Research Department Working Paper *No:11*

CALCULATION OF OUTPUT-INFLATION SACRIFICE RATIO:

The Case of Turkey

October 2002

The Central Bank of the Republic of Turkey

CALCULATION OF OUTPUT-INFLATION SACRIFICE RATIO:
The Case of Turkey

A. Arzu Çetinkaya

Devrim Yavuz*

Research Department
The Central Bank of the Republic of Turkey
06100 Ulus Ankara TURKEY

E-mail: arzu.cetinkaya@tcmb.gov.tr
devrim.yavuz@tcmb.gov.tr

November 2002

Abstract -- This paper covers different approaches developed to measure the output costs of disinflation; namely the sacrifice ratio. A brief description of calculation methods with their shortcomings and a summary of the findings in the developed countries are given first. The description of the data and the results of the empirical study are covered next. We have found only two positive sacrifice ratios in the (3 x 3) matrix of 3 episodes and 3 techniques. And yet, they are too small to be compared with each other or with the ones in other countries. Analysis of output losses in disinflations showed that, in Turkey disinflations are not characterized by huge losses in output and affected significantly by positive supply shocks.

Keywords: Costs of Disinflation, Sacrifice Ratio

** We want to thank Kürşat Kunter for his guidance and valuable comments.*

1. INTRODUCTION

The tradeoff central banks face between output and inflation was a popular area of research for years. Since the introduction of the Philips curve in 1950s many economists were investigated if the tradeoff really exists or not. The labor market conditions, wage and price adjustments in the markets, the way the inflation expectations are formed and the effects of these factors on the inflation-output tradeoff were all discussed.

Today it's widely accepted by the economists that lower inflation rates give rise to long-run benefits for the society. However, there is also a strong belief that conducting monetary policy to slow down inflation involve some short-run costs in terms of loss in output, namely the sacrifice ratio. The sacrifice ratio is the output cost of reducing inflation and defined as the ratio of percentage loss of real output to change of trend inflation. In other words, it is the aggregate loss in output associated with a one percentage point fall in inflation.

Within the scope of this study, we are planning to test the applicability of these techniques to Turkey. During the estimation of sacrifice ratios for developing countries, the unstable path of inflation and growth rate in those countries may lead to some difficulties. The definitions of disinflation episodes for developed and developing countries will probably be different. Therefore we may have to change the definitions of trend inflation and disinflation episode since a stable and long-lived fall in inflation is much harder to observe in emerging countries. The determinants of sacrifice ratio in developed countries, like speed and size of the disinflation, initial level of disinflation, trade openness, central bank independence and credibility are not appropriate for emerging economies.

The theory and existing literature is going to follow this introduction. A brief description of the data is given in the third chapter. Fourth chapter covers the empirical study for the case of Turkey, fifth chapter concludes.

2. THEORY AND EXISTING LITERATURE

The sacrifice ratio is estimated most commonly by an expectations augmented Philips curve approach which simply defines a relationship between output measured as GDP or GNP and inflation (Okun 1978; Gordon and King 1982). The relation can be quantified given the time series of output and the relevant price index. That kind of an estimation of Philips curve captures the output-inflation tradeoff for the given time period. The basic equation is the following Philips curve with adaptive expectations.

$$y_t - y_t^* = \alpha (\pi_t - \pi_{t-1}) + u_t \ ; \ \alpha > 0 \qquad (1)$$

Where y_t and y_t* refer to actual and potential output and the term (π_t - π_{t-1}) is the disinflation occurred in time t. As α gets larger, the cost of disinflation increases. The main disadvantage with this approach is that the estimated sacrifice ratio is not varying over time. This approach constraints the output-inflation tradeoff to be the same during disinflations as during increases in trend inflation and temporary fluctuations in demand (Ball 1994).

An alternative way is then to use episode-specific methods to measure output losses occurred in individual disinflation episodes. That kind of measurement makes it possible to analyze how sacrifice ratios vary in time and for different conditions. The comparison of different economic policies in terms of output losses can also be made by using this approach, which was impossible with the single sacrifice ratio estimated, by using the Philips curve equation.

Ball (1994), has defined some specific disinflation episodes and calculate the tradeoff for each episode separately. The sacrifice ratio for some specific episode is then:

$$SR = \Delta Y / \Delta\pi \qquad (2)$$

Ball (1994) identifies disinflation episodes in which trend inflation falls substantially and defines trend inflation as a centered, nine quarter moving average of actual inflation. The time range between an inflation peak and an inflation through is called to be a disinflation episode. The sacrifice ratio in the given episode is then defined as the total deviation in output from its trend over the change in the trend inflation.

$$SR = \Sigma\ (y_t - y_t^*) / (\pi_t - \pi_{t-1}) \qquad (3)$$

The basic definitions related with disinflations in Ball's study were as follows:

Trend Inflation is a centered nine quarter moving average of actual inflation rate. Trend inflation in time (t) is then average of inflation rates between (t-4) and (t+4). Simply, trend inflation is a smoothened version of actual inflation.

Inflation Peak is a point in time where trend inflation is higher than the previous and the next 4 quarters.

Inflation Trough is a point in time where trend inflation is lower than the previous and the next 4 quarters.

Disinflation Episode is the time range that starts with an inflation peak and ends at an inflation trough with an annual rate at least two points lower than the peak.

The most delicate issue in calculation of sacrifice ratios is the measurement of the potential output. That is because; small differences in the fitted trends can make large differences for sacrifice ratios. This standard method introduced by Ball (1994) defines potential (natural) level of output based on the following three basic assumptions:

- The output is assumed to be at its potential level at the inflation peak[1]
- Output returns to its natural level four periods after the end of the episode[2]
- Trend output grows log linearly between the two points when actual and trend output are equal. Geometrically, trend output is the straight line connecting these two points.

Many economists have followed Ball's standard method, including Jordan (1997), Partow and Yuravlivker (1198), Junguito (1998), Bernake, Laubach, Mishkin, and Posen (1999) and Boschen and Weise (1999).

Ball's method of measuring potential output was an alternative to standard statistical filters such as HP filter. The problem with the method is that the economists cannot reach a consensus on the assumptions of it. The first assumption is widely accepted. The inflation is stable in an inflation peak; hence the output is at its potential in steady state. However, the question when the output is going to return to its potential level is questionable. Are there any long-lived or persistence effects? How long have the effects of the recession last? Ball (1994) assumed the output is going to return to its potential level a year after an inflation trough. This view was not shared by some economists.

Zhang (2001), suggested that the effects of a disinflation experience can be more persistent than it was assumed by Ball (1994). Thus, the assumption that output returns to its potential level four quarters after the end of an episode may understate the cost of disinflation episode (Zhang 2001). A number of other studies also offered empirical evidence that disinflation involves some long-lived effects. Blinder (1987), Romer and Romer (1989 and 1994), also found that disinflations resulting from monetary shocks have high persistence effects. The Philips curve in equation (1) with persistence effects takes the form

$$y_t - y_t^* = \alpha (\pi_t - \pi_{t-1}) + \beta (y_{t-1} - y^*_{t-1})u_t \; ; \alpha > 0, 0 < \beta < 1 \qquad (4)$$

[1] This assumption is reasonable because the change in inflation is zero at a peak. The natural level of output is often defined as the level consistent with stable inflation (Ball 1994).
[2] The logic behind the first assumption suggests that output returns to the trend at the trough, where inflation is again stable. In practice, however, the effects of disinflation are persistent: output appears to return to trend with a lag of about a year.

The coefficient β shows how strong is the persistence effect and as β approaches to1 degree of persistence increases. To insure an equilibrium solution it is assumed that $0<\beta<1$ (Zhang 2001).

Zhang (2001) also found that limiting persistence effect with four quarters has two main shortcomings. First, as persistence effects last possibly more than a year, Ball (1994) and other studies that did not take into account the persistence effects underestimate the true sacrifice ratio. Second, as strength of persistence effects differs among countries, previous studies may have produced misleading ranking of cross-country sacrifice ratios. Moreover Zhang (2001) modified Ball's (1994) method, relaxing the assumption that output returns to its potential level four quarters after the disinflation episode. He also used the HP-filter to calculate potential output. The empirical results from the data of G-7 countries revealed higher sacrifice ratios than the sacrifice ratios that don't account for long-lived effects.

When measuring potential output Zhang have followed Ball in his first assumption and assume that output is at its natural level at the start of a disinflation episode. However, he assumed that, recessions have some long-lived effects and made no assumptions about the degree of persistence; output could return to its potential at any time after the trough. "The difference between these two methods can also be seen from their implications about short-term loss and long-term loss. The standard method assumes actual output returns to its potential level by four quarters after the trough. Thus, short-term loss and long-term loss are the same; there is no further output loss beyond four quarters after the trough. The new method assumes there is a possible strong persistence effect, thus, short-term loss and long-term loss are not the same." (Zhang 2001).

Zhang's method for potential output operates as follows:

- Output was assumed to be at its potential at the beginning of the disinflation episode
- HP filter was used to predict potential output. HP filter of the log real GDP was calculated first and growth rates of HP filter were found next.
- The potential output was assumed to grow at the rate estimated by HP filter at the beginning of the episode.

These two studies, Ball (1994) and Zhang (2001) both assumed there exists no hysteresis effects, which can be regarded as very strong persistence effects. The hysteresis effect occurred if there exists a permanent effect of disinflation, in other words if the contractionary monetary policy affects the potential output. The idea was first discussed by Blanchard and Summers (1986) who introduced the term "hysteresis" to describe permanent effects of disinflation. Romer (1999) and Romer and Romer (1989 and 1994) argued that demand shifts may reduce output permanently. This means contractionary monetary policy can cause not only temporary deviations from trend output, but also a reduction in trend output.

In this paper we have used slightly modified versions of the Ball's and Zhang's techniques to estimate potential output and a standard HP filter approach. We have focused on short-run effects of disinflations and ignored any hysteresis effect.

3. DATA

For the inflation, we have used the monthly CPI index with the base year of 1987, which is available from 1987 till today. To provide convenience we have transformed the data to quarterly format. We simply take the index of the last month of the quarter as the index that quarter. We used annual inflation rate, which is rate of change between the index of the current quarter and the index of the same quarter of the previous year, in order to get rid of seasonality.

For output, the GDP with 1987 prices was used which is also available from 1987 till today in quarterly format. We have used log real GDP to decrease the scale of the data. Even in the logarithmic form, data displays significant seasonality, hence we have used the logarithm of seasonally adjusted real GDP. Tramo/Seats model and Demetra software were employed to deseasonalize GDP data (Figure 1).

4. EMPIRICAL STUDY

For the Turkish data we slightly modified the definitions of trend inflation and disinflation episodes based on the study by Lawrence Ball (1994). To obtain the disinflation episodes we first calculated the trend inflation. The trend inflation is simply a centered 5 period moving average of the year on year increase of the actual CPI. When the nine period centered moving average of actual inflation was used as the trend inflation, only a single disinflation episode can be found therefore we have changed the definition introduced by Ball (1994). By shortening the range of the moving average procedure we have found a less smoothened inflation trend in which disinflations can be seen more clearly.

Then we defined the inflation peak/trough as a point in time where the trend inflation was higher/lower than the previous and the next four quarters. Then an inflation episode is the period, which starts with an inflation peak and ends with an inflation trough. By these small modifications in Ball's approach we can find three clear disinflation episodes for Turkey in the period 1987-2001.

As the original CPI data is in monthly frequency we have also found disinflation episodes for the monthly data. For both the monthly and the quarterly data we applied two different definitions of trend inflation. The first definition is a more smoothened version of the actual inflation while the second one is a less smoothened version of it (Figure 2). The number of episodes found in the four different cases are illustrated in Table 1.

Table 1: Different Episodes for Alternative Definitions

Frequency	Trend Inflation (Centered Moving Average)	Peak	Trough	Number of e-Episodes
Monthly	25 months	π_t>12 months	π_t <12 months	1
Monthly	13 months	π_t >6 months	π_t <6 months	3
Quarterly	9 quarters	π_t >4 quarters	π_t <4 quarters	1
Quarterly	5 quarters	π_t >4 quarters	π_t <4 quarters	3

When a more smoothened version of the trend inflation is used only one clear disinflation episode can be found. On the other hand when the range of the moving average procedure is shortened three clear disinflation episodes were found for both the monthly and the quarterly data (Figure 3).

As mentioned before we have used quarterly data of trend inflation in calculation of the sacrifice ratio for compliance with the output data. The sole difference between Ball's definition of trend inflation and our definition is the length of the moving average procedure, which was 9 quarters in the former and 5 quarters in the latter.

In order to check if we are missing anything important by transforming the data to quarterly frequency, we have compared the episodes found by using the monthly data with those found with the quarterly data.

The results have shown that both the quarterly and monthly data pointed out the same disinflation episodes. The three episodes, which were found for the Turkish inflation data, are illustrated in Table 2.

Table 2: Disinflation Episodes for Turkish Inflation Data

Monthly (centered 7 months moving average)				
	Start	**End**	**Duration**	**Trend Inflation Decline**
Episode I	Jan 92	Dec 92	12 Months	6.6 points
Episode II	Oct 94	Dec 96	27 Months	38.3 points
Episode III	Jan 98	Jan 01	37 Months	45.7 points
Quarterly (centered 5 quarters moving average)				
	Start	**End**	**Duration**	**Trend Inflation Decline**
Episode I	92 Q1	92 Q4	4 Quarters	5.1 points
Episode II	94 Q4	96 Q4	9 Quarters	34.4 points
Episode III	98 Q1	00 Q4	12 Quarters	42.8 points

The first two episodes are similar to each other because in both, decline in inflation was mainly due to the base effect. The Gulf War in 1991 and the economic crisis in April 1994 were both associated with high inflation rates hence the periods following these shocks were identified with relatively lower inflation rates. Episode III, on the other hand, was different since two different stabilization programs put into practice between 1998 and 2001. The first one was announced in January 1998 and based on monetary targets while the second one was the well-known crawling-peg regime. In fact third disinflation episode was the only one where decline in inflation was a result of the implemented monetary policies.

Episode I, was a short period that followed the Gulf Crisis in 1991. The fall in trend inflation was limited with 5.1 percentage points. The study by Ball (1994) requires a minimum 2 points fall in trend inflation within an episode, however, for the high inflation countries such as Turkey this rate is not noticeable. In fact even a 5.1 percent decline in trend inflation do not point out a significant disinflation period for Turkey hence this period can be defined as a slight recovery after the shock that hit the economy by the Gulf War in 1991.

The second episode was a typical recovery from the 1994 economic crisis. It starts with the peak in the fourth quarter of 1994 where historically highest level of the trend inflation, 112.9 percent, was observed. The jump in the inflation was due to a currency crisis and a boost in the exchange rates. With moderate exchange rates in the post-crisis period a slow down in inflation was occurred and trend inflation fell down to 78.5 percent by the end of the episode.

However, the third disinflation episode was different than the others as in this period inflation was reduced by the implementation of two different stabilization programs. The first program was initiated in January 1998 and it was quite successful in bringing the inflation down, till the economy was disturbed by the Russian economic crisis in August 1998. The crisis has stopped the down turn in inflation however the trend inflation has followed a horizontal path just after the crisis. By the end of the year 1999 a new economic program supported by the IMF was initiated and inflation has started to fall again. The exchange rate based stabilization program has been implemented successfully till February 2001, however, it came to an end in February when the exchange rate was allowed to float. The trend inflation has begun to rise by the end of the year 2000.

To measure the output gap we have used three different methods in order to check whether the calculation method of the trend output alters the results significantly.

Method 1: The first method was the standard HP-Filter approach. Natural logarithm of quarterly GDP data is filtered by Hodrick-Prescott filter to get the potential GDP data[3]. By

[3] Software package E-views is employed for calculating Hodrick-Prescott potential output.

subtracting potential GDP data from seasonally adjusted GDP data, output gap data is found[4] (Figure 4).

Method 2: Second method is the one used by Ball (1994). The output is assumed to be at its potential level at an inflation peak and 4 quarters after an inflation trough. Then the trend output was increased at a constant rate between these two points (Figure 5).

Method 3: Finally as a third method a modified version of Ball's method which was used by Zhang (2001) has been employed. In this way of calculation, first of all the HP filter of the log real GDP was found. Secondly, the growth rate of the HP filter was calculated. Thirdly, the output is again assumed to be at its potential in an inflation peak and finally, the potential output was assumed to grow at the rate estimated by the HP filter (Figure 6).

As the first two episodes are known as recovery periods, we expected not to find clear output losses and noticeable sacrifice ratios for these episodes. While the output was in a downward trend, we observed high levels of inflation rates during the crisis periods hence a relative rise in output is very likely to occur in line with a fall in inflation in the post-crisis period. On the contrary, the third episode was characterized by a contractionary monetary policy under two different disinflation programs. Therefore, a significant output loss can be expected during this episode. However, as a well-known fact, we observe consumption booms during exchange rate based stabilization programs, which prevent output loss to increase substantially.

We found no significant positive sacrifice ratios, for none of the three episodes, regardless of the technique used in the calculation of the output loss. The method used for the potential output led to different results mostly in episode I. In the other two episodes the output loss as a percentage of potential GDP were found very close to each other for the different techniques. The results showed simply that, Turkish disinflation episodes are not really characterized by crucial losses in GDP (Table 3).

Table 3: Results

	Trend Inflation Decline	Output Gap (% of GDP)			Sacrifice Ratio		
		Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Episode 1	5.1	2.1	-0.8	0.1	-0.42	0.16	-0.02
Episode 2	34.4	0.3	0.4	3.3	-0.01	-0.01	-0.09
Episode 3	42.8	2.9	1.2	-3.7	-0.07	-0.03	0.09

[4] The seasonally adjusted GDP is computed by using the Demetra Software, which can also remove the calendar effect from the series.

In episode 1, employing methods 1 and 3 gave out no output loss and hence negative sacrifice ratios. An insignificant amount of output loss was found by using method 2, which resulted in a small sacrifice ratio pointing a 0.02 percent output loss for one percent decrease in trend inflation. For the second episode all three methods were resulted in negative and small sacrifice ratios, which were very close to each other. In the third and the last episode the sacrifice ratios were again very close and small.

The data used in the calculation, output losses and sacrifice ratios for each episode and for each technique can be found in the Appendix in a more detailed format.

To examine the inflation and output dynamics of episode 3 more precisely we have carried our analysis one step further and we have treated two stabilization programs as if they are two different disinflation episodes. In other words we have calculated two separate sacrifice ratios within the same disinflation episode. Episode 3a is the stabilization program started at the first quarter of 1998 and finished at second quarter of 1999. On the other hand Episode 3b, the crawling peg regime, was initiated at the first quarter of 2000 and has lasted for 4 quarters until the forth quarter of the same year.

The results were very much parallel to our expectations and have proved that we are right when we are assessing the effects of exchange rate based stabilization program in episode 3. For all methods episode 3a was characterized by a larger loss in output than the episode 3b. For methods 2 and 3 sign of the sacrifice ratios were also in line with our expectations. Output losses and positive sacrifice ratios for episode 3a was found while episode 3b is associated with output gains and negative sacrifice ratios. Only by using the first method, the standard HP filter, we have found negative sacrifice ratios for both of the episode, but output sacrifice in episode 3a is again larger than the output loss in episode 3b.

Table 4: The Results for the Two Different Stabilization Programs:

	Trend Inflation	Output Gap (% of GDP)			Sacrifice Ratio		
	Decline	Method 1	Method 2	Method 3	Method 1	Method 2	Method 3
Episode 3a	25.6	3.5	-2.2	-3.1	-0.14	0.09	0.12
Episode 3b	12.9	4.6	4.9	3.5	-0.35	-0.38	-0.27

5. CONCLUDING REMARKS

Having completed our analysis we have found two major problems with the sacrifice ratios calculated for Turkey:

- The first problem is the large fluctuations in the inflation data. The highest value in the series of the trend inflation is 112.9 percent, while the lowest one is 47.7 percent. The range of the data amounts to 65.2 points. When we look at episodes 2 and 3 we have seen 34.4

and 42.8 points of decline in trend inflation respectively. With this large changes in trend inflation a 2 or 3 percent loss in GDP end up with very small sacrifice ratios. In developed countries, as inflation rates are much more lower, the calculated sacrifice ratios are more reasonable and comparable with each other.

- The second problem is related with the nature of the disinflation periods. Calculation of sacrifice ratios aims to measure the costs of disinflation policies. The implementation of a disinflation policy is usually associated with a tight monetary policy, which, in turn, brings about a contraction in aggregate demand. However, we know that, shifts in aggregate supply also have significant effects on inflation. "It is likely that supply as well demand shifts occur during some episodes, and that supply shocks affect the sizes of the output losses and the changes in inflation. Thus, the sacrifice ratio for a given disinflation episode is a noisy measure of the effects of the demand contraction." (Ball 1994). For the Turkish episodes especially in episode 2, the slow down in the rate of increase of the exchange rates had a significant supply-side impact on inflation. Even in episode 3 the Russian economic crisis had some effects on aggregate supply and hence on inflation.

The small and negative sacrifice ratios found for Turkey can be explained by the problems mentioned above. We have found only two positive sacrifice ratios in the (3 x 3) matrix of 3 episodes and 3 techniques. And yet, they are too small to be compared with each other or with the ones in other countries. Analysis of output losses in disinflations showed that, in Turkey disinflations are not characterized by huge losses in output and affected significantly by positive supply shocks.

REFERENCES:

Ball, Laurence, 1994, "What Determines the Sacrifice Ratio?" in N. G. Mankiw (eds.), *Monetary Polic*y, University of Chicago, 155-193.

Ball, Laurence, 1997, "Disinflation and NAIRU," in Christina Romer and David Romer (eds.) Reducing Inflation: Motivation and Strategy, University of Chicago Press, 167-185.

Ball, Laurence and N. Gregory Mankiw, and David Romer, 1988, "The New Keynesian Economics and the Output-Inflation Trade-Off," Brookings Papers on Economic Activities, 1, 1-65.

Bernanke, Ben, Thomas Laubach, Frederic S. Mishkin, and Adam S. Posen, 1999, "Inflation Targeting, Lessons from International Experience," Princeton University Press, Princeton, New Jersey.

Blanchard, Oliver and Lawrence H. Summer, 1986, "Hysteresis and the European Unemployment Problem," NBER Macroeconomics Annua1 l. edited by Stanley Fisher, 15-78.

Jordan, Thomas J. 1997, "Disinflation Costs, Accelerating Inflation Gains, and Central Bank Independence," Welt. Archiv 133, 1-21.

Gordon, Robert J. and Stephen King, 1982, "The Output Cost of Disinflation in Traditional and Vector Autoregressive Models," Brookings Papers on Economic Activity 1,205-242.

Zhang, Lawrence Huiyan, 2001, "Sacrifice Ratios with Long-Lived Effects" The Johns Hopkins University, Department of Economics, www.jhu.edu.

Appendix 1

episode 1

	Inf.	method 1			method 2			method 3		
		actual (sa)	**potential**	**gap**	**actual (sa)**	**potential**	**gap**	**actual (sa)**	**potential**	**gap**
1992-Q1	70.0	21937.9	21497.8	440.1	21937.9	21937.9	0.0	21937.9	21937.9	0.0
1992-Q2	69.9	22092.1	21720.0	372.1	22092.1	22295.0	-202.9	22092.1	22165.1	-73.0
1992-Q3	67.2	22541.3	21943.2	598.1	22541.3	22657.8	-116.6	22541.3	22393.3	147.9
1992-Q4	64.9	22618.5	22164.7	453.8	22618.5	23026.6	-408.1	22618.5	22619.8	-1.3
potential output during the episode				87325.7			89917.3			89116.1
total gap during the episode				1864.1			-727.5			73.6
total gap as percentage of potential output				2.1			-0.8			0.1
total decline in trend inflation				5.1			5.1			5.1
sacrifice ratio				-0.42			0.16			-0.02

episode 2

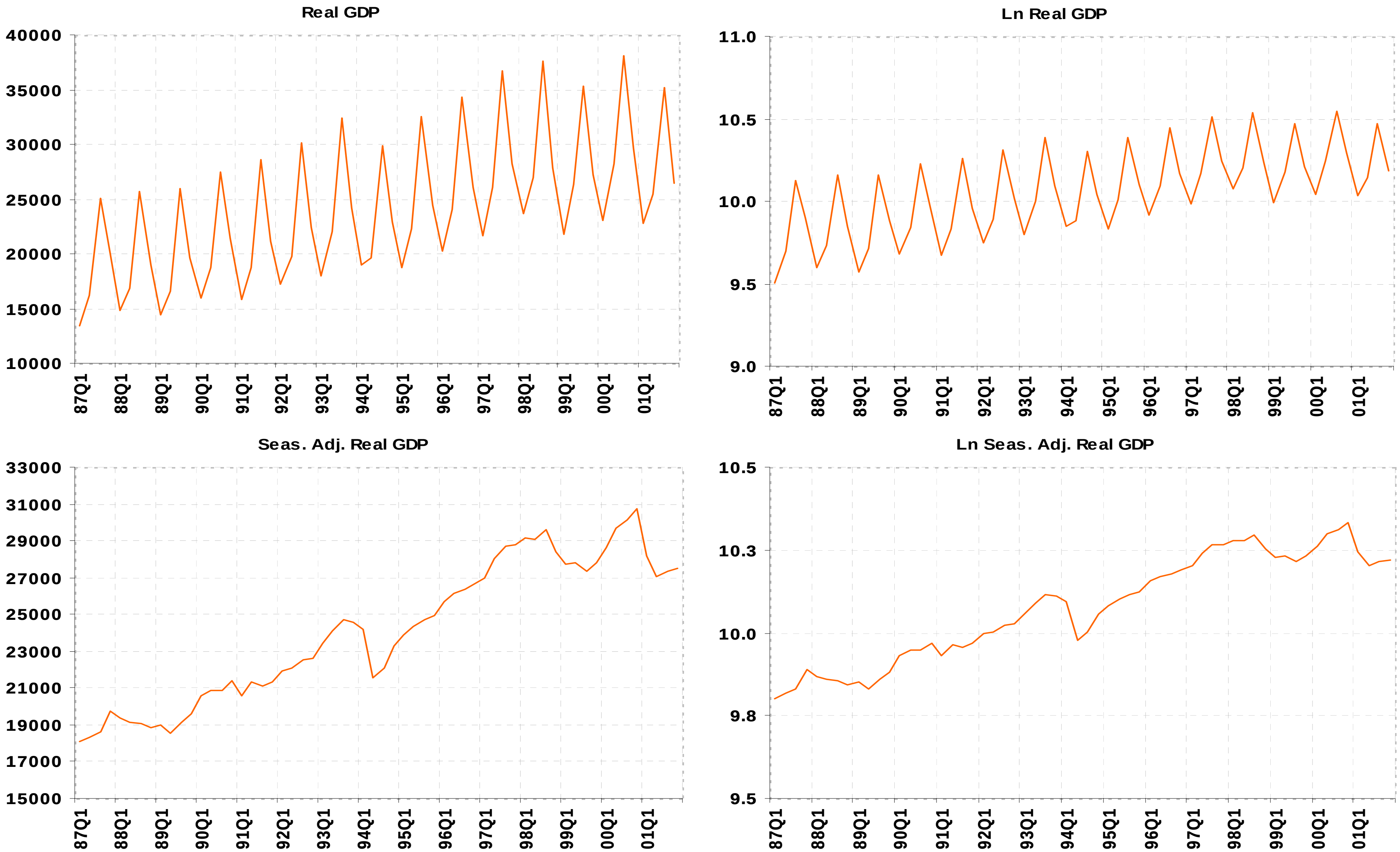
	Inf.	method 1			method 2			method 3		
		actual (sa)	**potential**	**gap**	**actual (sa)**	**potential**	**gap**	**actual (sa)**	**potential**	**gap**
1999-Q4	112.9	23308.8	23987.3	-678.4	23308.8	23308.8	0.0	23308.8	23308.8	0.0
1999-Q1	108.0	23889.0	24238.1	-349.1	23889.0	23720.9	168.0	23889.0	23551.8	337.1
1995-Q2	101.5	24354.0	24498.1	-144.1	24354.0	24140.3	213.7	24354.0	23803.8	550.2
1995-Q3	92.2	24718.7	24764.9	-46.2	24718.7	24567.2	151.5	24718.7	24062.25933	656.4
1995-Q4	83.2	24913.8	25034.1	-120.3	24913.8	25001.5	-87.8	24913.8	24323.07966	590.7
1996-Q1	82.0	25714.8	25305.7	409.1	25714.8	25443.6	271.2	25714.8	24586.20172	1128.6
1996-Q2	79.1	26145.4	25579.2	566.3	26145.4	25893.4	252.0	26145.4	24851.15755	1294.3
1996-Q3	78.7	26347.3	25850.5	496.8	26347.3	26351.2	-4.0	26347.3	25114.00088	1233.3
1996-Q4	78.5	26697.0	26114.4	582.6	26697.0	26817.1	-120.2	26697.0	25369.65968	1327.3
potential output during the episode				225372.2			225244.2			218970.8
total gap during the episode				716.5			844.5			7117.8
total gap as percentage of potential output				0.32			0.4			3.3
total decline in trend inflation				34.4			34.4			34.4
sacrifice ratio				-0.01			-0,01			-0.09

episode 3

	Inf.	method 1			method 2			method 3		
		actual (sa)	potential	gap	actual (sa)	potential	gap	actual (sa)	potential	gap
1998-Q1	90.5	29123.8	27265.3	1858.5	29123.8	29123.8	0.0	29123.8	29123.8	0.0
1998-Q2	86.5	29100.6	27448.7	1651.8	29100.6	29010.3	90.3	29100.6	29321.0	-220.4
1998-Q3	79.0	29627.2	27615.7	2011.4	29627.2	28897.2	730.0	29627.2	29500.5	126.6
1998-Q4	72.5	28426.6	27765.0	661.5	28426.6	28784.5	-357.9	28426.6	29661.1	-1234.5
1999-Q1	67.6	27710.3	27900.9	-190.6	27710.3	28672.3	-962.0	27710.3	29807.1	-2096.8
1999-Q2	64.9	27783.6	28027.6	-244.0	27783.6	28560.5	-776.9	27783.6	29943.4	-2159.7
1999-Q3	64.5	27318.8	28145.2	-826.4	27318.8	28449.2	-1130.4	27318.8	30069.8	-2751.1
1999-Q4	63.7	27839.2	28252.8	-413.5	27839.2	28338.3	-499.1	27839.2	30185.5	-2346.3
2000-Q1	60.6	28646.1	28353.2	292.9	28646.1	28227.8	418.3	28646.1	30293.5	-1647.4
2000-Q2	55.8	29667.7	28449.0	1218.7	29667.7	28117.8	1549.9	29667.7	30396.5	-728.9
2000-Q3	49.9	30118.9	28538.8	1580.0	30118.9	28008.2	2110.7	30118.9	30493.1	-374.2
2000-Q4	47.7	30722.7	28621.2	2101.5	30722.7	27899.0	2823.7	30722.7	30581.6	141.0

	method 1	method 2	method 3
potential output during the episode	336383.5	342088.8	359377.1
total gap during the episode	9701.9	3996.6	-13291.7
total gap as percentage of potential output	2.9	1.2	-3.7
total decline in trend inflation	42.8	42.8	42.8
sacrifice ratio	-0.07	-0.03	0.09

Figure 1



Real GDP
40000
35000
30000
25000
20000
15000
10000
87Q1
88Q1
89Q1
90Q1
91Q1
92Q1
93Q1
94Q1
95Q1
96Q1
97Q1
98Q1
99Q1
00Q1
01Q1
Ln Real GDP
11.0
10.5
10.0
9.5
9.0
Seas. Adj. Real GDP
33000
31000
29000
27000
25000
23000
21000
19000
17000
15000
Ln Seas. Adj. Real GDP
10.5
10.3
10.0
9.8
9.5

Figure 2

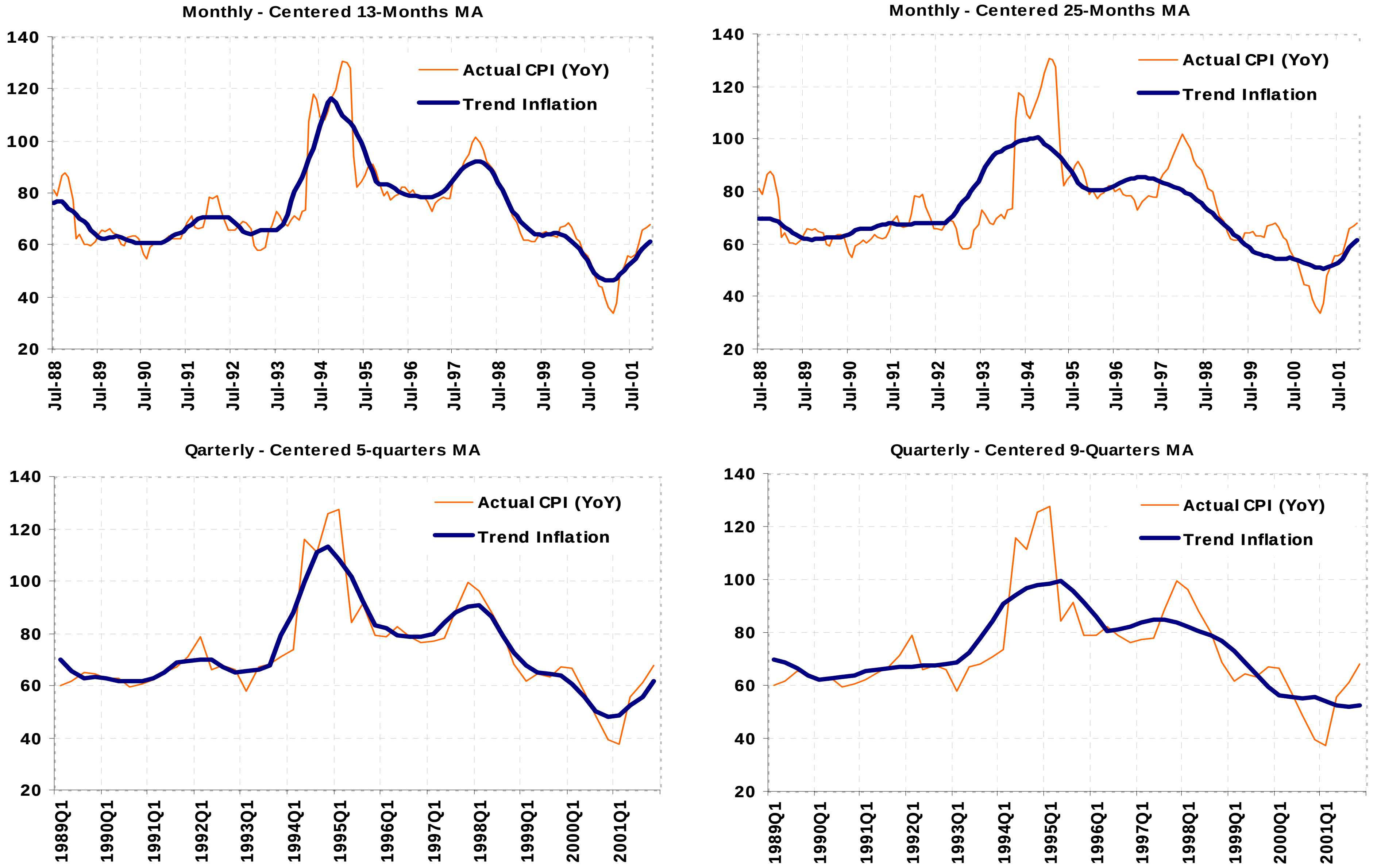

Monthly - Centered 13-Months MA
Actual CPI (YoY)
Trend Inflation
140
120
100
80
60
40
20
Jul-88
Jul-89
Jul-90
Jul-91
Jul-92
Jul-93
Jul-94
Jul-95
Jul-96
Jul-97
Jul-98
Jul-99
Jul-00
Jul-01
Monthly - Centered 25-Months MA
Actual CPI (YoY)
Trend Inflation
Qarterly - Centered 5-quarters MA
Actual CPI (YoY)
Trend Inflation
1989Q1
1990Q1
1991Q1
1992Q1
1993Q1
1994Q1
1995Q1
1996Q1
1997Q1
1998Q1
1999Q1
2000Q1
2001Q1
Quarterly - Centered 9-Quarters MA
Actual CPI (YoY)
Trend Inflation

Figure 3

Trend Inflation and Disinflation Episodes

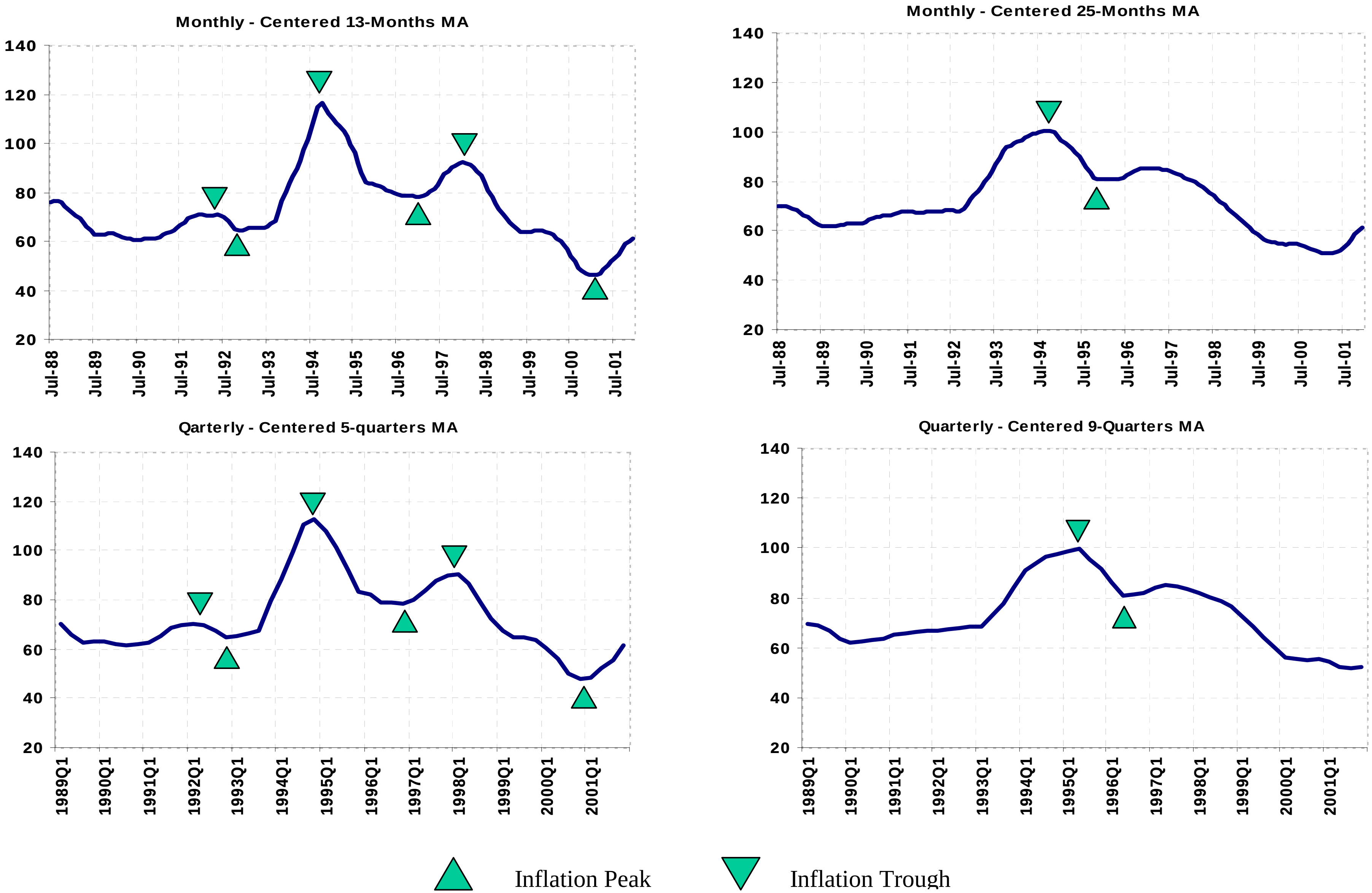


Figure4

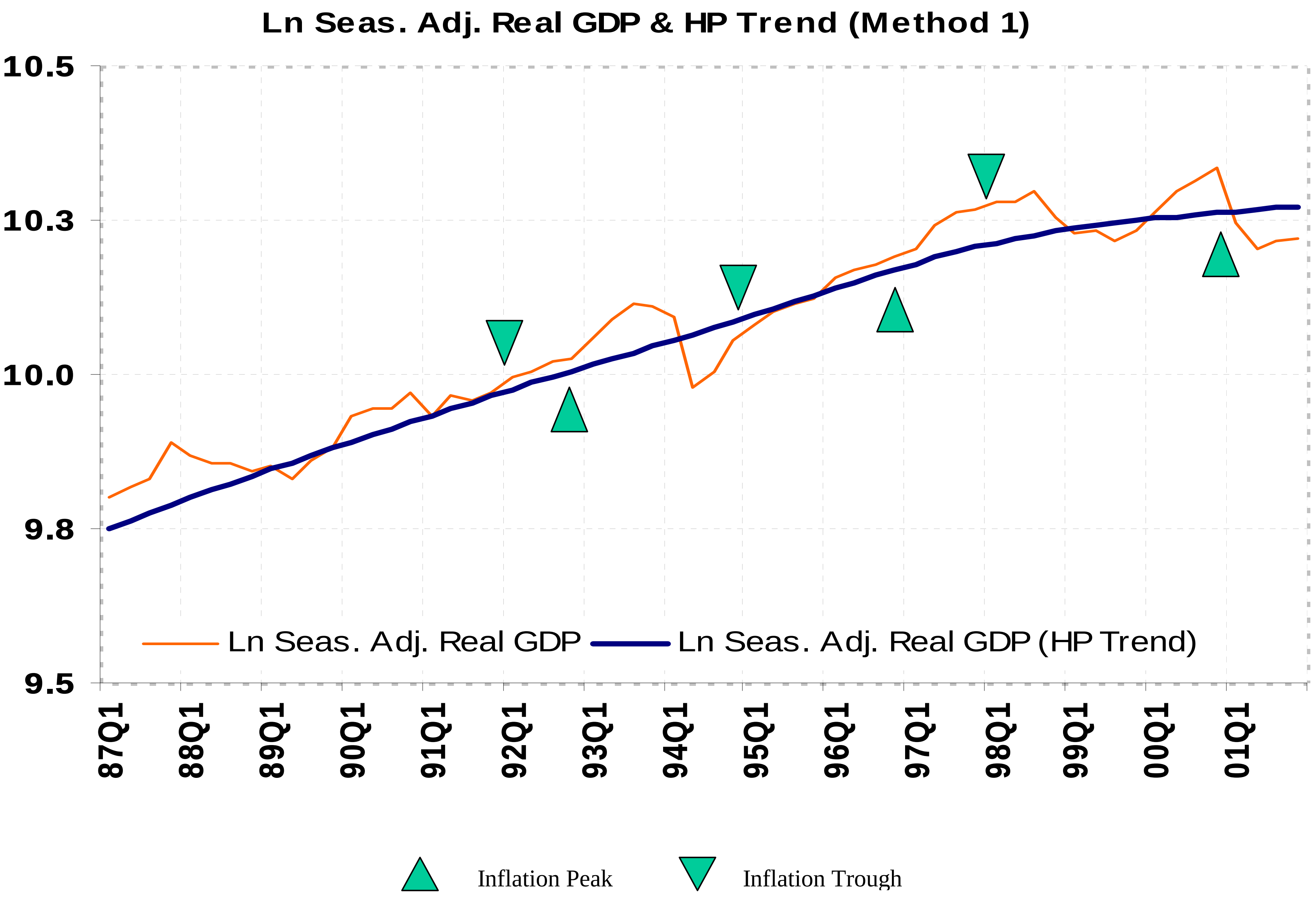

Ln Seas. Adj. Real GDP & HP Trend (Method 1)
10.5
10.3
10.0
9.8
9.5
Ln Seas. Adj. Real GDP
Ln Seas. Adj. Real GDP (HP Trend)
87Q1
88Q1
89Q1
90Q1
91Q1
92Q1
93Q1
94Q1
95Q1
96Q1
97Q1
98Q1
99Q1
00Q1
01Q1
Inflation Peak
Inflation Trough

Figure 5

Ln Seas. Adj. Real GDP & Potential Output (Method 2)

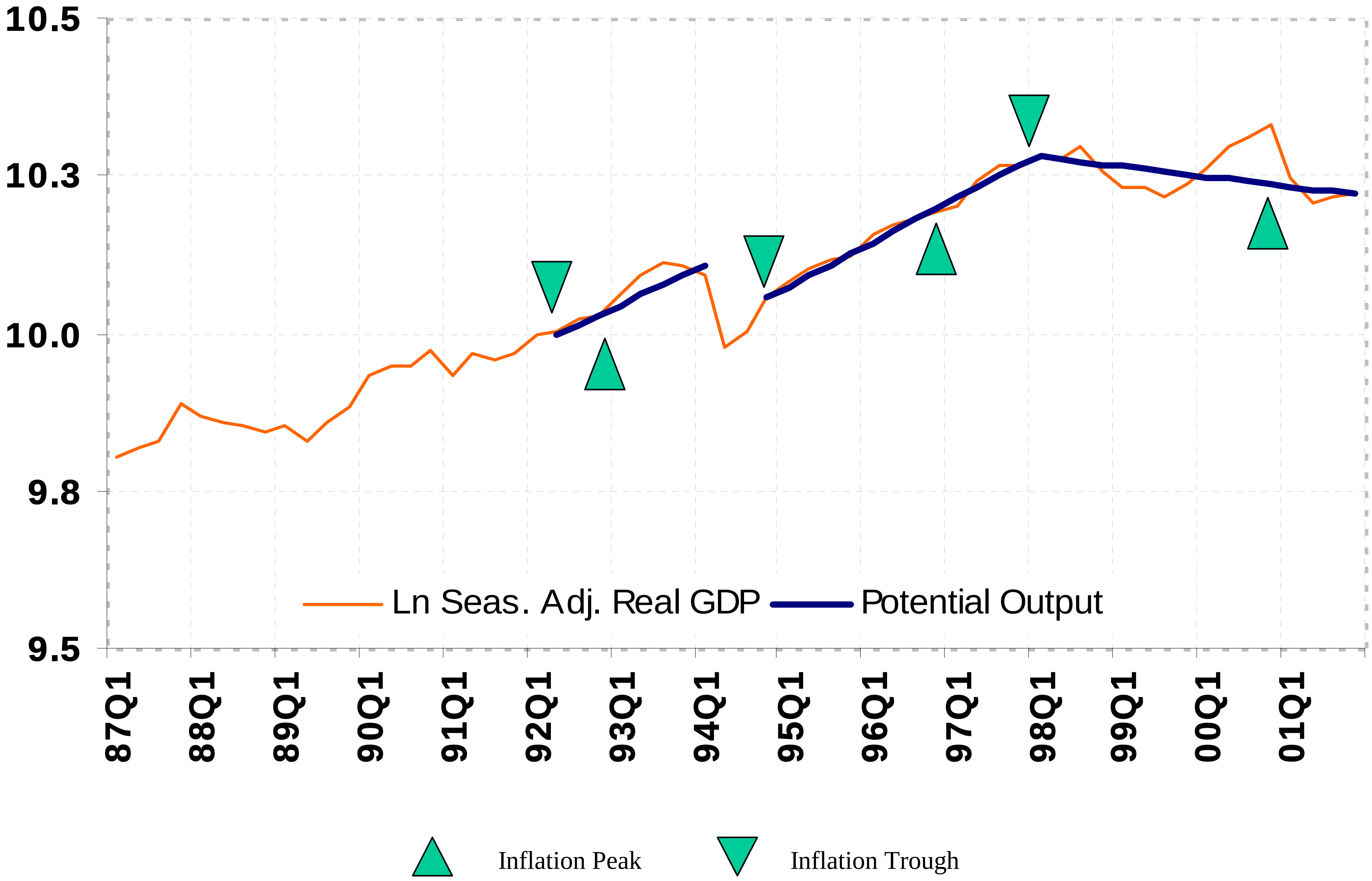
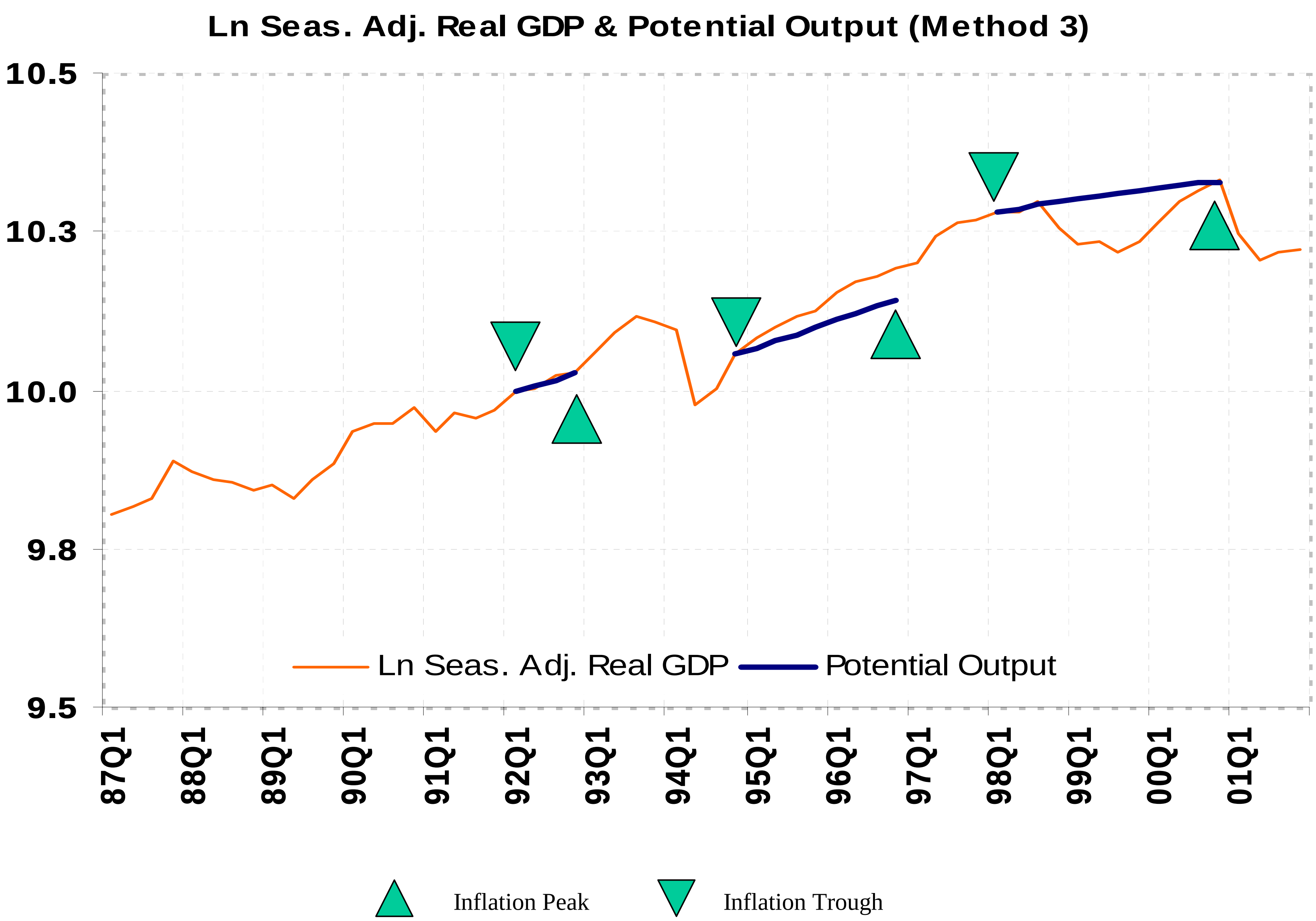


Figure 6


Ln Seas. Adj. Real GDP & Potential Output (Method 3)
10.5
10.3
10.0
9.8
9.5
87Q1
88Q1
89Q1
90Q1
91Q1
92Q1
93Q1
94Q1
95Q1
96Q1
97Q1
98Q1
99Q1
00Q1
01Q1
Ln Seas. Adj. Real GDP
Potential Output
Inflation Peak
Inflation Trough