Do Inflation Targeting Regimes Reduce Inflation Uncertainty? Evidence From Five Industrialized Countries

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Abstract

Using a time-varying parameter model with GARCH specification, we investigate whether there is a structural break in expected inflation and two types of inflation uncertainties for five industrialized countries after the implementation of inflation targeting. Both non-parametric and parametric test results indicate that the inflation targeting regimes are particularly successful in reducing expected inflation while there is less evidence that implementation of inflation targeting reduces inflation uncertainty significantly.

Keywords: Inflation Targeting, Expected Inflation, Inflation Uncertainty, Time Varying Parameter Models

JEL Codes: C32, E52, E58

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1 Introduction

Reduced confidence in activist policies coupled with the empirical findings that low inflation promotes long-run economic growth gave way to redesigning monetary policies. As a result, price stability has emerged as the overriding goal of central banks. In this context, introducing commitment technologies and enhancing credibility are thought to minimize the loss in terms of output and employment to achieve price stability.

At the beginning of 1990's, motivated by the above-mentioned factors, some industrialized countries, pioneered by New Zealand, have adopted "inflation targeting" regimes. These regimes can be characterized by "increased communication" and "credibility by rules", which are the two factors that are thought to reduce any uncertainty and affect inflation expectations positively. However, it should be noted that Inflation Targeting also allows for stabilizing negative supply shocks as long as long run price stability objective is not distorted. Therefore, as stated in Bernanke et al (1999), the regime can also be named as "constrained discretion" in which output stability has been accounted for without creating a time-inconsistency problem for the monetary authority.

Although inflation targeting regimes are viewed to be successful, there are also some critical studies, which state that achieving price stability is independent of inflation targeting. For example, Cecchetti and Ehrman (1999) argue that over the last decade, aversion to inflation variability increased in all major economies irrespective of whether they are operating under inflation targeting or not. They argue that the main reason for this aversion is the significant costs induced by distorting allocation decisions of individuals and firms. Also, Bernanke et al (1999) discuss that inflation targeting is not new and add that Germany and Switzerland have already employed a kind of hybrid inflation targeting for a long period of time. Moreover, it is often reported that the United

States economy has a monetary framework that is very close to the spirit of inflation targeting. Finally, employing survey results, Johnson (2002) states that although there is a decrease in the level of expected inflation after the implementation of inflation targeting, there is not a change in inflation variability. He also finds that 'inflation targeting' countries do not significantly differ -in terms of inflation performance- from other economies which have not adopted such regimes.

In this study, we take the above discussion as our starting point and test whether there has been a structural break in expected inflation and inflation uncertainty after the implementation of inflation targeting. Our sample consists of five industrialized countries, Australia, Canada, New Zealand, Sweden and United Kingdom, which have adopted inflation targeting regimes for sufficiently long periods of time. First, we employ a time-varying parameter framework with GARCH specification, which allows us to derive two distinct types of inflation uncertainties, -structural uncertainty and impulse uncertainty- along with expected inflation. While the former can be thought as uncertainty that arises from changes in the model, the latter can be viewed as uncertainty from unforeseen shocks to inflation. Therefore, instead of employing the survey-based inflation forecasts and expectations, we derive both the expected inflation and the uncertainty series from a dynamic time-series model. Finally, we use non-parametric and parametric tests to detect any possible structural break in these three derived series.

The advantages of such an approach are twofold. First, we derive both expectations and measures of uncertainty directly from the data. Therefore, the problems that may be faced in survey-based studies, which is stated in Bomberger (1996), will not be encountered here. Second, even if the survey results are accurate, our methodology will provide further empirical findings by employing a different approach, which will enable us to have more inference about the success of inflation targeting on inflation dynamics.

Our non-parametric test results show that the mean and the variance of expected inflation are significantly lower after the implementation of inflation targeting. The results also imply that both types of uncertainties sharply decrease for New Zealand, Sweden and the United Kingdom.

Finally, the results gathered from structural break test proposed by Banerjee et al (1992) provide further empirical support for a decrease in expected inflation. Especially, a structural break for the mean of expected inflation is detected for all of the countries around the time of official announcement of the regime. However, the results are less promising for the inflation uncertainty series after the implementation of the regime.

As a result, our findings support the views put forth by Johnson (2002), which state that while inflation targeting is successful in changing inflation expectations, it is less successful in reducing inflation uncertainty.

The next section briefly discusses the relationship between inflation targeting regimes, expected inflation and inflation uncertainty. Then, we will introduce our baseline model in which expected inflation and inflation uncertainties are derived. In the fourth section, after the results are displayed, the structural break tests are applied along with an interpretation. The final section concludes.

2 Inflation Targeting and Uncertainty

Within the last decade, a dense amount of studies in central banking have been devoted to the search for a nominal anchor. In this context, 'inflation targeting' has emerged as the appropriate framework, in which 'increased communication' and 'accountability', the two main characteristics of the regime, are viewed to eliminate any type of uncertainties about price stability. However, as mentioned above, Johnson (2002)'s findings cast some doubt about the positive impact of inflation targeting framework on inflation variability[1]. Also, several studies, including Bernanke et al (1999) and Groenveld (1998) show that the implementation of inflation targeting does not exhibit any change in actual inflation process.

Another critical issue that is often discussed in the literature is the flexibility of the inflation targeting regime and its impact on macroeconomic uncertainty. While some studies such as Clarida et al (1999) argue that monetary authorities should accommodate supply shocks as long as the long-run price stability objective has not been distorted, Dittmar et al (1999) prefer a 'strict inflation targeting' policy and state that setting multiple objectives increase uncertainty about inflation and future price levels. They conclude that if inflation-targeting regimes achieve price stability and reduce uncertainty, this success will be due to less weight attached to output stability. Gavin (2003), on the other hand, argues that the reason behind the success of inflation targeting is the extra information that central banks provide to concentrate expectations on a common trend. Such information will reduce uncertainty about long run inflation, eliminate any confusion about the stance of monetary policy and decrease the likelihood of any forms of instability.

The above discussion also implies a policy proposal for other countries that have not followed explicit inflation targeting. For example, Gurkaynak et al (2003) discuss that the United States economy could benefit more if the Federal Reserve becomes more explicit about long-run inflation objectives since United States interest rates react excessively to macro data releases and news about monetary policy.

[1] See Bernanke and Woodford (2003) for a recent detailed discussion on inflation targeting.

3 Measuring Inflation Uncertainty

There are two commonly used procedures to measure inflation uncertainty in the literature. The first one is the survey-based approach as employed by Hafer (1986) and Davis and Kanogo (1996). Recently, close to these two studies, Johnson (2002) used two measures derived from the surveys, which are standard deviation of expected inflation and average absolute size of inflation forecast errors. However, as Bomberger (1996) noted, using the dispersion of the survey forecast does not fully provide a measure of uncertainty, rather it provides a measure of disagreement. Also, it may be the case that forecasters may try to avoid deviating from others' forecasts, which may cause a bias.

The second approach is to employ a class of Autoregressive Conditional Heteroscedasticity (ARCH) models, as in Grier and Perry (1998) and Kontonikas (2002). Such a methodology adequately captures inflation uncertainty by using the conditional variance of the residuals of inflation specification. However, such models fail to account for the structural changes in the inflation process, which also provides another major source of uncertainty. A time-varying parameter framework, which relaxes the assumption that the regressors have the same impact on the inflation process during the sample period, seems to fit this purpose. In this context, the randomness in the time-varying estimates reflects the uncertainty inherent in the structure of the inflation process. Also, if there is a change in the expectations due to the course of the monetary policy (which is to be expected at the beginning stage of an inflation targeting regime), it will again be observed in the time-varying parameter estimates. As a result, time-varying parameter models and the Kalman Filter, which emerges as the estimation method, are capable of measuring inflation uncertainty by estimating the time-varying conditional variance of a variable's parameter estimates.

3.1 The Model

In this study, we combine two of the above-mentioned methodologies and follow a time-varying parameter model with GARCH specification. Such a methodology was first introduced by Evans (1991). By employing such a model, we do not only improve over standard ARCH models, but we also derive two distinct types of inflation uncertainties: one emerging from the conditional variance of the residuals of inflation specification and the other representing the randomness of the structure of the inflation process. Formally, the model can be written as:

$$\pi_{t+1} = X_t \beta_{t+1} + \varepsilon_{t+1}, \text{ where } \varepsilon_{t+1} \sim N(0, h_t) \tag{1}$$

$$\beta_{t+1} = \beta_t + v_{t+1}, \text{ where } v_{t+1} \sim N(0, Q) \tag{2}$$

$$h_t = h + \sum_{i=0}^{m} \phi_i \varepsilon_{t-i}^2 + \sum_{i=1}^{n} \gamma_i h_{t-i} \tag{3}$$

In the model above, π_t denotes the inflation rate and X_t is the regressor matrix, which consists of the constant term, the lagged variables of the inflation rate and a dummy variable which takes the value of one after the country has adopted inflation targeting regime.

In the first equation, ε_t is normally distributed with a time varying conditional variance of h_t, which indicates the changes in uncertainty about the future inflation at time t. The third equation presents the conditional variance of the inflation residuals and implies that if past forecasts deviate substantially from the real rate, uncertainty will increase.

The second equation, on the other hand, represents the evolution of time varying parameters, which are asssumed to follow a random walk. As explained in Evans (1991), such an assumption can be defended on theoretical grounds: If the structural variations in the economy are due to changing views about the structure of the economy, then it would be almost impossible to predict any future changes in policy and movements in time-varying betas, which would justify the choice of a random walk assumption. Also in the second equation, v_{t+1} is the vector of shocks to β_{t+1}, and it is normally distributed with a homoscedastic covariance matrix of Q.

After presenting the inflation equation, the next step is to include the Kalman Filter updating equations. In such a setting, Kalman Filter enters into process for two reasons. First, in a time-varying parameter framework, Kalman Filter emerges as the estimation methodology, where time varying parameters are treated as unobserved components. Second, and more importantly, the updating equations regarding Kalman Filter enable us to decompose different types of inflation uncertainties. The updating equations are:

$$\begin{aligned}
\pi_{t+1} &= X_t E_t \beta_{t+1} + \eta_{t+1} && (4) \\
H_t &= X_t \Omega_{t+1|t} X_t^T + h_t && (5) \\
E_{t+1}\beta_{t+2} &= E_t \beta_{t+1} + \left[\Omega_{t+1|t} X_t^T H_t^{-1} \right] \eta_{t+1} && (6) \\
\Omega_{t+2|t+1} &= \left[I - \Omega_{t+1|t} X_t^T H_t^{-1} X_t \right] \Omega_{t+1|t} + Q && (7)
\end{aligned}$$

The conditional covariance matrix of β_{t+1}, which represents the structural uncertainty of the inflation process, is denoted by $\Omega_{t+1|t}$. Recalling that X_t denotes the regressor matrix, the term H_t in equation (5) represents the conditional variance of inflation, which consists of both h_t and the conditional variance of $X_t\beta_{t+1}$, which is $X_t \Omega_{t+1|t} X_t^T$. Then, equation (5) shows that two types of uncertainties, -which originate from shocks to inflation process (ε_{t+1}) and from the shocks to the structure of inflation (v_{t+1})$-$ can be decomposed and estimated. On the other hand, the sixth equation shows how the estimates of time-varying betas are updated with respect to the past forecast errors. Finally, both equations (6) and (7) show how the new information about the inflation process is reflected in the conditional distribution of β_{t+1}. Therefore, in such a setting, while analyzing inflation dynamics, both past forecast errors and new information regarding the inflation process is accounted for.

The above discussion implies that it is possible to derive two different types of inflation uncertainties. First, ε can be thought as shocks that hit the economy. Then, the time-varying parameters will show how these shocks are propogated through the economy. Such a terminology is consistent with Frisch and Slutsky's distinction between impulses and propagation[2]. Then, the uncertainty stemming from the randomness in β gives a measure of *structural uncertainty*, which is measured by $X_t \Omega_{t+1|t} X_t^T$. It can also be thought as the uncertainty due to changes in the structure of the model. On the other hand, the uncertainty that originates from the randomness in ε can be named as *impulse uncertainty*, which is measured by h_t[3]. Such an uncertainty can be viewed to arise from shocks or unexpected developments in the inflation process. Such a distinction may also have important policy implications from the view of monetary policy. If the impulse uncertainty stems from the shocks that are viewed as mostly temporary, then the Central Banks might not have strong incentives to change the course of monetary policy. However, if these shocks are propagated through the economy through time-varying elements, which causes an uncertainty in the structure of inflation process, then long-run price stability objectives may be distorted and Central Banks may have good reasons to account for this factor in the policymaking process.

3.2 Justification of the Model

As noted above, we assume an autoregressive process for the inflation equation along with a constant term and dummy variable representing the period under inflation targeting. For each country, the length of the lags are chosen with respect to both Akaike and Schwarz Information Criteria.

[2] See Blanchard and Fischer (1989), page 277.

[3] We are grateful to Peter N. Ireland for his suggestions on this issue.

On the other hand, ARCH-LM tests are employed to test the presence of an ARCH effect. It is found that an ARCH specification is appropriate for all the countries examined. After various specifications, GARCH (1,1) is selected as the process to assess the conditional variance.

3.2.1 Data

The sample consists of five industrialized countries, Australia, Canada, New Zealand, Sweden and United Kingdom, which have adopted inflation targeting early in the 1990's. These countries are known to be among the earliest inflation targeters. Table 1 shows the adoption dates of inflation targeting, the frequency of the data and the full sample period used in this study.

Table 1: Data Sample

Country	**Date Adopted**	**Sample Period**
Australia	April 1993	1980-2003, Quarterly
Canada	February 1991	1980-2003, Monthly
New Zealand	March 1990	1980-2003, Quarterly
Sweden	January 1993	1980-2003, Monthly
United Kingdom	October 1992	1980-2003, Monthly

For all of the cases, seasonally adjusted CPI inflation has been used. Augmented Dickey-Fuller test shows that inflation rate is stationary in all of the cases examined. Although most of the countries in the sample announce CPI inflation as the target variable, such a choice can also be criticized since CPI is sensitive to energy prices and seasonal factors such as food prices. However, the main goal of this study is to examine whether the expected inflation and inflation uncertainty have reduced after the implementation of inflation targeting. Since CPI is the most commonly observed price index, which is closely associated with the expectations about inflation in the economy, we believe that using CPI inflation does not cause a flaw in the analysis.

4 Results and Structural Break Tests

In this section after the regression results are presented for each country, the expected inflation series are displayed along with actual inflation. Next, a simple non-parametric test is employed to detect whether the differences in expected inflation and the two types of inflation uncertainty are statistically significant after these countries have adopted inflation targeting. Finally, by using the structural break test proposed by Banerjee et al (1992), we test whether the shift to the inflation targeting regime has caused either a shift in trend or a break in mean for inflation uncertainties and expected inflation.

4.1 Regression Results

Table 2 presents the t-statistics for the dummy variable in the regressor matrix that denotes the inflation targeting period. Also, the lag length of inflation series in the regressor matrix where SIC and AIC take the minimum values are reported.

Table 2: Regression Results

Country	$t - Stat$ **(Dummy for I.T.)**	**Lag Length**
Australia	4.73	3
Canada	29.43	5
New Zealand	7.53	3
Sweden	19.64	1
United Kingdom	33.5	1

As it can be seen in Table 2, the t-statistics regarding the dummy variable that represents the inflation targeting period is very high. Such a result implies that implementing inflation targeting has been an important factor in explaining the inflation dynamics for all of the countries. For robustness purposes, the ERM period is dropped out of the sample but the results did not change significantly.

The graphs for expected inflation and the two types of inflation uncertainties are displayed in Figures 1-5, at the end of the text. The vertical lines represent the official announcement of the inflation targeting regimes for each country. One common feature of the figures is that although impulse uncertainty takes on slightly lower values, the two types of uncertainties tend to comove together. Also, the figures imply that the expected inflation and the actual inflation do not diverge significantly from each other for most of the periods. It would also be useful to discuss some of the spikes in the graphs for each country, especially after the announcement of the inflation targeting regime. For Australia, the increase in both expected inflation and uncertainty series in the second half of 2000 is due to the introduction of the goods and services tax. Similarly for Canada, a new goods and services tax to take effect at the beginning of 1991 could be a factor for some of the increase in both expected inflation and uncertainty in 1991. Also in New Zealand, the sharp increase at the end of 1986 can be attributed to the introduction of goods and services tax for that period. Interestingly, the VAT increases in Sweden in the first quarters of 1990 and 1991 seem to generate a similar increase. Finally, for the United Kingdom, it can be observed that the effects of the tight monetary policy conducted between 1980 and 1983 resulted both in a lower expected inflation path and uncertainty level. The sharp increase near the end of 1990 can be explained either by the peak that inflation had in September 1990 or by the membership to ERM on October 8, 1990. It can easily be seen that after the ERM period and the official announcement of inflation targeting, both expected inflation and the two types of inflation uncertainties were lowered significantly.

4.2 Non-Parametric Tests

In this section, a simple non-parametric test will be applied to detect whether the changes in the mean and the variance of expected inflation along with two types of inflation uncertainty are statistically significant. The expected inflation is derived from equation (4). Structural uncertainty is estimated as $X_t \Omega_{t+1|t} X_t^T$

in equation (2) and impulse uncertainty is the variance of the disturbance term, h_t. Under the null hypothesis, there is no difference in mean or variance between two sub-periods. Table 3 through 6 present the test results regarding the three variables.

Table 3: Non-Parametric Test Results For The Mean Of Expected Inflation

Country	Pre-I.T. Mean	Post-I.T. Mean	Test Statistic
Australia	1.91	0.63	11.15 (Reject)
Canada	0.52	0.14	16.26 (Reject)
New Zealand	3.18	0.63	6.09 (Reject)
Sweden	0.65	0.21	15.33 (Reject)
United Kingdom	0.65	0.18	14.98 (Reject)

Table 4: Non-Parametric Test Results For The Variance Of Expected Inflation

Country	Pre-I.T. Variance	Post-I.T. Variance	Test Statistic
Australia	0.37	0.16	2.27 (Reject)
Canada	0.05	0.01	4.07 (Reject)
New Zealand	8.35	0.15	54.57 (Reject)
Sweden	**0.02**	**0.09**	**3.70 (Reject)**
United Kingdom	0.11	0.01	10.22 (Reject)

Table 5: Non-Parametric Test Results For The Mean Of Structural Uncertainty

Country	Pre-I.T. Mean	Post-I.T. Mean	Test Statistic
Australia	0.41	0.39	0.48 (Cannot Reject)
Canada	**0.06**	**0.08**	**-1.75 (Cannot Reject)**
New Zealand	1.99	0.33	5.44 (Reject)
Sweden	0.19	0.17	2.38 (Reject)
United Kingdom	0.18	0.15	3.96 (Reject)

Table 6: Non-Parametric Test Results For The Mean Of Impulse Uncertainty

Country	Pre-I.T. Mean	Post-I.T. Mean	Test Statistic
Australia	0.33	0.30	0.98 (Cannot Reject)
Canada	**0.044**	**0.052**	**-1.96 (Cannot Reject)**
New Zealand	0.13	0.12	3.17 (Reject)
Sweden	0.17	0.15	4.85 (Reject)
United Kingdom	0.16	0.12	5.67 (Reject)

Table 3 clearly shows that the average expected inflation is significantly lower after the implementation of inflation targeting for all of the countries. We find similar results in Table 4 when we consider the test results for the variance of expected inflation except Sweden, where, actually, the variance increased sharply. Also, the case of New Zealand is interesting. While New Zealand has the smallest (though significant) t-statistics when the mean of the expected inflation is considered, it has by far the largest value when the variance of the expected inflation is taken. Therefore, it can be stated that inflation targeting regime in New Zealand is effective mostly on reducing the variability of inflation expectations, while the opposite can be claimed for the Swedish case.

Table 5 and 6 displays the results regarding the two derived inflation uncertainty series, which are very similar. While we observe that both structural uncertainty and impulse uncertainty decrease significantly for New Zealand, Sweden and the United Kingdom, we fail to find a statistically significant difference for Australia and Canada. In fact, the uncertainty series seem to increase slightly (though not statistically significant) for Canada after the adoption of inflation targeting.

Consequently, the non-parametric results reveal that while inflation targeting regimes are promising in reducing expected inflation and its variability (if we exclude the case of Sweden), the evidence is weaker when inflation uncertainty measures are considered. The next step is to test whether the change in the expected inflation and the uncertainty measures are strong enough such that these series exhibit structural break after the implementation of inflation targeting.

4.3 Structural Break Tests

To test whether there has been a shift in mean or a shift in the trend for expected inflation and the two types of inflation uncertainties, the methodology proposed in Banerjee et al (1992) is employed. There are two major advantages of the test in our case. First, the break date is unknown a priori, and, therefore, the date for the adoption of inflation target need not be imposed. Second, the test searches for two types of breaks: "shift in trend" and "shift in mean". *Shift in trend test* provides information about whether there has been a change in the slope of the trend. *Shift in mean,* on the other hand, provides information about a jump or a break in the trend.

Finally, the test assumes that the series are constructed from a vector of regressors. Since the two types of inflation uncertainties and the expected inflation are derived from such a process, the above-mentioned test can be employed without any reservation.

The only disadvantage of the test is that it is designed for single break points. One obvious method to eliminate this disadvantage is to focus on the range where you suspect that a structural break is present. This is the methodology that will be followed here: we will search for a structural break in a range of 10 years, which take the beginning of inflation targeting period as its mid-point.

The structural break test results for a *shift in trend* can be seen in Table 7. It can be seen that there is no evidence of a trend break when two types of inflation uncertainties are considered. This is not surprising for Australia and Canada since the non-parametric test results for these two countries also failed to find statistically significant differences in two sub-periods for both structural uncertainty and impulse uncertainty. However, Table 7 further indicates that inflation targeting does not lead to a change in the *slope* of the trend for two types of inflation uncertainties when other countries are also considered. On the other hand, the results are more promising in terms of expected inflation: we detect a shift in the trend for Australia and Sweden right after the implementation of inflation targeting. Especially for Sweden, the shift in trend takes place on February 1993, only one month after the official announcement of inflation targeting.

Table 8 presents the results for a *shift in mean*, which detects a jump or a break in the trend. It is expected that the results in Table 8 should not contradict with the results gathered in the non-parametric test since both types of tests investigate whether the differences in the average expected inflation and the uncertainty measures are statistically significant. Similar to the findings of Table 7, we do not observe a shift in mean when structural uncertainty is considered. For impulse uncertainty, on the other hand, the shift in mean takes place for New Zealand, Sweden and Australia. However, only for New Zealand, the break occurs after the implementation of the inflation targeting. For Sweden and Australia, the break takes place approximately three years before the official announcement. Therefore, combining the findings of both parametric and non-parametric tests, there is only weak evidence that inflation targeting significantly reduces any uncertainty regarding the inflation process.

Finally, and more importantly, the first column of Table 8 displays the shift in mean results for expected inflation. The results are strictly in favor of inflation targeting regimes and they are consistent with the non-parametric results of Table 3. We find that there is a structural break according to shift-in-mean test results for all of the countries. Moreover, the break occurs right after these countries officially announce inflation targeting[4].

Consequently, the findings in this paper imply that inflation targeting regimes are particularly successful in reducing average expected inflation. However, there is less evidence about the positive impact of inflation targeting in reducing the uncertainties regarding the inflation process.

At that point, two studies, which provide further support for the results in this paper should be mentioned. To test for the degree of inflation persis-

[4]Especially for United Kingdom and New Zealand, the breaks occur at October 1992 and the first quarter of 1990, respectively. These dates also represent the official announcement of inflation targeting.

tence, Levin and Piger (2003) analyze whether there is a structural break in the inflation process for industrial countries. Interestingly, while they find a shift in mean in the inflation dynamics for inflation targeting countries, they fail to find a structural break in the trend, which is totally consistent with the findings of this paper. More importantly, using quarterly data, the break dates that they find for the five countries are 1991:1 for Australia, 1991:3 for Canada, 1989:4 for New Zealand, 1993:2 for Sweden and finally 1991:1 for United Kingdom. These break dates are almost identical with the break dates in this paper when Canada, New Zealand and Sweden are considered, while they are slightly different for Australia and UK[5]. In another study, Neumann and von Hagen (2002) analyze whether inflation targeting has brought credibility to countries which implemented the regime. Investigating the policy reaction functions of the Central Banks to inflation shocks and large supply shocks, they find that pre-inflation targeting and post-inflation targeting periods exhibit significant differences. Their findings imply that inflation targeting is particularly successful in reducing inflation and enables Central Banks to achieve a higher degree of credibility. Overall, it can be stated that the findings in our paper find robust empirical support from the other studies that focused on the inflation dynamics after the implementation of inflation targeting.

Table 7: Shift in Trend Test Results

Country	Expected Inflation	Structural Unc.	Impulse Unc.
Australia	1994:Q1	None	None
Canada	None	None	None
New Zealand	None	None	None
Sweden	1993:M2	None	None
United Kingdom	None	None	None

[5] Actually, if GDP price deflator is taken as the appropriate price index from Levin and Piger (2003), the break dates for UK coincide.

Table 8: Shift in Mean Test Results

Country	Expected Inflation	Structural Unc.	Impulse Unc.
Australia	1995:Q1	None	1990:Q3
Canada	1991:M8	None	None
New Zealand	1990:Q1	None	1992:Q2
Sweden	1993:M5	None	1990:M1
United Kingdom	1992:M10	None	None

5 Conclusion

In the beginning of 1990's, motivated by the search for a nominal anchor, several industrialized countries adopted inflation targeting regimes to achieve price stability. Incerased communication and accountability, the two main characteristics of these regimes, are thought to eliminate any uncertainty regarding the inflation process as well as to reduce expected inflation. Although the inflation performance of these countries improved, some recent studies criticized the seemingly success of inflation targeting. Recently, in a panel data framework, Johnson (2002) employed survey results and showed that there has been an improvement in average expected inflation. However, his results also indicate that inflation variability that is derived from surveys have not improved significantly.

In this study, instead of using the survey-based results, we derive both expected inflation and two types of inflation uncertainty -structural and impulse uncertainty- from a time-varying parameter model with GARCH specification. The sample consists of five industrialized countries, which have adopted inflation targeting at the beginning of 1990's. Our methodology, which is previously employed in Evans (1991), allows us to decompose two types of uncertainties, which provides an extra source of information about the inflation process.

The results gathered from non-parametric tests show that the average expected inflation significantly decreases after the announcement of inflation targeting. Except Canada, it is also found that there is an improvement in the variance of expected inflation. The findings about inflation uncertainty series are less clear, however. While it is found that the two types of uncertainty series significantly decrease for New Zealand, Sweden and United Kingdom, we do not find the same evidence for Australia and Canada.

Next, the structural break test proposed by Banerjee et al (1992) is applied to these three derived series. The test searches for both a *shift in the trend* and a *break in the mean*. While we fail to find any *shift in trend* for the inflation uncertainty series, we detect a *shift* for expected inflation only in Australia and Sweden right after the announcement of inflation targeting regime. The structural break test results of inflation uncertainty series for a *break in mean* are slightly different. We do not find any break in structural uncertainty for all of the countries. On the other hand, a break for impulse uncertainty is detected when Australia, Sweden and New Zealand are considered. However, only for New Zealand, the break occurs after the implementation of inflation targeting.

Finally, the most promising results in favor of inflation targeting is obtained when the structural break test is applied to detect a *break in mean* for expected inflation. For all of the countries, we find a structural break in the expected inflation due to the implementation of inflation targeting. For New Zealand and United Kingdom, the break occurs right at the time of the adoption. For Canada and Sweden, on the other hand, we detect a shift in mean within six months after the implementation of the regime. Agents in the economy may have waited for a short period to revise their expectations about inflation. Only for Australia, the shift in mean takes place six quarters after the official announcement. These findings regarding the expected inflation are also consistent with the results of the non-parametric tests, which also find that the differences between expected inflation for the two sub-periods are statistically significant.

Consequently, the results obtained in this study provide support for the findings of Johnson (2002). The inflation targeting regimes are particularly successful in reducing expected inflation. However, there is less evidence that inflation uncertainty is significantly decreased with the adoption of inflation targeting. As a final note, in all the cases considered, New Zealand, the pioneer of inflation targeting, seems to be the most successful country.

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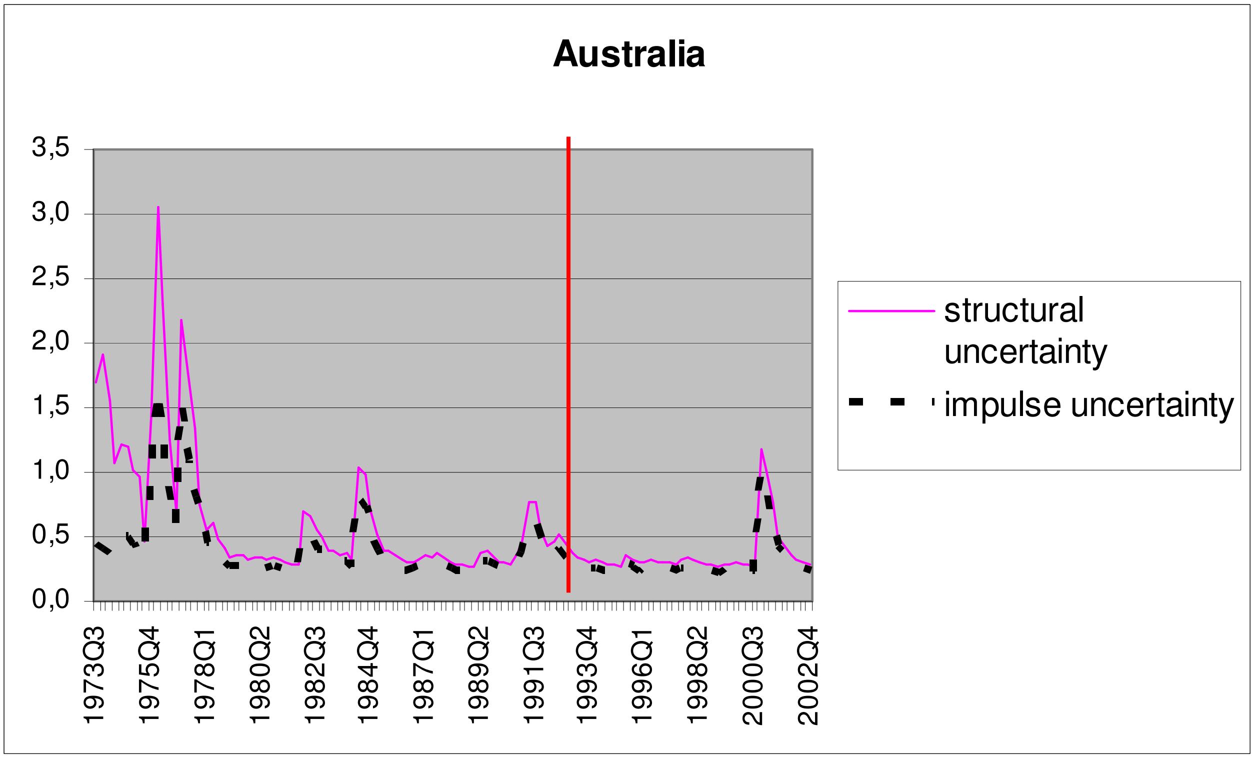
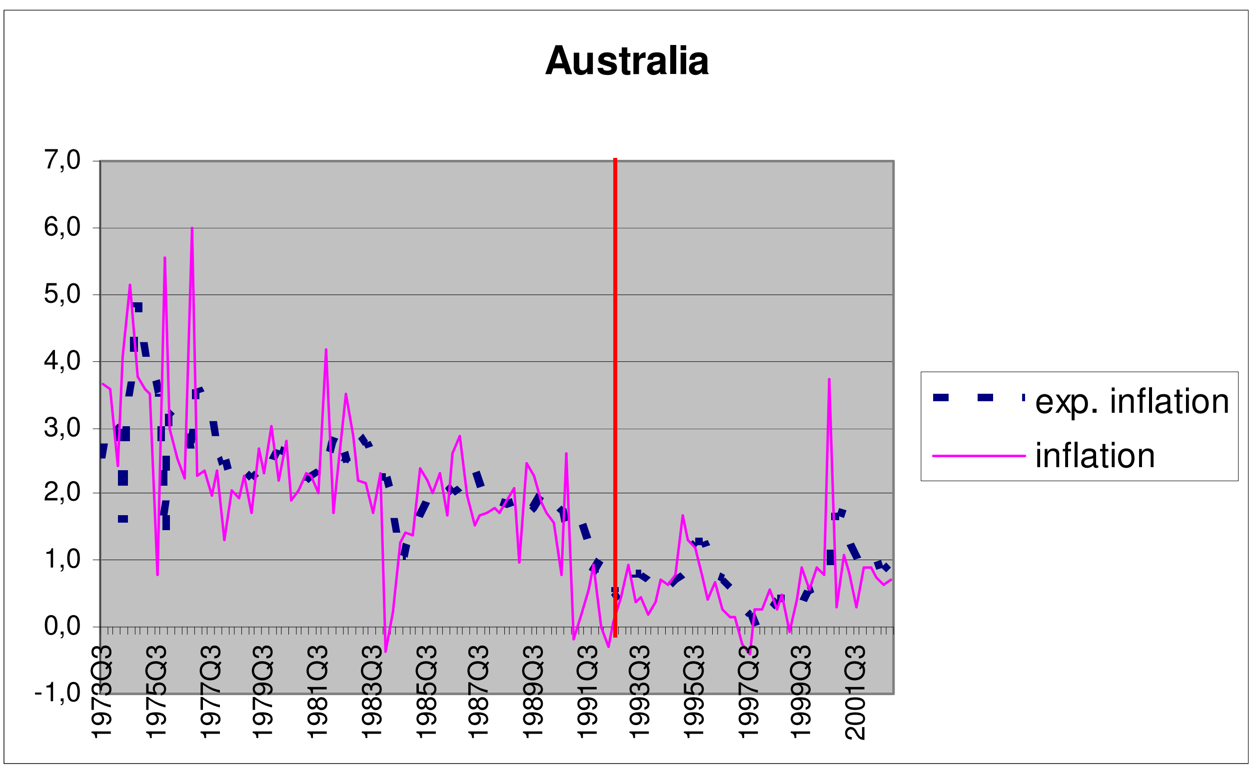

Australia
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
1973Q3
1975Q4
1978Q1
1980Q2
1982Q3
1984Q4
1987Q1
1989Q2
1991Q3
1993Q4
1996Q1
1998Q2
2000Q3
2002Q4
structural uncertainty
impulse uncertainty


Australia
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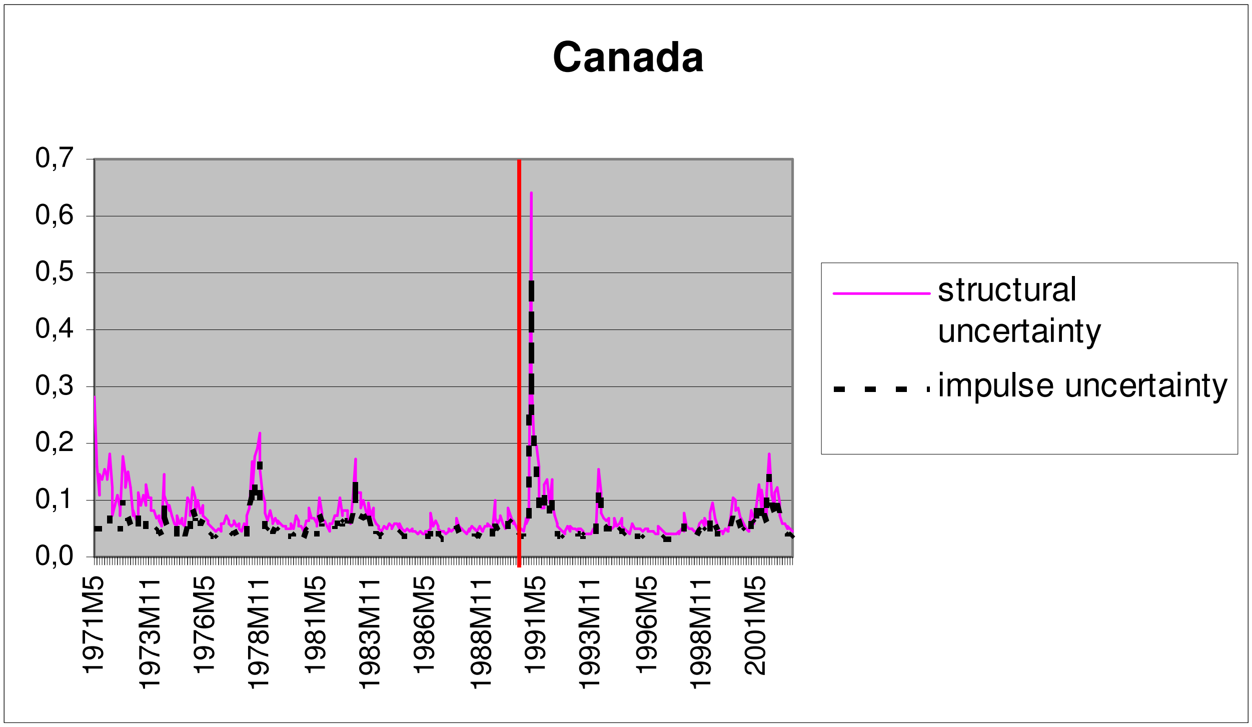
6,0
5,0
4,0
3,0
2,0
1,0
0,0
-1,0
1973Q3
1975Q3
1977Q3
1979Q3
1981Q3
1983Q3
1985Q3
1987Q3
1989Q3
1991Q3
1993Q3
1995Q3
1997Q3
1999Q3
2001Q3
exp. inflation
inflation


Canada
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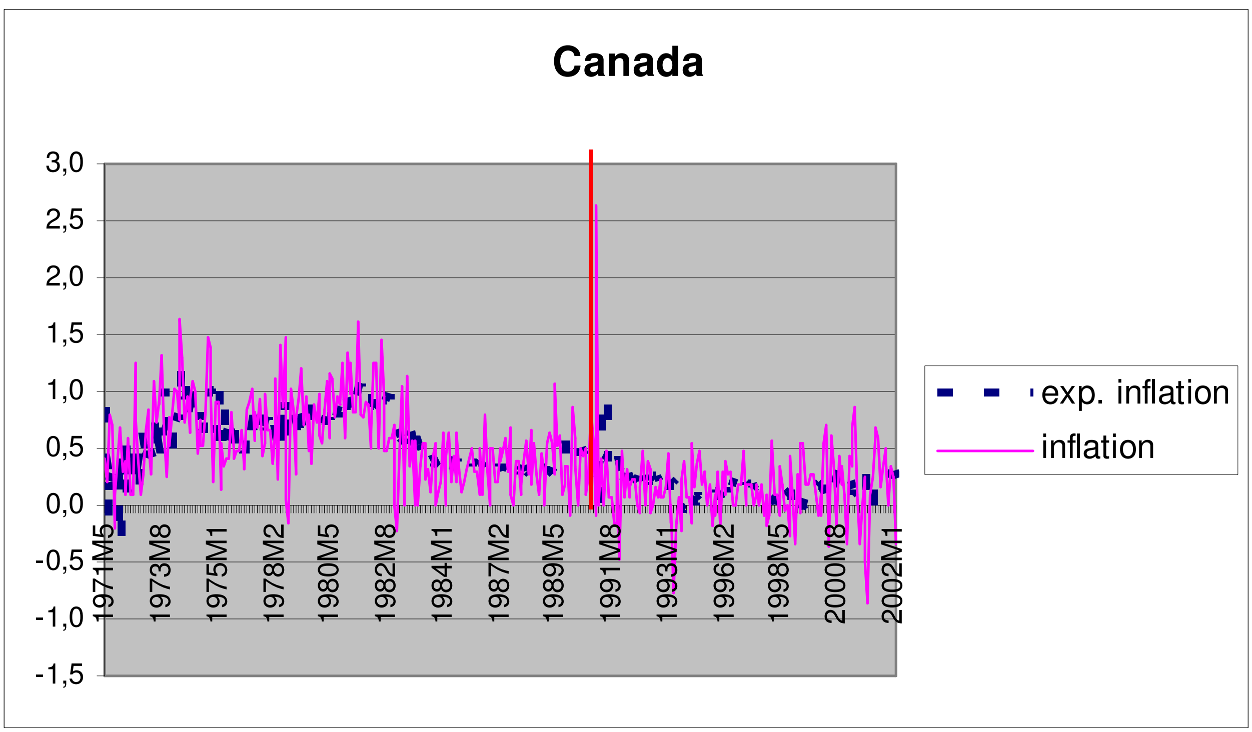
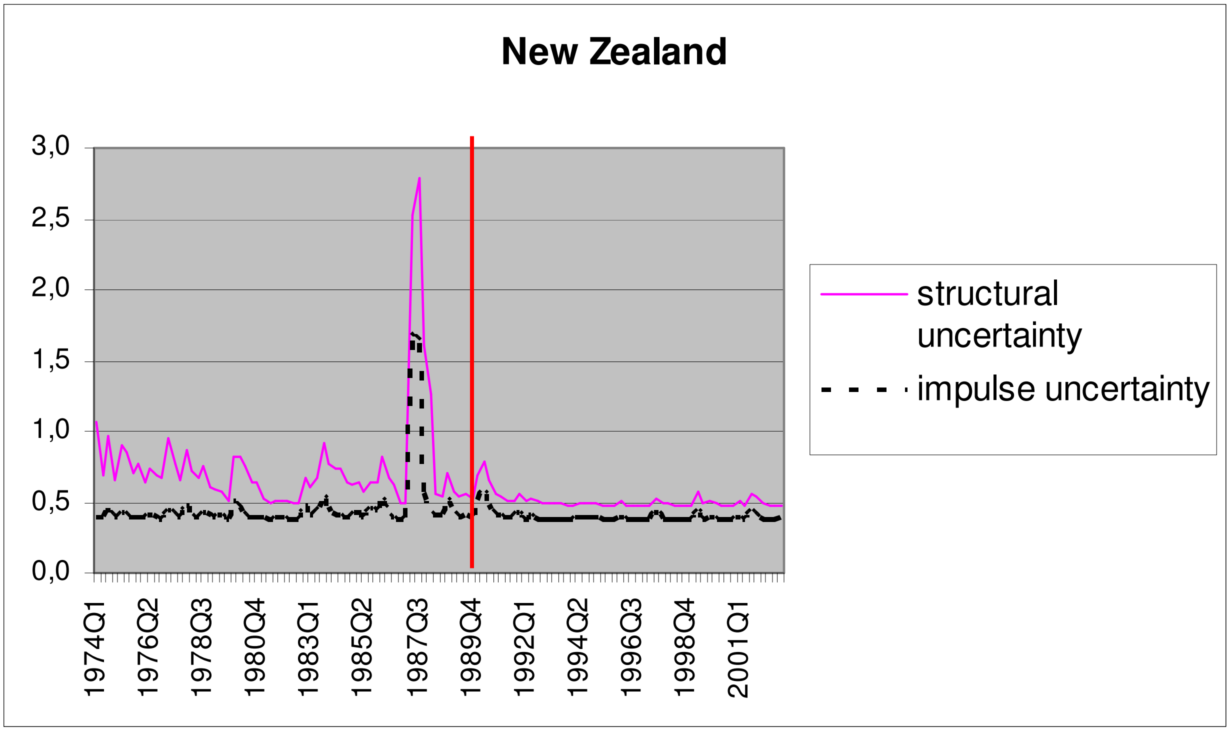
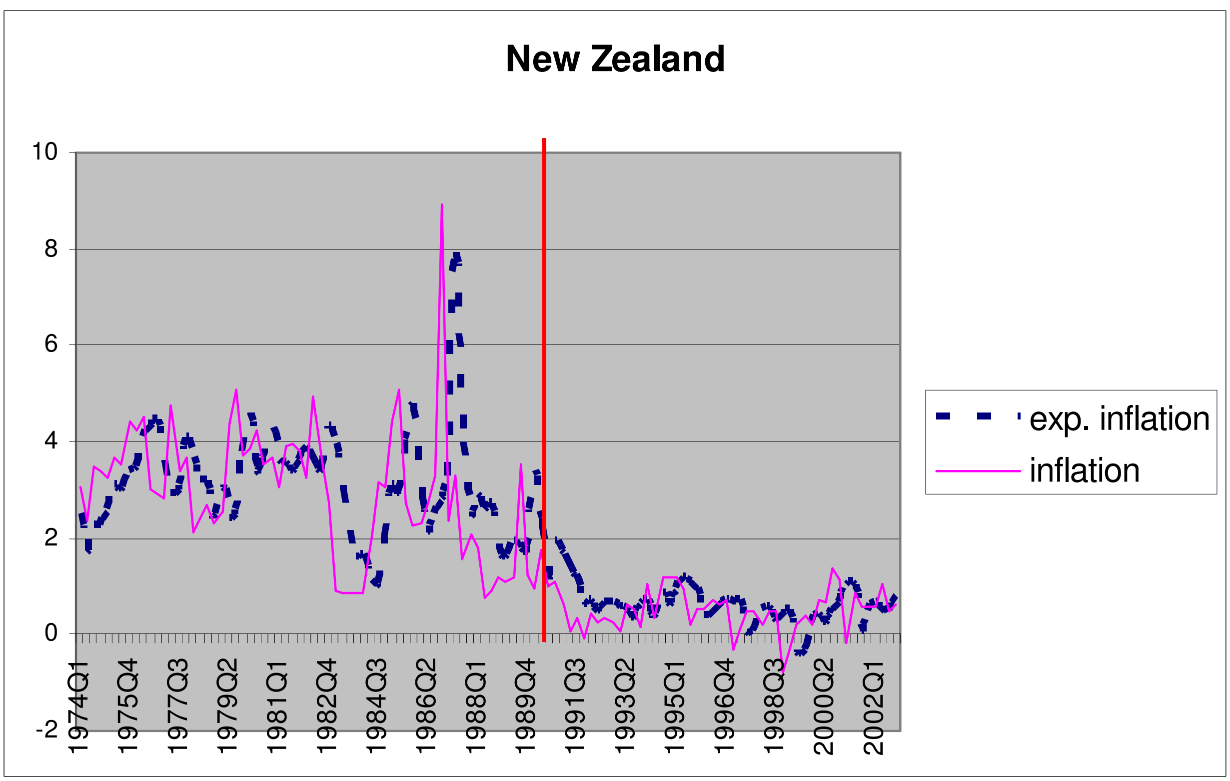
0,6
0,5
0,4
0,3
0,2
0,1
0,0
1971M5
1973M11
1976M5
1978M11
1981M5
1983M11
1986M5
1988M11
1991M5
1993M11
1996M5
1998M11
2001M5
structural uncertainty
impulse uncertainty

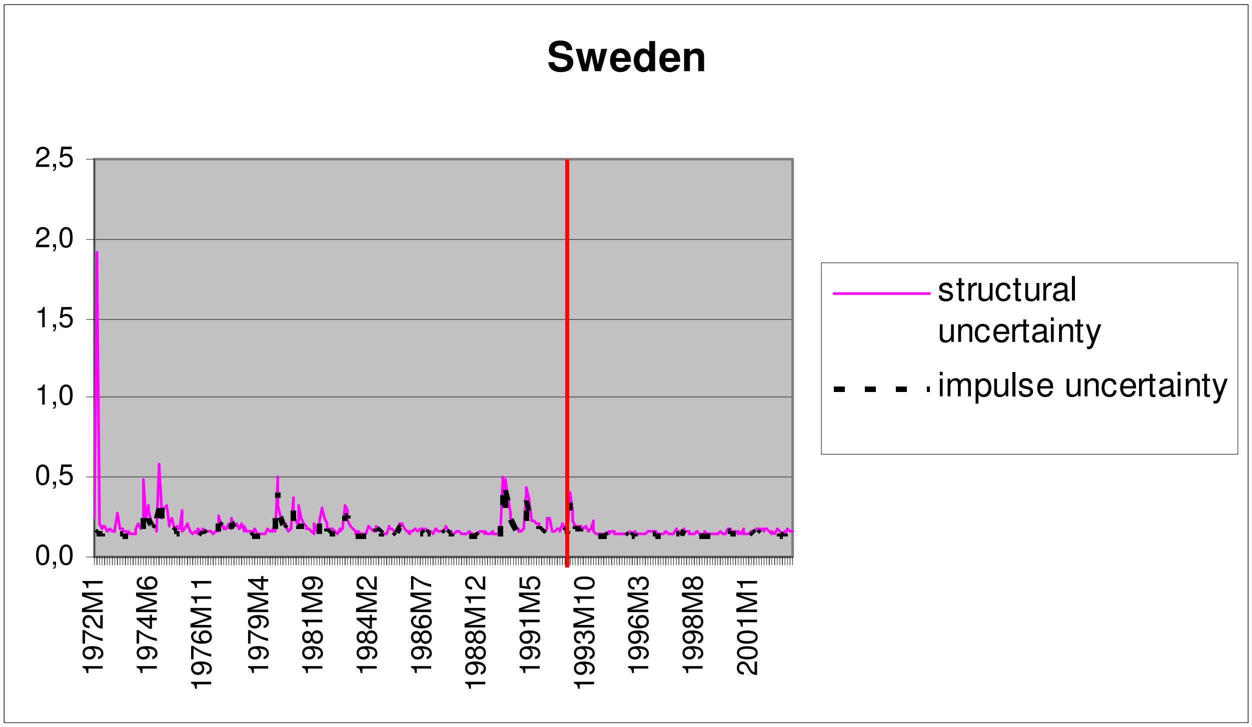

Canada
3,0
2,5
2,0
1,5
1,0
0,5
0,0
-0,5
-1,0
-1,5
1971M5
1973M8
1975M1
1978M2
1980M5
1982M8
1984M1
1987M2
1989M5
1991M8
1993M1
1996M2
1998M5
2000M8
2002M1
exp. inflation
inflation



New Zealand
3,0
2,5
2,0
1,5
1,0
0,5
0,0
1974Q1
1976Q2
1978Q3
1980Q4
1983Q1
1985Q2
1987Q3
1989Q4
1992Q1
1994Q2
1996Q3
1998Q4
2001Q1
structural uncertainty
impulse uncertainty



New Zealand
10
8
6
4
2
0
-2
1974Q1
1975Q4
1977Q3
1979Q2
1981Q1
1982Q4
1984Q3
1986Q2
1988Q1
1989Q4
1991Q3
1993Q2
1995Q1
1996Q4
1998Q3
2000Q2
2002Q1
exp. inflation
inflation



Sweden
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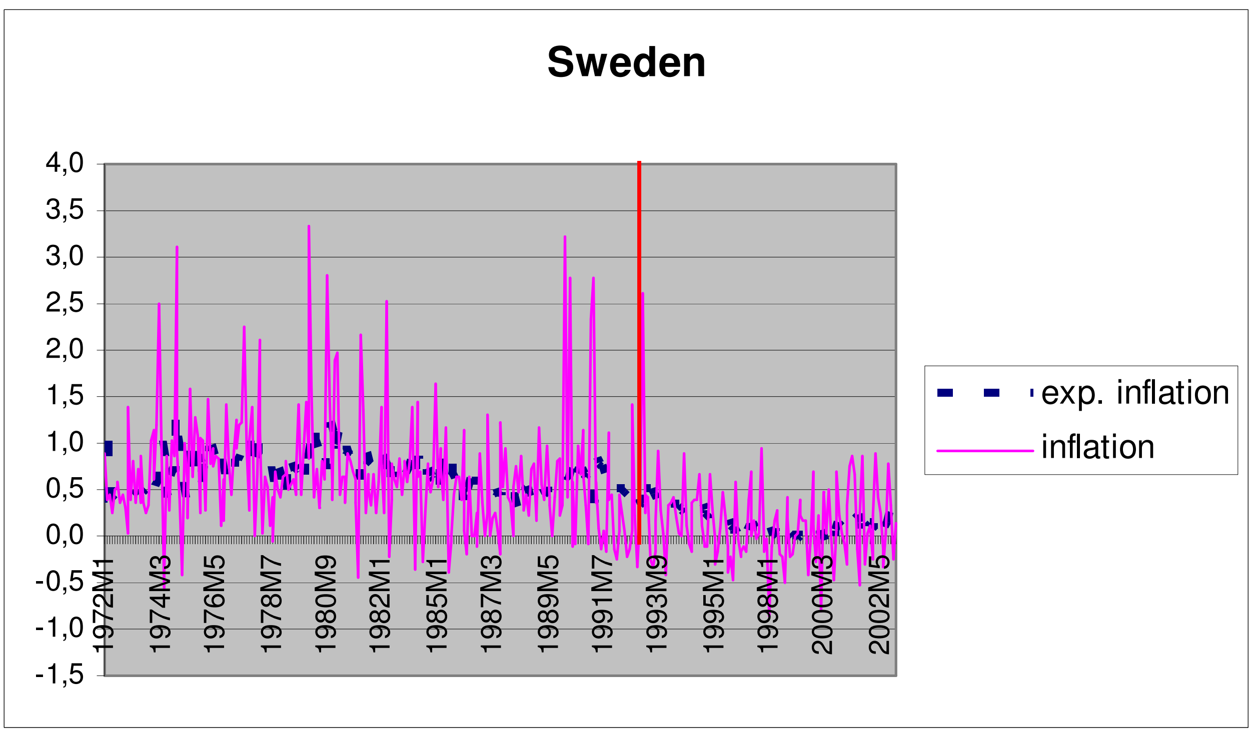
1,5
1,0
0,5
0,0
1972M1
1974M6
1976M11
1979M4
1981M9
1984M2
1986M7
1988M12
1991M5
1993M10
1996M3
1998M8
2001M1
structural uncertainty
impulse uncertainty



Sweden
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0,0
-0,5
-1,0
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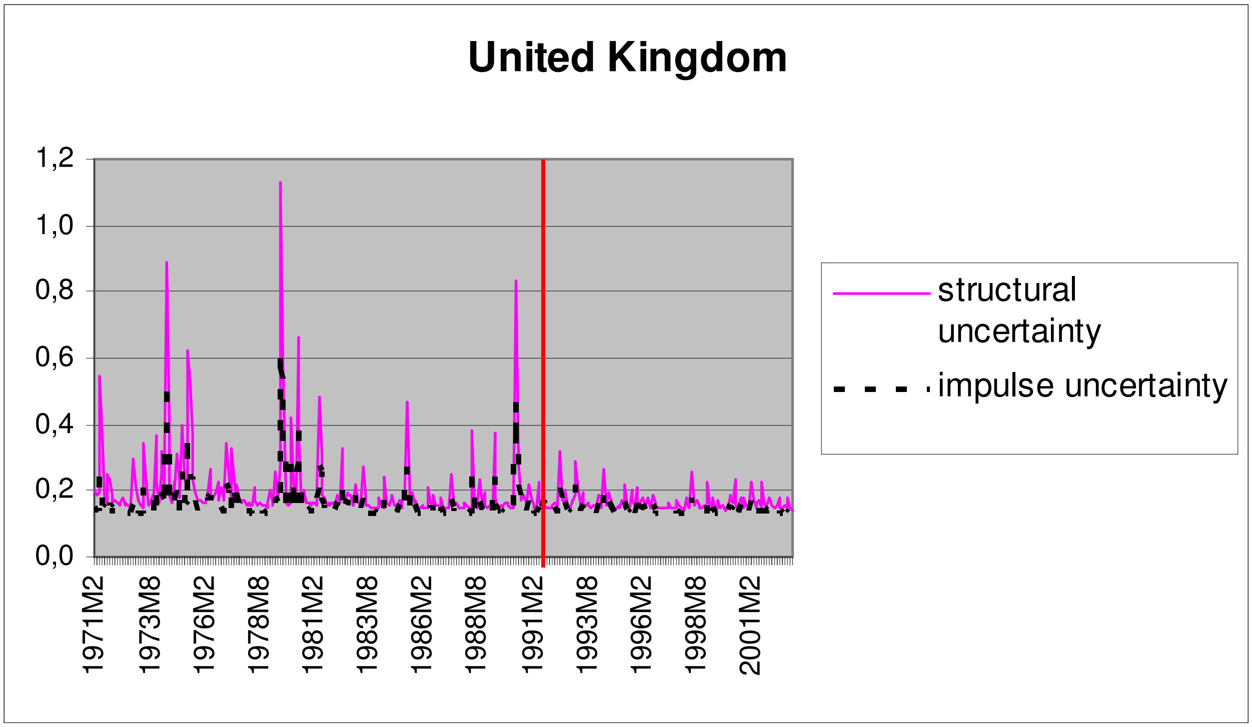
1972M1
1974M3
1976M5
1978M7
1980M9
1982M11
1985M1
1987M3
1989M5
1991M7
1993M9
1995M11
1998M1
2000M3
2002M5
exp. inflation
inflation



United Kingdom
1,2
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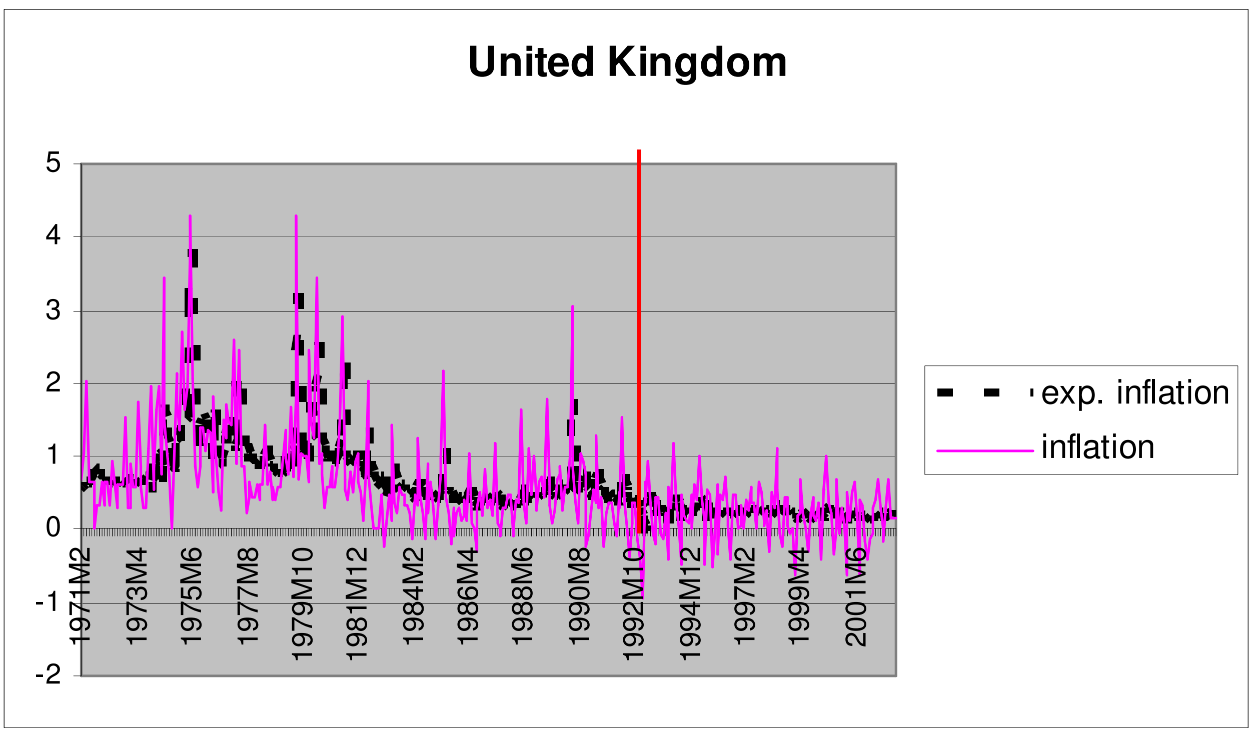
0,6
0,4
0,2
0,0
1971M2
1973M8
1976M2
1978M8
1981M2
1983M8
1986M2
1988M8
1991M2
1993M8
1996M2
1998M8
2001M2
structural uncertainty
impulse uncertainty



United Kingdom
5
4
3
2
1
0
-1
-2
1971M2
1973M4
1975M6
1977M8
1979M10
1981M12
1984M2
1986M4
1988M6
1990M8
1992M10
1994M12
1997M2
1999M4
2001M6
exp. inflation
inflation