Price Distributions and Core Inflation Measures: How Do They Differ in a Rapidly Structurally Adjusted Economy?

Mohamed Hassan

Abstract

This paper investigates price distributions and core inflation measures in Egypt. First, it uses moment analysis to document the characteristics of the cross-sectional distribution of price changes, and show their implications for the aggregate inflation and core inflation measures. Second, it uses exclusion-based methods and asymmetric trimmed methods to build core inflation measures. Third, it examines the relative performance of exclusion-based core, trimmed means, and weighted medians as measures of underlying inflation. The results lend support to the use of weighted medians, exclusion-based core, followed by trimmed means as useful measures of underlying inflation. Finally, the paper highlights the importance of treating the informational content of core inflation measures cautiously when the economy is subject to relatively long lasting and rapid structural changes.

Field of research: Economics

JEL: C32, C43, E31

Assistant Professor, Department of Economics, Faculty of Economics and Political Sciences, Cairo University, Giza, Egypt, and Advisor at the Central Bank of Egypt. Email: mhassandiab@yahoo.com
The author wishes to thank Heba Shahin and Mariana Rizk for excellent research assistance. All errors are mine.

I. Introduction

Several countries that explicitly, or implicitly, target inflation have recognized that targeting headline CPI inflation may not be appropriate or even feasible. In part, this reflects the consensus that monetary policy should not be held responsible for non-monetary, and often transitory, factors affecting prices. Such factors usually introduce transient noise into prices making it hard to forecast inflation over the medium-term. This of course increases the difficulties associated with the implementation of an inflation targeting strategy.

From a practical point of view, prices that are most subject to supply shocks typically tend to be the most volatile. Consequently, it might not be feasible to target a price index that includes them. Furthermore, it has been argued that these prices contain less information about the long-term trend in inflation. This leads us to the concept of the core inflation measure. A core measure should provide as much information on the underlying inflation trend as is possible from each month's consumer price index (CPI) data (Bryan, Cecchetti, and Wiggins 1997). In addition, core inflation should track the changes in the components of CPI that are expected to persist for several years and therefore becomes useful for medium-term inflation forecasting (Bryan and Cecchetti 1994; Blinder 1997). Moreover, it should be timely, simple, and easy to understand so that policy makers can use it to communicate effectively with the public.

It is generally accepted that inflation is a monetary phenomenon in the long run. Hence, core inflation is expected to measure the component of CPI change that is related to monetary aggregates (Wynne, 1999). Nevertheless, some economies might have been going through a relatively long period of transition[1]. During that period, it is usually the case that many structural adjustments are taking place causing relative prices of some goods to increase for a longer period than usual. This therefore generates persistent variation in inflation. Under these circumstances, the underlying inflation not only will be closely related to the monetary aggregates but also will capture some structural developments. Since the structural adjustments are outside the control of the policy makers in the central banks, the information content of the core inflation measures should be treated cautiously.

This paper documents the characteristics of the cross-sectional distribution of price changes in Egypt and uses exclusion-based methods and trimmed mean methods to build core inflation measures. It applies different criteria to choose among core measures. In addition, it highlights the importance of cautiously treating the informational content of such measures when the economy is subject to long lasting structural changes. The rest of the paper is organized as follows. Section 2 presents moments analysis of the data. Section 3 constructs the core inflation measures. Section 4 compares and evaluates the different core measures. Section 5 tackles the implications of a structural change process on the informational content of core inflation measures. Section 6 concludes.

II. Moments Analysis of the Data

The purpose of this section is to examine the properties of the sample statistics of the data available and their implications for the headline and core inflation measures. The data set used is composed of 45 components of the CPI and covers the period, January 2004 to September 2007.[2] The relationships among the cross-sectional moments of inflation shed lights on the sources and consequences of inflation. For example, it is argued that higher inflation is associated with more variable cross-sectional inflation which is costly (Fischer and Modigliani, 1980; Fischer et al., 1981). In addition, if the cross-sectional distributions of price changes are non-normal, this would have important implications for the construction of core inflation measures.[3]

Following Bryan and Cecchetti (1999), we begin by computing each component's price change over horizon h:

$$\pi_{it}^{h} = \frac{1}{h}\ln\left(p_{it} / p_{it-h}\right)$$

where p_{it} is the index level for component i at time t. From this, we define the mean inflation in each time period as

$$\pi_t = \sum_i w_i \pi_{it}$$

where w_i is the weight attached to each of the components. We also define m_{1t} as the sample mean. The higher-order central moments are then as follow

$$m_{rt} = \sum_i w_i \left(\pi_{it} - \pi_t\right)^r$$

Skewness and kurtosis are the scaled third and fourth moments, respectively:

$$S_t = \frac{m_{3t}}{\left(m_{2t}\right)^{3/2}}$$

and

$$K_t = \frac{m_{4t}}{\left(m_{2t}\right)^2}$$

It is important to recall that if the cross-sectional distribution of price changes at a given point in time is generated by a normal distribution, skewness and kurtosis would be equal to 0 and 3 respectively.

Table 1: Summary of Sample Moments of Price Change Distributions

	Average of:			
Time Horizon	Mean	Std. Dev.	Skewness	Kurtosis
1-month	7.2	28.7	2.0	17.3
3-month	6.8	17.1	2.1	14.2
6-month	6.5	11.5	1.7	8.6
12-month	6.5	7.2	1.5	6.1
18-month	6.4	6.0	1.3	5.0
24-month	6.3	5.1	1.2	5.2

Source: Table A1.1-A1.6 in Appendix A
Note: the table reports time series averages at annual rates.

Table 1 displays the average of the various weighted cross-sectional moments computed over horizons of one to twenty four months.[4] Average mean inflation lies between 7.2 and 6.3 for 1-month horizon and 24-month horizon respectively. On the other hand, average standard deviation is considerably high for up to 6-month horizon. While it reaches about 29 for 1-month horizon, it settles down at about 7 and 5 for 12-month and 24-month horizons respectively. It is worth mentioning that there is a positive relationship between mean inflation and standard deviation over all time horizons (see figure A3.1-A3.6 in appendix A). Granger causality tests (table A3 in appendix A) show that mean inflation Granger causes standard deviation (relative price variability) at 12-month horizon.[5] The direction of causality is reversed at 1-month horizon. This means that a considerable effort is needed to bring inflation down to the rate that is consistent with price stability in terms of the level and the volatility, otherwise the average inflation will stay in the neighborhood of 6 to 8 percent in the medium-term with a relatively higher average standard deviation. In addition, the time horizon for targeting specific rate should not be less than two years, given the higher volatility of cross-sectional price changes over lower time horizons.

It is important to notice that skewness, on average, is about 1.2 to 2 depending on the time horizon. In addition, the cross-sectional data are not only skewed to the right over an individual month or year but almost over all months and for all time horizons (see tables A1.1 to A1.6 in appendix A). The persistent positive skewness implies that standard deviation (relative price variability) and inflation will be positively correlated. Moreover, it was found that skewness is higher in low inflation times than in higher inflation times (see figure A4 in appendix A).[6] The high and positive skewness at relatively lower inflation rates reflects unusually high price changes for a few products.[7] Granger causality tests (table A3 in appendix A) show that Skewness Granger causes mean inflation at 1-month and 12-month horizons.

On the other hand, average kurtosis was notably high for shorter horizons. It considerably declines from 17.3 for 1-month horizon to about 5 for 18-month and 24-month horizons. When the average sample kurtosis reaches that high level, the sample mean might become a very poor estimator of the mean of the cross-sectional distribution of inflation. The skewness and kurtosis in the longer time horizons (12-month, 18-month, and 24-month price changes) are lower because a significant portion of large monthly movements are usually reversed within 12-month horizon. In addition, prices that are subject to annual adjustment (i.e. education) also create lower skewness and kurtosis in these longer horizon series.

There are many explanations for asymmetric skewness of price changes (see Silver and Ioannidis, 1996). Menu cost models provide one explanation (Ball and Mankiw, 1995). They are built around the hypothesis that there are costs to undertaking price changes. Therefore, price setters will change their prices if their desired prices lie outside the bounds of the menu cost; otherwise prices will remain unchanged. It is believed that price setters wishing to increase their nominal prices will do so more often than those preferring the opposite. This of course causes the skewness of price changes to be asymmetric. Roger (2000) suggests that the main reasons behind such asymmetric skewness are the infrequently adjusted prices due to regulated prices, seasonal goods, and goods sampled less frequently, rather than the price stickiness of menu costs. The later explanations fit the Egyptian case fairly well.

One can add one more institutional explanation that fit the situation in many of the developing countries that are going through prolonged transition toward market oriented economies. These countries usually adopt fast and large liberalization process without first creating the high-quality institutions that are required for such process. For instance, while removing the distortion in the price system through minimizing the distorted intervention of the government is highly welcomed, the absence of a well functioning institution that guards a well drafted and a compact antitrust law can set the stage for some unwanted monopolistic behavior in the markets. Such behavior can worsen the effect of adverse supply shocks. This is because those monopolistic powers usually set the prices such that they increase more than proportion when the prime cost increases while the opposite does not occur when the prime cost decreases. This is consistent with the explanation given by Domberger and Fiebig (1993); they show that collusive prices in oligopolistic markets that are sticky downwards make the distribution of price changes skewed to the right.

Implications of non-normality of price changes for core measures

It is critical to arrive at a good estimate of the measure of central tendency in the population distribution using the observed sample distribution. To this end, two important implications of non-normality should be highlighted. First, when there is skewness, mean percentiles should be used as an alternative to the median (see figures A2.1-A2.6 in appendix A).[8] Second, the mean should not be used as an estimator when the cross-sectional distribution of price changes is fat-tailed.[9] The later implies that when using the exclusion-based method to build core measures, the resulting estimator may be neither efficient nor robust because cross-sectional price changes may still suffer from non-normality after exclusion (Silver 2006).

III. Measures of Core Inflation

Analysts have proposed a number of different methods to build core inflation measures. The most frequently used ones are the exclusion based methods and the symmetric and asymmetric trimmed methods.[10]

Exclusion-based methods

We use the exclusion-based method to construct a core CPI inflation measure that excludes from the headline CPI the components whose prices are administrative or highly volatile.

CPIXAF core measure

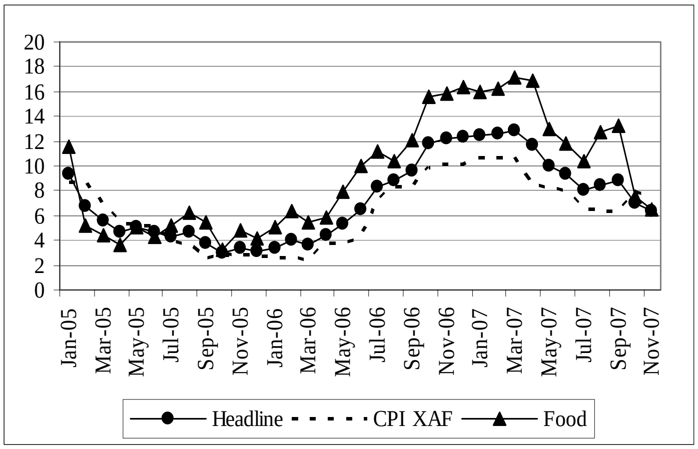
This core measure excludes from the CPI rental of housing, miscellaneous services related to the dwelling, water supply, electricity, gas, and other fuels; in addition to all food items. It systematically excludes these items because their prices are mainly set administratively (rent, power, and energy), or are highly volatile (food items).[11] Rent, power, and energy are subject to discrete changes that fail to persist, and more importantly, they are outside the control of the Central Bank.[12] On the other hand, the exclusion of the food items is based on two grounds. First, the large movements in food prices usually arise from supply disruptions such as unexpected weather changes. In fact, table 2 shows that the majority of food items are among the most volatile ones. Second, the weight of food in CPI is quite large, which makes any possible change in food relative prices largely affect CPI headline inflation.

Table 2: Volatility of CPI Components, 2004:1-2007:9

Item	Weight	Std. Dev. (1-month)	Std. Dev. (12-month)
Postal services	0.1	81.3	14.1
Vegetables	3.7	75.5	15.6
Fruits	3.1	74.4	10.0
Telephone and telefax equipment	1.9	67.5	16.5
Water supply and miscellaneous services relating to the dwelling	1.1	64.0	14.7
Package holidays	3.0	59.5	13.3
Accommodation services	0.0	57.2	14.3
Tobacco	2.8	56.2	7.6
Newspapers, books and stationery	1.7	48.9	18.3
Tertiary education	1.7	36.8	6.2
HH textiles	0.5	34.1	8.3
Secondary education	1.7	32.4	7.1
Milk, Cheese and eggs	5.1	31.9	6.9
Operation of personal transport equipment	2.4	31.8	7.3
HH appliances	0.6	31.4	8.1
Other Food products	1.9	29.9	7.5
Meat	10.7	29.0	8.9
Personal care	3.4	23.8	7.6
Pre-primary and basic education	2.4	22.6	4.6
Fabrics	0.3	22.2	5.9
Goods and services for routine HH Maintenance	3.2	22.1	3.1
Sugar , jam, honey, chocolate and confectionery	1.8	22.0	5.6
Clothing tailoring	0.2	21.7	3.0
Fish & seafood	2.6	21.0	2.3
Purchase of vehicles	0.8	20.7	2.8
Out-patient services	1.0	19.2	3.1
Bread & Cereals	5.3	18.9	6.4
Catering	2.5	18.3	3.6
Hospital services	1.0	17.6	4.0
Footwear	1.8	16.2	1.9
Transport services	2.4	14.9	2.9
Electricity, gas and other fuels	2.8	13.9	4.5
Clothing	8.2	13.0	2.5
Pulses	0.6	11.9	2.4
Personal effects	1.5	11.9	2.3
Audio-visual, photographic and information processing equipment and accessories including repairs	0.5	11.3	2.4
Glassware, tableware and household utensils	0.2	10.2	2.2
Recreational & Culture services	0.7	9.8	1.6
Oil & Fats	2.7	9.1	2.3
Medical products, appliances and equipment	2.5	8.6	2.0
Furniture, furnishing, carpets and other floor covering and repairs	0.4	7.6	1.9
Rentals for housing	7.0	6.7	1.4
Mineral water, soft drinks and juices	0.6	5.7	0.6
Maintenance and repair of the dwelling	0.8	2.6	0.5
Coffee, tea and cocoa	0.8	1.9	0.5

Figure 1 shows that CPIXAF inflation measure has been lower than headline inflation since late 2005 due to food inflation that has been systematically higher than headline inflation since that time until September, 2007. During the following months, food inflation became lower than the headline inflation.

Figure 1: Inflation in CPI X Administered Prices and Food, Headline Inflation, and Food Inflation



Trimmed methods

The exclusion-based measures exclude the same fixed set of components from each month's headline CPI, even though the volatility of these components might not be large in every month. This means that a loss of information might occur. The so-called trimmed mean is another measure of core inflation that avoids such loss of information. It removes from headline inflation all large relative price changes every month. The excluded components therefore change from month to month.

There are statistical and economic rationales for the trimmed mean. The statistical one emphasizes that when the cross-sectional distribution of price changes is not normal, the trimmed mean will be a more robust estimator for the average price change than the CPI headline inflation, which averages across all components. The economic rationale highlights the advantage of trimming the monthly cross-sectional distributions of price changes such that only the persistent component of the aggregate price level is retained. Hence, such trimming would eliminate relative price changes that are outliers because it removes every month the price changes that are much larger or smaller than the monthly average. But what if some relative price changes persist for a relatively longer period?

Symmetric and asymmetric measures

A trimmed mean removes specified portion of the upper and lower tails of the distribution of price changes every month. The normality of the distribution of price changes gives rise to symmetric trimming while the non-normality suggests relying on asymmetric trimming.

We showed that the cross-sectional distributions of price changes using Egypt's data are clearly non-normal; they are skewed to the right and leptokurtic. To build the trimmed mean measures, we first exclude from CPI headline the administered items excluded from the exclusion-based core. We then construct three asymmetric trimmed means (TMean1_4, TMean1_7, TMean1_9) by removing 5 percent, 8 percent, and 10 percent of the tails of the distribution of price changes. The three measures remove only 1 percent from the right tail while removing 4 percent, 7 percent, and 9 percent from the left tail respectively.[13] They avoid sacrificing the valuable information included in the price changes in the far, but not the farthest, right tail. The structural adjustments that the Egyptian economy have been going through since 1990s which have accelerated since 2004- especially the increase in openness and the faster pace of the integration in the global economy, in addition to resizing the government and reengineering its role- caused relative prices of some goods to increase for a longer period than usual. This type of information is valuable and should be included in the measured inflation, without allowing the trimming treats it as noise.[14] This implies that the trimming should be less harsh on the right hand side of the distribution of price changes.

It is informative to investigate which prices are trimmed from the right tail on the ground that their information content helps the least in detecting trend inflation shifts. Table C1 in appendix C displays the frequency with which an item is excluded from the right tail of the distribution. It shows that food items account for about 60 percent of the total frequency. Prices of vegetables and fruits are excluded more than 38 percent of the time. More over, bread and cereals, and telephone and telefax equipments are excluded about 11 percent of the time.

Figure 2: Trimmed Mean Measures and Headline Inflation

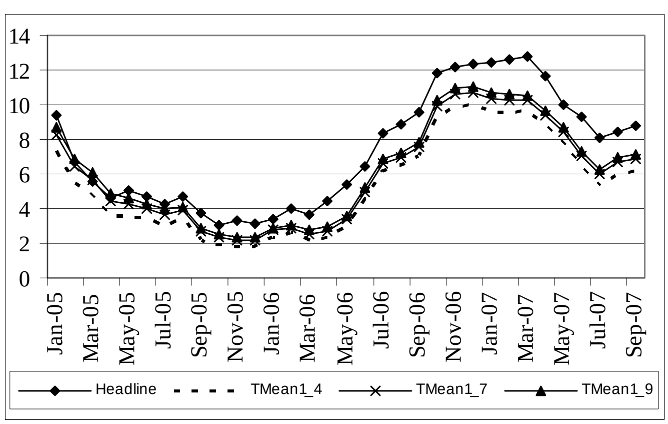
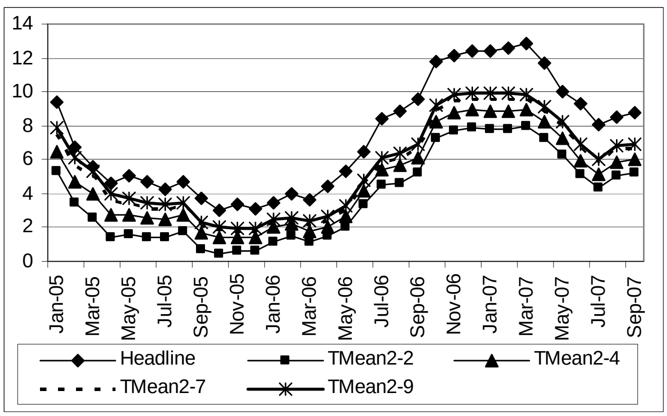


Figure 2 displays headline inflation, and the three asymmetric trimmed means. TMean1_4 appears to be systematically lower than headline inflation which may indicate that it is not trimming enough the left side of the distribution of price changes. In fact, when trimming 7 percent and 9 percent from the left side of the distribution, it was found that the most frequently trimmed components are either vegetables or fruits that exhibit higher volatility (see tables C 2.1 and C 2.2 in appendix C).

It is worth mentioning that if one removes more than one percent from the right tail, trimmed mean measures decrease systematically and significantly. Figure 3 displays the CPI headline and four other trimmed means: TMean2_2, TMean2_4, TMean2_7, and TMean2_9. They all systematically underestimate the CPI headline inflation. Again, these trimmed means seem to miss price changes that provide useful information on the persistent component of the aggregate price level.

Figure 3: A Little Harsher Trimmed Measures

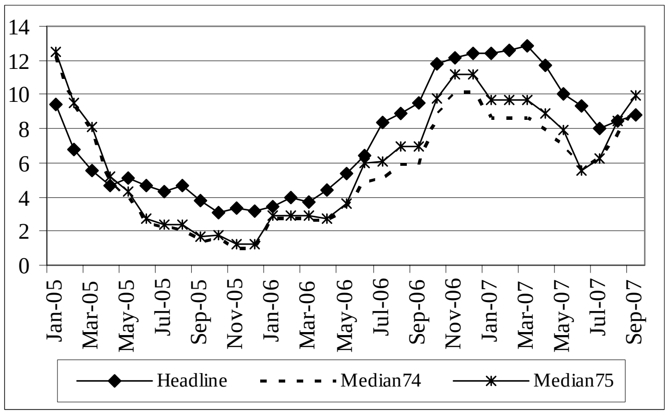


Adjusted median CPI

The median CPI was introduced as another core inflation measure by Bryan and Cecchetti (1994). This measure is constructed by trimming all monthly price changes but the midpoint of the distribution, assuming that the distribution is normal. The strong and persistent right skewness in the distribution of price changes gives rise to the adjusted median.[15] In such distributions, the mean will correspond to a percentile that is higher than the 50^{th} percentile. After determining this percentile, the sample value of it can be considered as an estimator for the population mean. According to Roger (1997), the median might be superior to the trimmed mean if the distribution of price changes chronically has very fat tails.

The cumulative distributions (figures A2.1-A2.4 in Appendix A) show that the percentile of the distribution that is zero standard deviations from the mean ranges between 77 and 66 for 1-month and 12-month time horizons respectively. The exploratory analysis suggests that the 74th percentile seems the most appropriate center. Therefore, we build the adjusted median measure by trimming all monthly price changes but the 74th percentile of the distribution.[16] To demonstrate the appropriateness of the 74th percentile, we also build another adjusted median using the 75th percentile.

Figure 4: Weighted Medians and Headline Inflation



The frequency of untrimmed components for Median74 and Median 75 (tables C3.1 and C3.2) show that price of meat is included 23 percent of the time. It is worth mentioning that the perfect core inflation measure does not exist. Preferring one core measure to another should depend on practical considerations such as empirical performance and complexity (Clark, 2001).

IV. The Performance of Core Inflation Measures

Evaluating the historical performance of core inflation measures relies on three common criteria: transparency of construction, tracking trend inflation, and predictability.[17] Obviously, the construction of exclusion-based measures, trimmed means, and adjusted medians are straight forward. Nevertheless, the exclusion-based measure is easier in terms of communication.

Tracking trend inflation

An important criterion by which measures of underlying inflation are often evaluated is how closely they move with some measure of the long-run trend rate of CPI inflation. This test refers to two respects of tracking trend inflation: similarity of means, and the ability to match movements in some measure of trend inflation over time.
A good core inflation measure is expected to reproduce the mean of headline inflation over a period that is long enough to eliminate the effect of short-term relative price changes. Hence, the core measure should neither understate nor overstate the long-term trend rate of headline inflation; any systematic deviation will negatively affect the credibility of the measure. Therefore,

looking at the deviation from the average CPI headline can give a clue. Another approach to test for bias is by performing a cointegration between headline inflation and core rate; and then a unity coefficient can be tested (see Freeman, 1998; Marques et al., 2003). The later approach seems the appropriate one. Nonetheless, it suffers from the usual problems of using cointegration tests over relatively very short samples like the one this paper uses.

Table 3: Summary Statistics of Headline and Core Measures of Inflation

	Mean	Std. Dev.	Minimum	Maximum
Headline	7.36	3.34	3.05	12.82
CPI XAF	6.31	2.81	2.48	10.65
TMean1_4	5.37	2.79	1.83	9.99
TMean1_7	5.97	2.89	2.17	10.70
TMean1_9	6.25	2.94	2.32	11.05
Median74	5.57	3.15	1.01	12.26
Median75	6.13	3.40	1.26	12.49

Correlation matrix

	Headline	CPIXAF	TMean1_4	TMean1_7	TMean1_9	Median74	Median75
Headline	1.00						
CPI XAF	0.95	1.00					
TMean1_4	0.99	0.96	1.00				
TMean1_7	0.99	0.97	1.00	1.00			
TMean1_9	0.98	0.97	1.00	1.00	1.00		
Median74	0.85	0.88	0.87	0.89	0.89	1.00	
Median75	0.88	0.90	0.90	0.91	0.92	0.99	1.00

Table 3 shows that all core inflation measures but the TMan1_4 have averages that are not far from the average of the headline inflation. Of course, one should take into account the different supply shocks that have been hitting the Egyptian economy, especially since early 2006.[18] These shocks can keep the CPI headline higher than the core measures for many consecutive months of the considered period that is too short to allow for smoothing out the effect of such shocks.

In addition to matching the average rate of CPI headline, a core inflation should accurately track the trend rate of inflation. In fact, Vega and Wynne (2002) argue that "posing the question of core inflation as that of detecting changes in trend inflation in real time is the most sensible way to choose between competing measures of core." Unfortunately the covered period is relatively too short to have major fluctuations in trend inflation, which could have enhanced the ability of this criterion in evaluating the different measures of inflation.

Trend inflation rate is estimated in three different ways: a centered 13-month moving average of headline inflation,[19] the quadratic trend, and the H-P filter. We drop 6 observations from each of the end points in case of the quadratic trend and the H-P filter. This is because H-P filter tends to produce distorted estimates of the trend at end points of sample. To evaluate the accuracy with which core inflation tracks the trend of headline inflation, we use the standard deviation of the difference between core and trend inflation. This standard deviation becomes low when core measure accurately tracks trend inflation. In addition, we measure the volatility of core measure around trend inflation using root mean squared errors (RMSE).

$$RMSE = \sqrt{\sum_{t=1}^{T} \left(\pi_t^{core} - \pi_t^{trend}\right)^2 / T}$$

where π^{core} refers to a measure of core inflation and π^{trend} is a measure of trend inflation.

Table 4: Comparisons among Different Core Measures

	Std. Dev. Of the difference between inflation measure and inflation trend			RMSE		
	centered MA	Quadratic	HP	centered MA	Quadratic	HP
Headline	1.25	2.51	2.53	1.22	2.45	2.47
CPI XAF	0.94	2.07	2.10	0.92	2.02	2.05
TMean1_4	0.88	2.00	2.03	0.86	1.95	1.99
TMean1_7	1.00	2.13	2.17	0.97	2.08	2.11
TMean1_9	1.05	2.20	2.24	1.03	2.15	2.18
Median74	0.82	1.90	1.90	0.81	1.85	1.85
Median75	1.08	2.27	2.27	1.05	2.22	2.21

Table 4 shows that the trend volatility of all core measures was lower than that of the headline regardless the way of constructing the trend and the way of measuring the trend volatility. Excluding the TMean1_4 on the ground that it seems systematically biased downward, Median74, exclusion-based core, and TMean1_7 outperform TMean1_9 and Median75.

Before moving to the last criterion, it is worth looking at whether or not the constructed core measures can track changes in trend inflation in real time in advance. Figure D1 in Appendix D sheds some light on the power of the various core measures in detecting the changes in trend inflation that occurred in early 2006 and in the second quarter of 2007. One can notice that only weighted medians apparently turned up before the upward trend in headline inflation becomes obvious in mid 2006; furthermore, medians clearly turned down before the slightly downward trend in headline becomes evidenced around mid 2007.[20]

Predicting future inflation

Finally, core measure should help predict future inflation in the headline measure. It is important to emphasize that the type of predictability one should expect to see is the near-term one. The search for good measures of underlying inflation is widely viewed as a search for measures that have a high signal-to-noise ratio for current underlying inflation, rather than for leading indicators of inflation (Brischetto and Richards, 2006).[21] Therefore, one can think of any expected predictability as a statistical and fairly short-term phenomenon.

To assess the near-term predictability power of the core inflation measures, Granger causality tests between headline inflation and each of the core measures are performed using the first difference of monthly (yoy) inflation series. The causality should only go from core measures to CPI headline inflation. The tests results displayed in table 5 show that all core measures Granger cause headline CPI inflation.[22] Only for trimmed mean measures, does the causality go both ways.[23] These results indicate that these measures of underlying inflation have information that help predict a more noisy measure (CPI headline inflation). Moreover, the medians and the exclusion based core are superior to the trimmed means measure according to this criterion.

Table (5): Granger Causality Tests of Headline CPI Inflation versus Core Inflation Measures, Jan 2005-Sept 2007

Core Inflation Measure	Lag Length*	Core Inflation does not Granger Cause Headline Inflation	Headline Inflation does not Granger Cause Core Inflation
		Chi-sq Probability	
CPI XAF	4	0.027	0.423
TMean1_4	4	0.058	0.033
TMean1_7	4	0.076	0.079
TMean1_9	4	0.077	0.105
Median74	4	0.045	0.815
Median75	5	0.010	0.356

*Lag length is chosen based on Akaike Information Criterion
Note: Granger causality tests are conducted on the first differences of inflation measures

In conclusion, the overall results build a strong case for the medians and the exclusion-based measure, followed by the TMean1_7 as good core measures. They are closer to the best measure of the underlying inflation.

V. A Final Remark on the Information Content of Core Measures

Many developing and emerging market economies have gone through notable structural adjustments, especially since late 1980s, which include resizing the public sector, trade reform, tax reform, financial liberalization, reshaping the price setting of administered prices, among other things. Under relatively long lasting structural adjustments, it is likely that some large price shocks could be outliers in cross-sectional price change distribution for a number of consecutive periods.[24] Using exclusion-based methods or/and some harsh trimming methods could eliminate persistent outliers and therefore ignoring potentially useful information about future inflation. Consequently, less harsh trimming methods and exclusion-based methods should be treated as complements.

On the other hand, the concerned central banks need to be able, to some extent, to decompose the persistent increase in relative prices to the portion coming from the demand, the share belonging to the supply, and finally the part attributed to the institutional aspects stemming from structural adjustments. If the latest plays the dominant role, the concerning central bank must be ready to live with a relatively high and persistent inflation for relatively long period provided that the dynamics of inflation process is not explosive and the inflation expectations in the long run is anchored at low level.[25] This will help the players in the markets to perceive the seemingly permanent relative price changes stemming from the institutional aspects as a medium-term phenomenon at most.

VI. Conclusions

This paper investigates price distributions and core inflation measures in Egypt. It highlights the implications of the characteristics of cross-sectional distributions of price changes for measuring inflation, especially when the economy is subject to relatively long lasting and rapid structural changes.
The paper shows that CPI component price changes are not normally distributed; they are skewed to the right and fat-tailed in a persistent way. The persistent positive skewness implies that standard deviation and inflation will be positively correlated. Granger causality tests show that mean inflation Granger causes standard deviation at 12-month horizon. Under a relatively higher average mean and average standard deviation in the sample, a considerable effort is needed to bring inflation down to the rate that is consistent with price stability in terms of the level and the volatility. In addition, the time horizon for targeting specific rate should not be less than two years given the higher volatility of cross-sectional price changes over lower time horizons.

On the other hand, the excessive kurtosis suggests that the sample mean may be a very poor estimator of the mean of the cross-sectional distribution of inflation. To provide better measures for persistent underlying inflationary pressures, the paper uses exclusion based methods to construct a core measure. In addition, it uses asymmetric trimmed methods to build five more cores: three trimmed means and two weighted medians. The overall results build a strong case for the weighted median that trims all monthly price changes but the 74th percentile of the distribution, and the exclusion-based measure, followed by the trimmed mean that trims 1 percent and 7 percent from the right and the left tails of price-change distribution respectively. These cores are closer to the best measure of the underlying inflation than the other measures including CPI headline.

Finally, the paper highlights the importance of treating the informational content of core inflation measures cautiously when the economy is subject to relatively long lasting and rapid structural changes. A central bank therefore can avoid unnecessary overreaction to supply shocks that might get magnified by such structural changes, especially the institutional related ones.

References

Bagliano, Fabio C., Roberto Golinelli, and Claudio Morana. 2002. "Core Inflation in the Euro area". *Applied Economics Letters*, 9, 353-357.

Ball, Laurence, and N. Gregory Mankiw. 1995. "Relative-Price Changes as Aggregate Supply Shocks". The Quarterly Journal of Economics, 110, 161-193.

Blinder, Allan S. 1997. Commentary on "Measuring Short-Run Inflation for Central Bankers." Federal Reserve Bank of St. Louis, Review, May/June, Vol. 79, No.3, pp. 157-160.

Brischetto, Andrea, and Antony Richards. 2006. "The Performance of Trimmed Mean Measures of Underlying Inflation". Reseve Bank of Australia, Research Discussion Paper, No. 10.

Bryan, Michael F., and Stephen G. Cecchetti 1994. "Measuring Core Inflation". in N. Gregory Mankiw, ed., Monetary Policy, University of Chicago Press, Chicago, pp 195-215.

Bryan, Michael F., Stephen G. Cecchetti, and Rodney L. Wiggins II. 1997. "Efficient Inflation Estimation", National Bureau of Economic Research, Working Paper no. 6183, September.

Bryan, Michael F., and Stephen G. Cecchetti. 1999. "Inflation and the Distribution of Price Changes". The Review of Economics and Statistics, 81, 188-196.

Cecchetti, Stephen G. 1997. "Measuring Short-Run Inflation for Central Bankers". Federal Reserve Bank of St. Louis, Review, Vol. 79, No.3, pp. 143-155.

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

Cutler, Joanne. 2001. "Core Inflation in the UK". Bank of England, Discussion Paper, No. 3.

Domberger, S. and D., Fiebig. 1993. "The Distribution of Price Changes in Oligopoly", Journal of Industrial Economics, XLI, 295-313.

Fischer, Stanley, and Franco, Modigliani. 1980. "Towards an Understanding of the Real Effects and Costs of Inflation". National Bureau of Economic Research, Working Paper, No. 303.

Fischer, Stanley, Robert, Hall, and John, Taylor. 1981. "Relative shocks, Relative Price Variability, and Inflation". Brooking Papers on Economic Activity, No. 2, PP. 381-441.

Freeman, Donald G. 1998. "Do Core Inflation Measures help Forecast Inflation?" Economics Letters, 58, 143-147.

Friedman, M. 1977. "Nobel Lecture: Inflation and Unemployment". Journal of Political Economy, 85, 451-72.

Marques, Carlos Robalo, Pedro Duarte Neves, and Luıs Morais Sarmento. 2003. "Evaluating Core Inflation Indicators". Economic Modeling, 20, 765-775.

Quah, Danny, & Shaun P. Vahey. 1995. "Measuring Core Inflation". The Economic Journal, 105, 1130-1144.

Roger, Scott. 1997. "A Robust Measure of Core Inflation in New Zealand", 1949-96, Reserve Bank of New Zealand, Discussion Paper, G97/7.

Roger, Scott. 2000. "Relative Prices, Inflation and Core Inflation". IMF Working Paper, No. 00/58.

Silver, Mick, and Christos Ioannidis. 1996. "Inflation, Relative Prices and their Skewness". Applied Economics, 28, 577-584.

Silver, Mick. 2006. "Core Inflation Measures ad Statistical Issues in Choosing Among them". IMF Working Papers, No.97.

Vega, Juan-Luis, and Mark A. Wynne. 2002. "A First Assessment of Some Measures of Core Inflation for the Euro Area". German Economic Review, Vol. 4, No.3, pp. 269-306.

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

Appendix A: Characteristics of Cross-Sectional Price Change Distributions

Table A1.1: Moments of Cross-Sectional Distribution

1-month

	Mean	Std. Dev.	Skewness	Kurtosis
Feb-04	21.2	35.1	1.7	5.1
Mar-04	18.6	55.2	4.6	24.6
Apr-04	18.2	39.9	0.9	5.7
May-04	0.6	26.1	-1.4	7.7
Jun-04	2.3	16.8	-1.3	6.5
Jul-04	9.6	39.8	4.5	29.8
Aug-04	-2.2	12.1	-2.5	9.3
Sep-04	15.8	43.3	2.4	8.1
Oct-04	13.2	36.0	3.4	14.1
Nov-04	0.0	31.3	2.1	30.2
Dec-04	2.6	15.6	3.0	11.4
Jan-05	2.2	31.3	5.8	40.0
Feb-05	-4.0	19.9	-4.6	23.0
Mar-05	5.6	33.3	1.8	12.9
Apr-05	7.4	20.7	1.8	9.4
May-05	4.1	11.4	2.8	10.8
Jun-05	-1.7	13.8	-3.6	18.9
Jul-05	4.0	15.4	4.8	49.3
Aug-05	2.1	5.7	2.9	10.6
Sep-05	4.3	39.2	2.9	17.5
Oct-05	6.9	22.8	5.2	33.5
Nov-05	1.3	11.1	4.8	26.5
Dec-05	1.1	10.0	2.3	11.0
Jan-06	6.6	18.5	4.2	39.6
Feb-06	0.8	17.3	2.4	16.6
Mar-06	2.4	20.9	0.4	4.8
Apr-06	13.3	41.9	4.3	22.0
May-06	13.5	37.1	2.5	9.3
Jun-06	10.3	96.9	-3.0	16.9
Jul-06	25.8	73.0	2.8	9.6
Aug-06	9.0	43.7	2.5	18.2
Sep-06	10.5	30.9	3.5	17.1
Oct-06	28.0	51.3	2.1	6.5
Nov-06	6.4	25.9	1.5	13.7
Dec-06	1.8	10.5	-1.8	24.1
Jan-07	8.1	25.2	3.3	21.0
Feb-07	2.7	10.0	4.7	24.3
Mar-07	3.4	17.0	4.1	19.3
Apr-07	3.2	23.8	4.9	26.8
May-07	-0.9	14.7	-2.6	11.2
Jun-07	3.1	17.7	1.7	8.7
Jul-07	11.8	42.0	3.3	17.3
Aug-07	12.1	30.0	0.0	5.3
Sep-07	12.0	27.6	3.1	12.0
Average	7.2	28.7	2.0	17.3

Table A1.2: Moments of Cross-Sectional Distribution

3-month annualized				
	Mean	Std. Dev.	Skewness	Kurtosis
Apr-04	19.3	24.5	2.1	7.7
May-04	12.5	20.6	2.7	12.5
Jun-04	7.0	18.7	-1.6	9.1
Jul-04	4.1	20.6	-0.2	9.6
Aug-04	3.2	16.4	1.7	14.5
Sep-04	7.7	18.2	1.6	8.3
Oct-04	8.9	24.0	3.4	15.3
Nov-04	9.6	19.7	2.9	11.5
Dec-04	5.3	14.5	4.4	26.9
Jan-05	1.6	13.3	4.2	23.3
Feb-05	0.3	11.1	4.7	31.8
Mar-05	1.3	18.0	-0.8	13.0
Apr-05	3.0	18.5	-0.8	12.4
May-05	5.7	18.0	2.6	15.4
Jun-05	3.3	6.8	1.0	8.6
Jul-05	2.1	5.1	4.7	47.8
Aug-05	1.5	5.3	4.1	42.5
Sep-05	3.5	16.6	4.3	21.0
Oct-05	4.5	17.3	4.0	17.9
Nov-05	4.2	15.3	4.0	17.6
Dec-05	3.1	10.5	3.9	17.0
Jan-06	3.0	9.1	1.5	12.8
Feb-06	2.8	9.5	2.2	12.4
Mar-06	3.3	11.3	1.5	7.3
Apr-06	5.5	18.3	1.9	7.8
May-06	9.7	18.9	2.2	6.7
Jun-06	12.4	34.8	-0.6	6.6
Jul-06	16.5	31.0	1.1	3.3
Aug-06	15.0	33.7	-0.5	6.8
Sep-06	15.1	24.1	2.0	6.6
Oct-06	15.8	25.5	1.7	5.8
Nov-06	15.0	23.5	2.0	7.0
Dec-06	12.0	19.8	2.0	6.7
Jan-07	5.4	12.0	-0.1	7.8
Feb-07	4.2	9.7	1.9	11.6
Mar-07	4.7	11.4	2.6	11.1
Apr-07	3.1	16.3	5.0	27.2
May-07	1.9	10.8	5.0	27.5
Jun-07	1.8	9.4	-1.1	9.5
Jul-07	4.7	16.3	1.3	11.8
Aug-07	9.0	20.8	0.0	7.4
Sep-07	12.0	18.3	2.1	7.3
Average	6.8	17.1	2.1	14.2

Table A1.3: Moments of Cross-Sectional Distribution

6-month

	Mean	Std. Dev.	Skewness	Kurtosis
Jul-04	11.7	12.8	1.1	4.7
Aug-04	7.8	13.3	0.9	6.6
Sep-04	7.4	11.2	0.3	4.1
Oct-04	6.5	11.6	0.3	4.7
Nov-04	6.4	10.6	1.6	7.4
Dec-04	6.5	11.4	2.3	8.0
Jan-05	5.3	12.2	2.6	9.3
Feb-05	5.0	9.7	2.6	10.0
Mar-05	3.3	9.7	2.9	12.7
Apr-05	2.3	12.3	-1.0	10.0
May-05	3.0	10.8	1.3	9.6
Jun-05	2.3	10.9	-1.5	11.6
Jul-05	2.6	9.3	-0.3	10.2
Aug-05	3.6	8.1	3.0	14.4
Sep-05	3.4	7.0	3.5	15.6
Oct-05	3.3	9.5	3.6	15.8
Nov-05	2.8	9.2	3.8	16.8
Dec-05	3.3	9.4	3.5	15.1
Jan-06	3.7	7.0	3.0	11.3
Feb-06	3.5	7.9	2.5	8.9
Mar-06	3.2	8.5	1.8	6.1
Apr-06	4.2	10.2	1.8	6.0
May-06	6.3	10.1	1.9	5.6
Jun-06	7.8	15.1	-0.9	6.8
Jul-06	11.0	14.7	1.8	6.7
Aug-06	12.4	17.3	0.9	4.3
Sep-06	13.7	19.7	0.4	3.4
Oct-06	16.2	20.3	0.2	2.2
Nov-06	15.0	20.3	0.1	3.5
Dec-06	13.6	16.3	1.2	3.4
Jan-07	10.6	14.1	1.7	6.4
Feb-07	9.6	12.7	1.8	6.8
Mar-07	8.4	12.2	1.8	5.8
Apr-07	4.3	10.8	2.7	13.2
May-07	3.1	8.5	3.3	15.4
Jun-07	3.3	7.9	2.2	9.5
Jul-07	3.9	7.6	2.8	11.2
Aug-07	5.5	8.3	2.1	7.4
Sep-07	6.9	8.4	1.6	5.6
Average	6.5	11.5	1.7	8.6

Table A1.4: Moments of Cross-Sectional Distribution

12-month

	Mean	Std. Dev	Skewness	Kurtosis
Jan-05	8.5	8.0	1.4	5.9
Feb-05	6.4	7.7	2.0	8.8
Mar-05	5.3	7.7	1.3	9.4
Apr-05	4.4	7.0	2.4	13.4
May-05	4.7	6.8	2.8	14.0
Jun-05	4.4	6.5	3.2	16.8
Jul-05	3.9	5.0	1.5	6.4
Aug-05	4.3	5.4	1.8	6.7
Sep-05	3.3	4.8	2.2	8.6
Oct-05	2.8	4.1	1.9	6.2
Nov-05	2.9	4.6	2.1	7.0
Dec-05	2.8	4.5	2.3	7.4
Jan-06	3.1	4.5	2.5	9.8
Feb-06	3.5	5.3	2.3	8.4
Mar-06	3.3	5.4	1.9	6.1
Apr-06	3.8	6.6	1.9	6.0
May-06	4.6	6.3	1.5	4.1
Jun-06	5.6	8.1	0.3	4.2
Jul-06	7.4	8.1	1.3	4.2
Aug-06	7.9	8.7	0.7	3.5
Sep-06	8.5	8.2	0.9	3.4
Oct-06	10.2	9.1	0.5	2.3
Nov-06	10.6	9.5	0.6	2.6
Dec-06	10.7	9.9	0.6	2.6
Jan-07	10.8	9.4	0.8	3.2
Feb-07	11.0	9.3	0.7	2.7
Mar-07	11.1	9.7	0.8	2.5
Apr-07	10.2	8.6	0.6	2.2
May-07	9.0	8.4	0.8	2.4
Jun-07	8.4	8.7	1.3	4.6
Jul-07	7.3	7.1	1.2	4.8
Aug-07	7.5	7.2	1.5	5.6
Sep-07	7.6	7.6	1.5	5.2
Average	6.5	7.2	1.5	6.1

Table A1.5: Moments of Cross-Sectional Distribution

18-month

	Mean	Std. Dev.	Skewness	Kurtosis
Jul-05	6.5	5.8	0.9	3.7
Aug-05	5.5	5.4	1.1	5.2
Sep-05	4.7	4.7	1.6	8.2
Oct-05	4.0	4.8	1.7	8.3
Nov-05	4.1	4.7	1.9	8.4
Dec-05	4.0	5.1	1.9	7.2
Jan-06	3.9	4.4	1.3	4.5
Feb-06	4.0	4.8	1.6	4.7
Mar-06	3.3	4.9	2.1	7.3
Apr-06	3.3	5.2	2.2	7.8
May-06	4.0	5.7	2.3	8.2
Jun-06	4.5	5.1	1.3	5.3
Jul-06	5.8	5.3	1.2	4.4
Aug-06	6.5	5.3	0.9	3.9
Sep-06	6.8	6.1	0.9	3.2
Oct-06	7.9	7.8	1.1	4.2
Nov-06	8.0	7.9	1.3	4.9
Dec-06	8.2	8.1	1.6	6.2
Jan-07	8.4	7.5	1.4	5.2
Feb-07	8.5	7.3	1.4	5.1
Mar-07	8.4	6.3	0.7	3.0
Apr-07	8.2	6.0	0.6	2.7
May-07	8.1	5.7	0.5	2.5
Jun-07	8.2	5.6	0.4	2.5
Jul-07	8.5	6.7	1.0	3.9
Aug-07	9.1	7.3	0.7	3.0
Sep-07	9.7	7.7	0.8	2.8
Average	6.4	6.0	1.3	5.0

Table A1.6: Moments of Cross-Sectional Distribution

24-month

	Mean	Std. Dev.	Skewness	Kurtosis
Jan-06	5.8	4.6	0.6	3.1
Feb-06	5.0	4.1	0.9	4.4
Mar-06	4.3	3.9	1.4	5.5
Apr-06	4.1	4.7	2.9	15.2
May-06	4.6	5.1	2.3	10.4
Jun-06	5.0	5.2	1.8	8.5
Jul-06	5.6	4.9	0.8	2.9
Aug-06	6.1	5.2	1.1	3.7
Sep-06	5.9	5.0	1.1	4.1
Oct-06	6.5	5.0	0.7	2.6
Nov-06	6.8	5.1	0.7	2.7
Dec-06	6.7	5.0	0.6	2.4
Jan-07	7.0	4.7	0.6	2.6
Feb-07	7.3	5.2	0.9	3.5
Mar-07	7.2	5.6	1.6	6.4
Apr-07	7.0	5.8	1.6	6.2
May-07	6.8	5.5	1.4	5.6
Jun-07	7.0	5.4	1.3	5.2
Jul-07	7.3	5.9	1.3	4.8
Aug-07	7.7	6.1	1.2	4.7
Sep-07	8.0	5.7	0.8	3.5
Average	6.3	5.1	1.2	5.2

Table A2.1: Augmented Dickey-Fuller Unit Root Test for Moments

Constant			
	Criteria	Lags	ADF stat
Mean_1m	AIC	3	-2.82
	SC	3	-2.82
Std.Dev_1m	AIC	0	-3.90**
	SC	0	-3.90**
Skewness_1m	AIC	0	-7.51**
	SC	0	-7.51**
Mean_12m	AIC	5	-2.35
	SC	1	-1.27
Std.Dev_12m	AIC	4	-3.22*
	SC	4	-3.22*
Skewness_12m	AIC	0	-2.15
	SC	0	-2.15
Constant +Trend			
	Criteria	Lags	ADF stat
Mean_1m	AIC	7	-3.07
	SC	3	-2.92
Std.Dev_1m	AIC	0	-3.85*
	SC	0	-3.85*
Skewness_1m	AIC	0	-7.48**
	SC	0	-7.48**
Mean_12m	AIC	5	-2.74
	SC	5	-2.74
Std.Dev_12m	AIC	6	-3.32
	SC	4	-3.73*
Skewness_12m	AIC	0	-3.08
	SC	0	-3.08

*(**) indicates the rejection of the null hypothesis of a unit root at 5%(1%) level of significance

Table A2.2: Phillips-Perron Unit Root Test for Moments

Constant		
	Bandwidth	PP stat
Mean_1m	4	-4.84**
Std.Dev_1m	2	-3.88**
Skewness_1m	1	-7.52**
Mean_12m	4	-1.36
Std.Dev_12m	4	-1.42
Skewness_12m	1	-1.99
Constant +Trend		
	Bandwidth	PP stat
Mean_1m	4	-4.76**
Std.Dev_1m	2	-3.83*
Skewness_1m	2	-7.56**
Mean_12m	4	-2.45
Std.Dev_12m	4	-1.95
Skewness_12m	1	-3.02

*(**) indicates the rejection of the null hypothesis of a unit root at 5%(1%) level of significance

Table A3: Granger Causality Tests of Mean Inflation versus Standard Deviation and Skewness

Variables	Time Horizon	Lag Length*	Std. Dev./ Skewness does not granger cause Mean inflation	Mean inflation does not granger cause Std. Dev./ Skewness
			Chi-sq Probability	
Std. Dev.	1 month	4	0.028	0.344
Skewness		1	0.005	0.773
Std. Dev.	12 month**	1	0.436	0.007
Skewness		1	0.091	0.366

*Logliklihood Ratio and Akaike Information criteria arrived at the same lag length
**Granger causality tests are conducted on the first differences for the 12-month horizon since mean, standard deviaton and skewness are I(1)

Figure A1: Cross-Sectional Distributions of Price Changes: 2004:2-2007:9

Figure A1.1

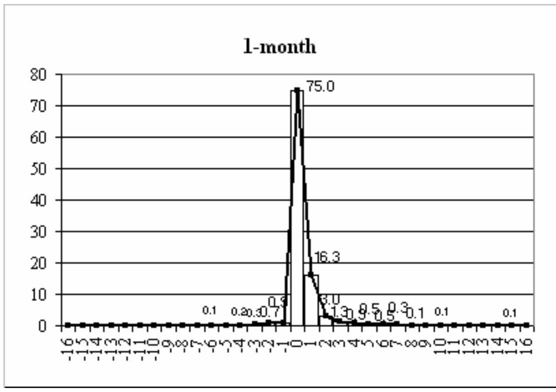


Figure A1.2

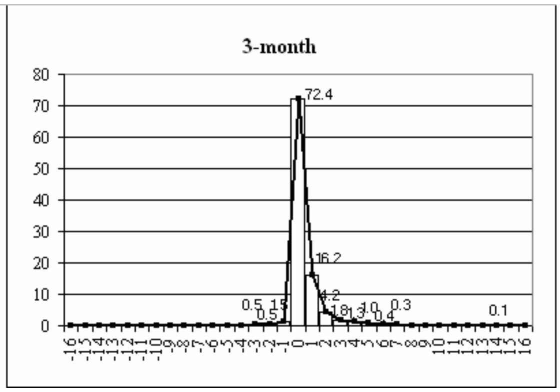


Figure A1.3

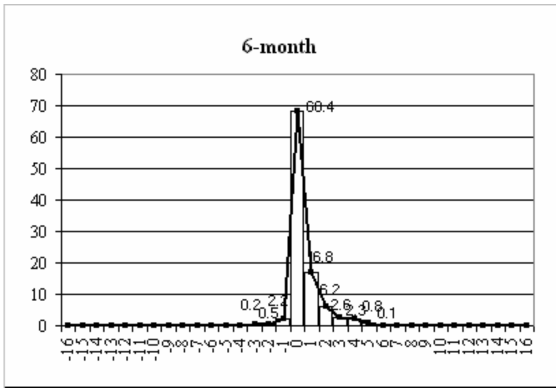


Figure A1.4

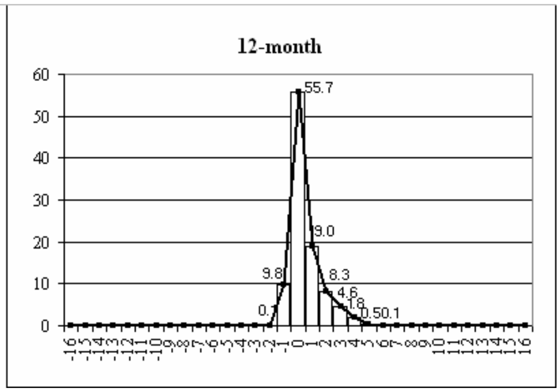


Figure A1.5

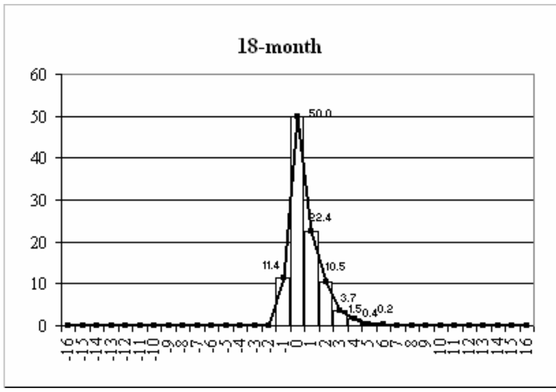


Figure A1.6

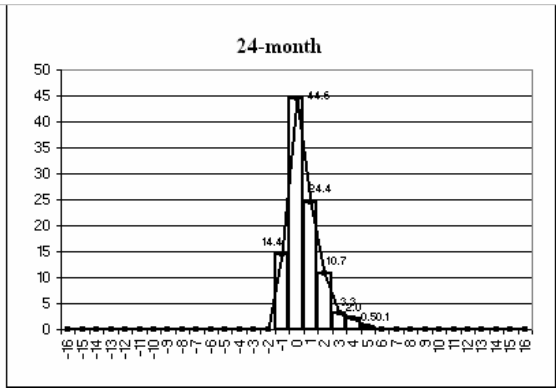


Figure A2: Cumulative Distributions of Price Changes: 2004:2-2007:9

Figure A2.1

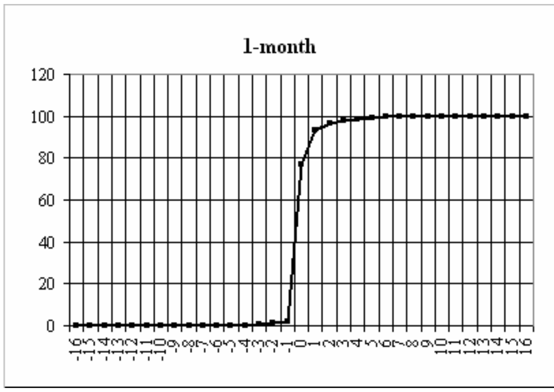


Figure A2.2

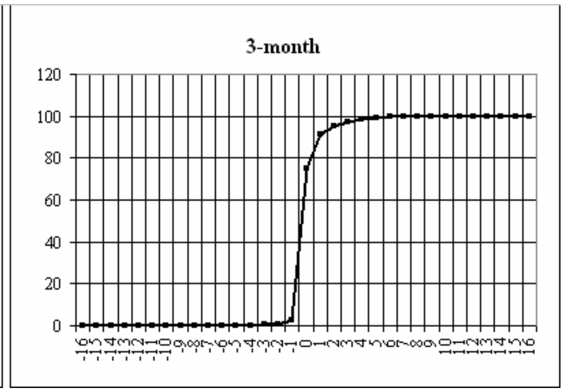


Figure A2.3

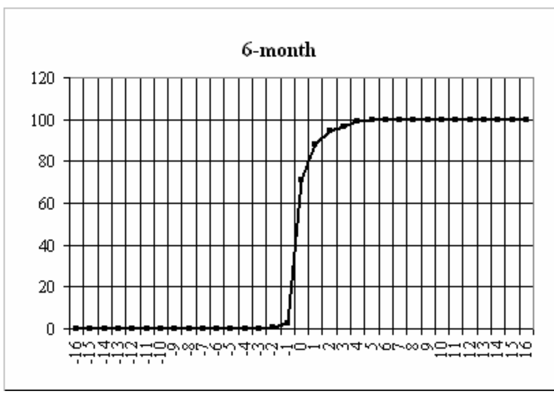


Figure A2.4

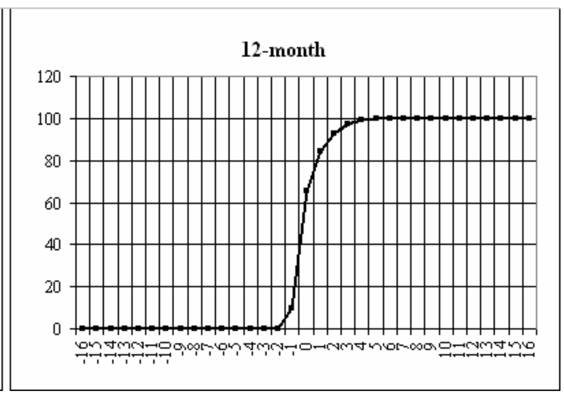


Figure A2.5

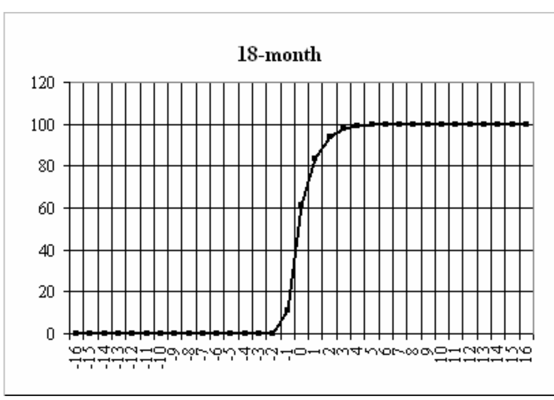


Figure A2.6

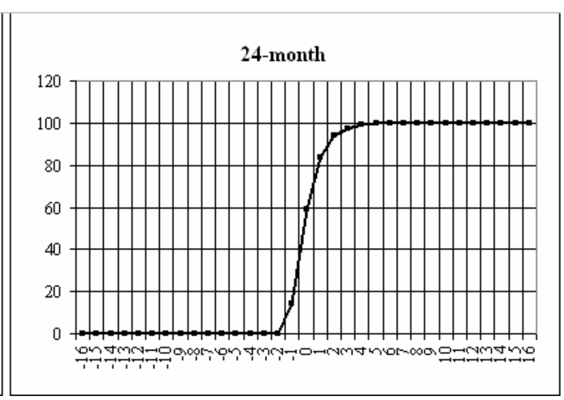


Figure A3: Mean Inflation versus Standard Deviation

Figure A3.1

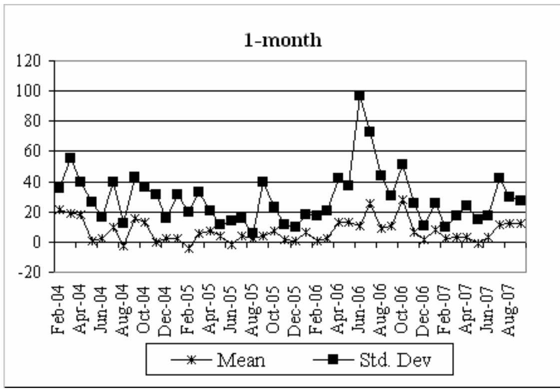


Figure A3.2

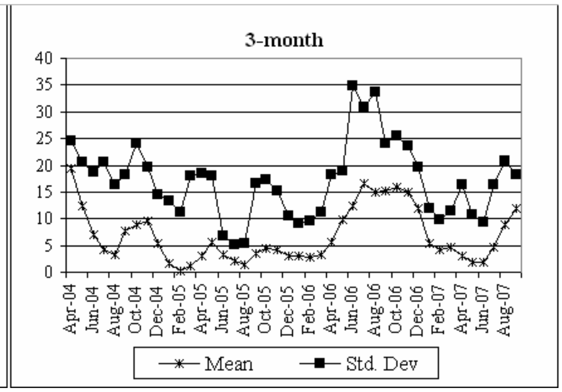


Figure A3.3

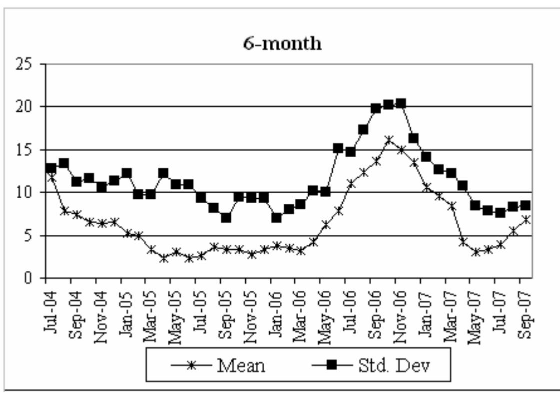


Figure A3.4

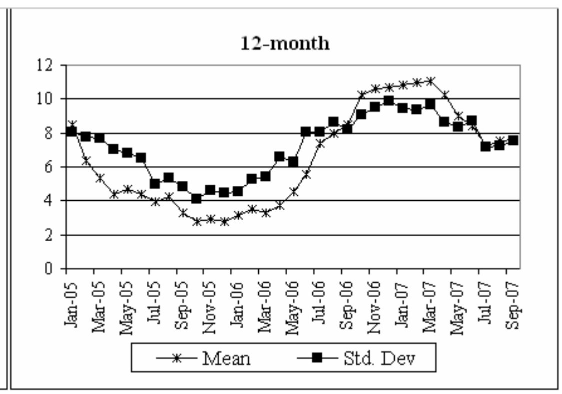


Figure A3.5

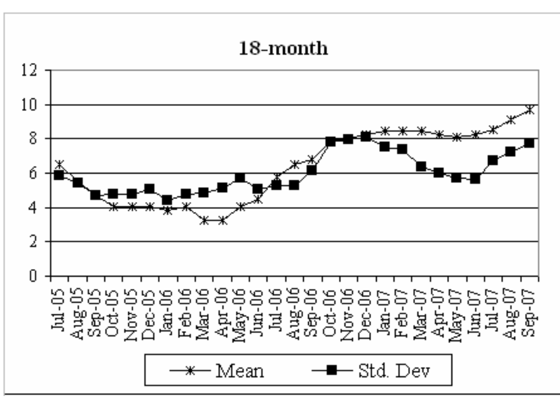


Figure A3.6

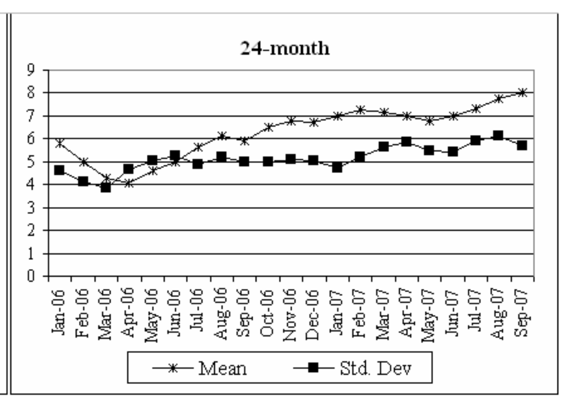


Figure A4: Mean Inflation versus Skewness

Figure A4.1

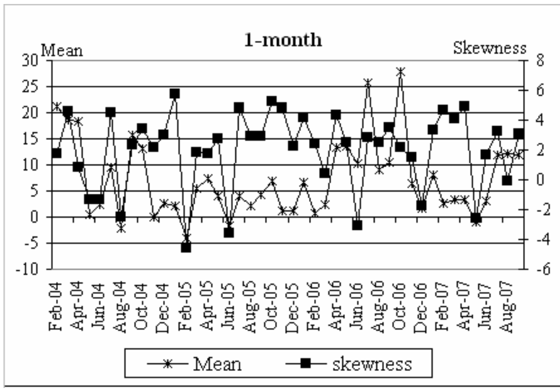


Figure A4.2

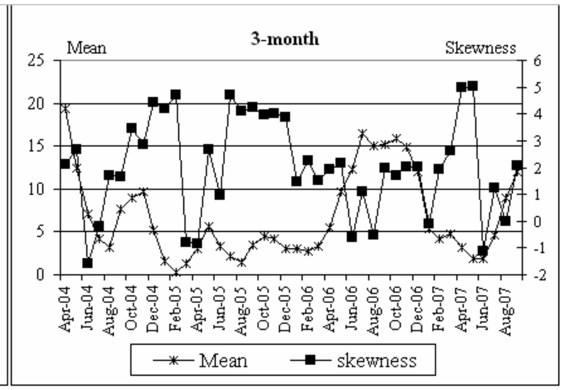


Figure A4.3

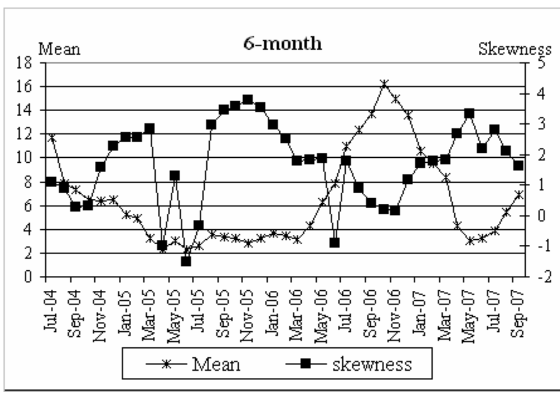


Figure A4.4

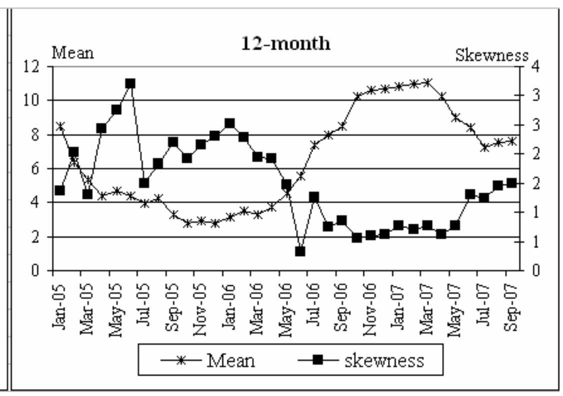


Figure A4.5

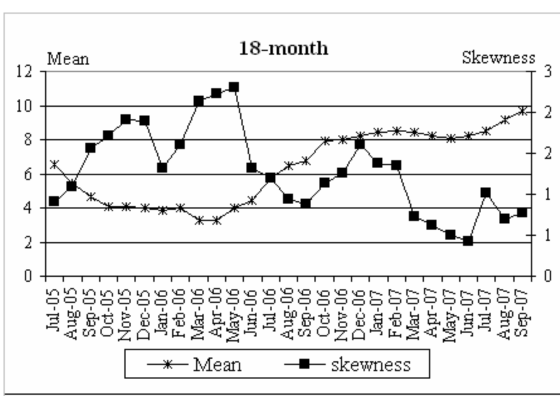
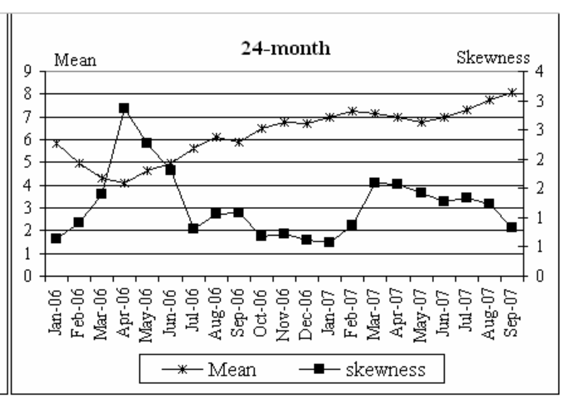


Figure A4.6



Appendix B: Computing Trimmed Means and Medians

The steps of calculating trimmed mean measures are taken from the Appendix in Clark (2001)

Trimmed mean:

We first exclude from CPI headline rent, power, and energy; then we normalize the weights of the included items to sum to 1.

Each month's trimmed mean inflation rate is calculated using the following steps.

1. Compute the simple monthly change (without annualization) in each component price index.

2. Sort the percent change in price from (numerically) smallest to largest, and sort the relative importance weights for each component along with the price changes. The ordered inflation rates and weights are denoted, respectively, π_i and w_i, $i = 1,2,...,n$.

3. Form the cumulative sum of the sorted relative importance weights for each ordered price change i. For example, the cumulative weight associated with π_3, the third-ranked price change, equals $w_1 + w_2 + w_3$.

4. Exclude those percent changes in price for which the cumulative weight is either less than 4 percent for instance (unusually small percent changes) or greater than 99 percent (unusually large percent changes).

5. For the first (smallest) percent change in price that has a cumulative weight greater than or equal to 4 percent, reset its weight w_i to the value of its cumulative weight less 4 percent.

6. For the last (largest) percent change in price that has a cumulative weight less than or equal to 99 percent, reset its weight w_i to the value of 99 percent less its cumulative weight.

7. Compute the trimmed mean inflation rate as

$$\left(1/\sum_{i=first}^{last} w_i\right)\sum_{i=first}^{last} w_i\pi_i ,$$

   where the summation start with the first (ordered) price change to be included and end with the last (ordered) price change to be included, and the first term effectively renormalizes the weights of the included components to sum to 1.

8. For the purpose of computing 12-month inflation rates, form a trimmed mean index series by setting the initial index value to 100 in January

2004 and then iteratively computing index values for each following month using the prior month's index value and the trimmed mean inflation rate for the month.

Weighted Median:

Each month's median CPI rate is calculated by first following steps 1-3 above and then simply setting the median rate equal to the first percent change in price with a cumulative weight greater than or equal to 74 percent (75 percent). 12-month inflation rates are calculated from a monthly index for the median CPI, computed as described in step 8 above.

Appendix C: Frequency of Trimmed Components for Trimmed Means and Frequency of Untrimmed Components for Medians

Table C1: Top Frequency (1%)

Item	Frequency	Percentage
Fruits	12	22.6
Vegetables	8	15.1
Bread & Cereals	3	5.7
Telephone and telefax equipment	3	5.7
Fish & seafood	2	3.8
Sugar , jam, honey, chocolate & confectionery	2	3.8
Other Food products	2	3.8
HH appliances	2	3.8
Postal services	2	3.8
Package holidays	2	3.8
Meat	1	1.9
Milk & Cheese and eggs	1	1.9
Oil & Fats	1	1.9
Tobacco	1	1.9
Fabrics	1	1.9
Footwear	1	1.9
Clothing tailoring	1	1.9
HH textiles	1	1.9
Goods and services for routine HH Maintenance	1	1.9
Out-patient services	1	1.9
Hospital services	1	1.9
Operation of personal transport equipment	1	1.9
Tertiary education	1	1.9
Accommodation services	1	1.9
Personal effects	1	1.9
Sum	**53**	**100.0%**

Table C2.1: Lower Frequency (7%)

Item	Frequency (components exhibiting 0 or negative value of price change)		Frequency (components exhibiting negative value of price changes)	
	Frequency	%	Frequency	%
Vegetables	14	21.2	14	25.5
Fruits	11	16.7	11	20.0
Fish & seafood	6	9.1	4	7.3
Personal effects	5	7.6	5	9.1
Coffee, tea and cocoa	4	6.1	1	1.8
HH appliances	4	6.1	4	7.3
Bread & Cereals	3	4.5	0	0.0
Milk & Cheese and eggs	3	4.5	3	5.5
Pulses	2	3.0	1	1.8
Tobacco	2	3.0	0	0.0
Purchase of vehicles	2	3.0	2	3.6
Audio-visual, photographic and information processing equipment and accessories including repairs	2	3.0	2	3.6
Meat	1	1.5	1	1.8
Other Food products	1	1.5	1	1.8
HH textiles	1	1.5	1	1.8
Hospital services	1	1.5	1	1.8
Operation of personal transport equipment	1	1.5	1	1.8
Transport services	1	1.5	1	1.8
Postal services	1	1.5	1	1.8
Telephone and telefax equipment	1	1.5	1	1.8
Sum	**66**	**100%**	**55**	**100%**

Table C2.2: Lower Frequency (9%)

Item	Frequency (components exhibiting 0 or negative value of changes)		Frequency (components exhibiting negative value of price changes)	
	Frequency	%	Frequency	%
Fruits	18	18.4	18	22.8
Vegetables	18	18.4	18	22.8
Fish & seafood	7	7.1	4	5.1
Bread & Cereals	6	6.1	0	0.0
Coffee, tea and cocoa	5	5.1	1	1.3
Personal effects	5	5.1	5	6.3
Pulses	4	4.1	3	3.8
HH appliances	4	4.1	4	5.1
Telephone and telefax equipment	4	4.1	4	5.1
Milk & Cheese and eggs	3	3.1	3	3.8
Purchase of vehicles	3	3.1	3	3.8
Mineral water, soft drinks and juices	2	2.0	0	0.0
Tobacco	2	2.0	0	0.0
HH textiles	2	2.0	2	2.5
Glassware, tableware and household utensils	2	2.0	2	2.5
Audio-visual, photographic and information processing equipment and accessories including repairs	2	2.0	2	2.5
Meat	1	1.0	1	1.3
Sugar , jam, honey, chocolate & confectionery	1	1.0	0	0.0
Other Food products	1	1.0	1	1.3
Clothing tailoring	1	1.0	1	1.3
Furniture, furnishing, carpets and other floor covering and repairs	1	1.0	1	1.3
Hospital services	1	1.0	1	1.3
Operation of personal transport equipment	1	1.0	1	1.3
Transport services	1	1.0	1	1.3
Postal services	1	1.0	1	1.3
Package holidays	1	1.0	1	1.3
Accommodation services	1	1.0	1	1.3
Sum	**98**	**100%**	**79**	**100%**

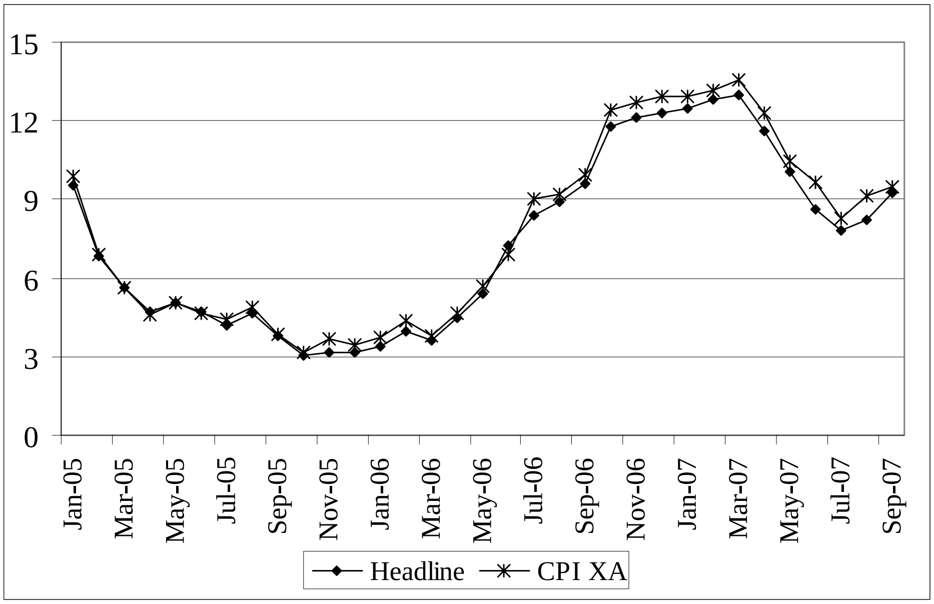
Table C3.1: Frequency of Untrimmed Components for Median74

Item	Frequency (components exhibiting 0 or positive value of price changes)		Frequency (components exhibiting positive value of price changes)	
	Frequency	%	Frequency	%
Meat	10	22.7	10	40.0
Catering	5	11.4	0	0.0
Pre-primary and basic education	4	9.1	1	4.0
Milk & Cheese and eggs	3	6.8	3	12.0
Tertiary education	3	6.8	0	0.0
Personal care	3	6.8	1	4.0
Secondary education	2	4.5	0	0.0
Accommodation services	2	4.5	0	0.0
Other Food products	2	4.5	2	8.0
Bread & Cereals	1	2.3	1	4.0
Fish & seafood	1	2.3	1	4.0
Pulses	1	2.3	1	4.0
Clothing	1	2.3	1	4.0
Footwear	1	2.3	1	4.0
Furniture, furnishing, carpets and other floor covering and repairs	1	2.3	1	4.0
Medical products, appliances and equipment	1	2.3	1	4.0
Out-patient services	1	2.3	1	4.0
Package holidays	1	2.3	0	0.0
Personal effects	1	2.3	0	0.0
Sum	**44**	**100%**	**25**	**100%**

Table C3.2: Frequency of Untrimmed Components for Median75

Item	Frequency (components exhibiting 0 or positive value of price changes)		Frequency (components exhibiting positive value of price changes)	
	Frequency	%	Frequency	%
Meat	10	22.7	10	40.0
Personal care	5	11.4	1	4.0
Milk & Cheese and eggs	4	9.1	4	16.0
Pre-primary and basic education	3	6.8	0	0.0
Tertiary education	3	6.8	0	0.0
Catering	3	6.8	0	0.0
Personal effects	3	6.8	0	0.0
Fish & seafood	2	4.5	2	8.0
Oil & Fats	2	4.5	2	8.0
Secondary education	2	4.5	0	0.0
Vegetables	1	2.3	1	4.0
Other Food products	1	2.3	1	4.0
Clothing	1	2.3	1	4.0
HH textiles	1	2.3	1	4.0
HH appliances	1	2.3	1	4.0
Medical products, appliances and equipment	1	2.3	1	4.0
Accommodation services	1	2.3	0	0.0
Sum	**44**	**100%**	**25**	**100%**

Figure C1
Headline With/Without Administered Prices



Appendix D: Core Measures and Their Ability to Detect Trend Changes in Real Time

Table D1: Time-Series of Core Measures

	Headline	CPI XAF	TMean1_4	TMean1_7	TMean1_9	Median74	Median75
Jan-05	9.39	8.68	7.28	8.24	8.72	12.26	12.49
Feb-05	6.74	8.68	5.45	6.40	6.85	9.31	9.54
Mar-05	5.56	6.88	4.69	5.63	6.06	7.85	8.07
Apr-05	4.65	5.44	3.56	4.44	4.84	4.77	5.18
May-05	5.07	5.24	3.56	4.28	4.59	3.97	4.29
Jun-05	4.69	5.15	3.36	4.00	4.29	2.51	2.70
Jul-05	4.28	3.83	3.06	3.68	3.96	2.16	2.42
Aug-05	4.68	3.82	3.38	3.90	4.12	2.13	2.38
Sep-05	3.76	2.56	2.22	2.67	2.87	1.38	1.64
Oct-05	3.05	3.04	1.92	2.36	2.55	1.53	1.78
Nov-05	3.33	2.85	1.84	2.20	2.36	1.01	1.26
Dec-05	3.14	2.88	1.83	2.17	2.32	1.01	1.26
Jan-06	3.43	2.60	2.39	2.74	2.88	2.69	2.95
Feb-06	4.00	2.60	2.58	2.89	3.02	2.69	2.95
Mar-06	3.66	2.48	2.15	2.54	2.74	2.69	2.95
Apr-06	4.41	3.71	2.36	2.72	2.92	2.56	2.75
May-06	5.35	3.79	2.98	3.37	3.59	3.45	3.64
Jun-06	6.44	4.23	4.56	4.95	5.19	4.90	6.02
Jul-06	8.37	7.31	6.15	6.62	6.89	5.01	6.06
Aug-06	8.89	8.30	6.49	6.98	7.26	5.89	6.95
Sep-06	9.55	8.25	7.02	7.55	7.84	5.89	6.95
Oct-06	11.79	9.85	9.33	9.94	10.29	8.68	9.77
Nov-06	12.15	10.14	9.90	10.63	10.99	10.10	11.20
Dec-06	12.38	10.08	9.99	10.70	11.05	10.10	11.20
Jan-07	12.43	10.61	9.58	10.31	10.66	8.59	9.68
Feb-07	12.61	10.65	9.59	10.29	10.64	8.59	9.68
Mar-07	12.82	10.64	9.66	10.27	10.55	8.59	9.68
Apr-07	11.68	8.44	8.78	9.40	9.68	7.92	8.87
May-07	10.02	8.37	7.74	8.43	8.72	6.99	7.93
Jun-07	9.29	7.90	6.31	7.03	7.32	5.51	5.51
Jul-07	8.05	6.56	5.34	6.00	6.26	6.25	6.25
Aug-07	8.47	6.35	6.03	6.72	6.99	7.66	8.45
Sep-07	8.79	6.41	6.17	6.84	7.12	9.14	9.94

Figure D1: Detecting Trend Changes in Real Time by Core Measures

Figure D1.1

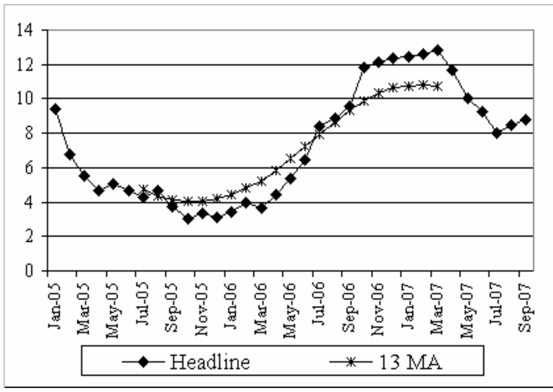


Figure D1.2

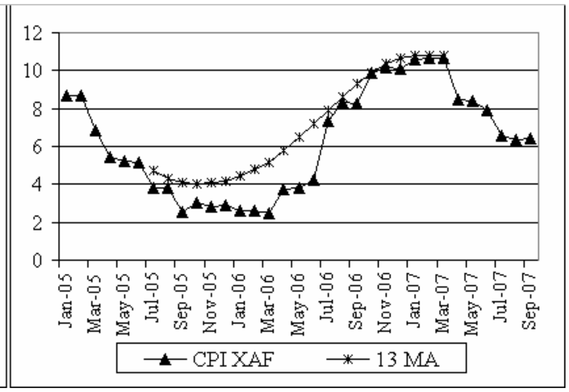


Figure D1.3

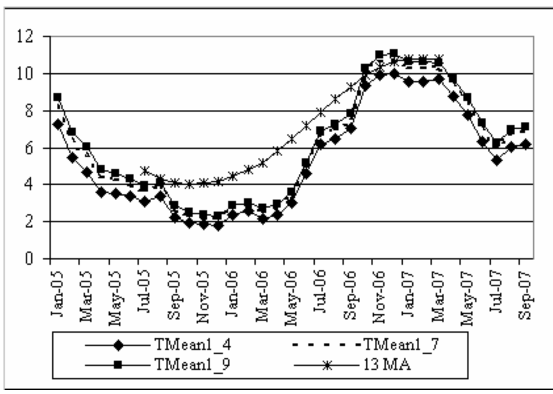
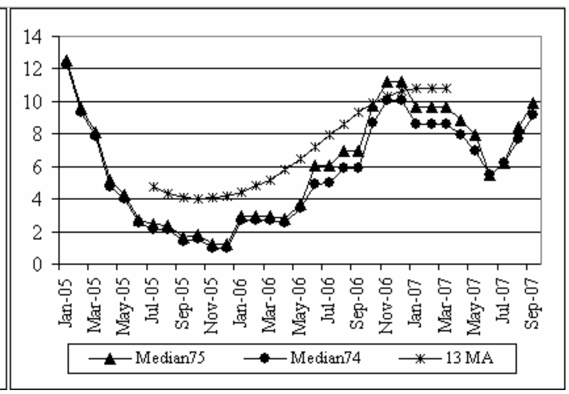


Figure D1.4



Appendix E: Testing the Predictability of Core Measures

Table E1.1: Augmented Dickey-Fuller Unit Root Test for Inflation Measures

Constant			
	Criteria	Lags	ADF stat
CPI	AIC	5	-2.19
	SC	1	-1.23
CPI XAF	AIC	3	-2.26
	SC	3	-2.26
TMean1_4	AIC	1	-1.41
	SC	1	-1.41
TMean1_7	AIC	1	-1.42
	SC	1	-1.42
TMean1_9	AIC	1	-1.43
	SC	1	-1.43
Median74	AIC	1	-1.39
	SC	0	-1.96
Median75	AIC	9	-0.98
	SC	0	-1.71
Constant +Trend			
	Criteria	Lags	ADF stat
CPI	AIC	9	-3.05
	SC	5	-2.68
CPI XAF	AIC	4	-2.62
	SC	4	-2.62
TMean1_4	AIC	6	-3.17
	SC	5	-2.85
TMean1_7	AIC	6	-3.20
	SC	5	-2.89
TMean1_9	AIC	6	-3.22
	SC	5	-2.90
Median74	AIC	5	-2.41
	SC	5	-2.41
Median75	AIC	8	-3.40
	SC	8	-3.40

*(**) indicates the rejection of the null hypothesis of a unit root at 5%(1%) level of significance

Table E1.2: Phillips-Perron Unit Root Test for Inflation Measures

Constant		
	Bandwidth	PP stat
CPI	4	-1.33
CPI XAF	4	-1.56
TMean1_4	4	-1.44
TMean1_7	4	-1.48
TMean1_9	4	-1.50
Median74	3	-2.18
Median75	3	-1.99
Constant +Trend		
	Bandwidth	PP stat
CPI	4	-2.48
CPI XAF	4	-2.03
TMean1_4	4	-2.28
TMean1_7	4	-2.29
TMean1_9	4	-2.30
Median74	1	-3.68*
Median75	0	-3.48

*(**) indicates the rejection of the null hypothesis of a unit root at 5%(1%) level of significance

Table E2: Granger Causality Tests of Headline CPI Inflation versus Core Inflation Measures, Jan 2005-Sept 2007

Core Inflation Measure	Lag Length*	Core Inflation does not Granger Cause Headline Inflation	Headline Inflation does not Granger Cause Core Inflation
		Chi-sq Probability	
CPI XAF	3	0.028	0.539
TMean1_4	1	0.215	0.685
TMean1_7	1	0.166	0.746
TMean1_9	1	0.129	0.795
Median74	1**	0.341	0.187
Median75	4	0.003	0.556

*Lag length is chosen based on Likelihood Ratio tests
**Lag length selected by LR test is zero
Note: Granger causality tests are conducted on the first differences of inflation measures

ENDNOTES

[1] Egypt has been going through enormous structural changes since early 1990s. The pace of such changes considerably increased since 2004. These changes include resizing the public sector, changing the role of the government, financial liberalization, trade liberalization, tax reform, and reshaping the price setting of administrative prices.

[2]The basket of CPI has increased considerably in January 2004. The sections increased to 12 instead of 8, the components have become 45, and the number of items has increased from about 650 to 892. While the period is relatively short, it provides a consistent set of data. The data are from the Central Agency for Public Mobility and Statistics (CAPMAS).

[3] These implications will be explained later.

[4] For more details see tables A1.1-A1.6, figures A1.1-A1.6, and figures A2.1-A2.6 in Appendix A. The figures are for the distributions of 1-month to 24-month price changes for the 45 components over the period, 2004:2-2007:9. Since the mean of price changes for each time horizon changes over time, the cross-sectional distribution at each point of time is normalized (measured in standard deviations from the mean of price changes at that point of time).

[5] Higher relative price variability associated with higher inflation distorts the price signals and leads to resource misallocation (Friedman, 1977).

[6] Ball and Mankiw (1995) found that there is a positive relationship between skewness and inflation. Bryan and Cecchetti (1999) argue that the positive correlation between the mean and skewness of cross-sectional price changes suggested by the menu cost and multi-sector model is due to small sample bias caused by price-change distributions' excess kurtosis.

[7]When regressing mean inflation on skewness and control for autocorrelation among errors terms, a positive statistically significant association emerges for 1-month horizon data.

[8] The mean will correspond to a percentile that is higher than the 50th percentile.

[9] When the distribution is leptokurtic (kurtosis is excessive) as in the case of price changes in Egypt, the median and the trimmed mean are more efficient than the mean (Cecchetti, 1997).

[10] There are some other approaches: volatility weights; persistence weights (Culter 2001); principal component-based measures; and model-based approaches (Quah and vahey 1995; Bagaliano, Golinelli, and Morana 2002). These alternative approaches have not been used in the central banks as widely as the exclusion-based methods and trimmed means methods.

[11] The weight of excluded administered items in CPI is 11.7 percent and the weight of food is 38 percent.

[12] Figure C1 in appendix C shows the difference between CPI headline inflation with and without these administered items.

[13] See the details in appendix B.

[14] Trimmed means measures that exclude any component experiencing a very large relative price change might miss price changes that provide critical information on trend inflation (Cutler 2001).

[15] The 50 percentile median would considerably underestimate the mean inflation given the excessive kurtosis and right skewness of cross-sectional distribution of price changes of Egypt's data.

[16] See the details in appendix B.

[17] Roger (1997) suggests that any candidate measure of core inflation should satisfy three criteria: timely, robust and unbiased, and easy to be reproduced by the people outside the central bank. In addition, Wynne (1999) emphasizes the forward looking characteristic of any core measure in the sense that it should have an information content that helps in forecasting headline inflation.

[18] The break of the avian flu, the adjustment of domestic prices of fuel, the longer than usual positive shock to vegetables domestic prices, and the increase in the international food prices represent the most important supply shocks during this period.

[19] Bryan and Cecchetti (1994) proposed a two- or three-year centered moving average of monthly headline CPI inflation rates as a reference measure for the long-run trend. Because of the lack of data, we used the centered 13-month moving average.

[20]Vega and Wynne (2002) noticed that none of their constructed core measures for the Euro Area was able to detect in advance the pickup in trend inflation that occurred around the time of the launch of EMU.

[21] Blinder (1997) states the following: "the key question on my mind (as a central banker) was typically: what part of each monthly observation on inflation is durable and what part is

fleeting … To me, the durable part of the information in each monthly inflation report was the part that was useful in medium- and near-term inflation forecasting".

[22] The test results are based on the lag length that was chosen using Akike information criterion. Table E2 in appendix E displays the test results using likelihood ratio criterion.

[23] This result is similar to the finding documented in other studies (see for example, Brischetto and Richards, 2006).

[24]This is because the markets usually need plenty of time to adjust to the newly introduced measures associating structural adjustments. In addition, introducing new institutions (i.e. anti trust laws) and activating them is not an easy process.

[25] This can be achieved by designing a strategy to attain price stability in the long-run (i.e. inflation targeting) and by communicating the most important elements of such strategy with the market players. Implicit inflation targeting could be a good strategy in the medium-term.