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A Nonparametric Approach to Evaluating Inflation-Targeting Regimes

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Abstract

We use a variety of nonparametric test statistics to evaluate the inflation-targeting regimes of Australia, Canada, New Zealand, Sweden and the UK. We argue that a sensible approach of evaluation must rely on a variety of methods, among them parametric and nonparametric econometric methods, for robustness and completeness. Our evaluation strategy is based on examining two possible policy implications of inflation targeting: First, a welfare implication and second, a real variability implication. The welfare implication involves evaluating a utility function, and tested by testing whether (1) the distributions of the levels and the growth rates of private consumption and leisure per capita remained unchanged under inflation targeting, i.e., first-order stochastic dominance; and (2) testing a linear combination of consumption and leisure per capita, where the parameter describing the utility of leisure or the relative preference of leisure is calibrated. Then we introduce nonparametric univariate and multivariate statistical methods to test whether the first and second moments of a variety of real variables, such as the real exchange rate depreciation rate, real GDP per capita growth rate in addition to private consumption per capita and leisure per capita growth rates, remained unchanged under inflation targeting, decreased or increased significantly. There seems to be some evidence of increased welfare under inflation-targeting regimes, but no concrete evidence is found that inflation targeting policy, in general, reduces (or increases) real variability. Some cross country differences are also found.

JEL Classification C02, C12, C14,E31
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1. Introduction

Inflation targeting countries such as Australia, Canada, New Zealand, Sweden and the UK have successfully maintained low and stable inflation rates from early 1990s to-date by pursuing flexible inflation targeting; i.e., targeting inflation with a watchful eye on output. This paper provides a nonparametric approach to evaluating inflation targeting. We argue that a sensible approach of evaluation must rely on a variety of methods, among them parametric and nonparametric econometric methods and even non econometric methods, for robustness and completeness.

The evaluation of inflation targeting as a monetary regime in this paper is based on examining two possible implications of the policy: First is a relative welfare implication (benefits) and second is a relative real variability implication (costs). A relatively successful inflation-targeting regime is one which maintains a low and a stable inflation rate for a long period of time. Well-anchored inflation expectations increase expected real income and current consumption, i.e., Permanent Income Hypothesis (PIH). And, anchored inflation expectations at a low level of inflation make the real rate of interest equal to the nominal rate, which may be equal to the 'natural' or the 'equilibrium' real rate of interest, Wicksell (1898).[i] Lower natural rates of interest may induce higher current consumption relative to future consumption. These two implication should induce welfare-improvement (i.e., higher levels of consumption).[ii]

Relative variability implications stem from the possibility that certain monetary regimes such as inflation targeting may induce real changes. Stabilization of inflation might be achieved on the expense of making other variables unstable. Mussa (1986) and Backus *et al.* (1995) among others suggest that the exchange rate regime is not neutral. In other words, the distributions of real variables may differ across monetary regimes. Monacell (2004), for example, provides different views.

Initial inspection of the data suggest that the distributions of real variables changed. Table 1 reports descriptive statistics for key real variables before and after inflation targeting for the five countries in our sample. These statistics show that the mean and the variance have changed. One question is whether real variables exhibited statistically significant sudden large shifts in their distributions before or after inflation targeting. A higher variability might be seen as an indictment of inflation-targeting regimes. The Reserve Bank of New Zealand Policy Targets Agreement with the minister of finance signed in December 16, 1999 added the following clause to the original 1989 Agreement, *"(c) In pursuing its price stability objective, the Bank shall implement monetary policy in a sustainable, consistent and transparent manner and shall seek to avoid unnecessary instability in output, interest rates and the exchange rate."*

We test the welfare and the real variability implications for periods before and after inflation-targeting regimes for the five countries mentioned above. We introduce nonparametric test statistics for sudden change in the moments.

For the welfare implications we use a variety of nonparametric tests for first-order stochastic dominance. We find significant results in favour of inflation-targeting regimes. *Ceteris paribus*, lower expected inflation might have played a significant role in welfare improvement, but no concrete evidence is found that inflation targeting policy, in general, reduces real variability. Some cross country differences are found. In some countries variability increased significantly under inflation targeting.

2. The welfare implication: first-order stochastic dominance

We begin with evaluating the welfare implication of inflation targeting. *Ceteris paribus*, regime A (after inflation targeting) is better than regime B (before inflation targeting) if the distribution of some real outcomes of regime A dominate the distribution of the same real outcomes of regime B, which in terms of the cumulative distribution functions of the two regimes, we say $A(x) > B(x)$ for all x.[iii] From the welfare implication point of view, the vector of outcomes of the regime, x could be the arguments of the utility function, $\log c_t$ and $\log(100 - h_t)$. We use the type of utility function of the stand-in household found in Prescott (2004):

$$1 \quad EU = E\left\{\sum_{t=0}^{\infty} \beta^t (\log c_t + \alpha \log(100 - h_t))\right\}$$

Where U is the utility function for the stand-in household, E is the expectations operator, β is the discount factor, c_t is consumption, h_t is hours-worked in market activity, which is assumed to be 100 time units a week, and $100 - h_t$ is leisure. When consumption and leisure in regime A first-order stochastic dominate consumption and leisure in regime B, regime A is said to be relatively better than B; overall, a welfare improvement under A.

Throughout this paper we maintain that regime A is independent of regime B from policy standpoint (no Lucas critique). We use a variety of tests to test the null hypothesis that every point in the distribution of consumption and leisure of A is equal to every point the distribution of consumption and leisure of B, or in other words, the PDF of consumption and leisure in A lies on top the PDF of consumption and leisure in B. The alternative is the inequality. We also test for equality of the medians of two distributions. In addition, we report the probability that one outcome under regime A is > the same outcome under regime B. This is important because in a situation where the hypothesis that outcomes of regime B equal to outcomes of regime A is rejected, we need to know which outcome of which regime dominates?

The first test for first-order stochastic dominance is the Wilcoxon (1945) Rank Sum test, which is also known as the Mann-Whitney (1947) two-sample statistic. It is a test for assessing whether two samples come from the same distribution. The null hypothesis is that the two samples are drawn from a single population, and therefore their probability distributions are equal. It requires the two samples to be independent, and the observations to be ordinal or continuous measurements, i.e. one can at least say, of any two observations, which is the greater.[iv] This test is one of the best-known non-parametric significance tests. It was proposed initially by Wilcoxon (1945), for equal sample sizes, and extended to arbitrary sample sizes and in other ways by Mann and Whitney (1947). MWW is virtually identical to performing an ordinary parametric two-sample *t* test on the data after ranking over the combined samples.[v]

The second test is the nonparametric K-sample test on the equality of median. It tests the null hypothesis that K samples were drawn from populations with the same median. In the case of two samples, the test statistic is distributed chi-squared and calculated with and without a continuity correction. We report only one statistic; fewer more statistics are calculated, but they are not reported because they have the same p values.

The third test for first-order stochastic dominance is the Kolmogorov-Smirnov, which is a well known non-parametric test to test for the equality of distributions. Rejection of the null by this test is probably an indication of the weakness of this test in cases where there are differences in the tail of the distributions. However, it is very powerful for the alternatives that involve clustering in the data.[vi]

3. The variability implication: testing for large shifts in the distribution

Changes in the monetary regime change the data generating process of macroeconomic variables. For example, inflation is expected to be an I(0) process under successful inflation-targeting regimes, but an I(1) process somewhere else. Engineers like to keep a process or a quality variable at a specified level (mean) with variability about the level as small as economically feasible. In most cases, when a change in the data generating process's distribution occurs it will entail a change in either the mean μ or the standard deviation σ. The test statistics that are available to quality control engineers interrogate the real time data as they are observed and sound alarm bells when the moments shift suddenly with high probability. A variety of the tests we will introduce here have been used in quality control literature for decades, Shewhart's (1939).

For the univariate straightforward case, we test separately the hypothesis that the mean of a variable X (it could be a time series or a panel) in regime A is equal to the mean in regime B, versus the alternative that the means are unequal. The test statistic for the mean of a univariate case is:

$$2 \quad R_i(\bar{X}_i) = \frac{\sqrt{n_i(\bar{X} - \mu)}}{\sqrt{\sigma^2}} \;,$$

where n_i is the number of observation; i is the number of samples $=1, 2, \cdots m$; $\bar{X}$ is the mean for a sample of size n_i ; μ is a pooled or overall mean

$\forall\ i = 1, 2, \cdots m$ calculated as $\sum_{i=1}^{m} n_i \overline{X} / \sum_{i=1}^{m} n_i$ and σ^2 is a pooled or overall variance calculated as $(n_i - 1)S_i^2 / \sum_{i=1}^{m} n_i - m$, and they both proxies for the population mean and variance, which are unobservable. The statistic $R_i(\overline{X}_i) \approx N(0,1)$ is measured in standard deviation units of a normal distribution.

However, we are more interested in testing whether the variance has changed, Friedman (1976).[vii] We compute the followings, in the order shown, to arrive at a statistic for the variance:

3 $V_i = (n_i - 1)S_i^2 / \sigma^2$;

4 $\eta_i = H_{n_i - 1}(V_i)$; and

5 $R_i(S_i^2) = \Phi^{-1}(\eta_i)$

Where V_i is the statistic for a sudden shift in the variance, which is distributed chi-squared. We mapped it onto a standard normal distribution to make the presentation of the results easy. $H(.)$ is the distribution function of the chi-squared random variable with $n_i - 1$ degrees-of-freedom and Φ^{-1} is the inverse of the standard normal distribution function.

Quality control statisticians plot $R_i(\overline{X}_i)$ and $R_i(S_i^2)$ against a relevant ordering variable such as time or on a chart that is marked with upper and lower control limits. The limits are usually take the value $\pm 3\sigma$, but could be tighter and take the value $\pm 2\sigma$. These limits, under a standard normal distribution function, are *prediction* or *tolerance* limits for the distributions of $R_i(\overline{X}_i)$ and $R_i(S_i^2)$. Note that a $\pm 3\sigma$ control limit constitutes a band of 0.99730 prediction intervals for future values of the statistics $R_i(\overline{X}_i)$ and $R_i(S_i^2)$ according to the Tchebysheff's theorem.[viii] In other words, values that fall in the tails of the standard normal curve are significantly different from values elsewhere under the bell-shaped curve, and represent inequality of distributions when two regimes are compared.

These charts are designed to function as alarm systems. They signal cases where deviations of observations from the mean, for example, are greater than $\delta\sigma$. They are also designed so that the probability of false alarm is small if the process is in statistical control. The probability of a false alarm is equal to $\beta(\delta)$, which is a type II error. This is the probability of a shift equal to $\delta\sigma$ will not be detected. The probability of detecting such a shift is $1 - \beta(\delta)$, which is the power of the test:

6 $\beta(\delta) = \Phi\left(Z_{\alpha/2} - |\delta| \sqrt{n_i}\right),$

Where Φ is the cumulative standard normal distribution function. We can calculate the power of the test for detecting sudden large shifts in the moments, so for example, with $n_i \geq 5$ and $\delta = 1.5$ the power is $1-\beta = 1-\{\Phi(3-1.5\sqrt{5}) - \Phi(-3-1.5\sqrt{5})\} = 0.638$. For an economic application of these control statistics see Razzak (1991). For other similar test statistics that are used in economic literature see Inclan and Tiao (1994) who use CUSUM tests and Chen and Gupta (1997).

What the economic literature is lacking is a variance equality test for more than one variable. In fact, even the statistical literature lacks a variance equality test for more than 3 variables. We provide a multivariate test for the equality of the variance for P variable.

For a multivariate normal variable we $X^T = [X_1, X_2 \cdots X_{\mathrm{P}}]^T$, where each X is iid, the superscript T denotes transpose, the variance (of the population) is a *function* called the *Generalized Variance*, which is the determinant of a matrix, Σ. This could be written:

$$\sum = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1\mathrm{P}} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2\mathrm{P}} \\ \vdots & \vdots & \vdots & \vdots \\ \sigma_{\mathrm{P}1} & \sigma_{\mathrm{P}2} & \cdots & \sigma_{\mathrm{PP}} \end{bmatrix}$$

The $\operatorname{cov}(X_i, X_j) = \sigma_{ij} \neq 0$, thus the Generalized Variance use more information in the data.

The determinant of the sample variance matrix S^2 is called the *Sample Generalized Variance,* where S^2 is the sample covariance matrix based on sample of size n.[ix]

Anderson (1958) shows that a convenient statistic for the generalized variance is the following form of the sample generalized variance:

$$7 \quad D_k = (n-1)\mathrm{P}\left[\frac{|S_k^2|}{|\Sigma|}\right]^{1/\mathrm{P}} > 0$$

And $k = 1, 2 \cdots m$.

The matrix S^2 is computed by:

$$8 \quad S_{ij}^2 = \frac{1}{n-1}\sum_{k=1}^{m}(X_{ki} - \overline{X}_i)(X_{kj} - \overline{X}_j)$$

And Σ is approximately:

$$9 \quad \overline{S}^2 = \frac{1}{N-m}\sum_{k=1}^{m}(n-1)S_k^2$$

Which is the mean of S^2 .

Unfortunately, for P>3, the statistic D_k has no exact distribution so we cannot test for the significance level. Ganadesikan and Gupta (1970) approximated the distribution by a Γ (Gamma) distribution with two parameters, a shape and a scale parameter,. They showed that the Γ distribution is best approximated when $n = 10$.

The shape parameter is:

10 $$h = \frac{\mathrm{P}(n - \mathrm{P})}{2}$$

And the scale parameter is:

11 $$\mathrm{A} = \frac{\mathrm{P}}{2}\left[1 - \frac{(\mathrm{P}-1)(\mathrm{P}-2)}{2n}\right]^{1/\mathrm{P}}$$

Just like what we have done earlier to simplify the interpretation of the statistic D_k , we transform the Γ distribution into a standard normal by computing the following:

12 $$u_k = G_{h,\mathrm{A}}(D_k)$$

Where G is the distribution function of the Gamma distribution with the two parameters above, and then the inverse of u_k

13 $$R_i(D_k) = \Phi^{-1}(u_k)$$

$R(D_k)$ and $R(S_i^2)$ are distributed standard normal and therefore the values could be $R(.) < 0 < R(.)$.

Just like the previous univariate statistics, a significant increase implies values of $R(D_k)$ > $\pm 3\sigma$.[x]

4. The data

We will examine data for Australia, Canada, New Zealand, Sweden and the UK. These countries adopted inflation targeting earlier than other countries, thus they have a longer span of data. The data cover the period March 1980 to December 2007. We use private consumption, hours-worked or leisure, GDP, and the real effective exchange rate. See data appendix for definitions). We plot the data in figures 1 to 6. Real GDP per capita has a positive upward trend. In figure 2, consumption per capita has gone through more pronounced changes than GDP, especially in Australia, Canada, New Zealand and Sweden, but also trended. All data have trend. Except for Sweden, hours worked increased during inflation targeting. Hours-worked declined significantly in Sweden under inflation targeting. We test the data for unit root and we could not reject it.[xi] Table 1 also summarizes the descriptive statistics for the I(0) growth rates of these variables.

5. Results

5.1 First order stochastic dominance

We test the welfare implications of inflation targeting. We said that anchoring inflation expectations at a low level induces individuals to expect higher real income, which leads to a higher *level* of current consumption of goods and services. The income effect also reduces hours worked (higher *level* of leisure since leisure is a normal good). Current consumption level also increases if the real interest rate is low. If expected utility is a function of consumption and leisure as stated earlier, the question is: Did the utility function (equation 1) remain unchanged after inflation targeting?

To answer this question we test for first-order stochastic dominance in real private consumption expenditures per capita, in leisure per capita, and in the linear combination $\ln \hat{c}_t + \alpha \ln(100 - \hat{h}_t)$ for a calibrated value of α. Per capita estimates will permit cross-country comparisons. The periods before inflation targeting are: March 1980 to December 1992 for Australia; March 1980 to December 1990 for Canada; June 1987 to December 1988 for New Zealand; March 1980 to December 1992 for Sweden and March 1980 to December 1991 for the UK.

Table 2 reports the p values of the statistics for first-order stochastic dominance. The table has six columns. The first column reports the countries, the second reports the variables, the third reports the p values for the Wilcoxon Rank Sum test (the Mann and Whitney test), the fourth column reports the *probability* that consumption per capita, leisure per capita and U in regime B (before inflation targeting) are greater than those in regime A. In column five we report the p value for testing whether the medians are equal across the two regimes. Finally we report the p value for the Kolmogorov-Smirnov test, which also tests for the equality of the variables across regimes.

For all countries, there is a strong rejection to the hypothesis that log private consumption per capita are equal across regimes, the p values are zero. The probability that the PDF is greater before inflation targeting is also small. The medians are unequal and the Kolomogrov-Smirnov also rejects the equality with zero p values.

Not so with the log leisure, Australia’s log leisure per capita seems to have declined. The equality hypothesis is rejected in favour of regime B. The probability that leisure in regime B is greater than that in regime A is 0.897. Of course, the medians are unequal and the Kolmogorov-Smirnov p value is zero, which also rejects equality.

Canada's distribution of leisure before inflation targeting and after inflation targeting seem equal; the p value for the Rank Sum test is 0.981. The probability that leisure before inflation targeting dominates is about half. The medians of the two distributions are equal; the p value is 0.847. The p value for the Kolmogorov-Smirnov is 0.966. Thus, Canada's level of leisure per capita has not significantly changed under inflation targeting.

For New Zealand, the equality of distributions of leisure is rejected with a p value of the Wilcoxon Rank Sum test equal to 0.045. The probability that leisure in regime B is greater than that under inflation targeting is 0.339. The hypotheses of the equality of the medians has a p value of 0.167. The Kolmogorov-Smirnov test statistic has p value of 0.138. Leisure most probably declined in New Zealand under inflation targeting. Figure 4 shows that clearly. These tests are inconclusive.

The level of leisure per capita has definitely increased in Sweden under regime A of inflation targeting. P values of all tests are zero. Leisure declined in the UK. The hypothesis of equality of the two distributions can be rejected, but the probability that log leisure per capita under regime B is larger than that under inflation targeting is 0.836. Sweden is the only country with significant increase in the log of leisure per capita under inflation targeting. These results are consistent with the data plotted in figure 4. In Sweden an increase in average propensity to consume, c/y, reduces hours-worked, hence increases leisure. Maybe the income effect dominates the substitution effect. However, Aussies and Brits, and may be the Kiwis have been substituting leisure (hours worked) for consumption.

We also examine the growth rates of consumption and leisure per capital. The results are different from the pervious results of the log levels. For Australia, there is a significant evidence that the growth rate of consumption under inflation targeting dominates. We cannot reject the equality in Canada. The probability that consumption growth before inflation targeting is > growth after inflation targeting is 0.57. In Sweden, consumption growth has significantly increased after inflation targeting. And, consumption growth has probably remained unchanged in the UK.

The growth of leisure per capita remained unchanged across regimes and in all countries, except for New Zealand. The probability that the growth rate of leisure per capita was higher before inflation targeting is 0.88.

Finally and most importantly, there is stronger evidence the level of the utility function has significantly increased over inflation targeting. We test a linear combination of consumption and leisure, $\log \hat{c}_t + \alpha \log(100 - \hat{h}_t)$. The results in table 2 show zero p values almost everywhere. We borrowed the value 1.57 for α from Prescott (2004). The number is most probably *ad hoc*. We also used 1.57 $\pm$0.20 and found no change in the results.

Our test statistics imply that inflation targeting has positive welfare implications. We interpret the results as being largely supportive of inflation-targeting regimes and vary only slightly across countries.

5.2 Testing the variability of the real variables

We apply the univariate and multivariate tests for sudden change in the mean and the variance to the log-differenced real effective exchange rate depreciation, real GDP per capita growth, real private consumption per capita growth and leisure per capita growth individually and as a 4 by 4 matrix. We choose a sample size of 8 quarters, which is consistent with the medium term used for policy by central banks, to calculate the statistics for the mean and the variance but we are only interested in the variance. We will report the statistics in tables 3-7, and plot selected figures for the test statistics for the variance only. .

Each figure has two plots, before and after inflation targeting or regime B and regime A. The plots represent standard normal distribution with control limits $\pm 2\sigma$ and $\pm 3\sigma$. We look for statistics that exceed $\pm 3\sigma$, but the $\pm 2\sigma$ is a more stringent limits. We have it for comparison only. Points that exceed the $\pm 3\sigma$ are dark, those that fall outside the $\pm 2\sigma$ limit but within $\pm 3\sigma$ are grey, and all points falling within $\pm 2\sigma$ are white. The majority of points are white. There are fewer large shifts.

In figure 7, we plot the univariate statistics for GDP per capita growth for all countries. Before inflation targeting the statistics indicate in-control process. There is no sudden shift in the variance. Some statistics for Australia and the UK are pretty close to exceeding the $\pm 3\sigma$ and Sweden was close the $\pm 2\sigma$ limits . Variability got worse after inflation targeting. The UK GDP per capita growth exhibited most significant shifts during that period. This kind of finding means that inflation targeting increased the variability of real GDP, in these countries. Other countries are fine, but the hypothesis that the variances are equal across regimes could not be rejected.

Figure 8 plots the univariate statistics for consumption growth per capita. No significant shifts in the variance is found in regime B. Under inflation targeting, Canada, New Zealand and the UK experienced no change in the variance. Australia and Sweden exhibited a significant shift in the variance in 1993-1994, which are the first two year after they adopted inflation targeting. Then Sweden experienced another large shift in 2005-2006. Like GDP per capita, these results are not unsupportive of inflation-targeting regimes. The variance of consumption has increased under inflation targeting at least in the case of Sweden 2005-2006. Generally speaking, we cannot reject the hypothesis that the variances are equal across regimes in all other countries.

Signals of instabilities are found in leisure per capita under inflation targeting. Figure 9 shows that the UK is most unstable. Canada experienced instability in the first year of inflation targeting. At the $\pm 2\sigma$ limit all other countries showed signs of instability. The labour supply seems most affected, which is something central banks do not seem to discuss often.

Figure 10 plots the real exchange rate depreciation rates. Australia and Canada's variability is unchanged across regimes, and largely stable. New Zealand's variability is much improved under inflation targeting. New Zealand never intervened in the exchange rate market. Sweden too, has a stable real exchange rate under inflation targeting. The UK experienced a jolt at the first two years of the adoption on inflation-targeting regime.

Finally, figure 11 plots the multivariate statistics for the sudden shift in the variance for all countries for the periods before and after inflation targeting. Australia and Sweden show significant instability and increase in variability at the beginning of the period of inflation targeting. Canada and New Zealand's variability improved under inflation targeting, while the UK experience no significant changes.

In summary, the hypothesis that the variances of the real variables in our sample are equal across regimes cannot be rejected in favour of inflation targeting in every country. Sweden and the UK exhibited greater variability under inflation targeting in some of the real variables such GDP, consumption and leisure at the expense of a more stable inflation. We found differences in the significance of variability across countries. New Zealand real exchange depreciation rates are more stable under inflation targeting. And in a multivariate sense, Canada and New Zealand have significantly lower real variability under inflation targeting. Uncertainty increases sharply during the year immediately after changing the regime or at the beginning of the sample, whether before or after inflation targeting. We conclude that we cannot provide a concrete evidence that inflation targeting policy, in general, reduces the variability of real variables.

6. Conclusions

Our objective was to provide a nonparametric methodology to evaluating inflation-targeting regimes in Australia, Canada, New Zealand, Sweden and the UK. We believe that evaluators ought to use variety of methods instead of relying on one particular approach, for completeness and robustness. In particular, we tested two possible implications of inflation targeting as a policy. First is a welfare implication and second is a variability implication. Successful inflation targeting reduces expected inflation, which in turns increases expected real income. Consistent with PIH, current level consumption of goods and services, and leisure should increase.

We used a variety of methods to test for first-order stochastic dominance. We found that the distribution of the level of consumption per capita dominates under inflation targeting, and in all five countries. A similar finding is found, but less universal, for the growth rate of consumption per capita. The level of leisure per capita, however, did not increase under inflation targeting, except for Sweden. People seem to have been working longer hours in all other countries over the period of inflation targeting.

That said, monetary policy is not the only effect on the supply of labour. Fiscal policy, namely tax policy, also has an intratemporal effect on the level of hours worked. Taxes distort the relative price of consumption and leisure. In the neoclassical model, an expected increase in the tax rate reduces the after-tax expected income, reduces current level of consumption, and increases the supply of labour. Hence, increases leisure. Sweden could have the largest tax rate among the countries in the sample (Nickell, 2003, p 12 table 2). Our paper does not account for changes in tax rates because we do not have complete data to calculate quarterly real after-tax GDP per capita.

We also found that the distribution of a linear combination of consumption per capita and leisure per capita dominates under inflation targeting, consistent with a higher utility function under inflation targeting.

The second implication of inflation targeting is real variability. We tested whether the variability of some real variables have changed under inflation targeting. In addition to well know univariate test for equality of the variance we introduced a multivariate test. These tests have been used in statistical quality control literature for decades to test for sudden changes in the variance. We found that, over intervals of two years which is the medium term for policy, real GDP per capita, real consumption per capita, real leisure per capita and the real depreciation rate exhibited similar or more variability under inflation-targeting regimes than earlier regimes. However, as expected, variability increases (uncertainty) at the regimes' switching periods. Some variables are more variable than others such as GDP per capita and leisure per capita growth rates. And, some countries experienced more variability in some variables than others such as Sweden and the UK while others like Canada and New Zealand seem to have less variability under inflation targeting. We cannot provide a concrete evidence that inflation targeting policy, in general, reduces real variability.

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Data:
The main sources of the data are:
OECD.stat: OECD online data base www.oecd.org
IFS: International Financial Statistics database, August 2008 (CD-ROM) IMF
ILO: Statistics and databases on line www.ilo.org

$\hat{c}$: is the natural logarithm of private consumption per person in the working age 15-64 years old. Quarterly frequency and seasonally adjusted. Source: OECD

$\hat{h}$: is the natural logarithm of average weekly hours worked per person in the working age 15-64 years old. Quarterly frequency. Annual total hours worked per worker extracted from OECD then we divided it by 52 weeks to get average weekly hours worked per worker. Source: OECD

$\hat{l}$: is the logarithm of average weekly leisure hours per person in the working age 15-64 years old. $\hat{l} = \log(100 - H)$ the assumption is that the population of working age 15-64 has 100 productive hours per week. Quarterly frequency. Source: OECD

Output is the natural logarithm of real GDP per person in the working age 15-64 years old. Quarterly frequency and seasonally adjusted. Source: OECD

Population is the population at working age 15-64 years old. Quarterly frequency. Source: OECD

The real effective exchange rate is quarterly frequency and the source is the IFS

The consumer price index, quarterly frequency and the source is the IFS

Code to calculate the multivariate statistics for sudden shifts in the moments SAS-IML

```
%macro razzak(dataset=, Variables=, K=6, S=8);
proc iml;
use &dataset;
read all into x var {&variables};
k=&k;/*-number of samples-*/
s=&s; /*- sample size-*/
p=ncol(x); /*-number of variables-*/
n=nrow(x); /*-total number of observation=k*s -*/
b=j(s,1,1);
j=(p-1)*(p-2)/(2*s);
scale=(p/2)*(1-j)##(1/p);
shape= p*(s-p)/2 ;
start qc;
do h=s to n by s;
gp=x(|(h-s+1):h,|);
mgp=gp(|:,|);

 if h=s then xb=mgp; else xb=xb//mgp;
 cssg=gp-(mgp@b);
 ssg=(cssg`*cssg);
 covg=(cssg`*cssg)/((s)-1);
 dcovg=det(covg);
 if h=s then do ;
ssp=ssg;;dcov=dcovg ;  end;

 else do ;ssp=ssp+ssg;dcov=dcov//dcovg; end;
 end;
xdb=x(|:,|)@b;
b=j(k,1,1);
cov=ssp/(n-k); /* this is a S bar matrix*/
 dsbar=det(cov);
 gamma=((s-1)*p)*(dcov/dsbar)##(1/p);
y=gamma/scale;
gamma=probgam(y,shape);
xdb=x(|:,|)@b;
t2=(s*diag((xb-xdb)*inv(cov)*(xb-xdb)`))(|,+|);
sample=(1:k);
colchr={'Z1' 'Z2' 'Z3' 'Z4' 'Z5' 'Z6' 'Z7' 'Z8' };

/* q1 is the standard normal for the variance R(D) in the paper*/

u=probchi(t2,p);
q=probit(u);
u1=probgam(y,shape);
q1=probit(u1);
output2=output2//(sample`||gamma||u1||q1);
colchr2={'Sample' 'Gam' 'u1' 'Q1'};
```

```
output=output//(sample`||t2||u||q||dcov);
colchr1={'SAMPLE' 'T SQUARE' 'U' 'Q' 'DET S'};
*print cov(|colname=colchr rowname=colchr|);
* print output(|colname=colchr1|);
* print output2(|colname=colchr2|) ;
create p0 from  output(|colname=colchr1|);
append from output;
close p0;
create p1  from  output2(|colname=colchr2|);
append from output2;
close p1;
finish ;
start main;
run qc;
finish;
run  main ;
quit;
proc print data=p0;
title "Country=&dataset";
title2'IML OUTPUT Dataset=P0';
run;
proc print data=p1;
title2'IML OUTPUT Dataset=P1';
run;
%mend;
data dataname;
 input Year$  GDP  RER   Consumption  Leisure….;
```

Table 1: Descriptive Statistics

	Before Inflation Targeting B		After Inflation Targeting A	
Australia	Mean	Standard Deviation	Mean	Standard Deviation
Inflation	7.36	3.06	2.60	1.44↓
Leisure	-0.01	0.78	-0.23	1.24↑
Consumption	1.04	1.60	2.41	1.24↓
GDP	0.80	2.21	1.81	1.00↓
Real Exchange Rate	-1.58	9.83	1.27	6.83↓
Canada				
Inflation	6.35	3.10	2.10	1.21↓
Leisure	-0.10	0.85	-0.02	0.58↓
Consumption	1.52	2.46	1.67	1.54↓
GDP	1.16	2.31	1.19	1.46↓
Real Exchange Rate	1.47	5.64	0.09	6.16↑
New Zealand				
Inflation	11.88	5.12	2.32	1.44↓
Leisure	0.74	0.55	-0.13	0.49↓
Consumption	1.02	2.102	1.80	2.04↓
GDP	0.26	1.36	1.27	1.76↑
Real Exchange Rate	1.25	9.16	0.59	8.06 !
Sweden				
Inflation	7.81	3.22	1.50	1.30↓
Leisure	0.02	0.55	0.06	0.65↓
Consumption	1.00	2.69	1.73	1.61↓
GDP*	0.84	1.90	1.86	1.56↓
Real Exchange Rate	0.42	5.76	-0.64	5.44↓
UK				
Inflation	7.49	4.19	2.77	0.86↓
Leisure	-0.001	1.00	-0.13	0.66↓
Consumption	2.62	2.87	2.45	1.18↓
GDP	1.36	1.85	1.68	0.72↓
Real Exchange Rate	1.16	8.70	0.94	6.39↓

-Inflation-targeting regime is defined over the period March 1993 – December 2007 in Australia; March 1991 – December 2007 in Canada; March 1990-December 2007 in New Zealand; March 1993 – December 2007 in Sweden; and March 1992 – December 2007 in the UK.

-The data are annualized growth rates defines as $(\ln x_t - \ln x_{t-4}) * 100$.

-Inflation is CPI inflation.

-Leisure is $100 - h_t$ and h_t is average weekly hours-worked per person (15-64).

-Consumption is per capita (per person of working age (15-64)).

-GDP is real GDP per capita growth.

-The real exchange rate depreciation rate is $(\ln q_t - \ln q_{t-4}) * 100$ where q_t is the effective real exchange rate.

* The OECD data have a very clear downward shift in the level around 1990, which must be interpreted carefully.

Table 2 : Tests for first-order stochastic dominance

	Wilcoxon Rank Sum Test Probability		Continuity corrected Pearson χ_1^{2} *	Kolomogrov-Simrnov
	P value $A = B$	Prob value $B > A$	P $median \quad A = median \quad B$	P value $A = B$
$\ln \hat{c}_t$ i				
Australia	0.000	0.004	0.000	0.000
Canada	0.000	0.048	0.000	0.000
NZ	0.001	0.200	0.001	0.000
Sweden	0.000	0.083	0.000	0.000
UK	0.000	0.009	0.000	0.000
$\ln(100 - \hat{h}_t)$ ii				
Australia	0.000	0.897	0.000	0.000
Canada	0.981	0.499	0.847	0.966
NZ	0.045	0.339	0.167	0.138
Sweden	0.000	0.001	0.000	0.000
UK	0.000	0.836	0.000	0.000
$\Delta \ln \hat{c}_t$				
Australia	0.000	0.252	0.000	0.000
Canada	0.212	0.572	0.319	0.006
NZ	0.275	0.374	0.428	0.416
Sweden	0.026	0.375	0.033	0.001
UK	0.990	0.501	0.845	0.027
$\Delta \ln(1 - \hat{h}_t)$				
Australia	0.397	0.548	0.561	0.281
Canada	0.151	0.417	0.550	0.043
NZ	0.000	0.880	0.001	0.000
Sweden	0.299	0.442	0.175	0.332
UK	0.712	0.479	0.557	0.103
$U = \ln \hat{c}_t + 1.57 \ln(100 - \hat{h}_t)$ iii				
Australia	0.000	0.001	0.000	0.000
	[0.00;0.00]	[0.001; 0.002]	[0.000;0.000]	[0.000;0.000]
Canada	0.000	0.008	0.000	0.000
	[0.00;0.00]	[0.005;0.013]	[0.000;0.000]	[0.000;0.000]
NZ	0.000	0.097	0.001	0.000
	[0.00;0.00]	[0.082;0.114]	[0.0010.001]	[0.000; 0.000]
Sweden	0.000	0.003	0.000	0.000
	0.00;0.00]	[0.001;0.007]	[0.000;0.000]	[0.000;0.000]
UK	0.000	0.001	0.000	0.000
	[0.00;0.00]	[0.001;0.001]	[0.000;0.000]	[0.000;0.000]

A denotes period under inflation-targeting regime and B is the period before inflation targeting. The periods before inflation targeting are: March 1980 to December 1992 for Australia; March 1980 to December 1990 for Canada; March 1980 to December 1989 for New Zealand; March 1980 to December 1992 for Sweden and March 1980 to December 1991 for the UK.

In column 3 H0 is that $A = B$ and the p value is for $prob >| Z |= 0$

In column 4 we report $p\{B\} > \{A\}$

i $\ln \hat{c}_t$ denotes consumption per capita.

ii $\ln(100 - \hat{h}_t)$ denotes leisure per capita.

iii $\ln \hat{c}_t + 1.57 \ln(100 - \hat{h}_t)$; we use 1.57 as a value for α in equation 1. This value id taken from Prescott (2004). We also conducted a sensitivity analysis by using [$\pm$ 20%] of the value. The p values are in square brackets.

* The test is in Hope, A. C. A. (1968). We calculate Pearson, Fisher's exact and one-sided Fisher's exact p values but do not report them because the values are identical to the one we reported here.

Table 3 – Univariate Statistics – Sudden Change in the Variance of GDP Per Capita Growth

Australia Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	0.004593	6.51E-05	7	0.032153	0.002839	6	0.000391	8.13982E-05	0.514428	4.800008	0.569708	0.17563
1982-1983	-0.00319	0.000258	8	-0.02555	0.002839	7	0.001809	8.13982E-05	-1.89125	22.2213	0.002327	-2.83013[#]
1984-1985	0.009018	5.66E-05	8	0.072145	0.002839	7	0.000396	8.13982E-05	1.937111	4.868396	0.67602	0.456597
1986-1987	0.004641	6.65E-05	8	0.037128	0.002839	7	0.000465	8.13982E-05	0.5649	5.717351	0.573113	0.184305
1988-1989	0.004157	3.56E-05	8	0.033252	0.002839	7	0.000249	8.13982E-05	0.413013	3.059799	0.879416	1.172072
1990-1991	-0.00403	2.11E-05	8	-0.03227	0.002839	7	0.000148	8.13982E-05	-2.15449[#]	1.812091	0.969505	1.873568
1992	0.006983	4.13E-05	4	0.027931	0.002839	3	0.000124	8.13982E-05	0.918554	1.521055	0.677419	0.460495
Australia – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	0.007817	5.93E-05	8	0.062532	0.005895	7	0.000415	3.32751E-05	0.942276	12.46467	0.086277	-1.36405
1995-1996	0.006847	1.35E-05	8	0.054777	0.005895	7	9.45E-05	3.32751E-05	0.466947	2.84044	0.89936	1.277914
1997-1998	0.009274	6.47E-05	8	0.074189	0.005895	7	0.000453	3.32751E-05	1.656696	13.60798	0.05861	-1.56655
1999-2000	0.003039	5.29E-05	8	0.024314	0.005895	7	0.00037	3.32751E-05	-1.40013	11.12037	0.133454	-1.11021
2001-2002	0.00564	1.3E-05	8	0.045119	0.005895	7	9.12E-05	3.32751E-05	-0.12501	2.741685	0.907826	1.327489
2003-2004	0.005034	3.1E-05	8	0.040269	0.005895	7	0.000217	3.32751E-05	-0.42229	6.521594	0.480327	-0.04933
2005-2006	0.003943	8.44E-06	8	0.031542	0.005895	7	5.91E-05	3.32751E-05	-0.95714	1.774603	0.971257	1.899592
2007	0.005237	1.03E-05	4	0.020947	0.005895	3	3.09E-05	3.32751E-05	-0.22818	0.928654	0.818508	0.909694

Continued – Table 3

Canada Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	0.00027	0.000127	7	0.001891	0.005564	6	0.000764	8.89307E-05	-1.48533	8.586489	0.198204	-0.84806
1982-1983	0.00284	0.000186	8	0.022723	0.005564	7	0.0013	8.89307E-05	-0.817	14.61729	0.04123	-1.73658
1984-1985	0.013037	3.61E-05	8	0.104298	0.005564	7	0.000253	8.89307E-05	2.241325#	2.839892	0.899408	1.278186
1986-1987	0.008216	9.19E-05	8	0.065732	0.005564	7	0.000643	8.89307E-05	0.795448	7.231128	0.405218	-0.23986
1988-1989	0.007064	2.63E-05	8	0.05651	0.005564	7	0.000184	8.89307E-05	0.44972	2.067877	0.955988	1.705916
1990	-0.00297	4.91E-05	4	-0.01189	0.005564	3	0.000147	8.89307E-05	-1.81032	1.657329	0.646462	0.375786

Canada – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1991-1992	-0.0024	4.37E-05	8	-0.01922	0.006089	7	0.000306	1.93672E-05	-5.45725*	15.80114	0.026997	-1.92689
1993-1994	0.004247	1.26E-05	8	0.033979	0.006089	7	8.85E-05	1.93672E-05	-1.18335	4.568926	0.712402	0.560417
1995-1996	0.005085	2.15E-05	8	0.040683	0.006089	7	0.00015	1.93672E-05	-0.64471	7.762884	0.353966	-0.37463
1997-1998	0.010708	1.64E-05	8	0.08566	0.006089	7	0.000114	1.93672E-05	2.968662#	5.909541	0.550351	0.126547
1999-2000	0.012182	1.8E-05	8	0.097453	0.006089	7	0.000126	1.93672E-05	3.916033*	6.517466	0.480785	-0.04818
2001-2002	0.005878	1.91E-05	8	0.047021	0.006089	7	0.000134	1.93672E-05	-0.13559	6.917573	0.437512	-0.15728
2003-2004	0.006208	1.82E-05	8	0.049664	0.006089	7	0.000127	1.93672E-05	0.076756	6.570968	0.474872	-0.06303
2005-2006	0.006302	8.23E-06	8	0.050416	0.006089	7	5.76E-05	1.93672E-05	0.137207	2.972865	0.887501	1.213346
2007	0.007091	1.28E-05	4	0.028365	0.006089	3	3.83E-05	1.93672E-05	0.455733	1.978638	0.576852	0.193848

Continued – Table 3

New Zealand Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	0.004318	0.000175	8	0.034546	0.00182	7	0.001222	0.00021	0.487394	5.815589	0.56144	0.154621
1982-1983	-0.00068	0.000212	8	-0.00544	0.00182	7	0.001484	0.00021	-0.48791	7.062894	0.422361	-0.19586
1984-1985	0.004403	0.000168	8	0.035224	0.00182	7	0.001176	0.00021	0.503927	5.59701	0.58751	0.221144
1986-1987	0.00094	0.000245	8	0.00752	0.00182	7	0.001715	0.00021	-0.1718	8.162307	0.3185	-0.4719
1988-1989	0.000121	0.000251	8	0.000968	0.00182	7	0.001757	0.00021	-0.33161	8.3622	0.301741	-0.5194

New Zealand – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1990-1991	-0.00384	0.000218	8	-0.03069	0.004114	7	0.001526	9.91056E-05	-2.25908[#]	15.40126	0.031186	-1.86364
1992-1993	0.00662	0.000158	8	0.05296	0.004114	7	0.001106	9.91056E-05	0.711863	11.15982	0.131798	-1.11793
1994-1995	0.006388	6.05E-05	8	0.051104	0.004114	7	0.000424	9.91056E-05	0.645948	4.273222	0.747825	0.667659
1996-1997	0.004227	0.000126	8	0.033816	0.004114	7	0.000882	9.91056E-05	0.031972	8.899602	0.259945	-0.64352
1998-1999	0.005881	7.72E-05	8	0.047048	0.004114	7	0.00054	9.91056E-05	0.501901	5.452772	0.604886	0.266016
2000-2001	0.005709	0.00011	8	0.045672	0.004114	7	0.00077	9.91056E-05	0.453033	7.769494	0.353358	-0.37627
2002-2003	0.005031	5.34E-05	8	0.040248	0.004114	7	0.000374	9.91056E-05	0.260402	3.771736	0.805662	0.862019
2004-2005	0.004315	5.84E-05	8	0.03452	0.004114	7	0.000409	9.91056E-05	0.056975	4.124895	0.765285	0.723406
2006-2007	0.002696	3.04E-05	8	0.021568	0.004114	7	0.000213	9.91056E-05	-0.40301	2.147206	0.951245	1.65705

Continued – Table 3

Sweden Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	-0.00501	0.000581	7	-0.03506	0.000278	6	0.003483	0.005195	-0.19406	0.670434	0.995107	2.583305#
1982-1983	-0.00205	0.007707	8	-0.01642	0.000278	7	0.05395	0.005195	-0.09146	10.38437	0.167817	-0.96283
1984-1985	0.004072	0.005897	8	0.032578	0.000278	7	0.041278	0.005195	0.148902	7.94536	0.337437	-0.41947
1986-1987	0.012773	0.006315	8	0.102187	0.000278	7	0.044205	0.005195	0.490345	8.50881	0.289869	-0.55377
1988-1989	0.00099	0.005931	8	0.007924	0.000278	7	0.041516	0.005195	0.027971	7.991155	0.333374	-0.43061
1990-1991	-0.00426	0.00499	8	-0.03407	0.000278	7	0.034933	0.005195	-0.17802	6.724066	0.458164	-0.10506
1992	-0.01074	0.003075	4	-0.04297	0.000278	3	0.009226	0.005195	-0.30578	1.775802	0.620215	0.306045

Sweden – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	0.000395	0.000446	8	0.003157	0.005435	7	0.003125	8.32182E-05	-1.56289	37.54979	3.68968E-06	-4.48263*
1995-1996	0.004578	2.36E-05	8	0.036624	0.005435	7	0.000165	8.32182E-05	-0.2658	1.982425	0.960806667	1.760124
1997-1998	0.008382	1.13E-05	8	0.067056	0.005435	7	7.94E-05	8.32182E-05	0.91364	0.954021	0.99553654	2.614843#
1999-2000	0.009027	3.72E-05	8	0.072216	0.005435	7	0.000261	8.32182E-05	1.113625	3.131108	0.872614508	1.138838
2001-2002	0.003209	1.55E-05	8	0.025672	0.005435	7	0.000109	8.32182E-05	-0.69026	1.305088	0.988302696	2.266927#
2003-2004	0.005698	1.59E-05	8	0.045584	0.005435	7	0.000111	8.32182E-05	0.081458	1.339593	0.987350074	2.236792#
2005-2006	0.007524	6.73E-05	8	0.060192	0.005435	7	0.000471	8.32182E-05	0.647615	5.660802	0.579865631	0.20155
2007	0.003904	2.14E-06	4	0.015616	0.005435	3	6.42E-06	8.32182E-05	-0.33572	0.077178	0.994427779	2.538138#

Continued – Table 3												
UK Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1980-1981	-0.00501	0.000581	7	-0.03506	0.002948	6	0.003483	0.00016996	-1.61492	20.49347	0.002261	-2.83923#
1982-1983	0.006194	0.000124	8	0.049552	0.002948	7	0.000868	0.00016996	0.704143	5.10707	0.646899	0.376961
1984-1985	0.005429	0.000177	8	0.043432	0.002948	7	0.001239	0.00016996	0.538172	7.289931	0.399329	-0.25508
1986-1987	0.008442	3.58E-05	8	0.067536	0.002948	7	0.000251	0.00016996	1.191859	1.474461	0.983181	2.124376#
1988-1989	0.00452	3.31E-05	8	0.03616	0.002948	7	0.000232	0.00016996	0.340959	1.363258	0.98667	2.216463#
1990-1991	-0.00288	0.000128	8	-0.02304	0.002948	7	0.000896	0.00016996	-1.26451	5.271814	0.62683	0.32347
UK – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1992-1993	-0.00416	0.001653	8	-0.03325	0.005598	7	0.011572	0.000266	-1.69178	43.51824	2.64873E-07	-5.01552*
1994-1995	0.011825	0.000372	8	0.094602	0.005598	7	0.002602	0.000266	1.080079	9.784479	0.201119351	-0.83763
1996-1997	0.005824	2.12E-05	8	0.046591	0.005598	7	0.000148	0.000266	0.039151	0.556997	0.999209868	3.15955*
1998-1999	0.009466	2.05E-05	8	0.075725	0.005598	7	0.000144	0.000266	0.670802	0.539937	0.99928671	3.189245*
2000-2001	0.004392	3.23E-05	8	0.035134	0.005598	7	0.000226	0.000266	-0.20926	0.849413	0.996906368	2.737694#
2002-2003	0.004314	1.49E-05	8	0.034514	0.005598	7	0.000104	0.000266	-0.2227	0.392191	0.999753385	3.484455*
2004-2005	0.007346	5.22E-06	8	0.058771	0.005598	7	3.65E-05	0.000266	0.303228	0.137397	0.999993074	4.346351*
2006-2007	0.005774	8.41E-06	8	0.046191	0.005598	7	5.89E-05	0.000266	0.030472	0.221345	0.999964421	3.972486*

Table 4 – Univariate Statistics – Sudden Change in the Variance of Consumption Growth

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
Australia Before Inflation Targeting												
1980-1981	0.001689	4.74E-05	7	0.011826	-0.00102	6	0.000284	5.20772E-05	0.993393	5.461189	0.48616	-0.0347
1982-1983	-0.00361	6.81E-05	8	-0.02892	-0.00102	7	0.000477	5.20772E-05	-1.01682	9.154375	0.241762	-0.70065
1984-1985	0.002023	8.01E-05	8	0.016184	-0.00102	7	0.000561	5.20772E-05	1.192714	10.77124	0.148914	-1.0411
1986-1987	-0.00425	6.89E-05	8	-0.03399	-0.00102	7	0.000482	5.20772E-05	-1.26523	9.255364	0.234838	-0.72301
1988-1989	0.001499	2.81E-05	8	0.011989	-0.00102	7	0.000197	5.20772E-05	0.98722	3.779026	0.804848	0.859068
1990-1991	-0.00358	3.76E-05	8	-0.02867	-0.00102	7	0.000263	5.20772E-05	-1.00462	5.05226	0.653586	0.395019
1992	-0.00011	9.14E-06	4	-0.00046	-0.00102	3	2.74E-05	5.20772E-05	0.251017	0.526549	0.913021	1.359597
Australia – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	0.002765	6.67E-05	8	0.022123	0.003146	7	0.000467	2.74641E-05	-0.20562	16.99102	0.017454	-2.10942[#]
1995-1996	0.001233	2.88E-05	8	0.009865	0.003146	7	0.000202	2.74641E-05	-1.03263	7.351151	0.393256	-0.27084
1997-1998	0.006159	1.85E-05	8	0.049272	0.003146	7	0.000129	2.74641E-05	1.625941	4.702578	0.696206	0.513519
1999-2000	0.003795	2.65E-05	8	0.030363	0.003146	7	0.000185	2.74641E-05	0.350294	6.752324	0.455115	-0.11275
2001-2002	0.001572	1.45E-05	8	0.01258	0.003146	7	0.000102	2.74641E-05	-0.84945	3.704693	0.813093	0.889352
2003-2004	0.005692	3.4E-05	8	0.045537	0.003146	7	0.000238	2.74641E-05	1.373984	8.678046	0.276605	-0.59296
2005-2006	0.000421	7.19E-06	8	0.003368	0.003146	7	5.03E-05	2.74641E-05	-1.47095	1.83279	0.968513	1.85937
2007	0.003919	1.82E-05	4	0.015675	0.003146	3	5.46E-05	2.74641E-05	0.294746	1.987402	0.575026	0.189184

Continued – Table 4

	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
Canada Before Inflation Targeting												
1980-1981	-0.00497	5.78E-05	7	-0.03476	0.004712	6	0.000347	7.7659E-05	-2.90562[#]	4.462465	0.614351	0.290679
1982-1983	0.00284	0.000186	8	0.022723	0.004712	7	0.0013	7.7659E-05	-0.6007	16.73888	0.01916	-2.07142[#]
1984-1985	0.013037	3.61E-05	8	0.104298	0.004712	7	0.000253	7.7659E-05	2.67206[#]	3.252082	0.860745	1.083672
1986-1987	0.008216	9.19E-05	8	0.065732	0.004712	7	0.000643	7.7659E-05	1.124807	8.280676	0.308496	-0.50012
1988-1989	0.007064	2.63E-05	8	0.05651	0.004712	7	0.000184	7.7659E-05	0.754839	2.368015	0.936704	1.527677
1990	-0.00297	4.91E-05	4	-0.01189	0.004712	3	0.000147	7.7659E-05	-1.7438	1.897879	0.59387	0.237513
Canada – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i \overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1991-1992	-0.00118	2.52E-05	8	-0.00942	0.002539	7	0.000176	2.17636E-05	-2.25315[#]	8.103132	0.323588	-0.45769
1993-1994	0.001633	2.25E-05	8	0.013064	0.002539	7	0.000158	2.17636E-05	-0.5494	7.244277	0.403897	-0.24327
1995-1996	0.000569	4.24E-05	8	0.00455	0.002539	7	0.000296	2.17636E-05	-1.19462	13.62221	0.058323	-1.56901
1997-1998	0.003389	2.38E-05	8	0.027112	0.002539	7	0.000167	2.17636E-05	0.51529	7.665587	0.363003	-0.35044
1999-2000	0.004788	1.41E-05	8	0.038306	0.002539	7	9.85E-05	2.17636E-05	1.36363	4.52668	0.717502	0.575437
2001-2002	0.001759	2.91E-05	8	0.01407	0.002539	7	0.000204	2.17636E-05	-0.47312	9.364156	0.227557	-0.74691
2003-2004	0.002263	1.19E-05	8	0.018107	0.002539	7	8.3E-05	2.17636E-05	-0.16718	3.815653	0.800749	0.844299
2005-2006	0.004407	8.83E-06	8	0.035257	0.002539	7	6.18E-05	2.17636E-05	1.132557	2.838743	0.899508	1.278755
2007	0.007903	1.32E-05	4	0.031611	0.002539	3	3.96E-05	2.17636E-05	2.299496[#]	1.819558	0.610688	0.281113

Continued – Table 4

New Zealand Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	ν_i	η_i	$R_i(S_i^2)$
1987-1988	0.002138	9.18E-05	5	0.010688	-0.00235	4	0.000367	0.000315	0.565211	1.164655	0.883883	1.194624
1988-1989	-0.00684	0.000539	5	-0.0342	-0.00235	4	0.002156	0.000315	-0.56521	6.835345	0.14485	-1.05878

New Zealand – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	ν_i	η_i	$R_i(S_i^2)$
1991-1992	-0.00602	7.95E-05	8	-0.04817	0.005873	7	0.000557	7.32872E-05	-3.9298	7.594411	0.369712	-0.33262
1993-1994	0.001427	5.44E-05	8	0.011417	0.005873	7	0.000381	7.32872E-05	-1.46879	5.195322	0.636141	0.348162
1995-1996	0.010165	5.77E-05	8	0.081321	0.005873	7	0.000404	7.32872E-05	1.418204	5.513427	0.597565	0.247049
1997-1998	0.007721	0.000129	8	0.061767	0.005873	7	0.000902	7.32872E-05	0.610663	12.31019	0.090809	-1.33579
1999-2000	0.00775	7.36E-05	8	0.062002	0.005873	7	0.000515	7.32872E-05	0.620339	7.031304	0.425628	-0.18752
2001-2002	0.008058	0.000115	8	0.064465	0.005873	7	0.000808	7.32872E-05	0.722076	11.01891	0.137797	-1.09027
2003-2004	0.010004	5.19E-05	8	0.080035	0.005873	7	0.000363	7.32872E-05	1.365075	4.956933	0.665219	0.426749
2005-2006	0.007775	5.99E-05	8	0.062203	0.005873	7	0.000419	7.32872E-05	0.62864	5.720057	0.57279	0.183483
2007	0.005989	3.25E-05	7	0.041922	0.005873	6	0.000195	7.32872E-05	0.035908	2.659452	0.850213	1.037347

Continued – Table 4												
Sweden Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1980-1981	-0.00301	0.000367	7	-0.0211	0.001128778	6	0.002204576	0.000157621	-0.87303	13.98659	0.029786	-1.88394
1982-1983	-0.00165	0.000121	8	-0.01322	0.001128778	7	0.000850354	0.000157621	-0.62667	5.394933	0.611885	0.284236
1984-1985	0.00488	0.000147	8	0.03904	0.001128778	7	0.001029158	0.000157621	0.845115	6.529333	0.47947	-0.05148
1986-1987	0.012957	0.000177	8	0.103654	0.001128778	7	0.001236652	0.000157621	2.664693#	7.845741	0.346393	-0.39508
1988-1989	0.001221	6.56E-05	8	0.009769	0.001128778	7	0.00045922	0.000157621	0.020818	2.913446	0.892892	1.242056
1990-1991	-0.00325	0.000155	8	-0.02602	0.001128778	7	0.001088457	0.000157621	-0.98715	6.905542	0.438781	-0.15406
1992	-0.00864	2.23E-05	4	-0.03455	0.001128778	3	6.68973E-05	0.000157621	-1.55587	0.424419	0.935153	1.515311
Sweden – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1993-1994	-0.0038	0.000297	8	-0.03042	0.003168	7	0.002077	6.60116E-05	-2.42689#	31.46235	5.10777E-05	-3.88551*
1995-1996	0.002324	1.71E-05	8	0.018595	0.003168	7	0.00012	6.60116E-05	-0.2938	1.813033	0.969460299	1.872919
1997-1998	0.006889	7.66E-06	8	0.055111	0.003168	7	5.36E-05	6.60116E-05	1.295185	0.812518	0.997314099	2.783856#
1999-2000	0.008681	0.000133	8	0.069444	0.003168	7	0.000932	6.60116E-05	1.918936	14.11752	0.049130215	-1.65335
2001-2002	0.00218	2.19E-05	8	0.017437	0.003168	7	0.000154	6.60116E-05	-0.3442	2.325816	0.939632647	1.551697
2003-2004	0.002731	7.51E-06	8	0.021851	0.003168	7	5.25E-05	6.60116E-05	-0.15212	0.796063	0.99748392	2.804976#
2005-2006	0.003186	4.74E-06	8	0.025488	0.003168	7	3.32E-05	6.60116E-05	0.006156	0.502773	0.999436266	3.256652*
2007	0.00315	3.74E-06	4	0.012598	0.003168	3	1.12E-05	6.60116E-05	-0.00462	0.169924	0.98229201	2.103568#

Continued – Table 4

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
UK Before Inflation Targeting												
1980-1981	-0.00425	0.000229	7	-0.02972	0.005172	6	0.001373	8.05496E-05	-2.77623#	17.04514	0.009119	-2.36076#
1982-1983	0.00567	4.65E-05	8	0.045357	0.005172	7	0.000325	8.05496E-05	0.156725	4.040241	0.775131	0.755851
1984-1985	0.007176	6.49E-05	8	0.05741	0.005172	7	0.000454	8.05496E-05	0.631537	5.640564	0.582288	0.20775
1986-1987	0.014566	6.16E-05	8	0.116528	0.005172	7	0.000431	8.05496E-05	2.960399#	5.351421	0.61716	0.298032
1988-1989	0.009582	6.89E-05	8	0.07666	0.005172	7	0.000482	8.05496E-05	1.389845	5.9891	0.541023	0.10301
1990-1991	-0.00289	3.38E-05	8	-0.02314	0.005172	7	0.000236	8.05496E-05	-2.54158#	2.933538	0.891082	1.232301
UK – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1992-1993	0.005969	4.85E-05	8	0.047753	0.005178	7	0.000339425	2.96869E-05	0.410721	11.43348	0.120797	-1.17101
1994-1995	0.004162	2.7E-05	8	0.033298	0.005178	7	0.000188821	2.96869E-05	-0.52727	6.360396	0.498353	-0.00413
1996-1997	0.007856	3.67E-05	8	0.062845	0.005178	7	0.000257073	2.96869E-05	1.39002	8.659465	0.278038	-0.58868
1998-1999	0.007856	3.67E-05	8	0.062845	0.005178	7	0.000257073	2.96869E-05	1.39002	8.659465	0.278038	-0.58868
2000-2001	0.005793	4.04E-05	8	0.046344	0.005178	7	0.000282815	2.96869E-05	0.319303	9.526595	0.217025	-0.78228
2002-2003	0.004833	9.67E-06	8	0.038667	0.005178	7	6.76937E-05	2.96869E-05	-0.17889	2.280254	0.942716	1.577993
2004-2005	0.002009	2.1E-05	8	0.016073	0.005178	7	0.000147342	2.96869E-05	-1.64499	4.963195	0.664455	0.424652
2006-2007	0.002945	1.75E-05	8	0.023564	0.005178	7	0.000122226	2.96869E-05	-1.15892	4.117153	0.766189	0.726354

Table 5 – Univariate Statistics – Sudden Change in the Variance of Leisure Growth

	$\bar{X}_i$	S_i^2	n_i	$n_i\bar{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\bar{X}_i)$	v i	η_i	$R_i(S_i^2)$
Australia Before Inflation Targeting												
1980-1981	-0.00126	7.83E-07	7	-0.00885	-9.9E-05	6	4.7E-06	9.7352E-06	-0.98834	0.482425	0.998046	2.885479#
1982-1983	0.001939	1.13E-05	8	0.015516	-9.9E-05	7	7.9E-05	9.7352E-06	1.847598	8.115429	0.322526	-0.46065
1984-1985	-0.00051	3.8E-06	8	-0.00407	-9.9E-05	7	2.66E-05	9.7352E-06	-0.37193	2.735463	0.908349	1.330655
1986-1987	-0.00142	5.03E-06	8	-0.01133	-9.9E-05	7	3.52E-05	9.7352E-06	-1.19421	3.61564	0.82283	0.926202
1988-1989	-0.00157	1.05E-05	8	-0.01256	-9.9E-05	7	7.35E-05	9.7352E-06	-1.33363	7.552791	0.373673	-0.32214
1990-1991	0.002206	2.53E-05	8	0.01765	-9.9E-05	7	0.000177	9.7352E-06	2.089479#	18.21935	0.011019	-2.28973#
1992	-0.00035	1.06E-05	4	-0.00139	-9.9E-05	3	3.19E-05	9.7352E-06	-0.15952	3.2789	0.35059	-0.38373
Australia – Inflation Targeting												
	$\bar{X}_i$	S_i^2	n_i	$n_i\bar{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\bar{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	-0.00081	7.06E-06	8	-0.0065	-0.00054	7	4.94E-05	4.99333E-06	-0.3412	9.900681	0.194272	-0.86226
1995-1996	-0.00046	1.27E-05	8	-0.00365	-0.00054	7	8.9E-05	4.99333E-06	0.110126	17.82713	0.012775	-2.23299#
1997-1998	-0.00075	1.44E-06	8	-0.00601	-0.00054	7	1.01E-05	4.99333E-06	-0.26398	2.012898	0.959123	1.740598
1999-2000	-0.00058	3.78E-06	8	-0.0046	-0.00054	7	2.65E-05	4.99333E-06	-0.04096	5.29991	0.623415	0.314462
2001-2002	0.001131	8.02E-07	8	0.00905	-0.00054	7	5.61E-06	4.99333E-06	2.119448#	1.1245	0.992563	2.435417#
2003-2004	-0.00143	5.99E-06	8	-0.01141	-0.00054	7	4.19E-05	4.99333E-06	-1.11716	8.395625	0.299003	-0.52727
2005-2006	-0.00056	2.91E-06	8	-0.00447	-0.00054	7	2.04E-05	4.99333E-06	-0.01974	4.083458	0.770116	0.739229
2007	-0.00125	5.59E-06	4	-0.005	-0.00054	3	1.68E-05	4.99333E-06	-0.63148	3.355794	0.339952	-0.41259

Continued – Table 5

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
Canada Before Inflation Targeting												
1980-1981	-0.00107	1.55E-06	7	-0.00751	-0.00019	6	9.27E-06	9.36386E-06	-0.76432	0.990262	0.985979	$2.19669^{\#}$
1982-1983	0.00251	2.97E-05	8	0.020081	-0.00019	7	0.000208	9.36386E-06	$2.494202^{\#}$	22.22161	0.002326	$-2.83017^{\#}$
1984-1985	-0.00041	3.33E-06	8	-0.00331	-0.00019	7	2.33E-05	9.36386E-06	-0.20883	2.48567	0.928172	1.462313
1986-1987	-0.00221	1.25E-05	8	-0.0177	-0.00019	7	8.73E-05	9.36386E-06	-1.87117	9.324102	0.230217	-0.73813
1988-1989	-0.00059	2.57E-06	8	-0.00473	-0.00019	7	1.8E-05	9.36386E-06	-0.37195	1.923805	0.963937	1.79832
1990	0.001267	1.7E-07	4	0.005069	-0.00019	3	5.11E-07	9.36386E-06	0.951344	0.054551	0.996666	$2.713017^{\#}$
Canada – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1991-1992	0.001969	2.44E-05	8	0.01575	-0.0001	7	0.00017	5.29555E-06	$2.548298^{\#}$	32.19508	3.74E-05	-3.96078^{*}
1993-1994	-0.00013	3.83E-06	8	-0.00101	-0.0001	7	2.68E-05	5.29555E-06	-0.02658	5.061198	0.652495	0.392065
1995-1996	0.000326	2.85E-06	8	0.002611	-0.0001	7	1.99E-05	5.29555E-06	0.529702	3.761601	0.80679	0.866129
1997-1998	-0.00073	9.42E-07	8	-0.00582	-0.0001	7	6.59E-06	5.29555E-06	-0.76638	1.244615	0.989863	$2.321241^{\#}$
1999-2000	-0.00121	5.58E-06	8	-0.00968	-0.0001	7	3.9E-05	5.29555E-06	-1.35915	7.371855	0.391215	-0.27615
2001-2002	0.000319	2.07E-06	8	0.002555	-0.0001	7	1.45E-05	5.29555E-06	0.520995	2.740353	0.907938	1.328167
2003-2004	-0.00119	2.79E-06	8	-0.00953	-0.0001	7	1.95E-05	5.29555E-06	-1.33539	3.683306	0.815446	0.898145
2005-2006	-6.9E-05	1.89E-06	8	-0.00055	-0.0001	7	1.32E-05	5.29555E-06	0.043656	2.491989	0.927699	1.458867
2007	-0.00036	7.94E-07	4	-0.00143	-0.0001	3	2.38E-06	5.29555E-06	-0.21943	0.45	0.929731	1.473788

Continued – Table 5												
New Zealand Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1986-1987	3.01E-05	6.79E-07	5	0.00015	0.001772	4	2.72E-06	2.81E-05	-0.73516	0.09672	0.998868	3.053154*
1987-1988	0.002767	4.08E-05	5	0.013834	0.001772	4	0.000163	2.81E-05	0.419769	5.814448	0.213441	-0.79454
1988-1989	0.00252	2.87E-05	5	0.012598	0.001772	4	0.000115	2.81E-05	0.315394	4.088832	0.394117	-0.2686
New Zealand – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1991-1992	0.002301	1.93117E-05	8	0.018412	-0.00038	7	0.000135	6.6577E-06	2.93796#	20.30457	0.004948	-2.57944#
1993-1994	-0.00137	3.03283E-06	8	-0.01096	-0.00038	7	2.12E-05	6.6577E-06	-1.08627	3.188765	0.867008	1.112359
1995-1996	-0.001365	1.25875E-05	8	-0.01092	-0.00038	7	8.81E-05	6.6577E-06	-1.08159	13.23471	0.066592	-1.50166
1997-1998	-0.000609	2.00579E-06	8	-0.00487	-0.00038	7	1.4E-05	6.6577E-06	-0.2522	2.108913	0.953567	1.680468
1999-2000	0.000365	3.95576E-06	8	0.002921	-0.00038	7	2.77E-05	6.6577E-06	0.815316	4.15914	0.761276	0.710413
2001-2002	-0.000812	8.86549E-06	8	-0.00649	-0.00038	7	6.21E-05	6.6577E-06	-0.47445	9.321298	0.230404	-0.73752
2003-2004	-0.000694	9.81773E-07	8	-0.00555	-0.00038	7	6.87E-06	6.6577E-06	-0.34539	1.03225	0.994291	2.529664#
2005-2006	-0.000971	6.57359E-06	8	-0.00777	-0.00038	7	4.6E-05	6.6577E-06	-0.6496	6.911567	0.438145	-0.15567
2007	-0.000254	2.60486E-06	8	-0.00204	-0.00038	7	1.82E-05	6.6577E-06	0.13623	2.738792	0.908069	1.328961

Continued – Table 5

Sweden Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	-0.00072	2.6E-07	7	-0.00503	-5.93108E-05	6	1.55707E-06	6.35604E-06	-0.69238	0.244974	0.999721	3.450834*
1982-1983	-0.00026	2.92E-07	8	-0.00211	-5.93108E-05	7	2.04726E-06	6.35604E-06	-0.22888	0.322097	0.999873	3.657859*
1984-1985	-0.00015	1.36E-06	8	-0.00121	-5.93108E-05	7	9.52315E-06	6.35604E-06	-0.1029	1.498283	0.982369	2.105336#
1986-1987	-0.00034	4.37E-06	8	-0.00273	-5.93108E-05	7	3.05978E-05	6.35604E-06	-0.31568	4.813977	0.682652	0.475129
1988-1989	-0.00101	3.54E-06	8	-0.00811	-5.93108E-05	7	2.47711E-05	6.35604E-06	-1.07011	3.897247	0.791534	0.811754
1990-1991	0.001496	1.78E-05	8	0.011972	-5.93108E-05	7	0.000124617	6.35604E-06	1.745435	19.60613	0.006486	-2.48452#
1992	0.001046	2.89E-05	4	0.004182	-5.93108E-05	3	8.65521E-05	6.35604E-06	0.876523	13.6173	0.003475	-2.69922#

Sweden – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	$n_i - 1$	$(n_i - 1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	0.002719	5.54E-05	8	0.021754	0.000205	7	0.000388	1.15123E-05	2.096153#	33.70174	1.95851E-05	-4.11245*
1995-1996	7.78E-05	6.58E-06	8	0.000622	0.000205	7	4.61E-05	1.15123E-05	-0.10576	4.000225	0.779751482	0.771354
1997-1998	-0.00076	6.72E-06	8	-0.00604	0.000205	7	4.7E-05	1.15123E-05	-0.80031	4.083337	0.770130201	0.739275
1999-2000	0.000258	5.62E-06	8	0.002061	0.000205	7	3.93E-05	1.15123E-05	0.04416	3.416285	0.844011352	1.011082
2001-2002	0.000496	2.4E-06	8	0.003966	0.000205	7	1.68E-05	1.15123E-05	0.242706	1.458776	0.983702616	2.137038#
2003-2004	-0.00072	4.46E-06	8	-0.00575	0.000205	7	3.12E-05	1.15123E-05	-0.76949	2.709486	0.910514593	1.343931
2005-2006	-0.00012	2.4E-06	8	-0.00099	0.000205	7	1.68E-05	1.15123E-05	-0.27421	1.458486	0.983712165	2.137273#
2007	-0.00083	4.5E-06	4	-0.00334	0.000205	3	1.35E-05	1.15123E-05	-0.6127	1.171661	0.759809007	0.705688

Continued – Table 5

UK Before Inflation Targeting

	$\bar{X}_i$	S_i^2	n_i	$n_i\bar{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\bar{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1980-1981	0.000977	8.56E-07	7	0.006839	4.81E-05	6	5.14E-06	1.44893E-05	0.645719	0.354651	0.999186	3.150841*
1982-1983	0.001522	2.59E-05	8	0.012172	4.81E-05	7	0.000181	1.44893E-05	1.094889	12.50917	0.08501	-1.37214
1984-1985	-0.00089	3.64E-06	8	-0.00709	4.81E-05	7	2.55E-05	1.44893E-05	-0.69384	1.758802	0.971977	1.910684
1986-1987	-0.00186	5.94E-06	8	-0.01485	4.81E-05	7	4.16E-05	1.44893E-05	-1.41497	2.869885	0.896772	1.263373
1988-1989	-0.00235	2.54E-05	8	-0.01881	4.81E-05	7	0.000178	1.44893E-05	-1.78316	12.29081	0.091392	-1.33223
1990-1991	0.002999	2.32E-05	8	0.023996	4.81E-05	7	0.000163	1.44893E-05	2.193057#	11.21669	0.129443	-1.12903

UK – Inflation Targeting

	$\bar{X}_i$	S_i^2	n_i	$n_i\bar{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\bar{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1992-1993	0.000718	5.26E-06	8	0.005747	-0.00045	7	3.67956E-05	9.50869E-06	1.07419	3.869676	0.79466	0.822697
1994-1995	-0.00071	3.21E-06	8	-0.00565	-0.00045	7	2.24983E-05	9.50869E-06	-0.23295	2.366079	0.936839	1.528772
1996-1997	-0.00362	5.2E-05	8	-0.02894	-0.00045	7	0.000363852	9.50869E-06	-2.90261#	38.26518	2.7E-06	-4.54898*
1998-1999	0.000116	6.41E-07	8	0.000929	-0.00045	7	4.48509E-06	9.50869E-06	0.521843	0.471684	0.999544	3.316207*
2000-2001	-0.00023	3.23E-06	8	-0.00181	-0.00045	7	2.26194E-05	9.50869E-06	0.207187	2.378816	0.935943	1.521579
2002-2003	0.000523	1.08E-05	8	0.004187	-0.00045	7	7.57837E-05	9.50869E-06	0.895298	7.969939	0.335252	-0.42546
2004-2005	-0.00018	3.04E-07	8	-0.00146	-0.00045	7	2.12598E-06	9.50869E-06	0.247363	0.223583	0.999963	3.964298*
2006-2007	-0.00025	6.18E-07	8	-0.00197	-0.00045	7	4.32687E-06	9.50869E-06	0.189681	0.455043	0.999595	3.349402*

Table 6 – Univariate Statistics – Sudden Change in the Variance of Real Exchange Rate Depreciation

Australia Before Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	vi	η_i	$R_i(S_i^2)$
1980-1981	0.016724	0.000296	7	-0.05724	-0.016	6	0.001774	0.001866	2.00432[#]	0.950273	0.987427	2.23916[#]
1982-1983	-0.00032	0.00079	8	0.325487	-0.016	7	0.005533	0.001866	1.026633	2.964543	0.888263	1.217341
1984-1985	-0.0317	0.003131	8	-0.50091	-0.016	7	0.021919	0.001866	-1.0274	11.74411	0.109294	-1.23029
1986-1987	-0.00997	0.00409	8	-0.42454	-0.016	7	0.028628	0.001866	0.395345	15.33877	0.031894	-1.85366
1988-1989	0.024124	0.001769	8	0.131973	-0.016	7	0.012385	0.001866	2.627173[#]	6.63573	0.467766	-0.08089
1990-1991	-0.00747	0.001157	8	-0.25195	-0.016	7	0.008097	0.001866	0.558712	4.33829	0.740092	0.643629
1992	-0.03383	0.001262	4	-0.03901	-0.016	3	0.003786	0.001866	-0.82532	2.028279	0.566558	0.167618
Australia – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	vi	η_i	$R_i(S_i^2)$
1993-1994	0.003437	0.000683	8	0.027497	0.004481	7	0.004779	0.000816	-0.10338	5.859214	0.556281	0.141547
1995-1996	0.00907	0.001494	8	0.07256	0.004481	7	0.010455	0.000816	0.454469	12.81749	0.076682	-1.42775
1997-1998	-0.01975	0.000594	8	-0.15803	0.004481	7	0.004161	0.000816	-2.4001[#]	5.101069	0.647631	0.378932
1999-2000	-0.00411	0.001119	8	-0.0329	0.004481	7	0.007836	0.000816	-0.85106	9.607221	0.211946	-0.79969
2001-2002	0.006744	0.000566	8	0.053952	0.004481	7	0.003961	0.000816	0.22412	4.856284	0.677496	0.460709
2003-2004	0.023541	0.001394	8	0.188326	0.004481	7	0.009761	0.000816	1.887575	11.96698	0.10165	-1.27221
2005-2006	0.004231	8.63E-05	8	0.03385	0.004481	7	0.000604	0.000816	-0.02473	0.740875	0.998002	2.878422[#]
2007	0.020902	0.000286	4	0.083606	0.004481	3	0.000857	0.000816	1.1499	1.050864	0.788947	0.802772

Continued – Table 6

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	vi	η_i	$R_i(S_i^2)$
Canada Before Inflation Targeting												
1980-1981	0.009224	0.003495	7	0.06457	0.003093	6	0.020969	0.000995	0.514199	21.06659	0.001785	-2.91391#
1982-1983	0.00734	0.000505	8	0.058724	0.003093	7	0.003537	0.000995	0.380818	3.553296	0.829549	0.952383
1984-1985	-0.01277	0.000384	8	-0.10218	0.003093	7	0.002688	0.000995	-1.42231	2.700449	0.911263	1.348571
1986-1987	-0.00572	0.00106	8	-0.04573	0.003093	7	0.007422	0.000995	-0.78978	7.456926	0.382902	-0.29787
1988-1989	0.021705	0.000142	8	0.173637	0.003093	7	0.000996	0.000995	1.668589	1.000444	0.994821	2.56367#
1990	-0.00401	0.000406	4	-0.01603	0.003093	3	0.001217	0.000995	-0.45016	1.222298	0.747661	0.667148
Canada – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	vi	η_i	$R_i(S_i^2)$
1991-1992	-0.00946	0.000412	7	-0.06619	0.003503	6	0.002471	0.000584	-1.41818	4.227924	0.645863	0.374175
1993-1994	-0.01296	0.000167	8	-0.1037	0.003503	7	0.001172	0.000584	-1.92642	2.004921	0.959567	1.745689
1995-1996	0.005326	0.000838	8	0.042609	0.003503	7	0.005865	0.000584	0.213327	10.03515	0.18659	-0.89053
1997-1998	-0.01259	0.000601	8	-0.10073	0.003503	7	0.004207	0.000584	-1.88291	7.19916	0.408442	-0.23155
1999-2000	0.004344	0.000456	8	0.034749	0.003503	7	0.003189	0.000584	0.09837	5.455914	0.604507	0.26503
2001-2002	-0.00517	0.000241	8	-0.04136	0.003503	7	0.00169	0.000584	-1.01471	2.89098	0.894901	1.253021
2003-2004	0.030116	0.000958	8	0.240929	0.003503	7	0.006705	0.000584	3.113705*	11.47303	0.119275	-1.17862
2005-2006	0.011902	0.000427	8	0.095212	0.003503	7	0.002992	0.000584	0.982638	5.118875	0.645459	0.373089
2007	0.033291	0.001869	4	0.133165	0.003503	3	0.005607	0.000584	2.464392#	9.594046	0.022352	-2.00743#

Continued – Table 6

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
New Zealand Before Inflation Targeting												
1980-1981	-0.0003	4.76842E-05	7	-0.00211	0.003203	6	0.000286	0.024411	-0.05932	0.01172	1	5.400019*
1982-1983	-0.00071	0.000541166	8	-0.0057	0.003203	7	0.003788	0.024411	-0.07087	0.15518	0.999989	4.253455*
1984-1985	0.003946	0.005498271	8	0.031564	0.003203	7	0.038488	0.024411	0.01345	1.576637	0.979537	2.044283#
1986-1987	0.017237	0.003601539	8	0.137897	0.003203	7	0.025211	0.024411	0.254066	1.032746	0.994283	2.52914#
1988-1989	-0.00459	0.000780178	8	-0.03676	0.003203	7	0.005461	0.024411	-0.14116	0.223717	0.999963	3.96381*
New Zealand – Inflation Targeting												
	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v_i	η_i	$R_i(S_i^2)$
1990-1991	-0.01513	0.000926	8	-0.12107	0.001458	7	0.006484	0.000871	-1.5897	7.440826	0.384467	-0.29377
1992-1993	0.001685	0.000569	8	0.01348	0.001458	7	0.003986	0.000871	0.021712	4.574395	0.711741	0.558479
1994-1995	0.011302	0.000156	8	0.090413	0.001458	7	0.001094	0.000871	0.943106	1.255551	0.989591	2.311272#
1996-1997	0.005775	0.000596	8	0.046203	0.001458	7	0.004173	0.000871	0.413618	4.788968	0.685698	0.483694
1998-1999	-0.0238	0.000947	8	-0.19043	0.001458	7	0.00663	0.000871	-2.42042#	7.607557	0.368467	-0.33592
2000-2001	-0.00915	0.001121	8	-0.07317	0.001458	7	0.007848	0.000871	-1.01603	9.005766	0.252242	-0.66745
2002-2003	0.030675	0.000694	8	0.245402	0.001458	7	0.004856	0.000871	2.799348#	5.572486	0.590456	0.228718
2004-2005	0.013494	0.000854	8	0.107952	0.001458	7	0.005981	0.000871	1.153159	6.863646	0.443214	-0.14283
2006-2007	-0.00172	0.001978	8	-0.01378	0.001458	7	0.013848	0.000871	-0.30479	15.8908	0.026133	-1.94094

Continued – Table 6

Sweden Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	-0.01107	0.001249	7	-0.07751	-0.00252	6	0.007494	0.000874	-0.76534	8.572321	0.199097	-0.84485
1982-1983	-0.01737	0.003055	8	-0.13893	-0.00252	7	0.021382	0.000874	-1.4203	24.45763	0.000946	-3.10659*
1984-1985	0.006853	0.000217	8	0.054822	-0.00252	7	0.001518	0.000874	0.896534	1.73685	0.972961	1.926218
1986-1987	-0.0002	3.42E-05	8	-0.00161	-0.00252	7	0.000239	0.000874	0.221747	0.273896	0.999927	3.796233*
1988-1989	0.011411	9.02E-05	8	0.091291	-0.00252	7	0.000632	0.000874	1.332611	0.722427	0.998157	2.903937#
1990-1991	-0.00223	0.000177	8	-0.0178	-0.00252	7	0.001237	0.000874	0.028113	1.414505	0.985123	2.173344#
1992	-0.00969	0.001988	4	-0.03875	-0.00252	3	0.005964	0.000874	-0.48479	6.82237	0.07778	-1.42016

Sweden – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1993-1994	-0.01989	0.002783245	8	-0.15915	-0.0032	7	0.019483	0.000902	-1.57183	21.59144	0.002987	-2.74925#
1995-1996	0.016331	0.001403969	8	0.130651	-0.0032	7	0.009828	0.000902	1.839062	10.8915	0.143422	-1.06507
1997-1998	-0.01346	0.000921497	8	-0.10771	-0.0032	7	0.00645	0.000902	-0.96636	7.148653	0.413568	-0.21838
1999-2000	-0.00481	0.000714413	8	-0.03847	-0.0032	7	0.005001	0.000902	-0.15149	5.542165	0.594103	0.238112
2001-2002	-0.00787	0.000325212	8	-0.06299	-0.0032	7	0.002276	0.000902	-0.44005	2.522884	0.925364	1.442108
2003-2004	0.006723	0.000133159	8	0.053784	-0.0032	7	0.000932	0.000902	0.934352	1.033	0.994278	2.528872#
2005-2006	-0.00447	0.000394826	8	-0.03575	-0.0032	7	0.002764	0.000902	-0.11944	3.062923	0.879121	1.170604
2007	0.006905	6.23923E-05	4	0.027622	-0.0032	3	0.000187	0.000902	0.672828	0.207436	0.97638	1.984142

Continued – Table 6

UK Before Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1980-1981	0.009387	0.002291	7	0.065706	0.000781	6	0.013747	0.001755	0.543531	7.833918	0.250525	-0.67284
1982-1983	-0.00538	0.002281	8	-0.04303	0.000781	7	0.015969	0.001755	-0.41585	9.099746	0.245574	-0.68848
1984-1985	-0.00547	0.002047	8	-0.04378	0.000781	7	0.014332	0.001755	-0.42217	8.166847	0.318112	-0.47299
1986-1987	0.001488	0.002435	8	0.011906	0.000781	7	0.017046	0.001755	0.047775	9.713625	0.205391	-0.82252
1988-1989	-0.0078	0.000758	8	-0.06238	0.000781	7	0.005309	0.001755	-0.5792	3.025384	0.882644	1.188309
1990-1991	0.013533	0.000792	8	0.108263	0.000781	7	0.005546	0.001755	0.861018	3.16048	0.86977	1.125306

UK – Inflation Targeting

	$\overline{X}_i$	S_i^2	n_i	$n_i\overline{X}_i$	μ	n_i-1	$(n_i-1)S_i^2$	σ^2	$R_i(\overline{X}_i)$	v i	η_i	$R_i(S_i^2)$
1992-1993	-0.01042	0.00236	8	-0.08338	0.002913	7	0.016518	0.000605	-1.53379	27.31182	0.000293	-3.43821*
1994-1995	-0.00342	0.000287	8	-0.02738	0.000364	7	0.002008	0.000605	-0.43546	3.319733	0.853934	1.053456
1996-1997	0.031982	0.000463	8	0.255853	0.000364	7	0.003243	0.000605	3.636347*	5.362795	0.615781	0.294418
1998-1999	0.006961	0.000533	8	0.055689	0.000364	7	0.003732	0.000605	0.75872	6.17095	0.519936	0.049994
2000-2001	0.001239	0.000267	8	0.00991	0.000364	7	0.001866	0.000605	0.100588	3.084926	0.877036	1.160299
2002-2003	-0.0078	0.00033	8	-0.06238	0.000364	7	0.002309	0.000605	-0.93869	3.818396	0.800441	0.843197
2004-2005	0.00407	0.000368	8	0.032558	0.000364	7	0.002575	0.000605	0.426187	4.257481	0.749689	0.673511
2006-2007	0.000698	0.000231	8	0.005583	0.000364	7	0.001617	0.000605	0.038374	2.673905	0.913443	1.362265

$\overline{X}_i$ is the mean; S_i^2 is the variance; n_i is a sample; μ is the overall mean; σ^2 is the pooled variance; $R_i(\overline{X}_i)$ is the statistic for a sudden change in the mean distributed standard normal; v i is the statistic for sudden change in the variance distributed chi-squared with n_i-1 degrees-of-freedom and we transformed it into $R_i(S_i^2)$ standard normal. Asterisks denote significant at a 3σ level and # denotes significant at a 2σ level and double.

Table 7: Multivariate Statistics for Sudden Shift in the Mean and the Variance

Australia

Regime B			Regime A		
Sample	$R_i(\overline{X}_i)$	$R_i(D_k)$	Sample	$R_i(\overline{X}_i)$	$R_i(D_k)$
81-82	0.54	-0.90	94-95	-0.09	3.05*
83-84	0.38	0.81	96-97	-0.99	2.04#
85-86	1.30	2.17#	98-99	0.05	0.77
87-88	0.89	-1.40	00-01	0.27	1.09
89-90	-1.34	1.28	02-03	0.56	1.64
91-92	-0.04	0.33	04-05	-0.93	0.91
			06-07	-1.16	-1.04

Asterisk denotes significant shift beyond the 3σ tolerance limits. The fact that the first observation of the inflation-targeting regime is significant may be due to a change in the regime, thus economically predicted.# denotes significant at the 2σ tolerance level.

Canada

Regime B			Regime A		
Sample[i]	$R_i(\overline{X}_i)$	$R_i(D_k)$	Sample	$R_i(\overline{X}_i)$	$R_i(D_k)$
Sep80-Mar82	-0.06	4.97*	92-93	1.83	-0.42
Jun82-Dec83	-2.04#	0.69	94-95	-1.58	1.41
Mar84-Sep85	0.64	-0.18	96-97	-0.86	1.30
Dec85-Jun87	0.91	2.25#	98-99	2.04#	1.04
Sep87-Mar89	0.08	-1.16	00-01	-0.42	1.40
Jun89-Dec90	0.44	-1.85	02-03	-0.45	1.05
			04-05	0.55	-0.25
			05-07	0.19	0.55

i The sample size is 7.
Asterisk denotes significant shift beyond the 3σ tolerance limits. # denotes significant at the 2σ tolerance level.

New Zealand

Sample	$R_i(\overline{X}_i)$	$R_i(D_k)$
87-88[i]	2.22#	2.47
89-90	3.45*	3.12*
91-92	0.82	0.60
93-94	0.98	-0.32
95-96	-0.76	-0.21
97-98	0.64	-0.15
99-00	0.88	1.05
01-02	0.84	-0.92
03-04	1.04	-0.35
05-07[ii]	-2.84#	-0.30

i Sample is from September 1987.
ii Sample ends in June 2007.
Asterisk denotes significant shift beyond the 3σ tolerance limits. # denotes significant at the 2σ tolerance level.

Sweden

	Regime B			Regime A	
Sample[i]	$R_i(\bar{X}_i)$	$R_i(D_k)$	Sample[ii]	$R_i(\bar{X}_i)$	$R_i(D_k)$
81-82	1.93	-0.14	Mar93-Jun94	1.53	6.27*
83-84	0.62	-1.08	Sep94-Dec95	-0.52	1.12
85-86	1.29	-2.44#	Mar96-Jun97	-1.27	-0.18
87-88	0.04	-0.45	Sep97-Dec98	-2.37#	-1.07
89-90	-0.13	-1.18	Mar99-Jun00	-1.25	-0.18
91-92	1.64	4.61*	Sep00-Dec01	0.16	-1.55
			Mar02-Jun03	-1.12	-1.09
			Sep03-Dec04	-1.42	-1.77
			Mar05-Jun06	-1.46	-1.00
			Sep06-Dec07	-1.36	-2.59#

i The sample is 8 observations.
ii The sample is 6 observations.
Asterisk denotes significant shift beyond the 3σ tolerance limits. The fact that the first observation of the inflation-targeting regime is significant may be due to a change in the regime, thus economically predicted. # denotes significant at the 2σ tolerance level.

UK

	Regime B			Regime A	
Sample[i]	$R_i(\bar{X}_i)$	$R_i(D_k)$	Sample[ii]	$R_i(\bar{X}_i)$	$R_i(D_k)$
80-82	2.53#	1.92	Jun92-Dec93	1.32	0.54
83-84	0.32	-0.70	Mar94-Sep95	1.09	1.47
85-86	-0.62	1.08	Dec95-Jun97	3.04*	0.61
87-88	3.22*	0.42	Sep97-Mar99	-0.87	-0.53
89-90	-1.48	-1.80	Jun99-Dec00	0.13	0.17
91-92	2.82#	-0.06	Mar01-Sep02	0.70	0.15
			Dec02-Jun04	-1.67	-0.10
			Sep05-Mar06	1.13	-2.06#
			Jun06-Dec07	-1.81	-2.84#

i The sample size is 8 and from June 1980 to March 1992.
ii The sample size is 7.
Asterisk denotes significant shift beyond the 3σ tolerance limits. # denotes significant at the 2σ tolerance level.

Figure 1: Log Real GDP per Person of Working Age

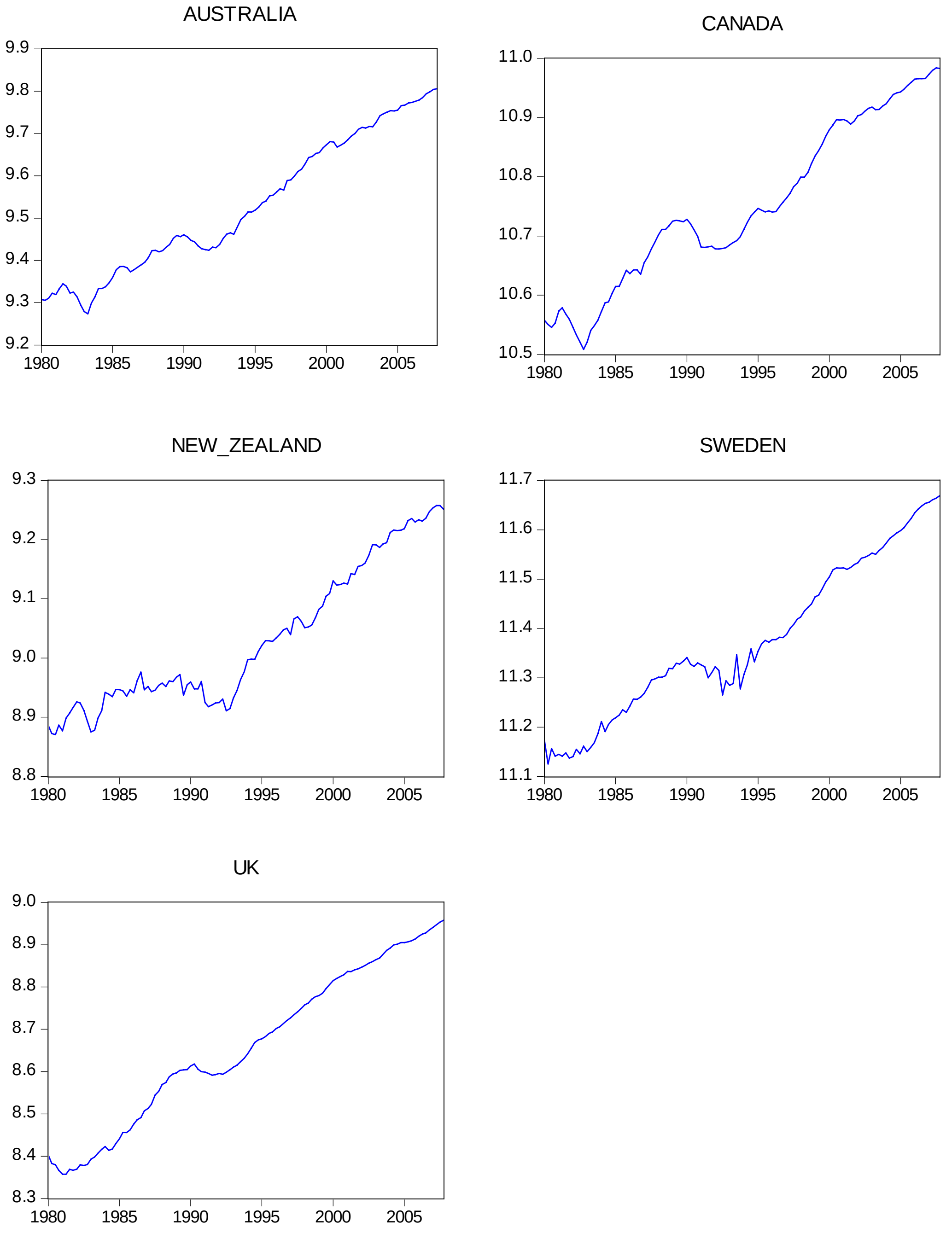


Figure 2: Log Consumption Per Person of Working Age Population

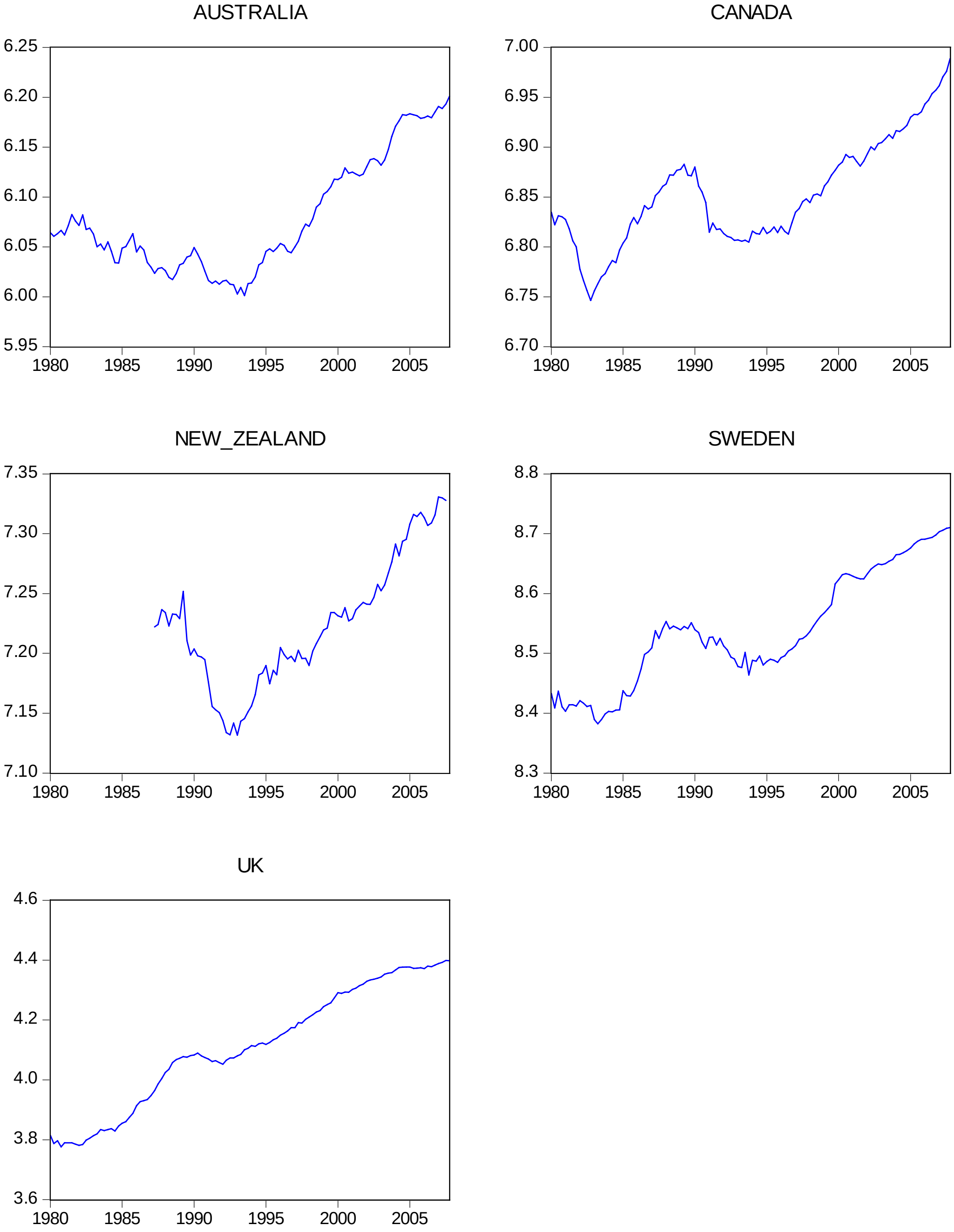


Figure 3: Average Weekly Hours Worked

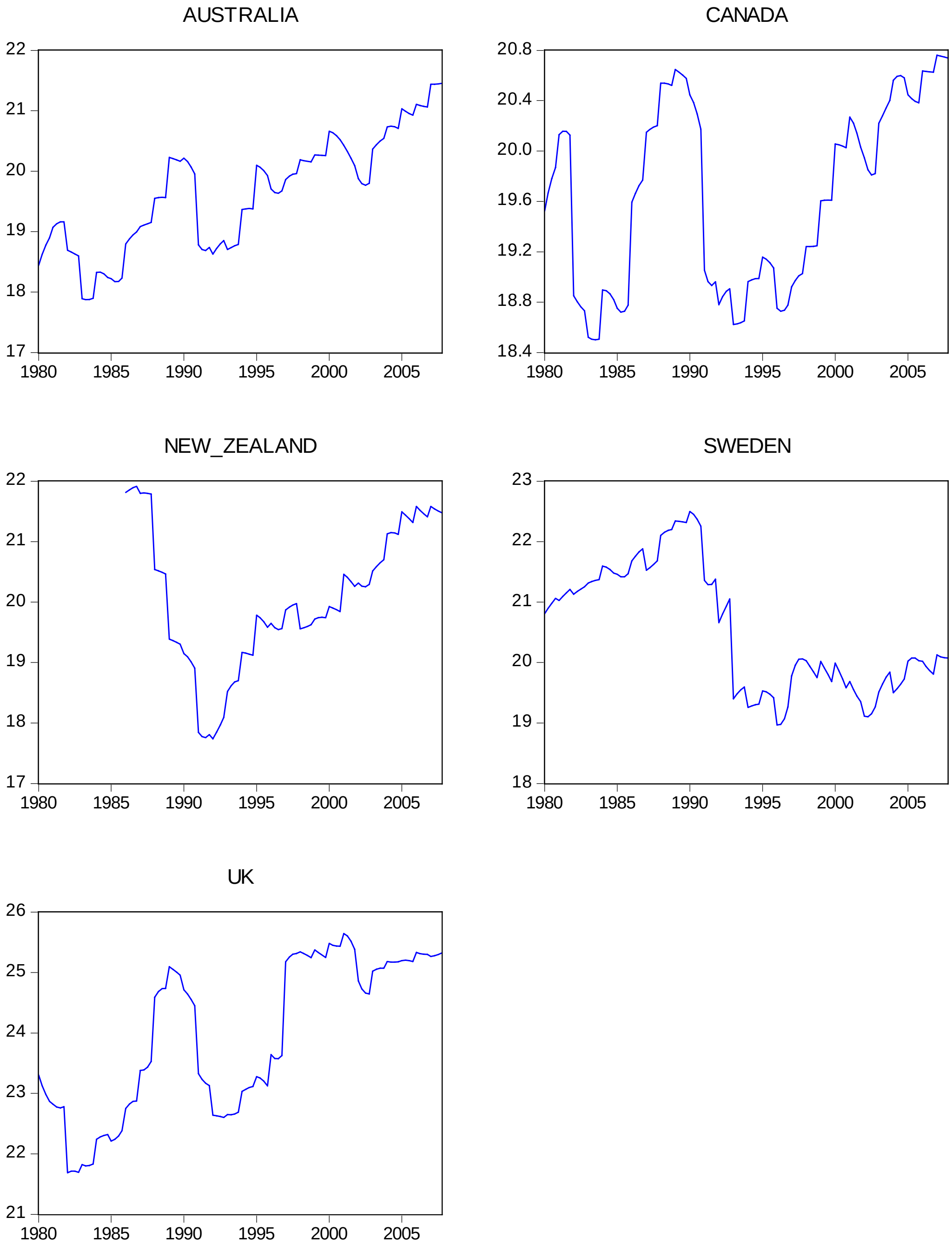


Figure 4: Log Leisure Per Person of Working Age Population

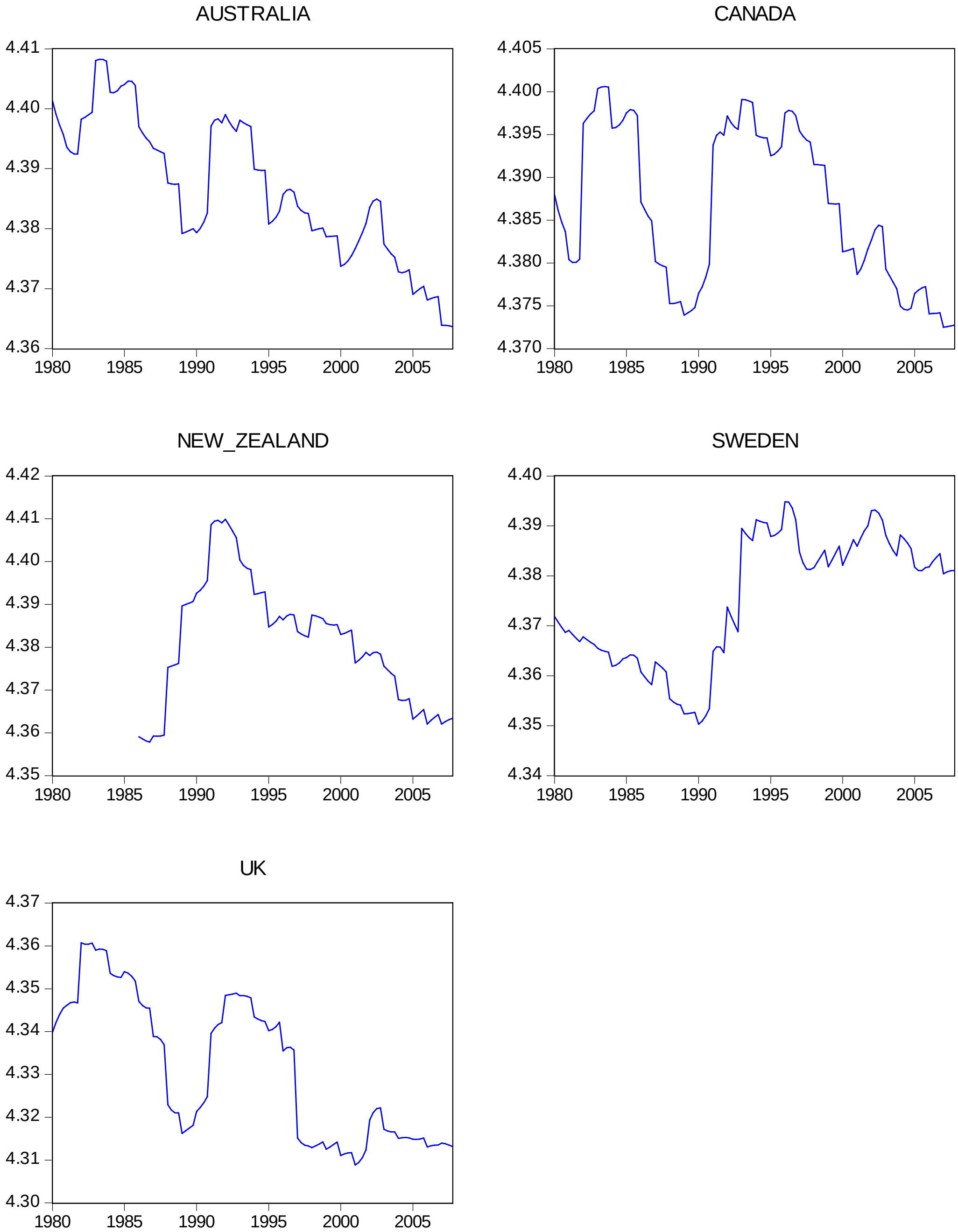


Figure 5: Working Age Population 15-64

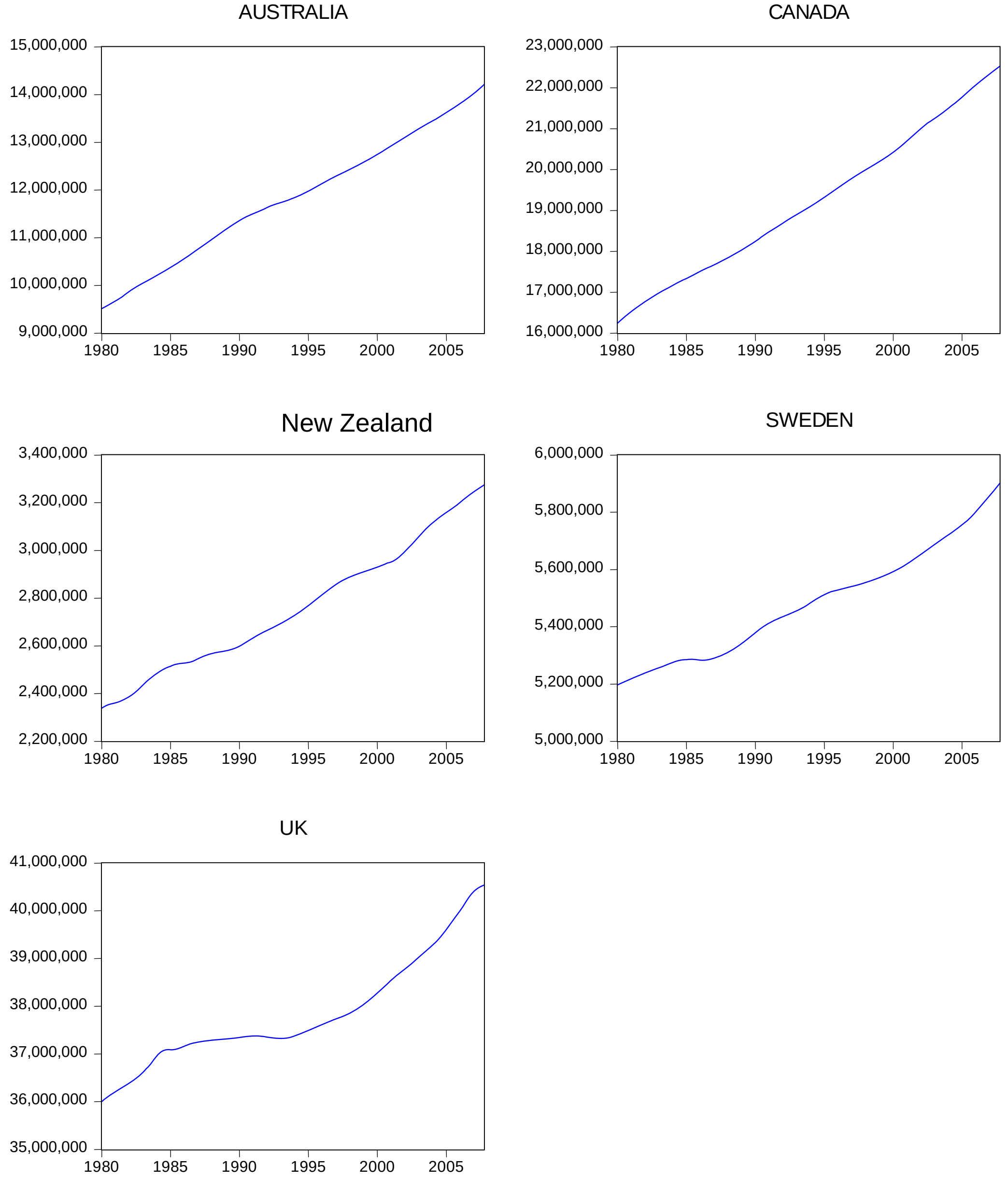


Figure 6: The Real Exchange Rates

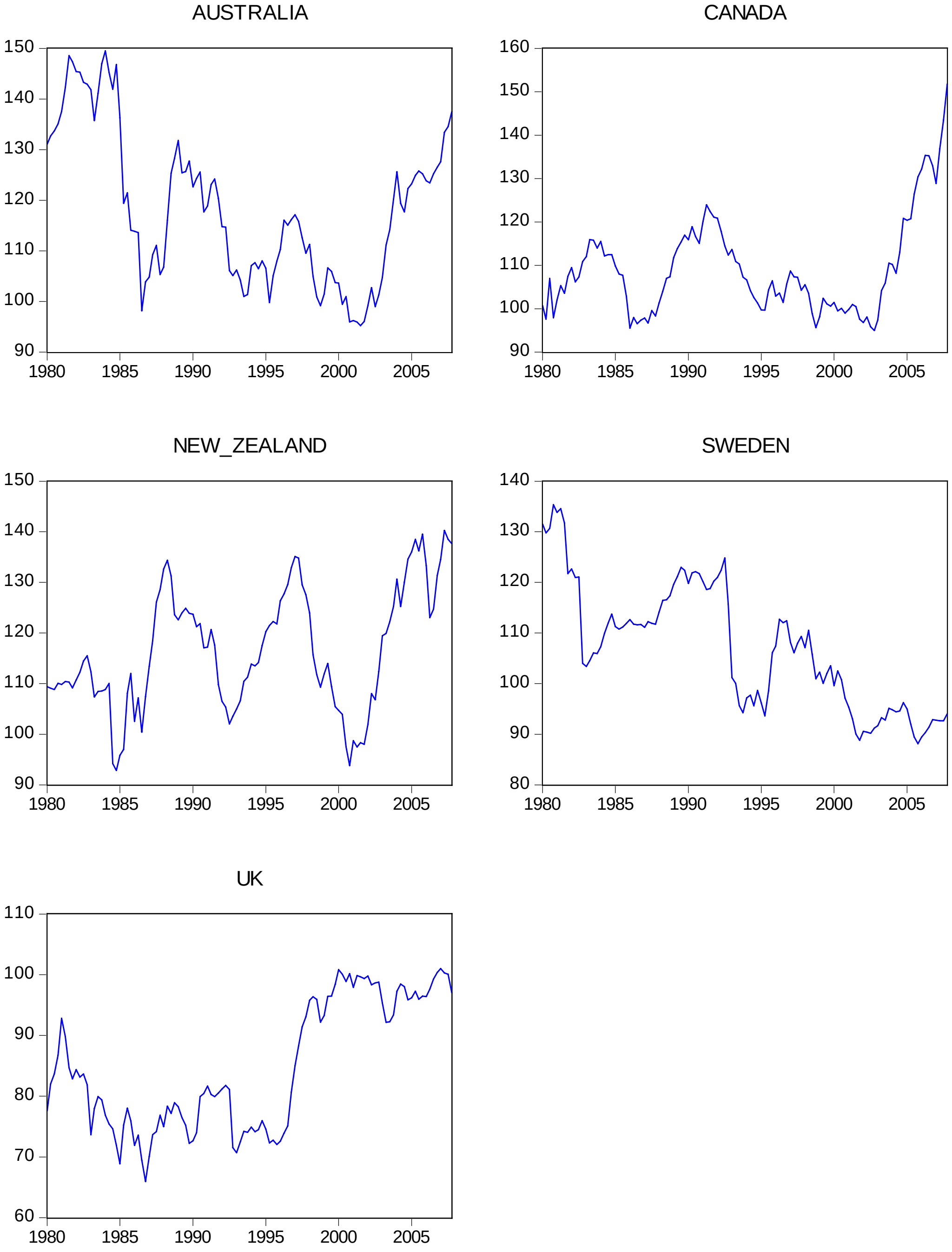
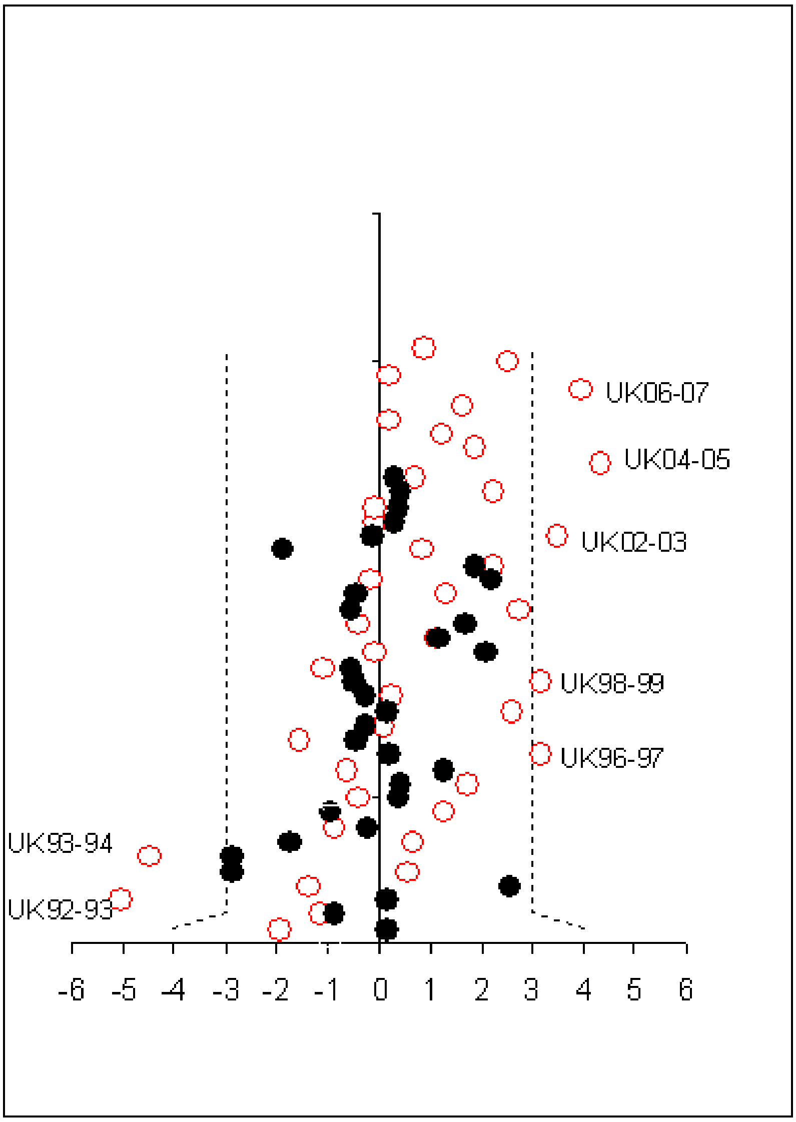
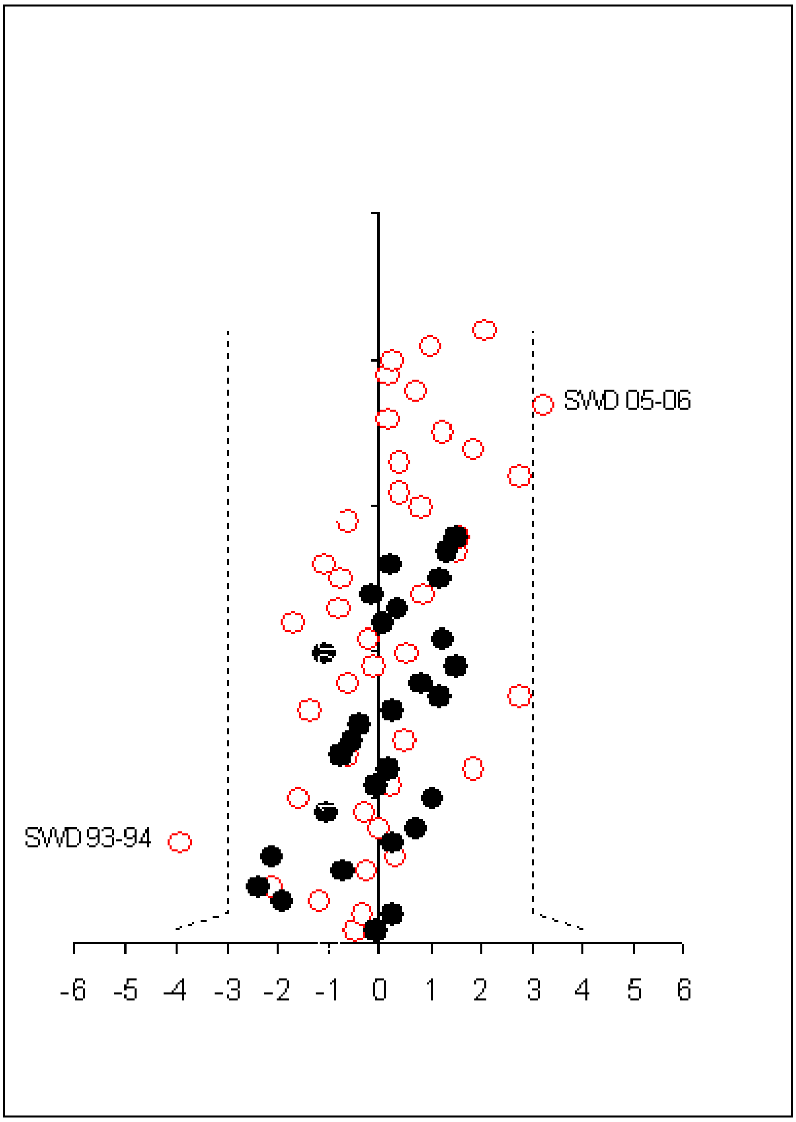


Figure 7: Univariate Statistics For Sudden Change in The Variance GDP Per Capita Growth



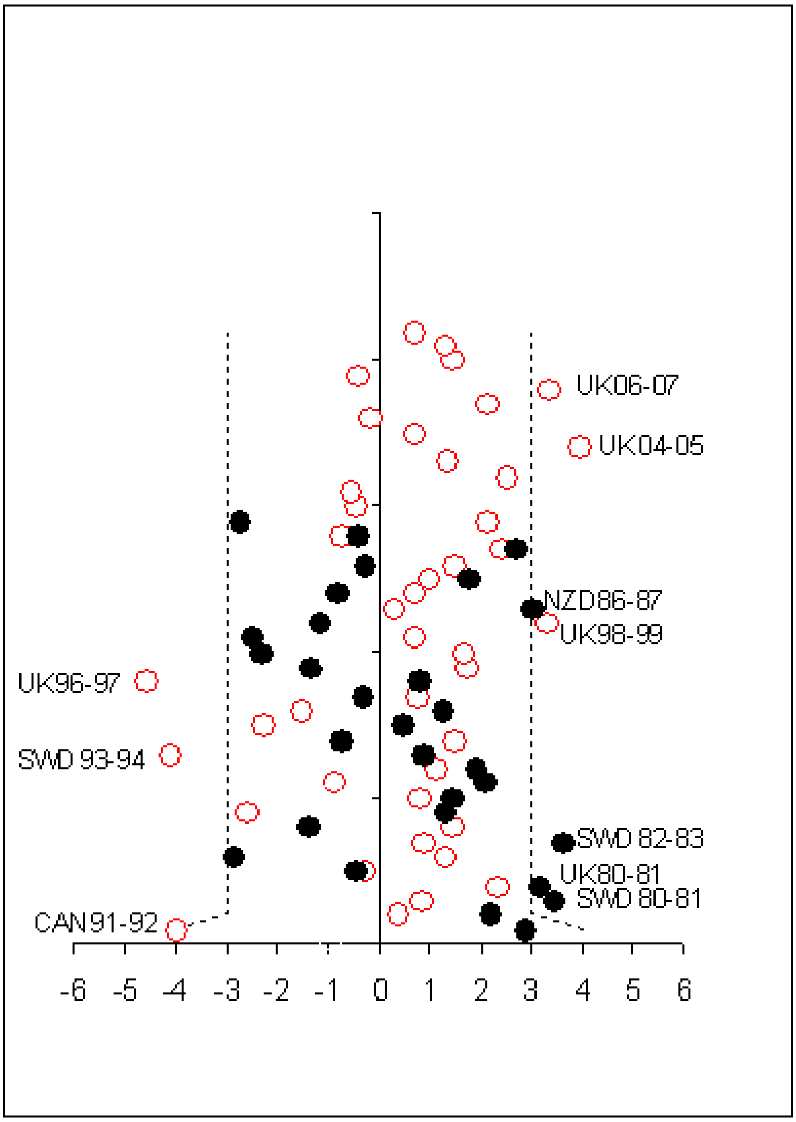
●	**Before Inflation Targeting**	○	**After Inflation Targeting**

Figure 8: Univariate Statistics For Sudden Change in The Variance Consumption Growth



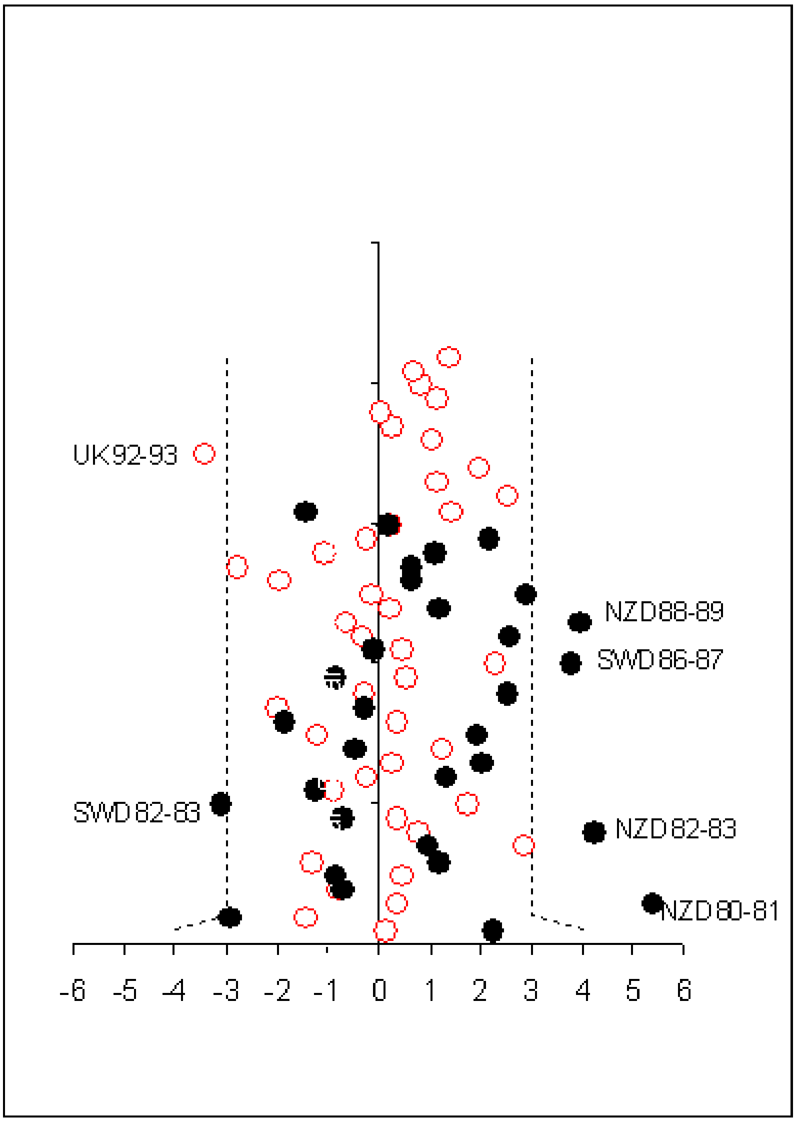
●	**Before Inflation Targeting**	○	**After Inflation Targeting**

Figure 9: Univariate Statistics For Sudden Change in The Variance Leisure Growth



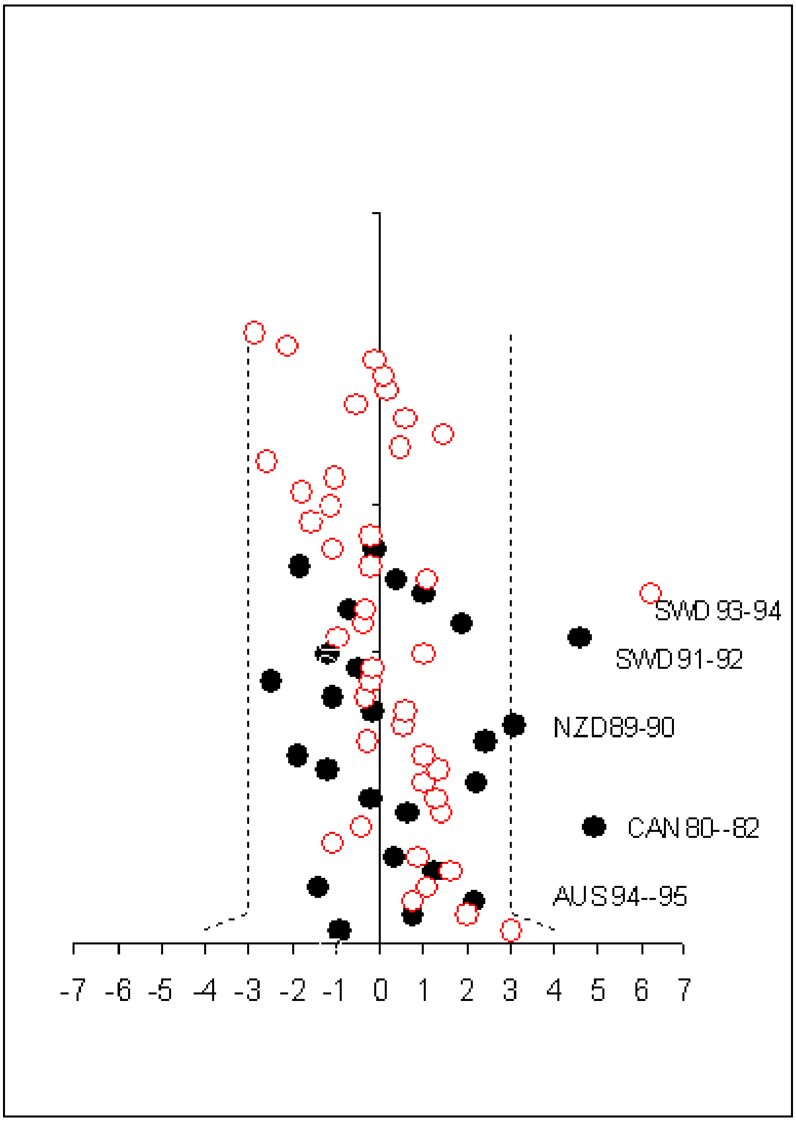
●	**Before Inflation Targeting**	○	**After Inflation Targeting**

Figure 10: Univariate Statistics For Sudden Change in The Variance Real Exchange Rate Depreciation



●	Before Inflation Targeting	○	After Inflation Targeting

Figure 11: Multivariate Statistics For Sudden Change in The Variance



●	**Before Inflation Targeting**	○	**After Inflation Targeting**

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i The idea in Wicksell (1898) was that when the inflation rate is low and stable the medium-term real interest rate in financial markets such as the yield on the 10-year bond indexed for inflation would be equal to an estimate of the long-term real returns on capital in an economy when inflation is stable.

ii IFS statistics show that the average real interest rates declined from 7.38, 6.9, 6.58 and 4.2 during the period 1980-1990 to 6.64, 4.38, 4.88 and 2.97 during the period 1991-2007 in Australia, Canada, Sweden and the UK respectively. It only increased in New Zealand, from 5.7 to 8.6.

iii In terms of the *distribution* function rather, we say $A(x) \le B(x)$ for all x. **Second-order stochastic dominance,** roughly speaking, means that lottery A have second-order stochastic dominance over lottery B if it is more predictable, i.e., it involves less risk. We don't think this is relevant to our objective.

iv In a less general formulation, the Wilcoxon-Mann-Whitney two-sample test may be thought of as testing the null hypothesis that the probability of an observation from one population exceeding an observation from the second population is 0.5. This formulation requires the additional assumption that the distributions of the two populations are identical except for possibly a shift (i.e. $f_1(x) = f_2(x+a)$). Another alternative interpretation is that the test assesses whether the Hodges-Lehmann estimate of the difference in central tendency between the two populations is zero. The Hodges-Lehmann estimate for this two-sample problem is the median of all possible differences between an observation in the first sample and an observation in the second sample.

v Wilcoxon Rank Sum test for two independent random variables X_1 and X_2 tests the null hypothesis that $X_1 \approx X_2$. The samples are n_1 and n_2 respectively. The data are ranked regardless of the sample to which they belong. If the data are tied, averaged ranks are used. The sum of the ranks for the observations in the first sample $T = \sum_{i=1}^{n_1} R_{1i}$. Mann and Whitney (1947) statistic is the number of pairs (X_{1i}, X_{2j}) such that $X_{1i} > X_{2j}$. These statistics differ only by a constant $U = T - \frac{n_1(n_1-1)}{2}$. Fisher's Principle of Randomization calculates the distribution of the test statistic. The randomization distribution consists of $\binom{n}{n_1}$ ways to choose n_1 ranks from the set of all $n = n_1 + n_2$ ranks and assign them to the first sample. $E(T) = \frac{n_1(n+1)}{2}$ and $Var(T) = \frac{n_1 n_2 S^2}{n}$ where S is the standard deviation of the combined ranks r_i for both groups; $S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(r_i - \bar{r})^2$, which is exact and holds both when there are no ties and where there are ties. Using normal approximation, $z = \frac{T - E(T)}{\sqrt{Var(T)}}$. For more details see STATA reference book, release 9.

vi The **Kolmogorov-Smirnov statistics is** (Kolmogorov (1933) and Smirnov (1939), Conover (1999) is not very powerful against differences in the tails of the distributions. It is, however, very powerful for alternative hypotheses that involve clustering in the data. The statistics to evaluate directional hypotheses are $D^+ = \max_x\{F(x) - G(x)\}$ and

$D^- = \min_x \{F(x) - G(x)\}$, where $F(x)$ and $G(x)$ are the empirical distribution functions for the sample that we are comparing. The combined statistic is $D = \max(|D^+|, |D^-|)$. The p value for this statistic can be obtained by evaluating the asymptotic limiting distribution. Let n_1 be the sample size for the first sample and n_2 is the sample for the second sample. Smirnov (1939) shows that $\lim_{n_1, n_2 \to \infty} \Pr\left\{\sqrt{n_1 n_2 / (n_1 + n_2} D_{n_1 n_2} \leq z \right\} = 1 - 2 \sum_{i=1}^{\infty} (-1)^{i-1} \exp(-2i^2 z^2)$. The first five terms form the approximation P_a used in the calculation (see STATA reference book). The exact p value is calculated by a counting algorithm (Gibbons (1971, p. 27-131). A corrected p value was obtained by modifying the asymptotic p value using a numerical approximation technique $Z = \Phi^{-1}(P_a) + 1.04 / \min(n_1, n_2) + 2.09 / \max(n_1, n_2) - 1.35 \sqrt{n_1 n_2 / (n_1 + n_2)}$ and p value = $\Phi(Z)$, where Φ is the cumulative normal distribution function.

[vii] See Milton Friedman, Inflation and Unemployment," Nobel Memorial Lecture, December 13, 1976. The increase in the variability of inflation of expected inflation may raise the natural level of unemployment in two different ways. It may work through reducing the efficiency of the prices to carry information to economic agents.

[viii] Chebyshev's inequality (also known as Tchebysheff's inequality, Chebyshev's theorem, or the Bienaymé-Chebyshev inequality) states that in any data sample or probability distribution, nearly all the values are close to the mean value, and provides a quantitative description of *nearly all* and *close to,* For any $k > 1$, the following example (where $\sigma = 1/k$) meets the bounds exactly. So $\Pr(X = 1) = 1/2k^2$; $\Pr(x = 0) = 1 - 1/k^2$ and $\Pr(X = -1) = 1/2k^2$ for that distribution $\Pr(|X - \mu|) \geq k\sigma = 1/k^2$. Equality holds exactly for any distribution that is a linear transformation of this one. Inequality holds for any distribution that is not a linear transformation of this one.

[ix] Anderson (1958) shows that the determinant of S^2 is proportional to the sum of squares of the volumes of all *parallelopes* formed by using as principle edges P vectors of $X_1, X_2, \cdots X_{\mathrm{P}}$ as one set of end points, and the mean of ε as the other with $\frac{1}{(n-1)^{\mathrm{P}}}$ as the factor of proportionality.

[x] A SAS – IML code to calculate the multivariate statistics for the case of three and more variables is in the appendix.

[xi] we tested all variables for unit root using a variety of common unit root tests with different specifications and lag specifications. We tested these lags thoroughly using a variety of common information criteria (Dickey and Fuller (1979, 1981), Said and Dickey (1984), Dickey and Pentula (2002), Perron (1990, 1988, 1989 and 1997), Phillips (1987), and Elliott (1999)). We could not reject the unit root hypothesis. These results may reflect the weak powers of these tests. We tested the data again for a shorter samples, after inflation targeting to avoid *potential* the break in the data. We still could not reject the unit root hypothesis. Sweden seems to have a break around 1990. Non rejection of the unit root for GDP per person, consumption per person, and leisure per person for Sweden could well be due to the break in the data, but the Perron test still does not reject the null. It is well understood that all common unit root tests lack power.