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MEASURING CORE INFLATION IN TURKEY

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Abstract : The value of money is the basic reference point for the monetary policy. This target can be achieved by continuous low inflation. In this respect, measuring inflation accurately is vital. Hence, monetary policy makers are not only interested in the definition of inflation but also in how to measure this process. To this end, many inflation targeting countries have selected consumer price index (CPI) as reference bundle for measuring inflation. This is based upon the signals which is reflected in CPI; change in the cost of minimum attainable utility level represented by the specified bundle and the final prices of producers which is presented to consumption of the final consumer. Although a good measure of cost of living CPI may not reflect the main concern of policy makers and, thus, be deficient in evaluation of the outcomes of the monetary policy. Therefore, a need to define a new measure underlying the trend in inflation arises for the policy makers. This measure might be called the core inflation.

Using the framework thus, this paper aims to obtain core inflation measures for Turkey by using statistical approach. One alternative is to exclude food and energy prices off CPI, a practice which is frequently come across in the countries monitoring core inflation series. The other two alternatives, weighted median and trimmed mean, are calculated by applying the concept of limited influence estimators (LIE).

I. INTRODUCTION

As the practice of inflation targeting has been adopted by various central banks since the beginning of 1990s an underlying inflation definition aiming to capture the monetary component of inflation, which had been defined since 1970s, has become a matter of interest. As conventional definitions of price indices reflect the effect of price changes on purchasing power, the underlying or “core inflation” serves as a mean providing enough room to central banks in monitoring the underlying inflationary dynamics which is induced by the monetary policies pursued. This function is assigned to the core inflation by means of eliminating the components of conventional price

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indices which adds noise terms such as measurement errors and/or random sector specific shocks which distorts the relative price concerns of the price setters. Hence, defining a core inflation series might be regarded as a process of filtering or purifying the conventional price index of the noise terms.

In a setting where more and more central banks adopt explicit or implicit inflation targeting framework for their policy actions it is not a coincidence that those central banks seek a new underlying inflation definition to evaluate the scope of their policy actions. That is so because in this framework the target variable is the core inflation and monetary tuning is performed vis-à-vis that target which reflects the behavior of trend inflation. An issue which is closely connected to that policy is the operational independence of central banks since such a condition is a pre-requisite to apply necessary intermediate tools whenever necessity arises in staying within the bands of trend inflation determined by the authorities.

As the Staff Monitoring Agreement signed with the IMF is about to turn to a Stand-by Agreement over a three year program Turkey has gripped the chance to complete a disinflationary program successfully. During this disinflationary period which might be claimed to be continuing since the beginning of 1998 it is a must to reorientate various policies and to lay the foundations of the framework which will be adopted in the end of the following 3 years. Since monetary policy is a vital part of this policy bunch in the new era to come it is important for the Central Bank to devise a frame to detect the outcomes of its policies. In this perspective constructing a core inflation definition is essential. Thus, this paper aims to calculate alternative indices for core inflation and to convey the results obtained thus.

To undertake the task mentioned above the paper comprises 5 sections. The following section defines the meaning of “core inflation” and reviews the theoretical fundamentals of the series whose construction process and results are presented in Section 3. After this, the results obtained in Section 3 are compared and implications based on the results are discussed in Section 4. Finally, Section 5 focuses on conclusions inferred from the work of previous sections and aims to comment on further study.

II. THEORETICAL BACKGROUND : THE CONCEPT OF UNDERLYING INFLATION

The concept of core inflation reflects a totally different view from the inflation measures based on conventional price indices. Inflation measures constructed in reference to the theory of the cost of living serves to understand the change in the minimum cost of attaining the utility level represented in the specified bundle. However, such an index based on the reference bundle reflects all the price changes in the items be it determined by the market forces, caused by external shocks, resultant of temporary factors or due to internal dynamics of inflationary forces. On the other hand, for a better policy conduct a need to capture the steady-state rate of inflation, that is the trend inflation, where no supply shocks are contained in the system and the output grows at the natural rate, has arisen.

As central banks are responsible of the value of fiat money they adjust the stock of base money which is under their direct control by referring to the demand for monetary base. So the subject matter of central banks is to deal with the stability of prices by using monetary tools. Hence, this is equivalent to say that central banks are responsible of taking measures against monetary part of inflation. The non-monetary part which arises by unexpected shocks are not within the reach of central banks. In this regard, a need for a scale which measures the part of inflation that is affected by monetary policies and which is a magnitude reflecting signals that is totally different from the one comprised in the conventional consumer price indices is required.

In order to satisfy the need of such a tool we should analyze the components of inflation more thoroughly. As shown in (1) rate of change of an individual commodity ($\pi_{I,t}$) contains an aggregate inflation component ($\pi_{,t}$) and a relative price component ($\theta_{I,,t}$).

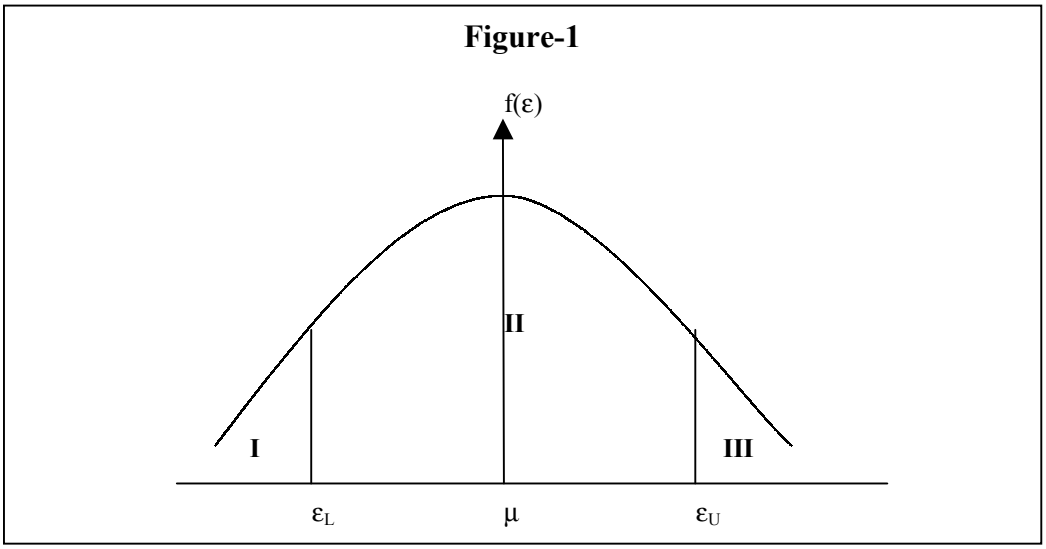
$$\pi_{I,t} = \pi_{,t} + \theta_{I,,t} \qquad (1)$$

In an economy firms initially determine their price changes by referring to the expected inflation rate ($\pi_{,t}$) which is the trend inflation, indeed. At this point no random shocks are expected. Hence, at the beginning of price setting period no change in relative prices are expected either (i.e. $\theta_{l,,t} = 0$). So at this naïve stage only the trend inflation (or the underlying inflation which might be denoted as π^c) is considered as the main determinant of the prices. At this point growth rate in the monetary stock (Δm) is treated as the estimator of the underlying inflation since in this setting money growth is the sole culprit of inflation. Hence we can write this as in (2)

(2) $\pi^c = (\Delta m)$

However, due to occurrence of unexpected shocks (ε) firms face changes in their relative prices ($\theta_{l,,t}$). Hence, after a shock the relative price component in (1) is no longer nil (i.e. $\theta_{l,,t} \neq 0$). But it should be kept in mind that everytime firms are tempted to adjust their prices to restore the initial condition of $\theta_{l,,t} = 0$ they face a menu cost which affect their attempt to eliminate relative price changes. So firms whose experienced magnitude of shocks surpasses the menu costs readjust their prices. This might be shown in figure-1.

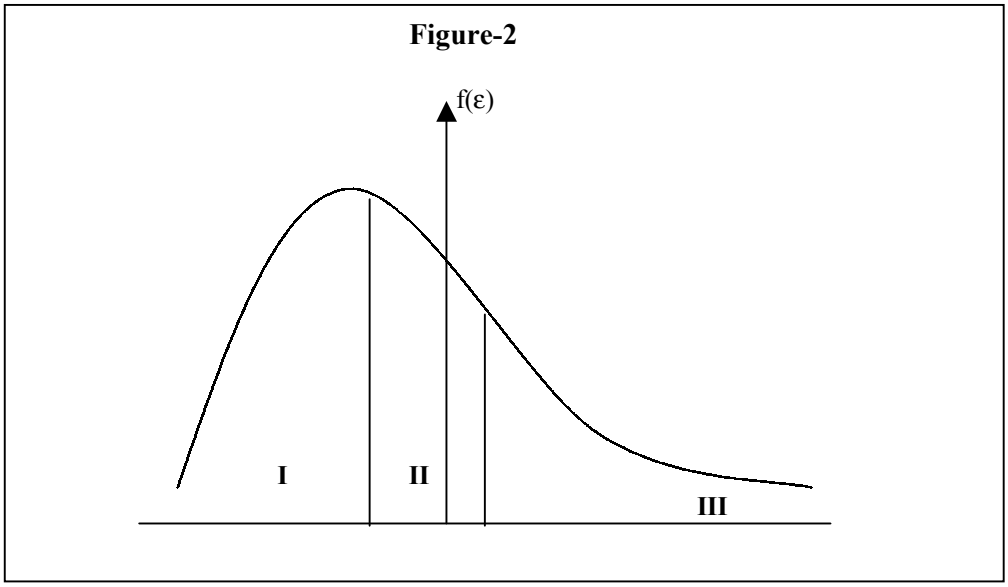
Figure-1



At this point the distribution of shocks becomes important. If the distribution of shocks has mean of zero and symmetric as in Figure-1 then the downward (price decrease area-I) and upward impacts (price increase area-II) offset each other leaving

the net effect zero. In this case there will be no change in the price level on the average ($\pi^c=\pi$). On the other hand, in case of asymmetry in the shocks this equality will not hold; if the distribution of the shocks are skewed to the right as shown in Figure-2 then upward pressure of prices (area III) will prevail, causing inflation rate surpassing the underlying measure. On the other hand, the reverse case releases inverse results.

Figure-2



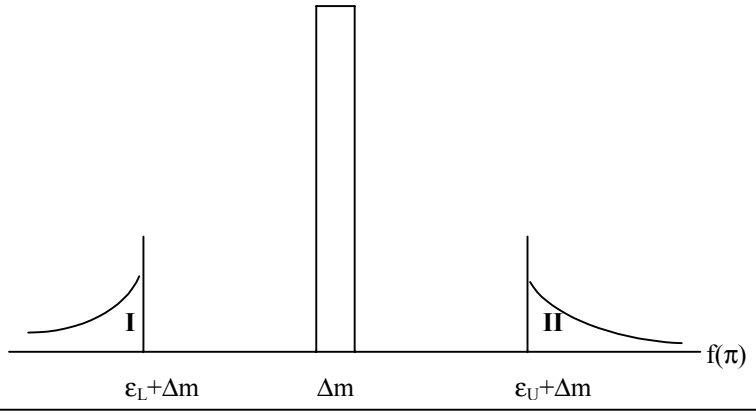
Hence, in order to reach the core part of inflation an elimination procedure on the factors causing rightward/leftward skewness and platykurtosis/leptokurtosis in the distribution of price changes should be applied. Of those methods the oldest is excluding the items causing volatility off the CPI basket such as food and energy. The rationale of this approach stems from the fact that the markets related with these products reflect supply shocks which are independent of monetary policy. The advantages of this approach lie in the ease of construction and comprehensibility by the agents. However, arguments against the reliability of this approach concentrate on the fact that these items are not the sole factors which introduce temporary shocks to the price indices.

As can be seen from the figures above when the distribution of specific shocks distorts the normality of the price changes the tails of the price changes will not average out properly. Hence, in this case conventional price index will overstate the

temporary shocks since it takes the distorted tail structure into consideration. In this setting the proposed approach in Bryan and Cecchetti (1993) is taking the weighted median of the conventional price index or applying the method of trimmed mean, methods both of which depend upon applying limited influence estimators(LIE), which are used in order to measure the central tendency of the distribution of the sectoral price shocks.

As stated above, firms whose menu costs exceed the magnitude of the sector specific shocks do not change their prices till the beginning of the next price setting period. So, the magnitude of the price changed by these firms which will last -till the next price setting period- might be defined as the change in the money stock (Δm). In this case, the distribution of price change created by such firms might be transformed to a spike which is represented by the value of (Δm) as shown in figure-3. Thus, weighted median approach rests upon taking the median values of the distribution which represents the spike in Figure-3.

Figure-3



In addition to the median approach another proposed estimator is the “trimmed mean” which depends on eliminating the outlying portion of the price changes representing the firms whose menu costs are exceeded by the temporary shocks and which lie in both of the tails over a specified boundary in figure-3 (areas I and II).

Hence, the limited estimator in this method is the mean obtained after excluding the outlier observations.

III. APPLICATION OF THE THEORY

In line of the theoretical background presented in the previous section we formed different core inflation series. In this effort 1994=100 Consumer Price Index (CPI) series within the period 1994:01-1999:10 is used. Thus, 3 different series reflecting the core inflation debate have been devised. The first of these series is obtained by removing the food and energy components from CPI (CPILFE). On the other hand, the series obtained by using the LIE approach are called the weighted median series (CPIMED) and the trimmed mean series (CPITM). In this section, further information as to how these series are constructed and basic statistics on these series is provided in this section while comparison among these series and inferences about them are presented in the next one.

CPLFE is obtained by eliminating the items in the CPI under the titles of “food, beverage and cigarette-tobacco” which represents a weight of 31.1 percentage points and of “electricity and gas” with the weight of 6.7 percent. On the other hand, one of the core inflation series obtained through the application of LIE is called “weighted median index” (CPIMED). In this case, the price changes of the 33 bundles comprising CPI are taken cross-sectionally. Then, the rate of price changes of each item are sorted in a descending order. At the end of this process the price change which falls in the 50^{th} percentile of the accumulated weights is taken as the core item. After determining the core items for each month we devise a new weighted index representing the core inflation whose main determinants are presented below;

Table-1 : Weights of CPIMED Index (%)

Items	Rent	Food	Clothing	Furniture	Electricity	Beverage	Others*
Weights	32.76	31.03	12.07	5.17	3.45	3.45	12.07

*”Others” include “hospital”, “service”, “residential repairing”, “housing items”, “pharmaceuticals”, “cigarette”, “kitchen utensils” each of which weighs 1.724%

As can be followed from the table above, CPIMED approach shows core inflation in Turkey is mainly represented by rent and food. This evidence shows

somewhat contradictory results with the frequently indicator of core inflation obtained by the removal of food and energy items (CPILFE). This can be attributed to the relatively competitive nature of the food sector in Turkey. In addition the evidence appearing in the “electricity” item might be due to the administered public prices since energy prices in Turkey is basically determined by public authorities. On the other hand, the rent component with the yearly frequency of adjustment and clothing industry with a competitive structure both on domestic and global scale help to form the stable behavior of CPIMED series.

For the series constructed by the “trimmed mean” approach we first eliminated the outlying items in the original falling beyond 85% of the price change distribution of the original 33-item bundle falling on both tails. After removing the outliers we take the mean value (μ_l) of the truncated bundle in each month. Hence we construct the CPITM series by means of those trimmed mean values.

Reviewing the calculation methods as provided above we can provide the basic statistics on these series in Table-2A and Table-2B, according to the use of annual monthly inflation rates, respectively.

Table- 2A : Basic Statistics of Different Core Inflation Measures

Annual Change	All items CPI	CPI ex. Food&Energy	Weighted Median	15% Trimmed Mean
Mean	0.598	0.594	0.584	0.797
Median	0.591	0.579	0.582	0.787
Maximum	0.815	0.793	0.832	1.202
Minimum	0.488	0.514	0.433	0.583
Standard Deviation	0.072	0.061	0.092	0.128
Skewness	0.880	1.439	0.543	1.108
Kurtosis	4.317	5.241	3.520	5.485
	Correlation Matrix			
All Items CPI	1.000	0.952	0.953	0.946
CPI ex. Food&Energy	0.952	1.000	0.904	0.916
Weighted Median	0.953	0.904	1.000	0.858
15% Trimmed Mean	0.946	0.916	0.858	1.000

Table- 2B : Basic Statistics of Different Core Inflation Measures

Monthly Change	All items CPI	CPI ex. Food&Energy	Weighted Median	15% Trimmed Mean
Mean	0.051	0.051	0.050	0.043
Median	0.048	0.047	0.050	0.038
Maximum	0.210	0.176	0.216	0.226
Minimum	0.019	0.027	0.018	0.025
Standard Deviation	0.025	0.020	0.027	0.026
Skewness	3.784	3.770	3.527	5.498
Kurtosis	25.360	23.653	23.006	38.963
	Correlation Matrix			
All Items CPI	1.000	0.923	0.946	0.897
CPI ex. Food&Energy	0.923	1.000	0.868	0.895
Weighted Median	0.946	0.868	1.000	0.868
15% Trimmed Mean	0.897	0.895	0.868	1.000

Analyzing the tables 2A and 2B we see that CPIMED improves the statistics of monthly and annual price changes. However, despite our expectations CPITM does not release good results as the CPIMED, as regards to the measures of mean, skewness and kurtosis. Also, referring to the correlation matrix we see a low relation between CPIMED and CPITM, both of which are devised by LIE based on measuring the central tendency of the distributions of price changes to represent the measure of core inflation. However, the relation of CPIMED and CPI is the highest of all. Finally, it is evident that the statistics obtained by using monthly price changes differ with respect to the statistics obtained by using annual inflation rates. This inconsistency may result from seasonality factors.

IV. COMPARISON OF THE SERIES

The graphs of the core inflation series compared to CPI are presented in the annex. According to these graphs CPIMED catches the complete picture of 1994 crisis (Graph-1B) while CPILFE underestimates (Graph-1A) and CPITM overestimates (Graph-1C) the same event. Referring to the graphs-2A we see that beginning by the

first months of the year 1998 CPILFE annual inflation series started to exceed CPI. Glancing at graph-3B we ascribe this development to the decreasing price shocks (negative skewness) in the energy and food sectors since the beginning of 1998. On the other hand, in graph-2B we see that CPIMED is systematically lower than CPI beginning by 1998:03. Combining this observations with graph-4B which reflects monotonously increasing level of external shocks we can say that disinflationary policies, hostile situation the clothing sector faced due to the global crisis and competitive structure of the food sector led the core inflation measure (CPIMED) deviate from CPI. Despite the dispersion seen between CPI and CPIMED, CPITM measure of core inflation still seems to follow CPI closely, which does not provide any message as to the policies implemented by the central bank.

Next we test if the external shocks which might be defined as the difference between CPI inflation and the calculated core inflation series are stationary i.e. I(0). In this case, stationarity refers to temporary nature of those shocks since in this case these series are mean reverting with zero mean and finite variance. ADF tests performed to this end are conveyed in Tables 3A and 3B in the Annex and release results pertaining to stationarity condition.

In addition to analyzing the stationarity of external shocks we also search if the defined core inflation series help predicting the future inflation at time t+h. This means, in fact, testing how much is the deviation of inflation in time t+h from inflation of today (t) is ascribed to the transient part of today. This might be shown in equation (3) as;

$$\textbf{(3)} \qquad \pi_{t+h} - \pi_t = \beta_0 + \beta_1 (\pi_t - \pi_t^{core}) + u_t$$

Here we test the joint restriction that $\beta_0 = 0$ and $\beta_1=1$ where β_1 indicates the excluded measure of inflation over- or under-predict the transitory movement in inflation at time t+h; if β_1 is less than 1 then transitory movements under-predicts the deviations in inflation h months ahead and vice versa. The test results are given in Tables 4A,4B,4C. Referring to the individual values of β_1 we see that most of the time the null hypothesis that $\beta_1=1$ can not be rejected due to high p-values which implies an

accurate prediction of transitory movements in inflation h period ahead. However, the joint tests reject the null hypothesis that β_0 = 0 and β_1=1.

V. CONCLUSION

This paper, utilizing the practices and the approaches proposed in the literature, constructs 3 different core measures for Turkey. Of those, the first one (CPILFE) is obtained by excluding the food and energy items from the Consumer Price Index (CPI). The other 2 core inflation series are obtained by applying the Limited Influence Estimator (LIE) method as introduced in Brian and Cecchetti (1993). The series obtained thus are called CPIMED (by applying "weighted median approach") and CPITM (by applying "trimmed mean approach") in the study.

The basic intuition under the definition of core inflation is to catch the monetary part of inflation (or the underlying trend inflation) by eliminating the transient shocks in the economy. In this regard, the meaning and signals obtained from a core inflation definition deviates from the signals reflected in traditional price indices, whose main concern is to illuminate the changes in the cost of living in the face of price changes.

The idea of CPILFE goes back to 1970s during which energy price shocks caused inflationary pressures. The idea under this approach is merely monitoring the developments in CPI without the mentioned items since these are the most frequently affected series by external shocks such as weather conditions and unexpected developments in energy prices. On the other hand, the weighted median method and trimmed mean approach are based on utilizing Limited Influence Estimators (LIE).

The rationale of using LIE is to pick the items which is placed in the middle of the price change distribution at each period. Hence, both methods aim to form a relatively stable path of inflation reflecting the direct impact of policy measures taken by the authorities by eliminating the effects of the outlier price changes. To this end, using LIE has a number of advantages; factors that are likely to last for a short time such as measurement errors, price setting mistakes or other noise terms gives a

misleading and distorted picture causing the measurement of living costs revealed in traditional price indices to be overestimated or underestimated. However, to the extent that such transient and unexpected factors fall in the tails of price change distribution the limited influence estimators are not affected by those noise terms. Hence, limited estimators provide a better measure of the underlying trend which characterizes the long run tendency of the price series.

The results of the study gives support to CPIMED as a measure to reflect the trends compared to the other two measures (CPILFE and CPITM); it improves the measures of skewness and kurtosis better, it catches the crisis of 1994 better, it reflects the disinflationary effects experienced during the period beginning by the year 1998, which is caused both by global conditions and domestic policy practices and releases a more satisfactory plot of external shocks compared to the other calculated series of core inflation.

The bundle defined for CPIMED series of inflation conveys that rent, food and clothing items are major determinants of the series. It is also seen that electricity-gas component is a part of the trend which reflects the inflationary expectations of the agents. This might be ascribed to the competitive nature of textile and food sectors, to frequency of rental contracts in Turkey and might give a hint to the administered nature of electricity by the public authorities. Although constructed thus, the weights of CPIMED bundle must be closely monitored in the near future since the time span the behavior of the bundles analyzed in this study is relatively short due to the data problem.

The paper also performs the ADF tests of the shocks individually derived for each of the core inflation series. This analysis shows the mean reverting nature of the shocks for each series. Finally, the power of each series to predict the future deviations of inflation measures (t+h) compared to the current period (t). In this analysis, none of the core inflation measures satisfies the joint test explained in the paper in detail. This, again, might be a defect stemming from the short sample period. Despite this outcome, it is detected that most of the time CPIMED releases significant results individually.

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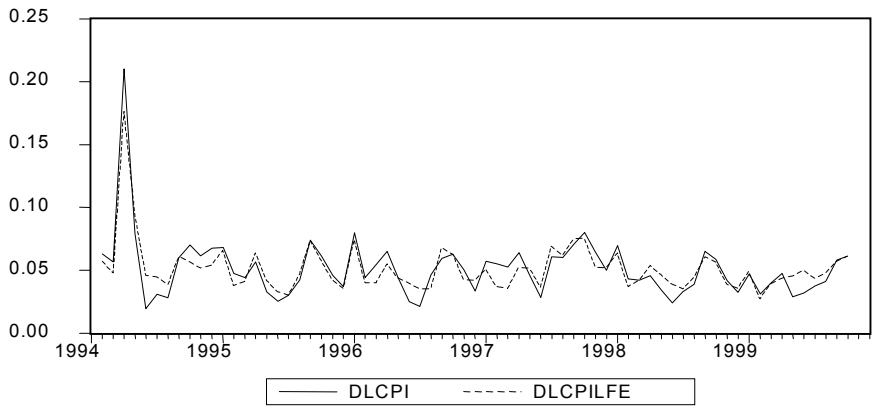
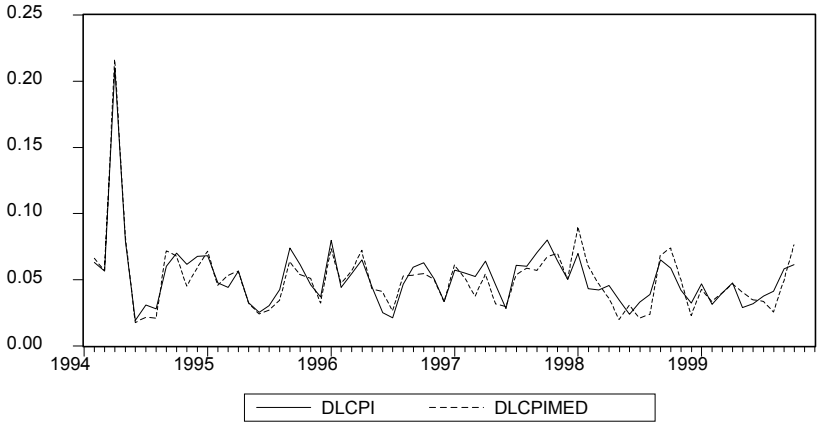
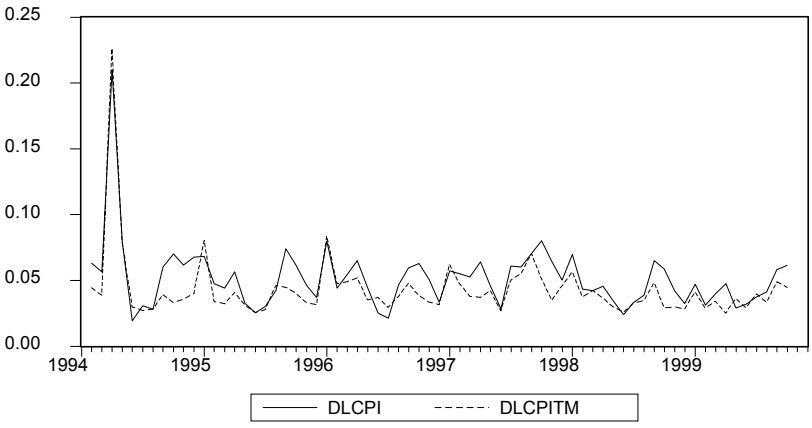
ANNEX



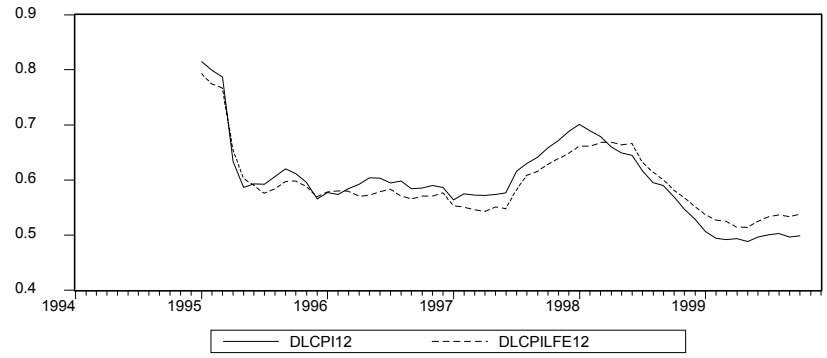
GRAPH –1A: Comparison of Monthly Inflation Rates (CPI and CPILFE)



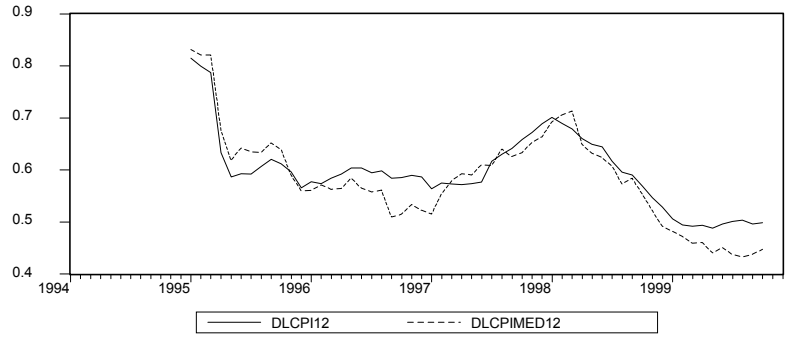
GRAPH –1B: Comparison of Monthly Inflation Rates (CPI and CPIMED)



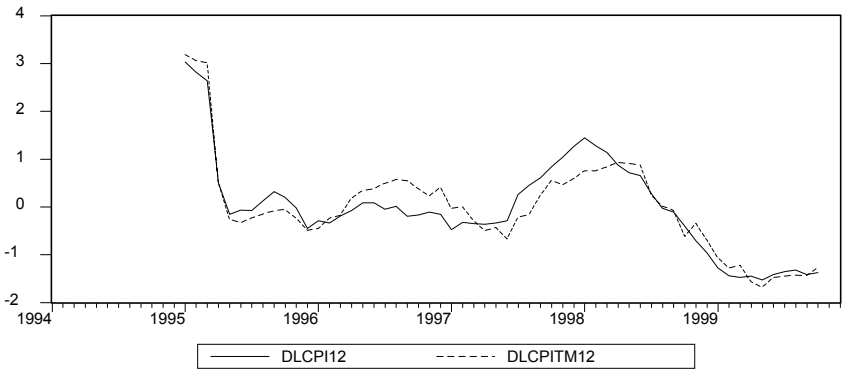
GRAPH –1C: Comparison of Monthly Inflation Rates (CPI and CPITM)



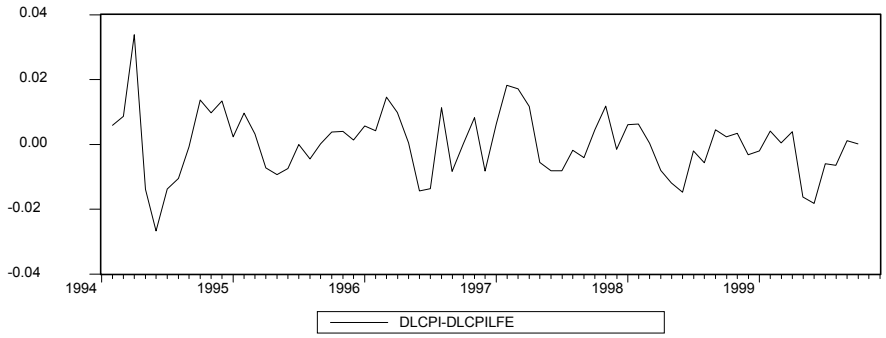
GRAPH –2A: Comparison of Annual Inflation Rates (CPI and CPILFE)



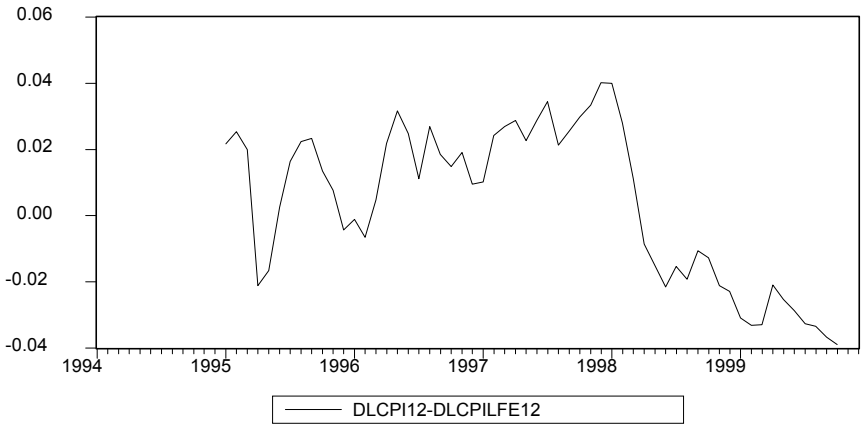
GRAPH –2B: Comparison of Annual Inflation Rates (CPI and CPIMED)



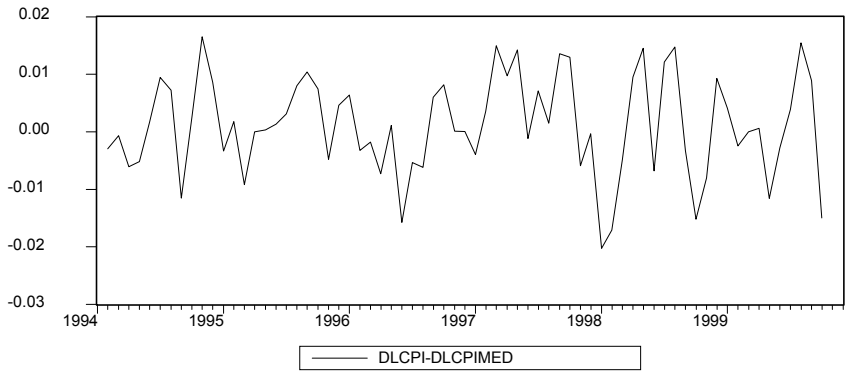
GRAPH –2C: Comparison of Annual Inflation Rates (CPI and CPITM)



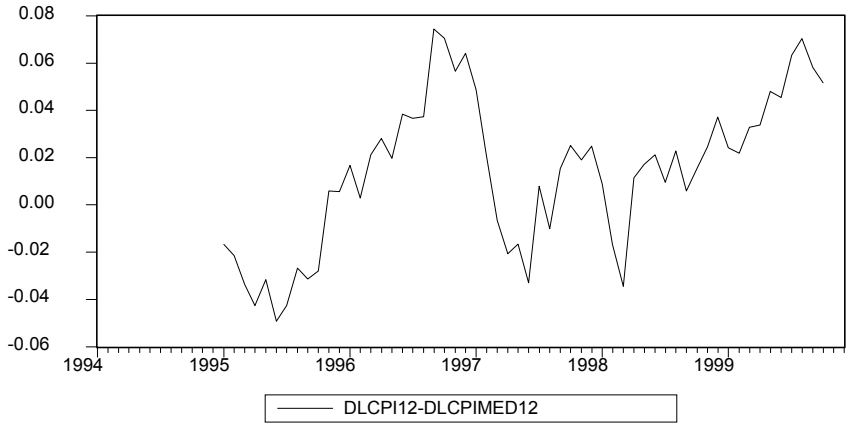
GRAPH-3A : Monthly External Shock Developments of CPILFE



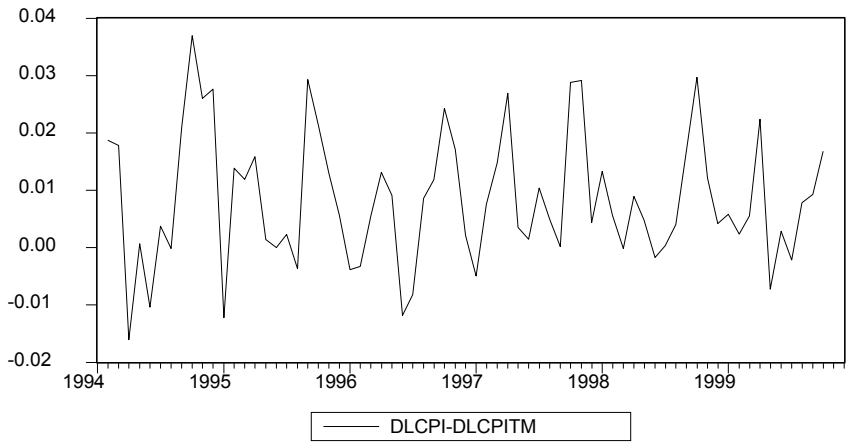
GRAPH-3B : Yearly External Shock Developments of CPILFE



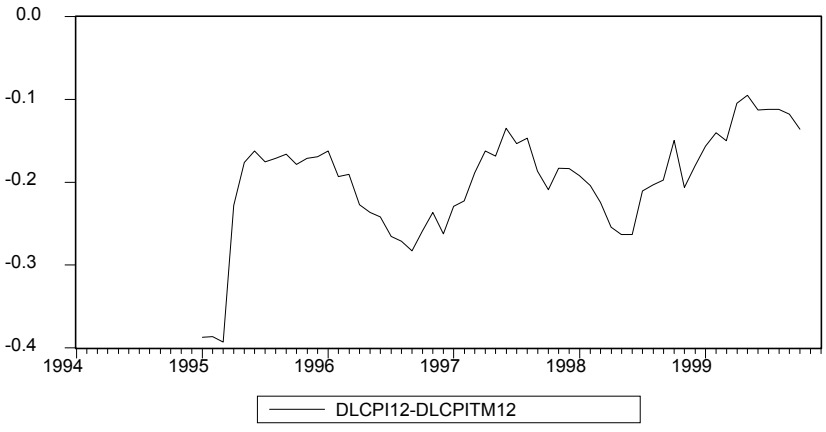
GRAPH-4A : Monthly External Shock Developments of CPIMED



GRAPH-4B : Yearly External Shock Developments of CPIMED



GRAPH-5A : Monthly External Shock Developments of CPITM



GRAPH-5B : Yearly External Shock Developments of CPITM

Table-3A : ADF Tests of Annual External Shock Measures
(Actual Inf. - Core Inf.)

	CPI-CPILFE	CPI-CPIMED	CPI-CPITM
t-stat.	-3.496**	-2.703***	-3.578*
p-value	0.001	0.009	0.001

*** 1% critical value, **5% critical value, ***10%critical value**

Table- 3B: ADF Tests of Monthly External Shock Measures
(Actual Inf. - Core Inf.)

	CPI-CPILFE	CPI-CPIMED	CPI-CPITM
t-stat.	-5.604*	-5.907*	-6.088*
p-value	0.000	0.000	0.000

*** 1% critical value, **5% critical value, ***10%critical value**

Table-4A :Regressions- 6 months ahead

CPI (t+6)	CPILFE	CPIMED	CPITM
R^2	0.024	0.009	0.441
β_0	-0.028 (0.01)	-0.026 (0.015)	0.136 (0.000)
β_1	0.511 (0.28)	0.224 (0.495)	0.766 (0.000)
p-value H_0 : (β_0 =0) p-value H_0 : (β_1 = 1) p-value H_0 : (β_0 =0, β_1 = 1)	0.010 0.296 0.005	0.015 0.021 0.001	0.000 0.060 0.000

p-values are given in parentheses

Table-4B :Regressions- 12 months ahead

CPI (t+12)	CPILFE	CPIMED	CPITM
R^2	0.005	0.077	0.157
β_0	-0.043 (0.024)	-0.044 (0.005)	0.105 (0.050)
β_1	0.394 (0.648)	0.892 (0.063)	0.661 (0.007)
p-value H_0 : (β_0 =0) p-value H_0 : (β_1 = 1) p-value H_0 : (β_0 =0, β_1 = 1)	0.024 0.483 0.005	0.005 0.818 0.012	0.050 0.151 0.000

p-values are given in parentheses

Table-4C :Regressions- 18 months ahead

CPI (t+18)	CPILFE	CPIMED	CPITM
R^2	0.093	0.207	0.023
β_0	-0.003 (0.896)	-0.048 (0.003)	0.015 (0.811)
β_1	-2.198 (0.056)	1.440 (0.003)	0.256 (0.347)
p-value H_0 : (β_0 =0) p-value H_0 : (β_1 = 1) p-value H_0 : (β_0 =0, β_1 = 1)	0.896 0.007 0.000	0.003 0.342 0.011	0.811 0.009 0.000

p-values are given in parentheses