MONETARY POLICY CHANGES AND UNIT ROOT STATISTICS

BY

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Abstract

Conventional unit root tests are biased towards non–rejection of the null when applied to variables characterised by a one–time change in their mean. Suggested modifications allowing for a break point require identification of an exogenous change initiated at the time of the break and not subsequently reversed. This paper suggests that modified tests are particularly useful in dealing with legislative changes. Two UK examples are given; the abolition of exchange controls in 1979 and the changes in monetary policy in 1980. Results suggest that allowing for a break changes the apparent order of integration of portfolio shares and real interest rates.

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1. Introduction

In two recent papers Evans (1989) and Perron (1990) have extended the standard unit root tests of Dickey and Fuller (1979) to a particular type of time series characterised by a one–time change in its mean level. Evidence provided in Perron (1990) suggests that for such time series the standard tests are biased towards non–rejection of the null. Thus a random shock may falsely appear to have a permanent rather than a transitory impact. Perron modifies the Dickey–Fuller test to allow for the presence of a change in the mean of the series under both the null and alternative hypotheses. The distribution theory underlying the new test statistics is dependent upon the date of the structural break being known. Banerjee *et al.* (1990) and Perron and Vogelsang (1991) calculate alternative distributions for when the date of the break point is unknown.

The difficulties with the Perron (1990) procedure are essentially threefold. First, inspection of the data to identify the break point may result in inappropriate inferences since the appropriate distribution theory depends upon the choice of the break point. Second, there are many series for which the existence of a break point might not be readily apparent. In such cases, following Banerjee *et al.* (1990) the appropriate statistic may be the minimum test statistic over all possible break points. Finally, the procedure assumes a one–time permanent change. Thus if a break point is found the researcher must be able to point to a development that was initiated at the date of the break and which has not subsequently been reversed.

However there are certain types of shock, such as changes in the legislative framework, for which these objections need not apply. The timing of policy changes can be accurately identified and thus the choice of break point can be said to be independent of knowledge of developments subsequent to the shock. Two empirical examples relating to monetary policy in the United Kingdom are provided below. The first is the abolition of foreign exchange controls at the end of 1979 and the second concerns the developments subsequent to the introduction of the Medium–Term Financial Strategy (MTFS) in 1980. Exchange control abolition serves to illustrate the point that, even at the time of announcement, policy changes are often expected to lead to changes in behaviour (NIER, 1979, pp.17–18).

The rest of the paper is as follows; Section 2 contains a description of the modified test statistics, Section 3 presents the results and Section 4 offers some concluding comments.

2. The Testing Strategy

Two classes of model are considered in Perron (1990), the 'additive' and 'innovational' outlier models. The first is used where the break is assumed to be instantaneous, whilst the second is used where the full impact of the break emerges following a period of adjustment. Below we set out the equations which modify the standard Dickey–Fuller tests for a unit root in the case where the data generation process is AR(p). The date of the break point is denoted by T_B (where $1<T_B<T$), the sample size is T, y_t is the series of interest, DTB_t a dummy variable equal to 1 at time (T_B+1) and zero elsewhere and DU_t a dummy variable equal to 1 at all times subsequent to T_B and zero elsewhere.

The additive outlier model involves the following two regressions:[1]

$$y_t = \alpha_1 + \delta_1 DU_t + \tilde{y}_t \qquad (1)$$

$$\Delta \tilde{y}_t = \beta_2 \tilde{y}_{t-1} + \psi_2 DTB_t + \sum_{1}^{p} \gamma_{2i} \Delta \tilde{y}_{t-i} + \varepsilon_t \qquad (2)$$

Equation (1) removes the deterministic component of y_t and (2) tests for the presence of a unit root in the resulting series $\tilde{y}_t$. The null of a unit root can be tested by using the t-test that $\beta_2=0$ in (2).

The innovational outlier model takes the form:

$$\Delta \tilde{y}_t = \alpha_3 + \delta_3 DU_t + \psi_3 DTB_t + \beta_3 \tilde{y}_{t-1} + \sum_{1}^{p} \gamma_{3i} \Delta \tilde{y}_{t-i} + \varepsilon_t \qquad (3)$$

Here the the deterministic component and the dynamics of the series are jointly estimated. The null of a unit root is again tested using a t–test that $\beta_3=0$. For both (2) and (3) the appropriate critical values are given in Perron (1990), Table 4. The chosen value at a given level of significance is dependent upon λ, where $\lambda = T_B/T$.

3. Results

In this Section we apply the unit root tests to two series, the share of overseas assets in the portfolios of UK financial institutions and ex–post real interest rates in the UK. The aim is to see whether these series are affected by two particular changes in monetary policy – the abolition of exchange controls in 1979 and the developments associated with the introduction of the MTFS in 1980. *A priori* the innovational outlier model is likely to be more appropriate for the portfolio share as evidence suggests that there are significant costs associated with portfolio adjustment (for example, Barr and Cuthbertson, 1991). In contrast the additive outlier model is more appropriate for the interest rate series.

The portfolio share of overseas assets is shown in Figure 1.[2] The mean share in the 1980s is 20.5% compared to 13.1% in the earlier part of the sample. A standard Augmented Dickey–Fuller (ADF) test for the presence of a unit root yielded (t–statistics in parentheses):

$$\Delta y_t = \underset{(1.0)}{0.326} - \underset{(-0.8)}{0.017}\, y_{t-1} + \underset{(2.2)}{0.212}\, \Delta y_{t-1} + \varepsilon_t \qquad (4)$$

Sample period:1964Q2–1990Q2; Standard Error = 0.91; LM(1) = 0.96; LM(4) = 2.66; LM(8) = 5.81;

LM(j) is a test for autocorrelation of order (j), distributed χ^2_j. The absence of serial correlation in (4) suggests that further dynamic terms are not required. With T=105, the appropriate critical value for the test statistic τ_μ is -2.89 (Fuller 1976, Table 8.5.2). Thus (4) fails to reject a null of the unit root in the portfolio share.[3] Even allowing for standardised drift (Nankervis and Savin, 1985) fails to reject the null as the appropriate critical value is approximately -2.2 (Schmidt 1990, Table 3).

The legislation abolishing UK exchange controls came into force in October 1979. Thus T_B represents 1979Q4, $DTB_t=1$ in 1980Q1 and $DU_t=1$ from 1980Q1 onwards. With T=105, $\lambda := 0.6$ (63/105) and the appropriate critical value at the 5% level is -3.38. Using equation (3) the resulting regression was:[4]

$$\underset{}{\Delta y_t} = \underset{(3.3)}{1.294} - \underset{(-3.53)}{0.102}\, y_{t-1} + \underset{(1.9)}{0.177}\, \Delta y_{t-1} + \underset{(3.8)}{1.044}\, DU_t - \underset{(-1.7)}{1.553}\, DTB_t \qquad (5)$$

Sample period:1964Q2–1990Q2; Standard Error = 0.86; LM(1)=2.15;
LM(4)=6.36; LM(8)=7.91; LM(12)=9.71;

In this example, the t-statistic -3.53 serves to reject the null of a unit root in favour of the alternative that the portfolio share is stationary around a broken mean.

Our second example uses the ex-post real interest rate in the UK defined using the Treasury Bill interest rate and the (backward looking) four quarter consumer price inflation rate. The series is shown in Figure 2. The profile of the series is similar to that in Figure 1 of Perron (1990), with negative real interest rates in evidence in the latter half of the 1970s and positive rates being observed in the 1980s. The results of the standard ADF test were:

$$\Delta y_t = \underset{(1.0)}{0.153} - \underset{(-2.28)}{0.075}\, y_{t-1} + \underset{(3.9)}{0.379}\, \Delta y_{t-1} + \varepsilon_t \qquad (6)$$

Sample period:1966Q3–1990Q3; Standard Error = 1.46; LM(1)=0.13;
LM(4)=4.89; LM(8)=6.99; LM(12)=7.99;

The t-statistic of -2.28 again fails to reject the null of a unit root. Allowing for standardised drift does not alter the result as the critical value only falls to -2.79.

It is interesting to ask if the monetary policy changes made in 1980 affected these tests. The MTFS introduced in the March budget set out formal monetary targets for the following 4 years. This was followed by the June abolition of the direct controls on bank expansion provided by the Supplementary Special Deposit scheme in operation since 1973 (often called the 'corset'), implying a greater reliance on interest rates to control the money stock. This can be tested using (1) and (2) with DU_t equal to 1 from 1980Q3 onwards and DTB_t equal to 1 in that quarter. The resulting regressions were:

$$y_t = -\underset{(-2.1)}{0.928} + \underset{(9.0)}{6.257}\, DU_t + \breve{y}_t \qquad (7)$$

Sample period:1966Q1–1990Q3

$$\Delta \breve{y}_t = -\underset{(-2.1)}{2.863}\, DTB_t - \underset{(-3.72)}{0.155}\, \breve{y}_{t-1} + \underset{(4.8)}{0.434}\, \Delta \breve{y}_{t-1} + \varepsilon_t \qquad (8)$$

Sample period:1966Q3–1990Q3; Standard Error= 1.35; LM(1)=0.01;
LM(4)=2.57; LM(8)=6.17; LM(12)=7.55;

With a sample size of 97, λ is again approximately 0.6 and the critical value is -3.38. Thus (8) rejects the null of a unit root in the ex-post real interest rate, placing some doubt on the finding from (6).

4. Conclusions

Making allowance for one-off policy changes when testing for the presence of a unit root provides a means of assessing the robustness of the findings from conventional test statistics. The examples in this paper carry considerable implications for econometric modelling of the variables considered. For example, if the portfolio share is treated as an I(1) process then at least one other I(1) variable must be included in its determinants. The alternative is to include an exchange control dummy and treat the share as being stationary around a split mean.

FOOTNOTES

1. (2) differs from the equivalent equation in Perron (1990). See Perron and Vogelsang (1991) equation (4) for details.

2. The data from 1975 is obtained from the CSO. Prior to 1975 data is taken from Crossley (1987). The adjustments required to obtain a consistent series are relatively minor.

3. Portfolio shares are often found to be I(1) processes even though they are ultimately bounded from above and below, see Barr and Cuthbertson (1991).

4. Higher order lagged difference terms were insignificant using conventional F-tests.

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SHARE OF OVERSEAS ASSETS IN THE PORTFOLIOS
OF UK FINANCIAL INSTITUTIONS (%)

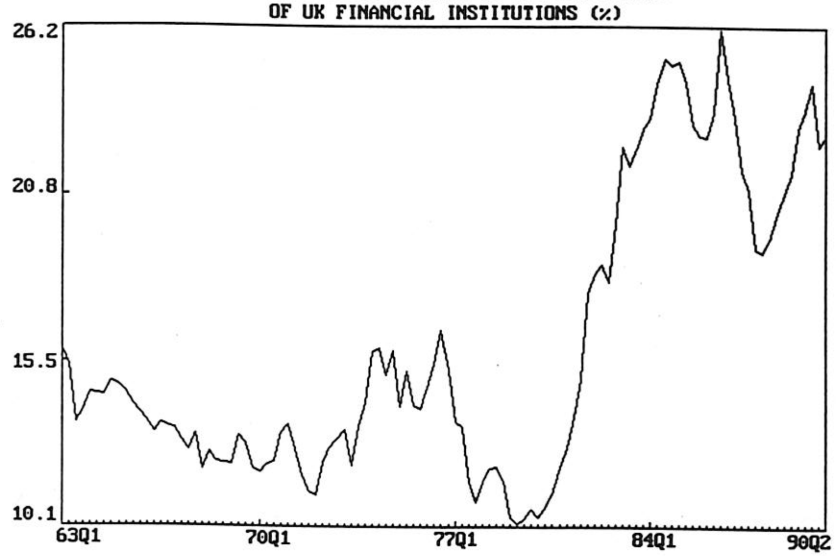

FIGURE 1

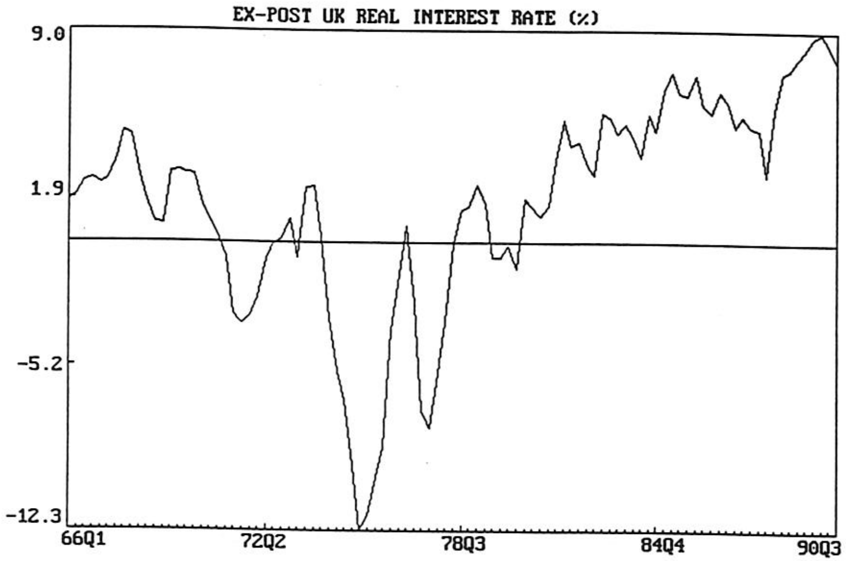
EX-POST UK REAL INTEREST RATE (%)
9.0
1.9
-5.2
-12.3
66Q1
72Q2
78Q3
84Q4
90Q3

FIGURE 2