. There is a fall in standard deviation from 10.39 percent in the earlier period to 9.04 percent for the period FY98-00. In the later period the standard deviation is quite large relative to mean indicating the high degree of noise in the data.




Although the degree of skewness[12] varies considerably from year to year, it remains positive on average. Thus, on average, the distribution of price changes is skewed to the right. Over the entire period the average skewness was 1.19 which is above the skewness of 0.2 found by Bryan *et al* (1997) for US price changes and the skewness of 0.6 found by Roger (1997) for New Zealand and Kearns (1998) for Australian price changes.




The kurtosis of the distribution of price changes is always larger than three in Pakistan's case over the period FY93 to FY00 (**Figure 1 & 2**). Over the entire period FY93-00 the average degree of kurtosis in the distribution of price changes was 13.68 for annual price changes, indicating considerable excess kurtosis compared to a normal distribution. This indicates that the distribution of price changes has considerably fatter tails than a normal distribution, implying that mean rate of headline inflation is likely to be distorted frequently by extreme movements in some prices. In statistical terms, the high kurtosis of the distribution implies that the CPImean inflation rate is not a robust or efficient measure of the general or central tendency of inflation.

This examination supports results earlier obtained by Bryan and Cecchetti (1993) for USA, Roger (1995) for New Zealand, and afterwards substantiated by various other country experiences. Roger (1995) found that at a quite disaggregated level, the distribution of price changes in New Zealand showed significant right skewness. In 1997, he extended his analyses to a more aggregated

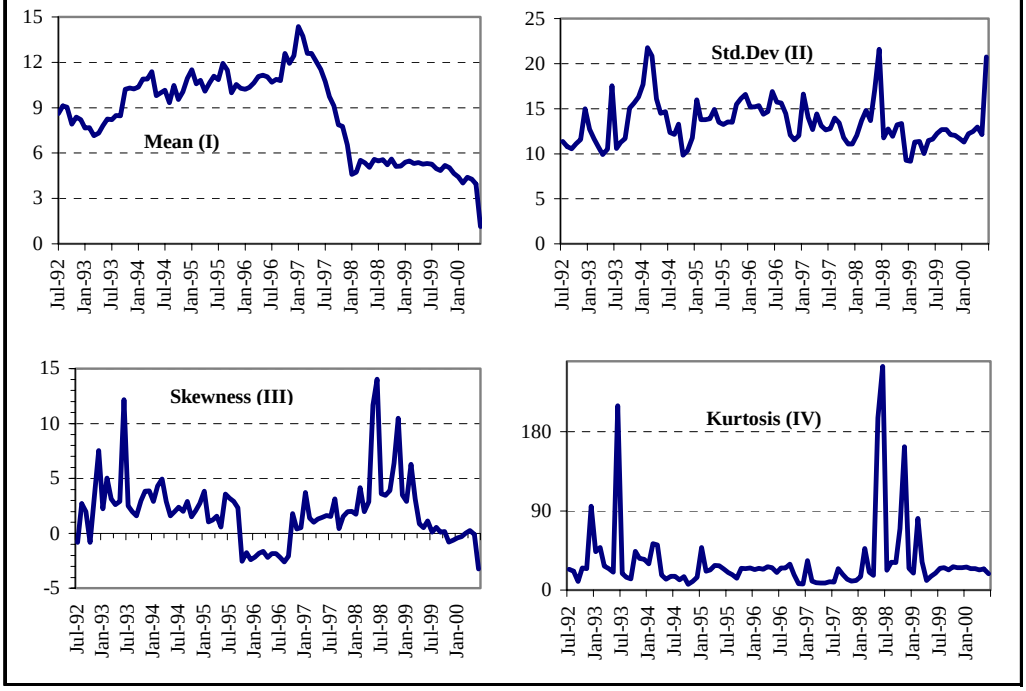
[12] The degree of skewness has significant implications for the unbiasedness of a measure of central tendency. For a normal distribution with a coefficient of skewness equal to zero, the mean and median coincide and both are unbiased. The unbisedness property of an estimator implies that the expected value (average value) of an estimator equals to the true value of its population parameter being estimated. However, if the distribution is skewed, the mean and median will diverge, making the mean to be a biased estimator of the central tendency. For example, if the distribution of price changes is skewed to right, then the median rate of inflation will lie below the mean and aggregate measure of inflation (CPI growth rate), which is actually an arithmetic mean, becomes biased and inefficient.

data over longer periods and found that distribution of price changes in New Zealand even at a high degree of aggregation, has not been close to normal, but rather showed chronically high kurtosis and right-skewness.

***Monthly Distribution of Price Changes***

The cross-sectional distribution of 12-month point-to-point inflation [13]shows greater volatility than the distribution of annual averages. **Figure 3** plots moments of distribution of 12-monthly CPI price changes. The top left panel shows 12-monthly mean price changes. The decline in inflation rate is clearly seen with the smaller mean price change over the period from July 1997 to June 2000 than over the earlier period. The mean price change in the period July 1992 to June 1997 was 10.28 percent compared to the 7.19 percent in the period July 1997-Jun 2000.

**Figure:3 Moments of Monthly Inflation (Percentage)**




The second panel, showing the cross-sectional standard deviation of 12-month inflation rates indicates significant dispersion of inflation rates, but also indicates that the degree of dispersion has not changed substantially even though the mean inflation rate has declined significantly. This suggests that the magnitude of relative price shocks in the Pakistan economy is largely independent of the level of aggregate inflation.

The plot of the coefficient of skewness in the third panel shows that during most of the period, price changes are positively skewed. The direction of skewness also suggests another important issue of correlation that may exist between moments of inflation, which is out of the scope of this paper. Calculating moments for 96 distributions of monthly price changes reflects that over the entire period the skewness was positive, 76 times and negative, 20 times. Overall average coefficient of skewness during the period remained 1.96 percent.

[13] Prices in a given month relative to their levels 12 months earlier, i.e. $P_t/P_{t-12}$.

The coefficient of kurtosis in the figure remained very large and greater than 3.0 almost each time, indicating the distribution of monthly price changes is always showing excess kurtosis relative to a normal distribution.

Pakistan's case exhibits, on the whole, two distinctive features of the distribution of price changes, which need to be considered while constructing a statistical measure of core inflation. First, the distribution of price changes is positively (right) skewed. Second, the distribution displays a degree of kurtosis much larger than a normal distribution. This implies that in a given month, a large proportion of CPI basket experiences price changes significantly different from the mean inflation rate, due to extreme observations. Given the skewness and kurtosis, the distribution of price changes was tested for normality in each time period, using Jarque-Bera test. The null hypothesis of normality was rejected in each case of the eight annual price distributions and 96 monthly price distributions.[14]

**III. Measuring Core Inflation**

It is obvious that the components of CPI basket will determine not only the behavior of the CPI but also those of core inflation indices, which is based on these components. Having examined the distributions of price changes, summarized by moments, section III suggests various methods for constructing core inflation. Different approaches have been used to develop a measure of core inflation, to gauge the underlying trend in inflation[15].

The choice of any particular definition lies on the relative efficiency of that very definition in tracking and forecasting the underlying inflation trend[16]. However, a core measure should also have some desirable properties, which makes it useful to be set as a policy target. To be widely accepted and useful for economic policy purpose, a core measure should be easily understood, available on timely basis, not subject to revisions, and capable of being easily verified (Roger 1997).

There is no single method to work out a core measure; there is a list of techniques ranging from simple exclusion to complex econometric models. A simple statistical analysis, however, will be helpful in explaining the basic idea. Empirical work in the field exposes two main approaches to compute underlying inflation. The first, approach is based on systematically excluding specific components of headline inflation rate that are regarded as subject to extreme price changes due to temporary non-monetary factors, such as seasonal supply shocks. The second approach is based on the use of limited influence estimators, particularly various trimmed means, to exclude extreme price changes. Both of these methods of measuring core inflation have their own advantages and disadvantages.

The exclusion approach is based on the subjective element as to which particular item or commodity group would be taken out of the original headline inflation, by observing relative inflation variation. The most unrefined version of exclusion approach takes out whole of the food and energy subgroups from the aggregate inflation measure. Besides, the choice of excluding items is constrained by the particular definition of CPI i.e. whether the domain of CPI is based on consumption or expenditure approach.[17] This is more obvious in cases where core measure is calculated by excluding particular items (e.g. interest rate, taxes or mortgage payments) from the headline inflation.

[14] This result conforms to different country experiences e.g., Kearns (1998) for Australia, Meyler (1999) for Ireland.
[15] Australia uses CPI excluding interest charges as a measure of core inflation, which is monitored along with headline inflation rate. UK and South Africa exclude mortgage interest payment from their price index and so on so forth.
[16] In practice both the terms, underlying and core inflation are used interchangeably.
[17] "Most CPIs are based on one of the three definitions, each involving a slightly different domain of prices: a consumption based approach; an expenditure approach based on household outlays; an expenditure approach based on household acquisitions…. For most goods and services three of the approaches are same but there are few areas like household expenditure on durable goods and on debt servicing, in which these alternative definitions of CPI are quite different…" For details, see Roger (1998), p 12.

The core measure using exclusion principle possesses the quality of being readily understandable, easy to compute and less demanding in terms of data requirements. It is also transparent and easily verifiable because of pre-specification of items excluded. But such a measure is not only constrained by the element of subjectivity in deciding as to which particular item to be excluded from the basket but also suffers from a potential risk of information loss. In other words, at times, the excluded prices may contain important information about the general trend of inflation.

Another major criticism to this approach is that temporary disturbances are not necessarily limited to specific sub-components. For example, a core measure calculated by excluding food and energy items does not necessarily imply that there would not be any noise in the remaining components.

Bryan and Cecchetti first presented the limited influence (LIE) estimator approach in 1993. Under this approach headline inflation is measured as a weighted average of cross-sectional price changes. But since the distribution of disaggregated price changes is not normal and highly kurtotic, the average inflation rate is an inefficient measure of overall price change[18]. For this purpose a robust measure of inflation is introduced in terms of statistical measure of trimmed mean. Although the weighted median is also an alternative but the paper concentrates on trimmed mean as a measure of underlying inflation.

A trimmed mean is calculated by arranging individual observations of price change in each period from the lowest to the highest values and then attaching zero weights to a fixed percentage of the prices from the both ends of the distribution while computing the mean value. Consequently, a trimmed mean is less susceptible to the effects of extreme observations than is the arithmetic mean. It is therefore less sensitive to fluctuations compared to that of simple mean for extremely skewed distributions. The use of such measures reflects the intuition that the type of shocks that may cause problems with price measurement are infrequent and agents do not instantly adjust to every change in prices, as there are menu costs of price adjustments.

On the plus side, for a trimmed mean estimator, a prior judgment for the choice of exclusion of items is avoided, but a decision is to be made about the level of trim to cut the tails of the cross-sectional price distribution. Unlike the exclusion approach, a trimmed mean estimator does not exclude any item *a priori*, rather systematically determine as to which item to be ignored at any point in time while calculating average prices.

On the negative side, for items whose prices do not follow a regular seasonal pattern but are rather sticky i.e., which do not change often, and not always in the same month of the year, the use of trimmed mean may result in quite a volatile inflation pattern. Such items would be showing zero inflation in some periods and quite high in the other. Not surprisingly, these items will be marked as outliers and trimmed in the tails of distribution. Statistically, this method is more justifiable, although it still poses the risk of information loss similar to the exclusion approach, but to a lesser extent.

In Pakistan's case the concept has not been very common[19], even among the policy makers. And hence, requires efforts on the part of State Bank of Pakistan or the Federal Bureau of Statistics to develop such a measure of underlying inflation, which can be used as a reference rate by the monetary policy makers while taking policy actions and communicating and explaining its monetary policy.

[18] Bryan and Cecchetti (1993), Roger (1995).

[19] Attempts have not been made to introduce the concept specifically with reference to monetary policy operations and implementation. A paper *"Permanent and temporary price variations: A decomposition analysis based on Stochastic Forecasting Models"* by Dr. Eatzaz Ahmed & Sheena Ali published in Pakistan Journal of Applied Economics, Volume XV, Nos. 1 & 2 (Summer & Winter), 1999 covered the issue of decomposing permanent and transitory components of different variables like Exchange rate, WPI and CPI by using econometric technique. The paper presents a simple decomposition analysis.

However, it must be ensured that the public also has confidence in the measured underlying price level. For this purpose, general public must be educated about the reasons and the methods to use it. Further, such a confidence could be enhanced, if the measurement of the core index is made outside the central bank, e.g. at the Federal Bureau of Statistics which also measures the CPI.

We have applied our analysis to a very disaggregated data set, covering the period from July 1991 to June 2000. The weights and prices of 460 items defined by the CPI basket have been taken as the sample space for working out a core index. The data is on the base of 1990-91 for which the monthly price data for the year 1990-91 was not available. Variation in CPI, which consists of a basket of 460 items, is considered a headline inflation rate. All core indices have been computed as Lespayeres, Carli type, throughout [20]. The data source is Federal Bureau of Statistics (FBS). Data seasonality is dealt by quoting a zero price change to an item in any off-season. The section includes measurement of core indices by using following approaches (**Table 5**):

**Table 2: Alternative Measures of Inflation: (Annual Averages)**

| Year | CPI | CPIVAM | CPIEXFE | CPIT20 | CPIT15 |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| 1992-93 | 9.84 | 9.70 | 8.44 | 9.64 | 9.48 |
| 1993-94 | 11.26 | 11.74 | 10.80 | 10.72 | 10.71 |
| 1994-95 | 13.02 | 13.11 | 9.99 | 11.04 | 11.35 |
| 1995-96 | 10.81 | 11.24 | 10.90 | 10.76 | 10.71 |
| 1996-97 | 11.78 | 11.83 | 11.70 | 11.50 | 11.55 |
| 1997-98 | 7.89 | 8.25 | 7.31 | 7.44 | 7.41 |
| 1998-99 | 5.75 | 5.86 | 5.63 | 5.38 | 5.34 |
| 1999-00 | 3.58 | 4.21 | 4.67 | 3.86 | 4.08 |

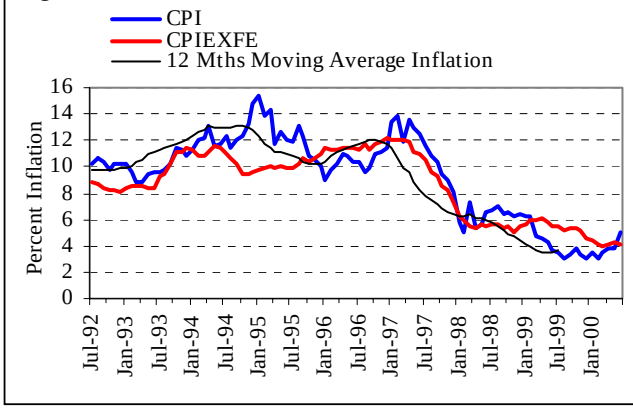
Notes: CPI: Consumer Price Index. CPIVAM: CPI volatility adjustment Method. CPIEXFE: CPI Excluding food and energy. CPIT20: 20 Percent Trimmed mean of CPI. CPIT15: 15 Percent Trimmed mean of CPI.

- Exclusion Approach
- Limited Influence Estimator

***Exclusion Approach***

The standard approach to the estimation of core inflation by this method is to remove the noisy elements from the headline inflation rate. The most extreme case is to take out whole of the food and energy components of CPI basket treating them as a noise. This type of exclusion from CPI basket has a weak economic justification, as it is not necessary that noise only comes from the items excluded or the leftover items do not have shocks. Exclusion of whole of the food and energy subgroups also poses a risk of information loss because both food and energy are heavily weighted subgroups. CPIEXFE calculated by excluding whole of the food and energy subgroups from CPI basket, which sheds a combined weight of 55.45 percent. The weight of the food subgroup is 49.35 percent and of fuel & lighting is 6.1 percent.

**Figure 4: CPIEXFE Inflation**

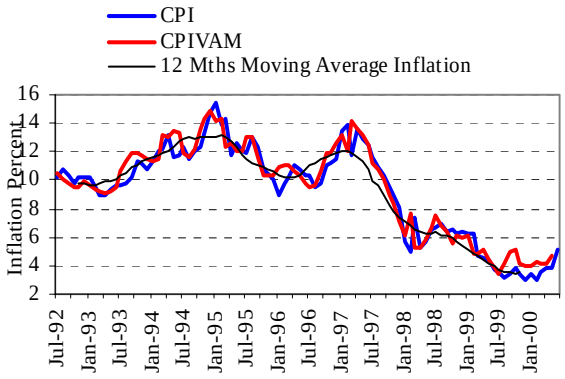



[20] Carli index (1804) is defined as weighted average of price ratios. For details see Axiomatic and Economic Approaches to Elementary Price Indexes W.E.Diewert (1995)

Practically, for developing countries such a measure would be undesirable because a large number of items included in the consumer basket show relative price volatility over the period and it would not be appropriate to delete such items entirely while calculating core measure. Besides, due to the structural transformation, the basket of volatile items keeps shifting over time; the exclusion of certain items on a permanent basis may, therefore, render the inflation measure less efficient.

Finally primary commodities have a strong influence on the underlying inflation as they form a sizeable part of household basket and crucial information of price-expectations e.g. food subgroups retains the largest share in the basket, although this share has declined in absolute terms over the years[21]. **Figure 4** reflects that exclusion of food and energy subgroups would effect the trend inflation to the extent it may convert an upward price movement, observed in headline inflation rate during 1994-97, into a declining inflation pattern.

**Figure 5: CPIVAM Inflation**




In order to have a practical solution to these considerations the approach adopted in this paper for estimating core inflation is the adjustment of volatility in the headline inflation by using coefficient of variation (CV). The approach uses the information that out of 460 items of CPI, 123 items (combined weight 44.61) had a CV under 100 percent and 242 items (combined weight 42.55) had a CV between 100-200 percent and 95 items having a combined weight of 12.84 percent have CV equal to or greater than 200. A monthly series of core inflation by volatility-adjusted method (CPIVAM) is computed by excluding all items of CPI, which have a CV of over 250 percent. The volatile commodities which get excluded from tailored basket are seasonal fruits, vegetables, spices, tea, lawn and cotton suits, news papers, doctor's clinic fee, bus and train fare, yearly motor cycle and car tax etc. The basket with a combined weight of 90 percent retains most of the food and energy items like wheat, rice, milk, petrol, natural gas charges, etc.

A cut-off at 250 percent CV is decided by trying different cut-off points, with the rationale that certain objectively selected items would remain excluded out of the basket once for all. It is also seems to be intuitively superior to the subjective approach usually adopted for exclusion. A larger exclusion of commodities having a combined weight greater than 10 percent will define a narrow basket and would be less representative. This is true in cases, where a larger proportion of consumer's income goes to the food and energy items' expenditure. On the plus side the method considers only those items for exclusion whose prices show greater volatility over the time period. **Figure 5** suggests that the items excluded from the basket while calculating CPIVAM do not affect the trend inflation rather removes minor fluctuations.

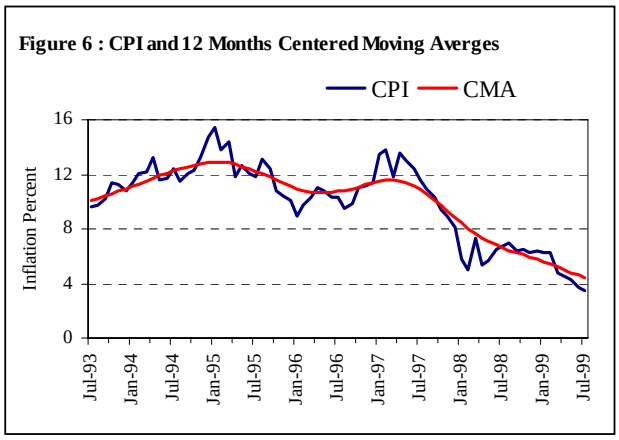
The monthly estimates of CPIVAM for the period from July 1992 to June 2000 are presented in **Table 5** and annual averages are given in **Table 2**. It can be seen that annual averages of CPIVAM moved in the range of 13.11 percent in 1994-95 to 4.21 percent in1999-00, with the period average of 9.49 percent during 1992-00, compared to the averages of CPI, which ranged from 3.58 percent in 1999-00 to 13.02 percent in 1994-95 with the period average of 9.24 percent (**Table 2**).

[21] "In Pakistan the share of food CPI basket has declined from 54 percent in 1969-70 to 40 percent in 2000-01…" For details, see SBP Annual Report FY02, p 61.

The estimation of core inflation by exclusion principle may be more suitable for advanced economies as the share of items showing distinctive price behavior are not only small but also easily identifiable. For example the share of food group in US CPI basket is 16 percent compared to 40 percent for Pakistan.

***Limited Influence Estimator Approach***

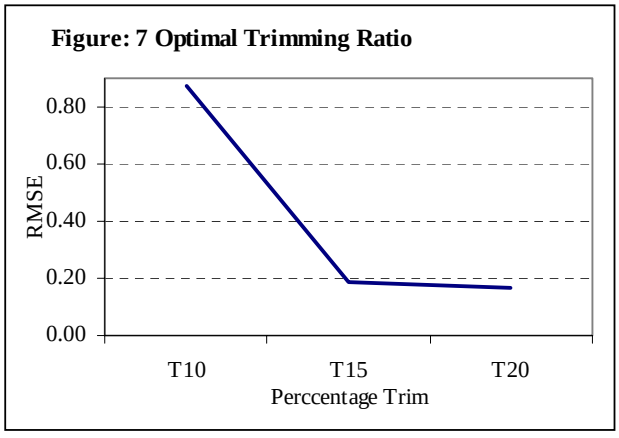
Following the series of work by Bryan and Cecchetti, a large number of empirical researches have been conducted and a number of countries have worked out their core measure, based on limited influence estimator approach such as trimmed mean. Scott Roger (1997) in case of New Zealand, Matea and Alvarez (1999) for Spain, Shiratsuka (1997) in Japan and Samanta (1999) in India, came to the conclusion that limited influence estimator such as trimmed mean gives a better picture of the price developments and provide more accurate predictions for future inflation. A trimmed mean estimator systematically redefines the consumer basket at any particular point in time, to gauge the underlying inflation trend.




The statistical justification for using trimmed mean estimates, as explained earlier, stems from the idea that the random draws from a normal distribution with different variances would produce a distribution of price changes with high kurtosis and for the reason simple weighted mean of data is not likely to produce an efficient estimation of the population parameter (Mohanty and Ramaiah 2000).

However, a judgment has to be made concerning the actual population parameter in question and the optimal level of trim. The aim is to find the trimming percentage that minimizes the gap between two inflation measures.

Technically speaking, this gap was measured by the Root Mean Square Error (RMSE). Following Bryan and Cecchetti (1996), a historical 12-month centered moving average CPI is worked out for the entire sample period. Originally, a 36-month centered moving average has been taken by Bryan and Cecchetti as a benchmark. In this paper a 12-month centered moving average is taken as the trend inflation and then a trimmed CPI basket with a trimming ratio which minimizes the Root Mean Square Error (RMSE) from the centered moving average series is calculated by using the following:




$$\text{RMSEa}=\sqrt{\sum_{t=1}^{n}(p_t^{\alpha}-\pi_t)^2/n}$$

Where $p_t^{\alpha}$ is the trimmed CPI with a trimming ratio of $\alpha$ percent from each tail of the price distribution at time t; $\pi_t$ is the 12-month centered moving average change in CPI at time t; and n is the number of samples. **Figure 6** gives the plot of monthly changes in CPI and its 12-month centered moving average CPI. RMSE is calculated for three different trimming ratios of 10, 15 and 20 percent (from each tail), each plotted in **Figure 7**. It can be seen that RMSE is lowest at 20 percent trim. Monthly estimates of CPIT20 and CPIT15 are presented in **Table 5** while annual averages given in **Table 2**.

Annual average CPIT20 varied in the range of 11.50 percent in 1996-97 to 3.86 percent in 1999-00 with a period average of 8.79 percent during 1992-00, which is lower than that of CPI at 9.24 percent. The most important point for a trimmed CPI is that none of the component of CPI got completely excluded while calculating core indices. For instance, dates are completely excluded under CPIVAM due to its high CV over the period while it is retained by the CPIT20.

**Figure 8: MOM Growth of CPI and Trimmed Mean CPI and Infaltion Differentials**

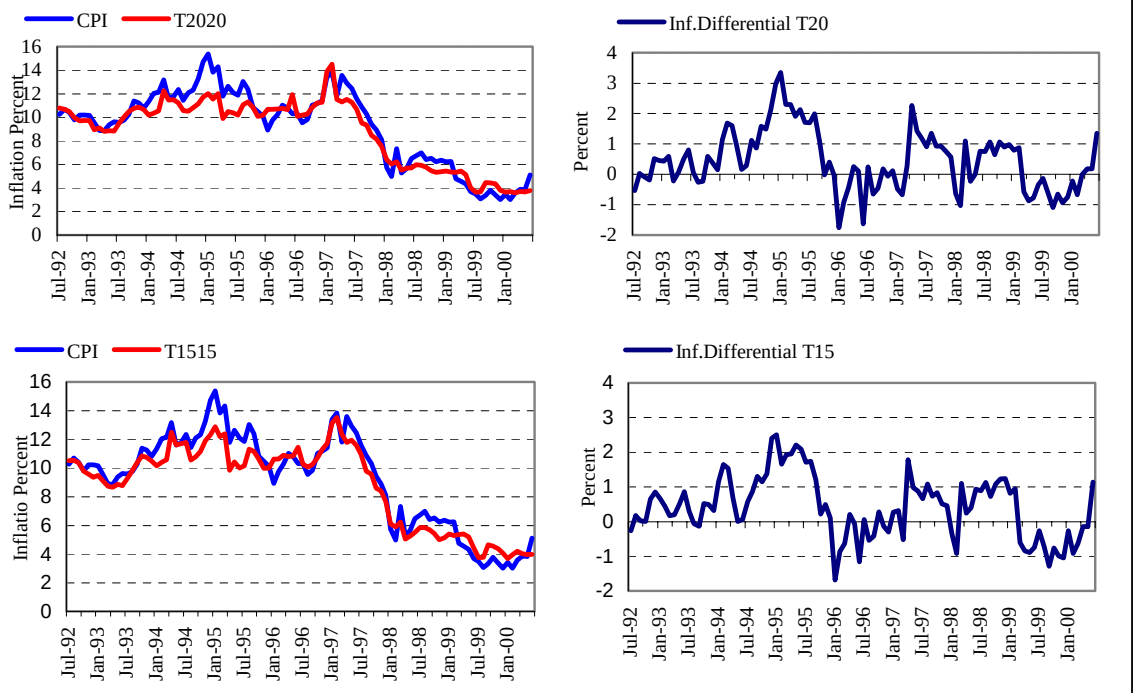



**Figure 8** plots the month over month growth rate of trimmed mean indices, and their inflation differentials with the headline (CPI) inflation rate. It can be seen from the figure that inflation differential is positive on average, in both the series whereas the CPIT20 is showing slightly higher inflation differential as compared to the CPIT15.

The movement of underlying inflation represented by trimmed mean measure of CPIT20 reveals that over a longer time horizon it has followed a similar path as that of headline inflation rate. There was a clear acceleration in the underlying inflation during 1990s with the peak coinciding with the year 1997 and thereafter inflation rate has shown signs of deceleration. The long run price behavior seems to reflect the underlying macro-economic conditions.

## IV. The Performance of Core Inflation Measure

The concept of core inflation described in the previous section suggests some basic criteria for evaluating the performance of these developed measures. The criteria which are commonly used to gauge the performance of the core measures includes how efficiently each measure tracks an estimate of underlying or trend inflation and what is the level of complexity for general understanding. The section examines these developed core measures on the basis of efficiency of these measures in tracking trend inflation rate.

Generally speaking a good measure of inflation should track trend inflation in two ways. First, over a long period of time, the average rate of core inflation should match with the average rate of headline inflation. Second, the core inflation should move closely with the trend rate of inflation.
For the first aspect, policy makers and analysts always prefer a measure of inflation that neither understates nor overstates the long-term trend inflation. Over a period of 30 years, for example, the long-term trend inflation rate can accurately be measured from the average rate of overall inflation, because the period is long enough to eliminate short-term fluctuations.

Unavailability of longer disaggregated data series created problems in ascertaining relative performance of different measures of core inflation. However, a comparison of different core measures with the CPI (Headline) inflation over a period of eight years reveals that from FY92 to FY99, each core indicator does not match the average rate of overall inflation. Except for CPIVAM, all three core indices, i.e. CPIT15, CPIT20 and CPIEXFE remain below the average rate of CPI inflation **(Table 3).**

This suggests that CPIVAM measure excludes all those items, which have a deflationary impact on overall rate of inflation. CPIVAM overstates overall inflation situation while trimmed mean inflation measures show a closer approximation to the average rate of CPI inflation.

**Table 3: Inflation Variability**

| | CPI | CPIVAM | CPIEXFE | CPIT20 | CPIT15 |
|---|---|---|---|---|---|
| **Mean** | 9.24 | 9.49 | 8.68 | 8.79 | 8.83 |
| **STDV*** | 3.24 | 3.15 | 2.61 | 2.89 | 2.88 |
| **CV** | 0.35 | 0.33 | 0.30 | 0.33 | 0.33 |

*STDV (Absolute measure of dispersion) calculated to show the variability of inflation around its mean rate.

Apart from comparing average rate of inflation, the core measure should also move closely with the trend rate. When trend inflation rises, for example, core inflation should also move accordingly. Trend inflation in a given month is estimated as the 12-month moving average of CPI inflation.

The accuracy with which core inflation tracks the trend is measured on a monthly basis as the standard deviation of the difference between core and trend inflation. For a core measure that moves closely with the trend, this difference tends to be small (**Table 4**).

**Table 4: Dispersion of Inflation Differential**

| | CPIVAM | CPIEXFE | CPIT20 | CPIT15 |
|---|---|---|---|---|
| **STDV*** | 0.58 | 1.60 | 0.98 | 0.89 |
| **STDV**** | 0.88 | 1.33 | 0.92 | 0.87 |

* Differential calculated from CPI inflation.

** Differential calculated from 12 months moving average inflation

According to the above criterion, CPIT15 appears to perform better relative to other measures, showing the lowest value of the standard deviation of the inflation differential from its trend rate. This indicates that the 15-percent trimmed mean has tracked movements in trend inflation more closely than other core indices. In monthly inflation rates from Dec 92 to Dec 99 the trend volatility of LIE based core measures is about 0.87 and 0.98 percent for CPIT15 and CPIT20 respectively.

By contrast, the trend volatility of the CPIEXFE, the most commonly used core measure, exhibits highest volatility at about 1.33 percent. CPIVAM also performs well compared to CPIT20 and CPIEXFE measures, as it shows lower trend volatility.

Given that the core measures based on the exclusion approach greatly suffer from information loss and have a relatively weak economic justification for excluding a vital portion of consumer basket especially in case of developing countries, core measures based on the limited influence estimator approach may do a better job in measuring the underlying inflation.

## V. Conclusion

Inflation data typically show a considerable degree of short-term volatility, which can neither be controlled in entirety by monetary policy actions, nor is such control necessarily desirable. Hence, for monetary policy analysis and formulation there is a need to develop inflation measures that are free from this type of noise. If these 'underlying' or 'core' inflation measures can be successfully constructed, they should, in principle, provide the monetary authorities with better signals than the observed ‘headline’ inflation rate. Although the concept of core inflation is very appealing from this point of view, it has, however one important drawback. Since it has not been well defined from a theoretical point of view, several estimation techniques for the unobservable core inflation component have been proposed but no consensus seems to exist as to which estimation technique performs best.

The paper finds that the price changes in Pakistan, as in other countries, are widely dispersed and also not distributed normally with a positive skewness and high kurtosis. The extreme price changes in the tails of the distributions are considered to be unrepresentative of the underlying inflation trend. These extreme price changes distort the mean rate of inflation, making it a less efficient measure of generalized inflation. Hence, measures of core inflation, which systematically filter out unrepresentative price changes, are more useful to policy makers.

The analysis reveals that core inflation measures derived from Limited Influence Estimator (LIE) perform better over the estimates based on the more traditional exclusion principle. Further research may be appropriate to determine more precisely the benefits of using different measures of core inflation in policy analysis. In particular, it may be useful to examine more closely the usefulness of alternative measures in inflation forecasting.

**Table 5: Alternative Measures Of Inflation: July 1992 to June 1996**

| Months | CPI | CPIVAM | CPIEXFE | CPIT2020 | CPIT1515 |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Jul-92 | 10.25 | 10.41 | 8.87 | 10.79 | 10.51 |
| Aug-92 | 10.70 | 10.45 | 8.65 | 10.68 | 10.53 |
| Sep-92 | 10.41 | 10.01 | 8.44 | 10.50 | 10.39 |
| Oct-92 | 9.79 | 9.81 | 8.25 | 9.99 | 9.78 |
| Nov-92 | 10.21 | 9.55 | 8.24 | 9.70 | 9.56 |
| Dec-92 | 10.21 | 9.51 | 8.13 | 9.75 | 9.35 |
| Jan-93 | 10.15 | 9.97 | 8.33 | 9.72 | 9.49 |
| Feb-93 | 9.55 | 9.67 | 8.59 | 8.95 | 9.10 |
| Mar-93 | 8.89 | 9.42 | 8.54 | 9.12 | 8.72 |
| Apr-93 | 8.87 | 9.27 | 8.47 | 8.80 | 8.67 |
| May-93 | 9.38 | 9.13 | 8.36 | 8.88 | 8.86 |
| Jun-93 | 9.63 | 9.15 | 8.43 | 8.83 | 8.76 |
| Jul-93 | 9.57 | 9.46 | 9.24 | 9.51 | 9.27 |
| Aug-93 | 9.77 | 10.58 | 9.45 | 10.03 | 9.83 |
| Sep-93 | 10.26 | 11.38 | 10.16 | 10.50 | 10.39 |
| Oct-93 | 11.38 | 11.91 | 11.09 | 10.78 | 10.85 |
| Nov-93 | 11.24 | 11.91 | 11.19 | 10.87 | 10.75 |
| Dec-93 | 10.81 | 11.79 | 11.40 | 10.66 | 10.48 |
| Jan-94 | 11.32 | 11.45 | 11.28 | 10.18 | 10.17 |
| Feb-94 | 12.05 | 11.38 | 10.88 | 10.36 | 10.40 |
| Mar-94 | 12.12 | 11.46 | 10.82 | 10.53 | 10.59 |
| Apr-94 | 13.17 | 13.11 | 11.12 | 12.25 | 12.49 |
| May-94 | 11.61 | 12.96 | 11.51 | 11.46 | 11.60 |
| Jun-94 | 11.76 | 13.45 | 11.40 | 11.48 | 11.70 |
| Jul-94 | 12.35 | 13.37 | 10.90 | 11.24 | 11.78 |
| Aug-94 | 11.43 | 11.89 | 10.60 | 10.57 | 10.56 |
| Sep-94 | 12.10 | 11.68 | 10.14 | 10.52 | 10.79 |
| Oct-94 | 12.32 | 12.19 | 9.48 | 10.83 | 11.16 |
| Nov-94 | 13.27 | 13.57 | 9.50 | 11.15 | 11.89 |
| Dec-94 | 14.72 | 14.35 | 9.54 | 11.73 | 12.32 |
| Jan-95 | 15.38 | 14.84 | 9.79 | 12.03 | 12.88 |
| Feb-95 | 13.84 | 14.16 | 9.95 | 11.56 | 12.19 |
| Mar-95 | 14.32 | 14.36 | 9.98 | 12.03 | 12.39 |
| Apr-95 | 11.80 | 12.34 | 9.92 | 9.90 | 9.85 |
| May-95 | 12.63 | 12.60 | 10.10 | 10.50 | 10.42 |
| Jun-95 | 12.09 | 12.02 | 9.97 | 10.39 | 10.00 |
| Jul-95 | 11.86 | 12.08 | 9.84 | 10.17 | 10.15 |
| Aug-95 | 13.04 | 13.08 | 10.21 | 11.06 | 11.31 |
| Sep-95 | 12.38 | 13.02 | 10.61 | 11.32 | 11.17 |
| Oct-95 | 10.84 | 11.66 | 10.40 | 10.86 | 10.62 |
| Nov-95 | 10.48 | 10.40 | 10.62 | 10.07 | 9.98 |
| Dec-95 | 10.11 | 10.32 | 11.02 | 10.15 | 10.00 |
| Jan-96 | 8.93 | 10.34 | 11.38 | 10.69 | 10.62 |
| Feb-96 | 9.76 | 10.86 | 11.20 | 10.69 | 10.62 |
| Mar-96 | 10.27 | 11.08 | 11.35 | 10.71 | 10.90 |
| Apr-96 | 11.03 | 11.04 | 11.40 | 10.77 | 10.81 |
| May-96 | 10.78 | 10.69 | 11.40 | 10.68 | 10.84 |
| Jun-96 | 10.30 | 10.28 | 11.41 | 11.92 | 11.45 |

**Table 5(contd.): Alternative Measures Of Inflation: July 1996 to June 2000**

| Months | CPI | CPIVAM | CPIEXFE | CPIT2020 | CPIT1515 |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Jul-96 | 10.32 | 9.84 | 11.31 | 10.07 | 10.25 |
| Aug-96 | 9.54 | 9.53 | 11.69 | 10.19 | 10.08 |
| Sep-96 | 9.83 | 9.64 | 11.34 | 10.29 | 10.25 |
| Oct-96 | 11.03 | 10.57 | 11.78 | 10.85 | 10.75 |
| Nov-96 | 11.18 | 11.91 | 11.94 | 11.24 | 11.31 |
| Dec-96 | 11.41 | 11.91 | 12.14 | 11.29 | 11.70 |
| Jan-97 | 13.40 | 12.54 | 11.99 | 13.89 | 13.13 |
| Feb-97 | 13.83 | 13.16 | 11.98 | 14.52 | 13.51 |
| Mar-97 | 11.82 | 12.04 | 12.08 | 11.54 | 12.34 |
| Apr-97 | 13.57 | 14.13 | 11.96 | 11.31 | 11.79 |
| May-97 | 12.93 | 13.58 | 11.19 | 11.50 | 11.95 |
| Jun-97 | 12.45 | 13.16 | 11.01 | 11.27 | 11.58 |
| Jul-97 | 11.59 | 12.43 | 10.56 | 10.68 | 10.93 |
| Aug-97 | 10.87 | 11.25 | 9.66 | 9.52 | 9.78 |
| Sep-97 | 10.29 | 10.70 | 9.22 | 9.36 | 9.56 |
| Oct-97 | 9.43 | 10.04 | 8.51 | 8.50 | 8.59 |
| Nov-97 | 8.92 | 8.99 | 8.18 | 8.16 | 8.41 |
| Dec-97 | 8.10 | 8.42 | 7.28 | 7.53 | 7.65 |
| Jan-98 | 5.75 | 7.04 | 6.29 | 6.39 | 6.09 |
| Feb-98 | 4.98 | 6.14 | 5.94 | 6.02 | 5.90 |
| Mar-98 | 7.32 | 7.64 | 5.55 | 6.23 | 6.22 |
| Apr-98 | 5.28 | 5.18 | 5.34 | 5.52 | 5.04 |
| May-98 | 5.65 | 5.32 | 5.59 | 5.66 | 5.25 |
| Jun-98 | 6.48 | 5.88 | 5.54 | 5.72 | 5.54 |
| Jul-98 | 6.74 | 6.66 | 5.60 | 5.98 | 5.85 |
| Aug-98 | 6.97 | 7.45 | 5.66 | 5.91 | 5.84 |
| Sep-98 | 6.42 | 6.80 | 5.41 | 5.78 | 5.70 |
| Oct-98 | 6.52 | 6.44 | 5.48 | 5.46 | 5.43 |
| Nov-98 | 6.23 | 5.52 | 5.09 | 5.34 | 5.00 |
| Dec-98 | 6.36 | 6.06 | 5.45 | 5.38 | 5.12 |
| Jan-99 | 6.23 | 6.03 | 5.58 | 5.43 | 5.41 |
| Feb-99 | 6.24 | 6.10 | 5.95 | 5.37 | 5.29 |
| Mar-99 | 4.76 | 4.86 | 5.99 | 5.34 | 5.36 |
| Apr-99 | 4.57 | 4.89 | 6.13 | 5.45 | 5.41 |
| May-99 | 4.34 | 5.11 | 5.74 | 5.12 | 5.22 |
| Jun-99 | 3.68 | 4.38 | 5.53 | 4.03 | 4.42 |
| Jul-99 | 3.49 | 3.82 | 5.42 | 3.64 | 3.76 |
| Aug-99 | 3.07 | 3.37 | 5.21 | 3.67 | 3.78 |
| Sep-99 | 3.35 | 4.11 | 5.33 | 4.45 | 4.64 |
| Oct-99 | 3.79 | 4.94 | 5.30 | 4.44 | 4.56 |
| Nov-99 | 3.39 | 5.08 | 5.14 | 4.33 | 4.38 |
| Dec-99 | 3.03 | 4.06 | 4.59 | 3.78 | 4.08 |
| Jan-00 | 3.43 | 3.98 | 4.44 | 3.65 | 3.69 |
| Feb-00 | 3.02 | 4.01 | 4.10 | 3.70 | 3.95 |
| Mar-00 | 3.57 | 4.28 | 4.01 | 3.58 | 4.21 |
| Apr-00 | 3.88 | 4.09 | 4.06 | 3.70 | 4.01 |
| May-00 | 3.84 | 4.13 | 4.29 | 3.66 | 3.98 |
| Jun-00 | 5.10 | 4.71 | 4.16 | 3.76 | 3.97 |

**Table 6: Summary of Statistics of Price Change Distribution July 1992 to June 2000**

| Months | Mean | Variance | STDEV | Skew | Kurt | Months | Mean | Variance | STDEV | Skew | Kurt |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 1 | 2 | 3 | 4 | 5 | 6 |
| Jul-92 | 10.34 | 76.07 | 8.72 | 14.32 | 851.33 | Jul-96 | 10.84 | 137.15 | 11.71 | 18.76 | 2710.20 |
| Aug-92 | 11.05 | 128.48 | 11.34 | 155.82 | 4738.77 | Aug-96 | 9.86 | 109.42 | 10.46 | -56.03 | 2478.54 |
| Sep-92 | 10.15 | 99.43 | 9.97 | -22.34 | 2939.81 | Sep-96 | 10.33 | 87.62 | 9.36 | 1.93 | 828.37 |
| Oct-92 | 9.93 | 106.06 | 10.30 | -43.63 | 3278.71 | Oct-96 | 11.73 | 150.42 | 12.26 | 99.00 | 2818.48 |
| Nov-92 | 10.56 | 146.80 | 12.12 | 188.69 | 5204.50 | Nov-96 | 11.82 | 144.89 | 12.04 | 49.11 | 1363.80 |
| Dec-92 | 11.03 | 369.78 | 19.23 | 682.23 | 31696.62 | Dec-96 | 11.91 | 127.35 | 11.28 | 26.86 | 1098.76 |
| Jan-93 | 10.57 | 208.90 | 14.45 | 263.38 | 10240.28 | Jan-97 | 14.01 | 206.50 | 14.37 | 224.50 | 9404.27 |
| Feb-93 | 9.84 | 173.27 | 13.16 | 291.35 | 10268.45 | Feb-97 | 14.27 | 165.82 | 12.88 | 60.36 | 1851.64 |
| Mar-93 | 8.91 | 110.90 | 10.53 | 48.60 | 2364.74 | Mar-97 | 12.12 | 118.36 | 10.88 | 19.21 | 996.87 |
| Apr-93 | 8.77 | 81.23 | 9.01 | 9.08 | 1124.33 | Apr-97 | 14.03 | 277.89 | 16.67 | 95.36 | 1950.82 |
| May-93 | 9.52 | 94.14 | 9.70 | 88.29 | 1779.34 | May-97 | 13.28 | 168.71 | 12.99 | 52.81 | 937.60 |
| Jun-93 | 10.68 | 612.78 | 24.75 | 1369.66 | 84045.96 | Jun-97 | 12.85 | 152.54 | 12.35 | 47.20 | 988.25 |
| Jul-93 | 9.69 | 84.16 | 9.17 | 61.58 | 1458.68 | Jul-97 | 12.03 | 156.34 | 12.50 | 44.74 | 968.72 |
| Aug-93 | 9.73 | 86.87 | 9.32 | 22.16 | 946.75 | Aug-97 | 11.58 | 251.88 | 15.87 | 239.30 | 7577.73 |
| Sep-93 | 10.15 | 98.07 | 9.90 | 18.67 | 979.22 | Sep-97 | 10.43 | 158.42 | 12.59 | 2.21 | 2099.17 |
| Oct-93 | 11.25 | 111.40 | 10.55 | 61.62 | 4892.72 | Oct-97 | 9.65 | 137.52 | 11.73 | 46.47 | 938.06 |
| Nov-93 | 11.37 | 125.15 | 11.19 | 101.95 | 3942.09 | Nov-97 | 9.22 | 128.24 | 11.32 | 46.43 | 974.85 |
| Dec-93 | 10.97 | 152.58 | 12.35 | 100.26 | 4264.83 | Dec-97 | 8.38 | 136.93 | 11.70 | 52.31 | 1101.04 |
| Jan-94 | 11.18 | 208.16 | 14.43 | 116.62 | 5972.48 | Jan-98 | 6.01 | 141.58 | 11.90 | 39.70 | 1952.86 |
| Feb-94 | 12.36 | 591.61 | 24.32 | 887.65 | 47077.76 | Feb-98 | 5.53 | 183.32 | 13.54 | 158.49 | 7879.18 |
| Mar-94 | 12.48 | 498.98 | 22.34 | 798.70 | 38100.07 | Mar-98 | 7.69 | 255.84 | 15.99 | 118.86 | 3663.37 |
| Apr-94 | 13.24 | 224.97 | 15.00 | 216.72 | 6312.47 | Apr-98 | 6.20 | 255.92 | 16.00 | 147.04 | 3599.05 |
| May-94 | 11.48 | 158.31 | 12.58 | 7.35 | 1965.98 | May-98 | 7.20 | 644.15 | 25.38 | 1154.52 | 67315.29 |
| Jun-94 | 11.80 | 181.46 | 13.47 | -17.33 | 2977.36 | Jun-98 | 8.16 | 1070.64 | 32.72 | 1963.88 | 136110.69 |
| Jul-94 | 12.19 | 135.55 | 11.64 | 51.45 | 1196.72 | Jul-98 | 7.20 | 166.82 | 12.92 | 100.44 | 2154.69 |
| Aug-94 | 11.42 | 143.49 | 11.98 | 49.25 | 946.05 | Aug-98 | 7.44 | 261.10 | 16.16 | 179.76 | 6836.17 |
| Sep-94 | 12.05 | 154.58 | 12.43 | 111.06 | 2107.14 | Sep-98 | 6.83 | 227.91 | 15.10 | 199.20 | 5897.09 |
| Oct-94 | 12.03 | 101.68 | 10.08 | 40.54 | 548.08 | Oct-98 | 6.96 | 302.92 | 17.40 | 433.22 | 16999.01 |
| Nov-94 | 12.85 | 132.97 | 11.53 | 77.82 | 1170.63 | Nov-98 | 6.70 | 382.08 | 19.55 | 751.79 | 36858.35 |
| Dec-94 | 13.92 | 171.72 | 13.10 | 131.82 | 2489.44 | Dec-98 | 6.29 | 131.92 | 11.49 | 121.57 | 2429.08 |
| Jan-95 | 14.56 | 267.46 | 16.35 | 233.95 | 9191.11 | Jan-99 | 6.19 | 96.98 | 9.85 | 77.98 | 1427.75 |
| Feb-95 | 13.19 | 223.99 | 14.97 | 139.92 | 4986.64 | Feb-99 | 6.46 | 211.50 | 14.54 | 391.49 | 15568.95 |
| Mar-95 | 13.65 | 226.62 | 15.05 | 165.50 | 5609.31 | Mar-99 | 5.41 | 184.59 | 13.59 | 187.06 | 6570.40 |
| Apr-95 | 11.29 | 250.04 | 15.81 | 220.49 | 7986.26 | Apr-99 | 4.80 | 113.40 | 10.65 | 2.99 | 1049.32 |
| May-95 | 12.21 | 267.99 | 16.37 | 200.37 | 7981.84 | May-99 | 4.67 | 158.30 | 12.58 | -29.25 | 2282.64 |
| Jun-95 | 12.01 | 251.90 | 15.87 | 298.55 | 7722.86 | Jun-99 | 4.58 | 182.37 | 13.50 | 18.30 | 3104.75 |
| Jul-95 | 11.50 | 197.64 | 14.06 | 258.27 | 7010.17 | Jul-99 | 3.83 | 126.95 | 11.27 | 17.23 | 1933.56 |
| Aug-95 | 12.88 | 214.86 | 14.66 | 238.21 | 6351.14 | Aug-99 | 3.91 | 153.78 | 12.40 | 63.59 | 3328.80 |
| Sep-95 | 12.24 | 193.16 | 13.90 | 181.51 | 4614.20 | Sep-99 | 3.92 | 123.40 | 11.11 | -13.15 | 2127.13 |
| Oct-95 | 10.46 | 128.73 | 11.35 | -46.76 | 2672.73 | Oct-99 | 4.41 | 103.18 | 10.16 | -17.52 | 2484.21 |
| Nov-95 | 10.26 | 174.21 | 13.20 | 92.56 | 5261.23 | Nov-99 | 4.26 | 118.81 | 10.90 | -61.61 | 3053.41 |
| Dec-95 | 10.18 | 175.95 | 13.26 | 47.90 | 5191.61 | Dec-99 | 3.77 | 117.41 | 10.84 | -45.90 | 2219.67 |
| Jan-96 | 10.51 | 190.05 | 13.79 | 76.70 | 3817.38 | Jan-00 | 3.89 | 93.75 | 9.68 | -7.81 | 1422.69 |
| Feb-96 | 10.51 | 190.05 | 13.79 | 76.70 | 3817.38 | Feb-00 | 3.45 | 119.54 | 10.93 | -49.73 | 2110.99 |
| Mar-96 | 10.87 | 201.78 | 14.20 | 88.90 | 3420.98 | Mar-00 | 3.84 | 115.64 | 10.75 | -32.72 | 1910.46 |
| Apr-96 | 11.69 | 145.19 | 12.05 | 89.05 | 1686.91 | Apr-00 | 4.49 | 140.78 | 11.86 | 62.68 | 3027.25 |
| May-96 | 11.40 | 129.04 | 11.36 | 86.25 | 1953.43 | May-00 | 4.18 | 98.16 | 9.91 | 13.37 | 1142.58 |
| Jun-96 | 11.53 | 182.06 | 13.49 | 23.77 | 3829.16 | Jun-00 | 2.67 | 306.72 | 17.51 | -278.82 | 7422.23 |

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