The Dynamic Relationship between Core and Headline Inflation

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Abstract

This paper investigates the dynamic relationship between headline and core inflation across monetary policy regimes for both the Consumer Price Index and Personal Consumption Expenditure deflator. Core inflation measures considered include the respective less food and energy inflation rates and the respective weighted median or trimmed mean inflation rates. Specifically when headline and core differ, we examine to what extent headline moves back to core and core moves back to headline and how quickly these adjustments happen. Furthermore, we study whether the direction and speed of adjustment depend on the measure of core, or the sample. For the most part, we find that the dynamic relationship between core and headline inflation measures varies over time as well as across different measures of core inflation. Measures of core inflation appear to adjust more to changes in headline inflation in the pre-1979 samples and less in post-1979 samples. Finally, we find that the dynamic relationship between the weighted median and trimmed mean Consumer Price Index inflation rates and their respective headline inflation rate are highly consistent across monetary policy regimes. This finding may suggest there is an optimal trimming that captures underlying inflation, independent of the monetary regime.

1. Introduction

Movements in headline inflation are a combination of movements in the underlying trend inflation rate as well as transitory price movements. The various measures of core inflation (less food and energy, weighted median, trimmed mean) represent various approaches to stripping out the transitory movements in prices. The degree to which a measure of core successfully captures the underlying trend inflation rate is usually assessed by looking at its ability to forecast headline inflation over some medium term (1-2 year) horizon. [1]

If a measure of core inflation contains information that is useful for forecasting the headline inflation rate at some future date, it necessarily follows that when there is a difference between headline and core inflation in the current period, headline inflation will, to some extent, revert back to core inflation. It is also possible, of course, that to some extent, when there is a difference between headline and core inflation in the current period, core reverts to headline inflation. We refer to the strength and direction of movement between headline and core over various horizons as the dynamic relationship between core and headline inflation. In this paper, we present evidence on the dynamic relationship between core and headline inflation for various measures of core inflation, over various sub-samples. Our overall objective is to determine whether the strength and direction of the dynamic interaction between core and headline inflation have changed and are related to monetary policy regimes.

[1] Most previous research has examined whether core inflation measures are good forecasters of future inflation. See Bryan and Cecchetti (1994), Wynne (1999), Clark (2001), Cogley (2002), Smith (2004), Dolmas (2005), Rich and Steindel (2005) for discussions of forecasting in the United States. See Le Bihan and Sedillot (2002), Bagliano and Morana (2003) and Stardev (2010) for discussions of forecasting in Europe.

We specifically investigate the following questions: When headline and core inflation differ, to what extent does headline move back to core and core move back to headline? How quickly do these adjustments happen? Do the direction and speed of adjustment depend on the measure of core, or the sample? And do changes in the dynamic relationship across samples match with changes in monetary policy regimes?

Kiley (2008) and Mehra and Reilly (2009) look at a similar set of questions. Kiley (2008) examines both the CPI and the Personal Consumption Expenditure deflator (PCE) and considers the respective less food and energy measures as core inflation. He finds using an error-correction approach that during the 1970s and early 1980s both headline inflation and core inflation adjust to close a gap between headline and core. After that headline inflation does the adjusting. Kiley does not discuss this result in relationship to monetary policy regimes.

Mehra and Reilly (2009) use the CPI less food and energy as the measure of core inflation. They show that both the speed and direction of adjustment between core and headline inflation appear to depend on the monetary regime. When monetary policy is accommodative (pre-1979), and there is a gap between the CPI less food and energy and headline CPI inflation rates, the gap is closed mainly through adjustments in the CPI less food and energy inflation rate. When monetary policy is less accommodative (post-1979) the gap is closed mainly through adjustments in the headline inflation rate. We expand on their work by looking at several different candidate measures of core inflation for the CPI as well as the PCE[2].

[2] Differences in the dynamic relationship between core and headline inflation across a 1979 or early 1980s sample split have been identified by other authors as well: Clark (2001), Blinder and Reis (2005), Rich and Steindel (2005) , Smith (2005), Mishkin (2007), Ball and Mazumder (2011) and Rosengren (2011).

For the most part, we find that the dynamic relationship between core and headline inflation measures varies over time as well as across different candidate measures of core inflation. Consistent with Mehra and Reilly (2009), measures of core inflation appear to adjust less to changes in headline inflation in post-1979 samples. The dynamic relationships between the median and trimmed mean CPI and their respective headline inflation rates appear to be the exceptions to this general finding. In particular, in both the pre-1979 and post-1979 samples, the bulk of the adjustment between those core and headline inflation rates comes mainly from changes in headline inflation.

We describe the data in section 2. In section 3 we present Granger causality tests. In section 4 we present our evidence on the dynamic relationship between headline and core inflation. Section 5 concludes.

2. Data

We analyze both the traditional measure of core inflation calculated from the CPI and PCE less food and energy and we also look at core inflation based on the median CPI and the trimmed mean CPI (Bryan and Cecchetti, 1994) and the trimmed mean PCE (Dolmas, 2005). All data are monthly annualized rates of change. The data Appendix lists the start and end dates for each series as well as the sources. Table 1 displays the summary statistics for the various candidate core and headline measures of inflation. There are two sets of each of the trimmed mean CPI and median CPI series. The original sets are available for the period 1967.01 through 2007.07. The revised sets are available from 1983.01 through 2011.04.

We analyze the full sample, 1959.01-2011.04 as well as the following sub-samples: 1959.01-1979.06, 1967.02-1979.06, 1985.01-2007.07, and 1985.01-2011.04. The split at

1979.06 accounts for the change in monetary policy initiated with the confirmation of Paul Volcker as the Chairman of the Federal Reserve. The post-1985 samples account for any changes due to the Great Moderation. And the other start and end dates are to accommodate the available data[3].

3. Granger Causality Tests

We tested for Granger Causality in the bi-variate VARs of each headline-core pairing. Our goal here is not to infer the direction of causality from these results, which is problematic because variables outside of the two variables contained in the VAR likely influence both headline and core inflation. Our goal is instead to assess the in-sample predictive content of one series from the other. The p-values for the null of no predicative content are presented in Table 2.

The Ganger Causality results are presented in Table 2. For the early sub-sample, both headline CPI and PCE inflation Granger Cause the less food and energy inflation series, but less food and energy does not Granger cause headline. It appears that during the pre-Volcker (pre-1979) era, transitory shocks to food and energy prices, which affected headline inflation, contained information about future movements in less food and energy inflation. This spillover from food and energy price shocks to less food and energy inflation is consistent with the findings of Clarida, Gali and Gertler (2000), Leduc, Sill and Stark (2007) and Mehra and Reilly (2009) that prior to 1979 the Fed accommodated shocks to inflation.

In the pre-Volcker sample beginning in 1967.02, headline inflation Granger Causes the median (only marginally) and trimmed mean CPI as well as the PCE less food and

[3] Mehra and Reilly used bi-annual data.

energy measures of inflation but not for the CPI less food and energy. This later result is somewhat puzzling given that the evidence presented by Clarida, Gali and Gertler (2000), showing that monetary policy was accommodative of price shocks in the 1970s.

The final nugget that can be gleaned from Table 2 is that the PCE less food and energy and the trimmed mean CPI are the only two measures of core inflation for which the candidate measure consistently contains predictive power for headline (we reject the null that core does not cause headline).

4. The Dynamic Relationship

In order to know how to test the dynamic relationship between headline and core inflation we need to understand if our measures of inflation have unit roots. We test for unit roots in our various measures of the level of inflation and first difference of inflation. The results for a unit root in the level of inflation, which are presented in Table 3a, differ across inflation measures and samples. The finding that the results vary with the measure of inflation and the sample is consistent with what other researchers have found and indicates that there is instability in these estimates.[4] To illustrate this instability we applied the parameter instability test developed by Ashley (1984). Figures 1a and 1b show the results. These figures show the implied root estimates from the ADF test allowing for the estimates to vary every five years. The exclusion estimates of core inflation are the estimators based on excluding the same elements from the inflation calculation each period (in this case food and energy). The limited influence estimators are the trimmed mean and median measures. For all measures of core and headline inflation, there is a substantial divergence in the implied root over the past 6 years.

[4] For a greater discussion of whether inflation has a unit root see Rose (1988), Culver and Papell (1997), Stock and Watson (1999), Henry and Shields (2004) and Basher and Westerlund (2008).

The results for a unit root in the first difference of inflation, as presented in Table 3b, indicate that the first difference of the various inflation measures is stationary.

Because of the instability indicated by the results in Table 3a, we follow an agnostic approach with respect to the unit root issue by presenting results from a cointegration model (which assumes a unit root is present) as well as a general dynamic adjustment model (which assumes stationarity).[5]

In the cointegration model we impose the restriction that the long run relationship between core π_t^C and headline inflation π_t^C is

$$\Delta\pi_t^C = \Delta\pi_t^H$$

The error-correction representations are therefore:

$$\Delta\pi_t^H = \alpha^H + \gamma^H(\pi_{t-1}^H - \pi_{t-1}^C) + \sum_{i=1}^{n}\beta_i^{H,H}\Delta\pi_{t-i}^H + \sum_{i=1}^{n}\beta_i^C\Delta\pi_{t-i}^{H,C} + \varepsilon_t^H \qquad (1.1)$$

$$\Delta\pi_t^C = \alpha^C + \gamma^C(\pi_{t-1}^H - \pi_{t-1}^C) + \sum_{i=1}^{n}\beta_i^{C,H}\Delta\pi_{t-i}^H + \sum_{i=1}^{n}\beta_i^{C,C}\Delta\pi_{t-i}^C + \varepsilon_t^C \qquad (1.2)$$

Table 4 reports the speed of adjustment parameters $(\gamma's)$. We see that when headline inflation is above core inflation, headline inflation falls $(\gamma^H \leq 0)$ and core inflation rises $(\gamma^C \geq 0)$.

Our estimated coefficients differ slightly from those presented in Mehra and Reilly for the CPILFE (the only measure of core they consider). They find that the bulk of the adjustment pre-1979 was from less food and energy to headline. We find that adjustment happened in both directions during that time period. The difference in our results could be due to the fact that Mehra and Reilly look at semi-annual data and we examine monthly

[5] Mehra and Reilly (2009) do the same.

data. Despite this difference, our results support their main conclusion about the adjustment between CPI and CPILFE. Prior to 1979, less food and energy (both CPI and PCE) adjusts to headline, however, the results for the other measures of core are mixed. The median CPI shows some adjustment of core to headline, but the bulk of the adjustment is from headline to core. The trimmed mean is all headline to core. After 1979, headline does the bulk of the adjustment (for all measures) although at times there are still statistically significant adjustments of the candidate core measures to headline.

For the trimmed mean inflation measures in the sample 1985-2007.07, the adjustment from headline to core is -1. When we added the data through 2011.04, the trimmed mean measures still show the strongest adjustment from headline to core, although it is no longer significantly different from the other estimated gammas.

Our general dynamic adjustment models are:

$$\pi_{t+f}^{C} - \pi_{t}^{C} = b_0^{C} + \lambda^{C}(\pi_t^{H} - \pi_t^{C}) + \sum_{i=1}^{n} b_i^{C}\pi_{t-i}^{C} + \mu_{t+f}^{C} \quad (2.1)$$

$$\pi_{t+f}^{H} - \pi_{t}^{H} = b_0^{H} + \lambda^{H}(\pi_t^{H} - \pi_t^{C}) + \sum_{i=1}^{n} b_i^{H}\pi_{t-i}^{H} + \mu_{t+f}^{H} \quad (2.2)$$

Where $\pi_{t+f} - \pi_t$ is the change in inflation (core in 2.1 and headline in 2.2) between time periods t and $t+f$; λ_f^H and λ_f^C measure the relationship between that change and the gap between headline and core inflation in period t. The parameters λ^H and λ^C are similar to the speed of adjustment coefficients $(\gamma\text{'}s)$; when headline inflation is above core inflation, we expect headline inflation to fall $(\lambda^H \leq 0)$ and core inflation to rise $(\lambda^C \geq 0)$.

Based on the findings by Mehra and Reilly (2009), we expect the size and signs of λ_f^H and λ_f^C to vary over the various sub-samples. Mehra and Reilly find that $\lambda_f^H = 0$ in the pre-Volcker period and λ_f^C is large and positive. In the Great Moderation λ_f^H is large and negative and λ_f^C is small or insignificant.

Tables 5 (a through d) display our estimated λ's from equations 2.1 and 2.2. The main results from these tables are as follows.

1. **The direction of adjustment depends on the measure of core as well as the sample period.**

   a. In the Pre-Volker period we find that headline does most of the adjustment. At times the less food and energy core measure adjusts albeit by the same or smaller amount than the headline adjustment. It is also interesting to note that some of the headline adjustment coefficients are statistically indistinguishable from -1 and the candidate core adjustment is zero, which suggests that headline does all the adjusting when the two series diverge. This result is different than Mehra and Reilly's (2009) findings but is consistent with Kiley (2008).

   b. In the Great Moderation period (post 1985), once again headline does the adjusting. In these samples, occasionally candidate core measures do some small adjusting. One puzzling result is that for the trimmed mean of both the CPI and PCE the adjustment coefficient on the candidate core measure is negative and significant at times. Perhaps the significance of the candidate core adjustment coefficients is attributable to our use of monthly data. Or there is overshooting by the headline measure that is adjusted to by the candidate core measure.

2. **The median CPI and trimmed mean CPI exhibit the most consistent patterns of adjustment across samples.**

a. The dynamic adjustment for the median CPI inflation rate: at the one-month time horizon, λ^H varies from -0.85 to -0.46 and λ^C varies from -0.01 to 0.18. At the 24-month time horizon λ^H varies from - 0.91 to – 1.12 and λ^C varies from -0.03 to 0.16. The dynamic adjustment for the trimmed mean CPI inflation rate: at the one-month time horizon, λ^H varies from -1.19 to -0.54 and λ^C varies from -0.05 to 0.02. At the 24-month time horizon λ^H varies from -1.17 to –1.25 and λ^C varies from -0.21 to -0.09. For the most part these coefficients are statistically indistinguishable from each other. The stability of the adjustment coefficients across monetary policy regimes is surprising and departs from the results of Mehra and Reilly.

b. For the other candidate core measures there is not much variation is λ^H but large variation in λ^C indicating that headline inflation has done most of the adjustment over different monetary policy regimes. Adjustment of core inflation to movements in headline inflation has lessened. Once again, Mehra and Reilly (2009) find large variations in both λ^H and λ^C so our results differ from theirs.

The end product of the dynamic adjustment processes described by the adjustment parameters $\gamma's$ and $\lambda's$ is presumably $\pi_{t+f} = \pi_t^C$ for some horizon *f*. In other words, the core measure of inflation at time *t* is an indicator for headline inflation at some future time *t+f*.

We tested the equality of headline and core inflation over various horizons, using the following equation:[6]

$$\pi^H_{t+f} - \pi^C_t = \delta^f + \eta_{t+f} \qquad (3)$$

Figures 1-5 display the estimates of δ^f for f=1, .., 24 for the various core-headline pairs over the full sample and the various splits.

Over the full sample, 1959.01-2011.04 (Figures 2a and b) the CPI less food and energy and PCE less food and energy inflation rates were unbiased predictors of headline inflation over all horizons (1-24 months). In the pre-1979 samples (Figures 3 and 4) each of the candidate core measures under predicted its respective headline measure, with the degree of under prediction growing with the horizon. Specifically, the under prediction most often becomes significantly different from zero at time horizons greater than 12 months. In the post-1985 samples (Figures 5 and 6) the bias disappears. These results are broadly consistent with the monetary policy hypothesis stated by Mehra and Reilly (2009). Namely, if the components of headline inflation that were stripped away to form core inflation have a positive mean, core inflation will consistently under predict headline inflation. One way for the stripped out components to have a positive mean inflation rate is for the Federal Reserve to accommodate positive shocks to those stripped out components. And that describes monetary policy in the 1970s.

In addition another possible explanation for these results is if the distribution of price changes is left-skewed.[7] Under left-skewness the core measures will be biased

[6] This is a form of equation (3) in Rich and Steindel (2005): $\pi^H_{t+f} - \pi^H_t = \delta^f_{t+f} + \theta^H(\pi^H_t - \pi^C_t) + \eta_{t+f}$ with the restriction that $\theta^H = -1$. Clark (2001), Hogan Johnson and Lefleche (2001), Cutler (2001) and Cogley (2002) also estimate this equation.

estimators of headline inflation. Therefore, the persistence of supply shocks (i.e. relative price changes) will be higher. This increased persistence may arise from accommodative monetary policy as indicated by Mehra and Reilly (2009) or may be a function of the public's inflation expectations and the fact that those inflation expectations are not shock anchored[8] (Ball and Mazumder (2011)).

5. Conclusion

Our aim in this paper was to measure the dynamic relationship between headline and core inflation for a broader set of potential core inflation measures than Mehra and Reilly (2009) considered. We find slightly different results than Mehra and Reilly (2009) in that headline inflation appears to do more of the adjusting prior to 1979. Our results from the Great Moderation are similar to theirs. Overall, we contribute to the core inflation literature by adding evidence that the dynamic adjustment process has changed although perhaps not as much as previous studies have found. In addition, we have found that the dynamic relationship between the median and trimmed mean CPI inflation rates and their respective headline inflation rates are highly consistent across monetary policy regimes. This finding may suggest there is an optimal trimming that can capture underlying inflation, independent of the monetary regime, but more research needs to be done on this subject.

[7] See Ball and Mankiw (1995) and Sommer (2004) for further discussion of the distribution of price changes in inflation measures.

[8] Shock anchoring implies that a transitory shock to inflation is not incorporated into the public's inflation expectations.

Data Appendix

CPI: Consumer Price Index-for all urban consumers, seasonally adjusted,
Sample: 1947.01-2011.04
Source: Bureau of Labor Statistics

CPILFE: Consumer Price Index-for all urban consumers, all items less food& energy, seasonally adjusted,
Sample: 1957.01-2011.04
Source: Bureau of Labor Statistics

CPIMED: Consumer Price Index-for all urban consumers, median, seasonally adjusted,
Sample: 1967.02-2007.07 original,
1983.01-2011.04 revised
Source: Federal Reserve Bank of Cleveland

CPITM: Consumer Price Index-for all urban consumers, 16% trimmed mean,
Sample: 1967.02-2007.07 original,
1983.01-2011.04 revised
Source: Federal Reserve Bank of Cleveland

PCE: Personal Consumption Expenditures: Chain-type price index, seasonally adjusted,
Sample: 1959.01-2011.04
Source: Bureau of Economic Analysis

PCELFE: Personal Consumption Expenditures: Chain-type price index less food& energy, seasonally adjusted,
Sample: 1959.01-2011.04
Source: Bureau of Economic Analysis

PCETM: Personal Consumption Expenditures: Chain-type price index, trimmed mean, seasonally adjusted,
Sample: 1977.01-2011.04
Source: Federal Reserve Bank of Dallas

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Table 1: Summary Statistics

	1959.01-2011.04	1959.01-1979.06	1967.02-1979.06	1985.01-2007.07	1985.01-2011.04
CPI	**3.91**	**4.45**	**6.33**	**3.00**	**2.87**
	3.82	3.77	3.50	2.61	3.19
CPILFE	**3.85**	**4.24**	**5.92**	**3.01**	**2.81**
	3.12	3.42	2.96	1.44	1.48
PCE	**3.51**	**4.11**	**5.74**	**2.59**	**2.49**
	3.01	3.08	2.76	2.04	2.37
PCELFE	**3.43**	**3.95**	**5.42**	**2.58**	**2.44**
	2.41	2.55	2.10	1.53	1.50
CPIMED	-	-	**5.97**	**3.23**	**2.92**
	-	-	2.81	1.17	1.11
CPITM	-	-	**5.95**	**2.90**	**2.76**
	-	-	2.79	1.16	1.22
PCETM	-	-	-	**2.66**	**2.53**
	-	-	-	0.90	0.95

Notes: The mean annualized inflation rates in bold, with standard deviations below.

Table 2: Granger Causality Tests

	1959.01-1979.06		1967.02-1979.06		1985.01-2007.07		1985.01-2011.04	
H_0=	H does not cause C	C does not cause H	H does not cause C	C does not cause H	H does not cause C	C does not cause H	H does not cause C	C does not cause H
CPILFE	**0.00**	**0.252**	**0.132**	**0.037**	**0.324**	**0.120**	**0.123**	**0.058**
CPIMED	**-**	**-**	**0.094**	**0.871**	**0.653**	**0.310**	**0.108**	**0.114**
CPITM	**-**	**-**	**0.017**	**0.056**	**0.109**	**0.021**	**0.006**	**0.012**
PCELFE	**0.002**	**0.593**	**0.021**	**0.023**	**0.073**	**0.000**	**0.047**	**0.000**
PCETM	**-**	**-**	**-**	**-**	**0.191**	**0.260**	**0.151**	**0.048**

Notes:
Each cell contains the p-value for the null hypothesis that H or C does not cause C or H where H is headline inflation and C is core inflation.
All VARs contained 11 lags, which is the lag length that minimized the AIC.

Table 3a: ADF Test Results, Level of Inflation

1959-2011.04	implied root estimate	p-value for null of unit root
CPI	0.87	0.014
CPILFE	0.90	0.014
PCE	0.87	0.0025
PCELFE	0.94	0.147
PCEMED	0.95	0.167
PCETM	0.95	0.126
1983.02-2011.04		
CPIMED	0.81	0.22
CPITM	0.86	0.067

Table 3b: ADF Test Results, First Difference of Inflation

1959-2011.04	implied root estimate	p-value for null of unit root
CPI	-2.92	0.00
CPILFE	-3.09	0.00
PCE	-2.57	0.00
PCELFE	-2.13	0.00
PCEMED	-1.94	0.00
PCETM	-1.63	0.00
1983.02-2011.04		
CPIMED	-2.22	0.00
CPITM	-2.13	0.00

Table 4: Speed of Adjustment Coefficients from the Cointegration Equations 1.1 and 1.2

	1959.01-1979.06		1967.02-1979.06		1985.01-2007.07		1985.01-2011.04	
	γ^H	γ^C	γ^H	γ^C	γ^H	γ^C	γ^H	γ^C
CPILFE	**-0.37****	**0.45****	**-0.29***	**0.35****	**-0.73****	**0.12****	**-0.66****	**0.04**
	(0.10)	(0.09)	(0.12)	(0.10)	(0.09)	(0.05)	(0.08)	(0.03)
CPIMED	-	-	**-0.61****	**0.22***	**-0.71****	**0.07***	**-0.64****	**0.03**
	-	-	(0.17)	(0.10)	(0.09)	(0.04)	(0.08)	(0.02)
CPITM	-	-	**-0.91****	**0.18**	**-0.96****	**-0.07**	**-0.76****	**-0.07***
	-	-	(0.25)	(0.15)	(0.11)	(0.04)	(0.09)	(0.03)
PCELFE	**-0.24***	**0.27****	**-0.13**	**0.26****	**-0.69****	**0.09**	**-0.65****	**0.02**
	(0.11)	(0.07)	(0.12)	(0.08)	(0.11)	(0.08)	(0.09)	(0.06)
PCETM	-	-	-	-	**-1.00****	**-0.09***	**-0.72****	**-0.06***
	-	-	-	-	(0.11)	(0.04)	(0.08)	(0.03)

*Statistically Significant at the 5% level
**Statistically Significant at the 1% level

Table 5: Adjustment Coefficients from Dynamic Adjustment Equations 2.1 and 2.2

5a.

1959.01-1979.06						
Coefficient	λ^H			λ^C		
Period *f*	1 Mo	24 Mos	48 Mos	1 Mo	24 Mos	48 Mos
CPILFE	**-0.51****	**-0.53****	**-0.69****	**0.52****	**0.49****	**0.28***
	(0.12)	(0.13)	(0.11)	(0.10)	(0.12)	(0.12)
PCELFE	**-0.46****	**-0.78****	**-1.08****	**0.15****	**0.19**	**-0.14**
	(0.16)	(0.18)	(0.16)	(0.05)	(0.14)	(0.13)

5b.

1967.02-1979.06						
Coefficient	λ^H			λ^C		
Period *f*	1 Mo	24 Mos	48 Mos	1 Mo	24 Mos	48 Mos
CPILFE	**-0.63****	**-0.62****	**-0.77****	**0.36****	**0.39***	**0.16**
	(0.15)	(0.16)	(0.09)	(0.09)	(0.16)	(0.16)
CPIMED	**-0.85****	**-1.12****	**-0.94****	**0.18**	**-0.03**	**0.10**
	(0.16)	(0.13)	(0.17)	(0.09)	(0.13)	(0.13)
CPITM	**-1.19****	**-1.24****	**-1.36****	**0.02**	**-0.09**	**-0.26**
	(0.16)	(0.15)	(0.17)	(0.14)	(0.16)	(0.13)
PCELFE	**-0.40****	**-0.72****	**-1.18****	**0.14***	**0.15**	**-0.28**
	(0.10)	(0.22)	(0.18)	(0.06)	(0.17)	(0.15)

5c.

1985.01-2007.07						
Coefficient	λ^H			λ^C		
Period *f*	1 Mo	24 Mos	48 Mos	1 Mo	24 Mos	48 Mos
CPILFE	**-0.49****	**-0.92****	**-0.93****	**0.14****	**0.06**	**0.05**
	(0.07)	(0.09)	(0.09)	(0.03)	(0.04)	(0.06)
CPIMED	**-0.51****	**-0.91****	**-0.97****	**0.08***	**0.16****	**0.09**
	(0.08)	(0.10)	(0.09)	(0.03)	(0.05)	(0.07)
CPITM	**-0.66****	**-1.17****	**-1.22****	**-0.04**	**-0.21****	**-0.26****
	(0.10)	(0.12)	(0.12)	(0.03)	(0.05)	(0.05)
PCELFE	**-0.38****	**-0.92****	**-0.87****	**0.22***	**0.10**	**0.12**
	(0.12)	(0.13)	(0.16)	(0.10)	(0.09)	(0.10)
PCETM	**-0.77****	**-1.22****	**-1.19****	**-0.06***	**-0.11****	**-0.15****
	(0.07)	(0.10)	(0.12)	(0.03)	(0.03)	(0.05)

5d.

1985.01-2011.04						
Coefficient	λ^H			λ^C		
Period *f*	1 Mo	24 Mos	48 Mos	1 Mo	24 Mos	48 Mos
CPILFE	**-0.43****	**-1.03****	**-0.93****	**0.09****	**0.01**	**0.05**
	(0.08)	(0.07)	(0.09)	(0.03)	(0.03)	(0.06)
CPIMED	**-0.46****	**-1.09****	**-1.06****	**0.01**	**-0.02**	**-0.05**
	(0.11)	(0.07)	(0.10)	(0.01)	(0.03)	(0.03)
CPITM	**-0.54****	**-1.25****	**-1.19****	**-0.05***	**-0.16****	**-0.17****
	(0.12)	(0.07)	(0.10)	(0.02)	(0.04)	(0.05)
PCELFE	**-0.39****	**-1.05****	**-0.87****	**0.12**	**0.02**	**0.12**
	(0.09)	(0.11)	(0.16)	(0.07)	(0.07)	(0.11)
PCETM	**-0.59****	**-1.23****	**-1.20****	**-0.04**	**-0.08**	**-0.15****
	(0.12)	(0.06)	(0.12)	(0.02)	(0.05)	(0.05)

*Statistically Significant at the 5% level
**Statistically Significant at the 1% level

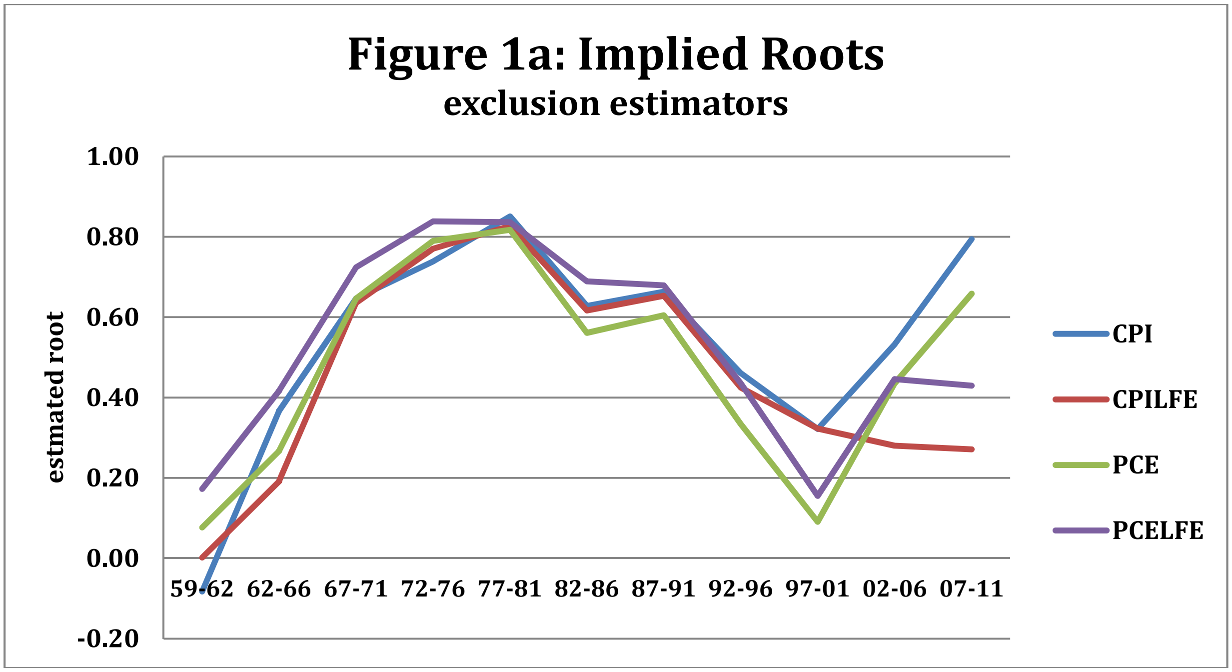
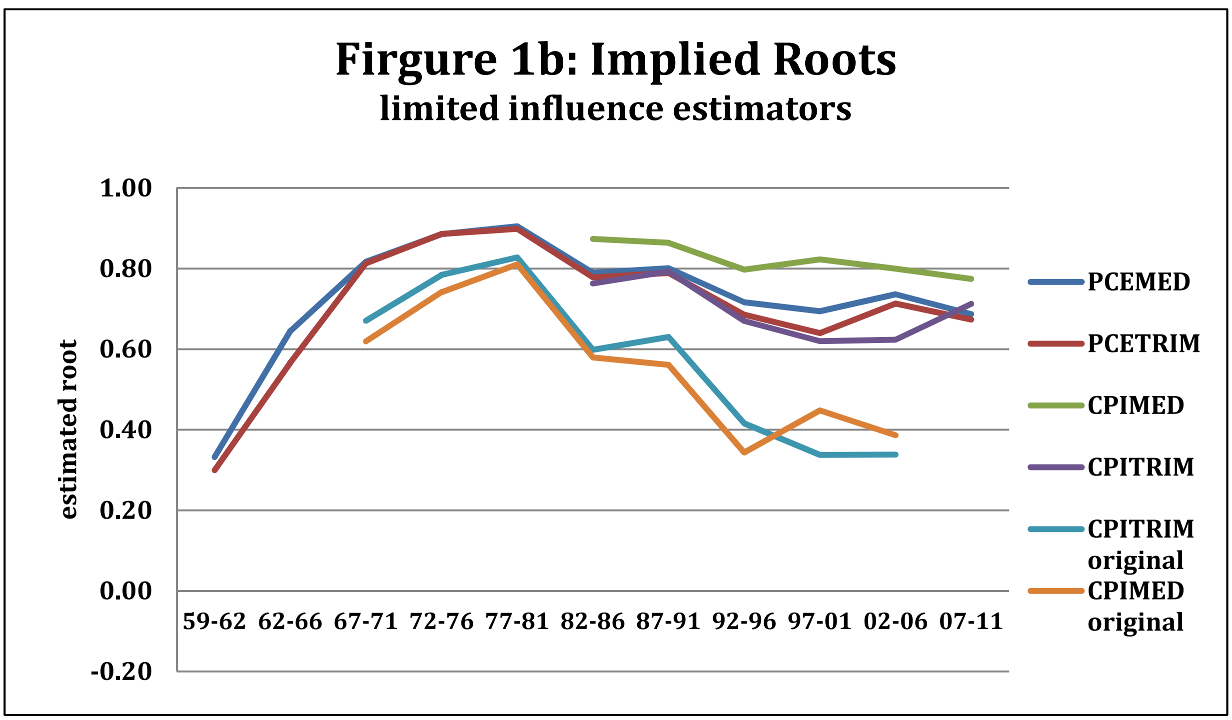


Figure 1a: Implied Roots
exclusion estimators
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
estmated root
59-62 62-66 67-71 72-76 77-81 82-86 87-91 92-96 97-01 02-06 07-11
CPI
CPILFE
PCE
PCELFE

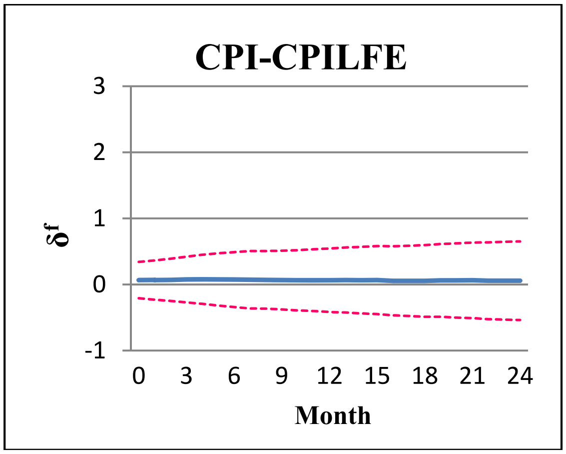

Firgure 1b: Implied Roots
limited influence estimators
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
estimated root
59-62 62-66 67-71 72-76 77-81 82-86 87-91 92-96 97-01 02-06 07-11
PCEMED
PCETRIM
CPIMED
CPITRIM
CPITRIM original
CPIMED original

Figures 2-6

Estimates of δ^f, f= 1,…, 24

Figure 2
1959.01-2011.04

2a.



2b.

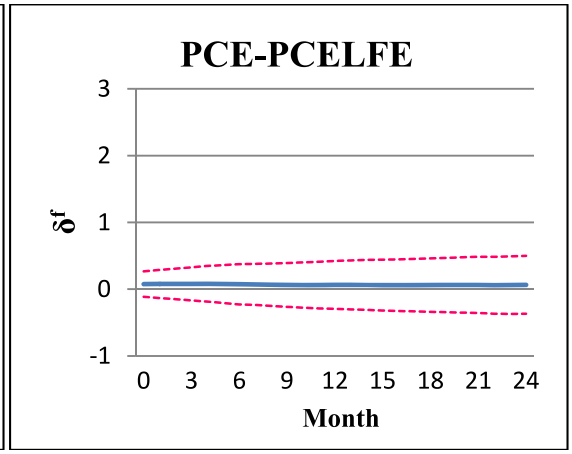
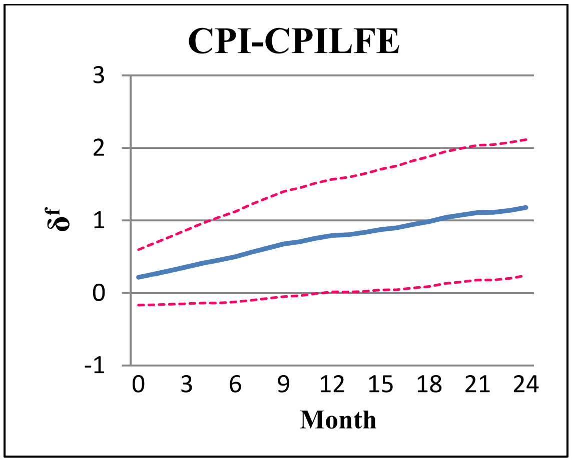


Figure 3
1959.01-1979.06

3a.



3b.

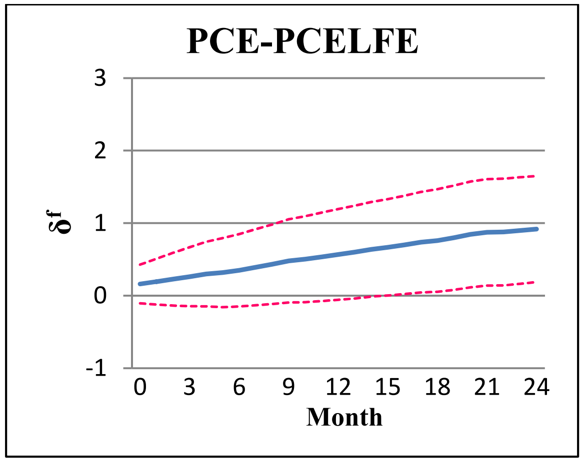


Figure 4
1967.02-1979.06

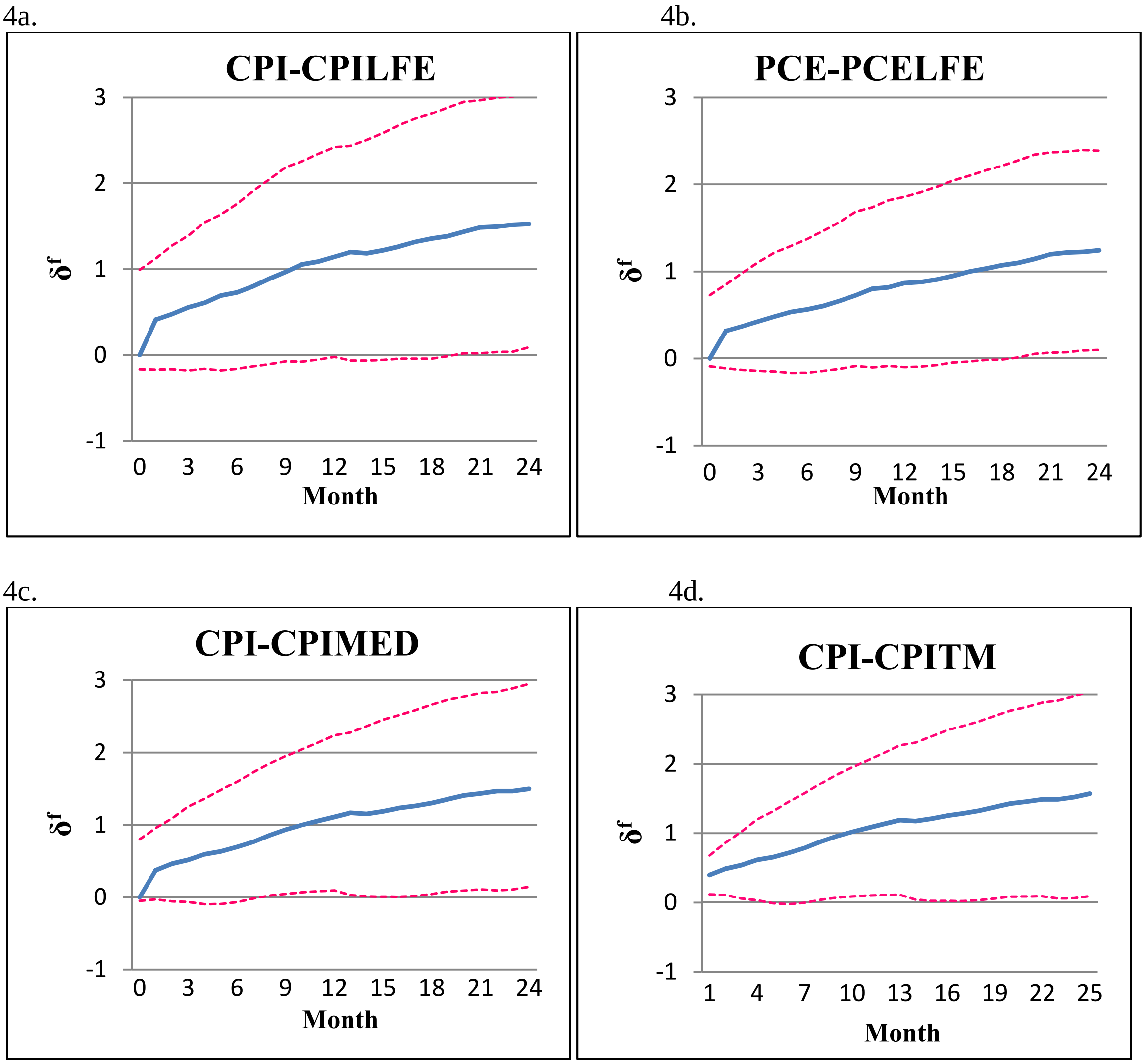
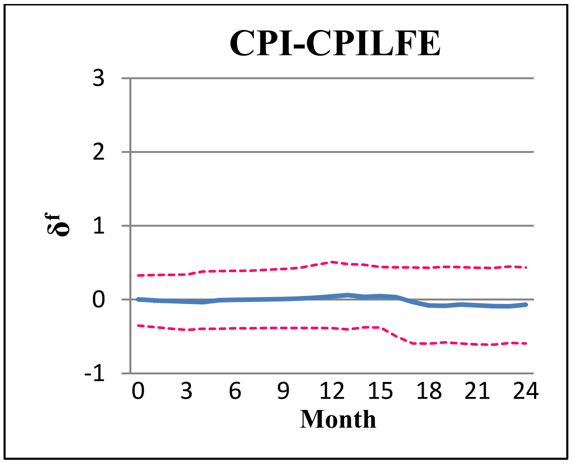
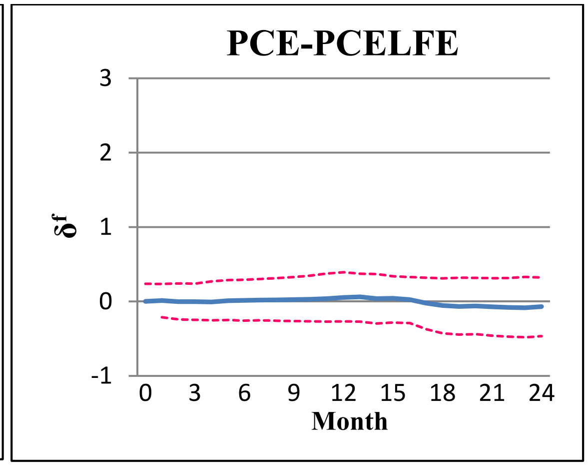


Figure 5
1985.01-2007.07

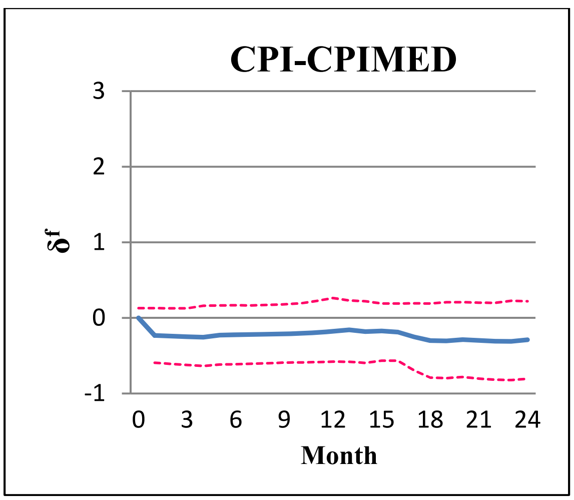
5a.



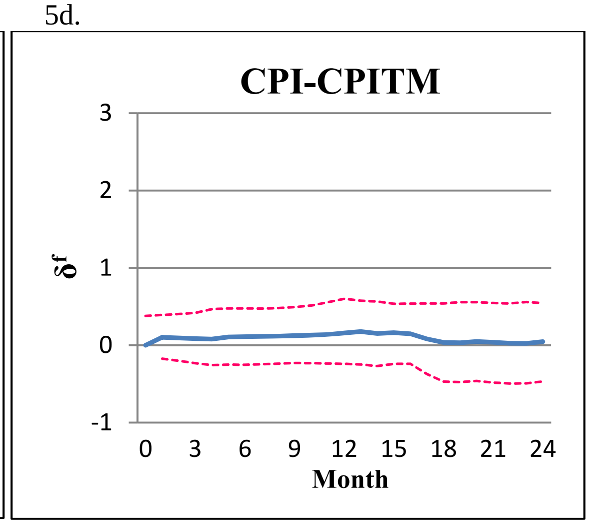
5b.



5c.



5d.



5e.

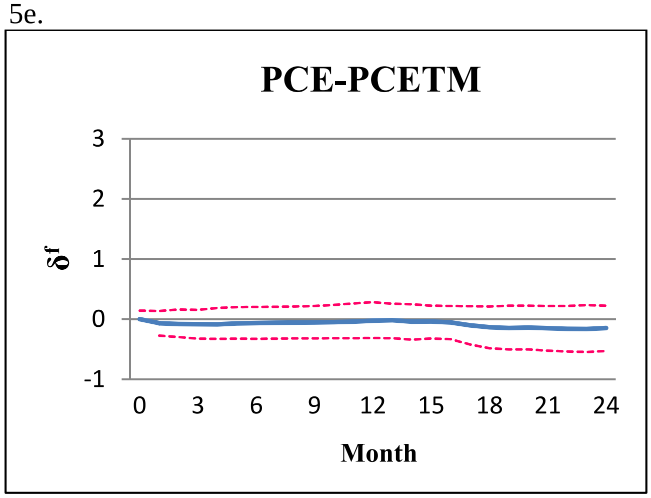
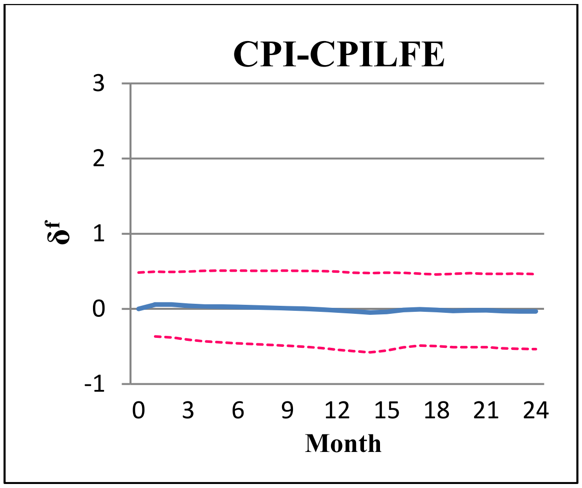
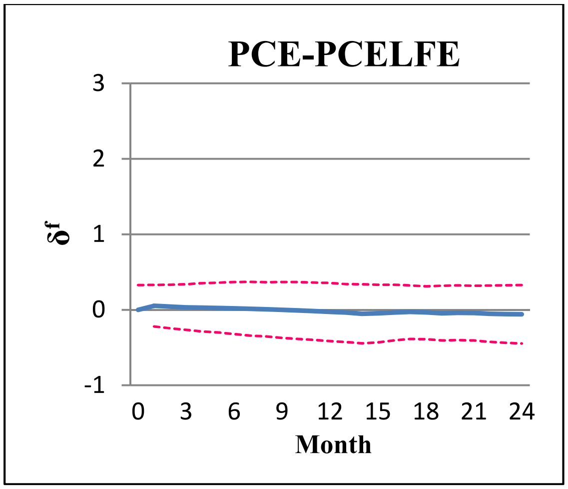


Figure 6
1985.01-2011.04

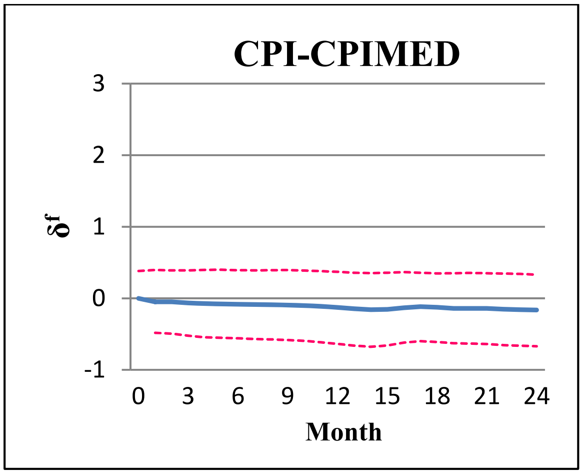
6a.



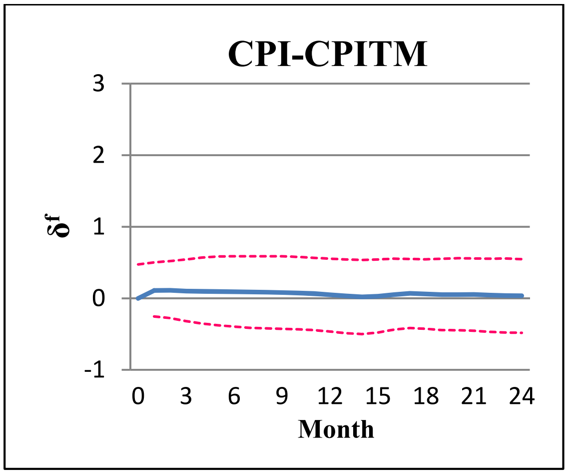
6b.



6c.



6d.



6e.