A Note on the Country Specific Nature of Asymmetric Adjustment: Australia and the UK

Steven Cook[1]

Abstract

Recent research has shown consumers' expenditure in both Australia and the UK to display asymmetric behaviour, but of differing forms. In this note the asymmetric natures of Australian GDP and investment are examined and compared with recent results for the UK. These results highlight the country specific nature of asymmetric behaviour more forcefully than previous results for consumption. This leads to different conclusions over the presence of asymmetry in the two economies rather than just its form.

1. Introduction

The possible asymmetric behaviour of economic time series over the business cycle has occupied the attention of economists since at least the time of Mitchell (1913) and Keynes (1936). However, recent years have witnessed an explosion of interest in asymmetry and non-linearity, both theoretically and empirically (see Mills, 1991; Mullineux and Peng, 1993 for surveys of the literature). Amongst the alternative methods proposed for assessing asymmetric behaviour in economic time series are the univariate tests of asymmetric 'deepness' and 'steepness' introduced by Sichel (1993). These tests, based upon original work by DeLong and Summers (1986), allow alternative forms of asymmetry, which may occur either individually or simultaneously, to be distinguished. While the deepness test considers whether recovery peaks are higher than recessionary slumps are deep, the steepness test considers asymmetry in terms of differing speeds at which peaks and slumps are approached. In a recent application, Cook (1999) examined the asymmetric nature of Australian consumers' expenditure and compared the findings with those for the UK contained in the seminal study of Holly and Stannett (1995). Interestingly, although both countries displayed asymmetric behaviour it was of different forms. While UK consumers' expenditure is characterised by asymmetry in the form of peaks being higher than slumps are deep, the asymmetric nature of Australian consumption is in the form of recessionary periods being approached more quickly than recovery periods. These results show that although there may be common features in cyclical behaviour across countries, there are also some country-specific elements. It is the differing cyclical behaviour between economies which will be further investigated here by examining the asymmetric nature of Australian GDP and private sector investment and comparing the results with those recently derived for the UK by Speight and MacMillan (1998) and Cook (1998). It will be seen that the results are more striking than those for consumers' expenditure, as the difference between economies is not just over the form of asymmetry, but whether or not asymmetry is actually present.

This note proceeds as follows. Section 2 presents the tests of asymmetry to be performed on Australian output and private sector investment. The results of applying these tests are given in section 3 along with a comparison with results already derived for the UK. Section 4 concludes.

2. Tests of asymmetric behaviour

The two tests of asymmetric behaviour employed here are the deepness and steepness tests of Sichel (1993). These tests are based upon the skewness of a time series, with the deepness test considering the relative depth of the recessionary slumps below trend compared to height of the recovery peaks above it. A negative deepness statistic indicates asymmetry in the form of slumps being deeper than peaks are tall, while a positive statistic indicates the opposite. In contrast, the steepness test considers possible asymmetry in terms of the speed at which peaks and slumps are approached. Again the statistic can be positive, indicating peaks are approached more rapidly than slumps, or negative, indicating slumps are approached more rapidly. The tests are constructed as follows. Considering a time series x_t (expressed in natural logarithms),

$$x_t = \tau_t + c_t + \xi_t \qquad (1)$$

where τ_t is the non-stationary trend component, c_t is the stationary cyclical component and ξ_t is the irregular component which is NID$(0,\sigma^2_\xi)$. The tests of asymmetry are performed upon the cyclical component c_t. To isolate the cyclical element a method of trend extraction is required. The choice of an appropriate method by which to detrend data is a controversial issue (see, *inter alia*), Harvey and Jaeger, 1993; Cogley and Nason, 1995), and the method employed here is the familiar Hodrick-Prescott (HP) (1997) filter. The HP filter is used as it has several factors in its favour. Firstly, its linear structure means that it can not induce asymmetry. Secondly, although it may accentuate peaks and slumps, this would be advantageous in the present context as it would allow any asymmetry present to be more easily detected. Thirdly, the HP filter also has some advantages over alternative approaches such as the structural time series model approach of Harvey and Jaeger (1993) and the closely related exponential smoothing filter (see King and Rebelo, 1993). The trend proposed by the HP filter arises as a solution to the convex minimization problem,

$$\min \sum_{t=1}^{T} \left\{ (x_t - \tau_t)^2 + \lambda \left[(1 - L)^2 \tau_t \right]^2 \right\} \qquad (2)$$

where L is the lag operator. The smoothing parameter, λ, can in theory be set at any value, with values other than zero causing the last term in (2) to smooth out the trend by penalizing the rate at which the slope of the trend changes. The extreme values of $\{0,\infty\}$ lead to the HP trend coinciding with the original series and a linear trend respectively. For quarterly data a value of λ=1600 has been shown to be optimal according to the transfer function derived by Harvey and Jaeger (1993), and is typically imposed in applied studies to remove low frequency components with a periodicity of more than 32 quarters. A value of 1600 is adopted here.

Once the cyclical element, c_t, of the time series has been extracted, the deepness and steepness tests of asymmetry can be constructed. The test of deepness is provided by the coefficient of skewness, and is given as,

$$D(c) = \frac{\left[T^{-1}\sum_{t=1}^{T}(c_t - \bar{c})^3\right]}{\sigma(c)^3} \quad (3)$$

where $\bar{c}$ is the mean of c_t, $\sigma(c)$ is the standard deviation of c_t, and T is the sample size. To test the significance of $D(c)$, a variable, z_t, is constructed and regressed upon a constant term, with the significance of the constant showing the significance of $D(c)$,

$$z_t = \frac{(c_t - \bar{c})^3}{\sigma(c)^3} \quad (4)$$

The steepness statistic, $ST(\Delta c)$, is calculated in a similar fashion to $D(c)$, but instead uses the first differences of the cyclical element,

$$ST(\Delta c) = \frac{\left[T^{-1}\sum_{t=1}^{T}\left(\Delta c_t - \overline{\Delta c}\right)^3\right]}{\sigma(\Delta c)^3} \quad (5)$$

where $\overline{\Delta c}$ is the mean of Δc_t, $\sigma(\Delta c)$ is the standard deviation of Δc_t, and T is the sample size. Again, the significance of $ST(\Delta c)$ is assessed via a constructed variable, z_t^{Δ}, which is regressed upon a constant term,

$$z_t^{\Delta} = \frac{\left(\Delta c_t - \overline{\Delta c}\right)^3}{\sigma(\Delta c)^3} \quad (6)$$

Due to the serially correlated nature of the constructed variables z_t and z_t^{Δ}, a serial correlation consistent variance-covariance matrix estimator is required to assess the significance of the constant terms in their regressions. Here Newey-West (1987) standard errors are used. As Newey-West standard errors employ a correction based upon estimated autocovariances, decisions have to be made concerning the appropriate kernels and bandwidths to use. With no overwhelming evidence available suggesting which particular kernel or bandwidth should be employed, a number of each is considered. Here the Parzen and Tukey kernels which use quadratic and trigonometric weights, respectively, for the autocovariances, are used. With the choice of the appropriate bandwidth being dependent upon the typically unknown degree of autocorrelation present in the series under investigation, the conventional procedure of using bandwidths corresponding to approximately one quarter and one third of the sample size is followed. Given the present sample of 153 observations, the alternative bandwidths are then 38 and 51. Consequently four asymptotic standard error estimates will be presented for the deepness and steepness tests using the three choices of kernel and two choices of bandwidth.[2]

3. *Results*

The data used in this study are quarterly, seasonally adjusted observations in 1989/90 prices on Australian GDP and private sector investment over the period 1959(3) to 1998(1).[3] Before presenting the results of the univariate tests of asymmetry, the strongly trending nature of the data can be considered. The clear trends present in the data are reflected in the results of Augmented Dickey-Fuller (ADF) tests performed upon the series. Denoting the natural logarithms of the output and investment series as y_t and i_t respectively, their orders of integration are assessed by conducting fifth order ADF tests upon y_t, Δy_t, i_t and Δi_t. The results of these tests are presented in table 1. It is apparent that both y_t and i_t are I(1), with the unit root hypothesis rejected for the first differences of the series, but not their levels.

Table 1: Unit root tests

	y	Δy	i	Δi
ADF(·)	-1.773	-5.598**	-2.525	-5.562**
5% critical value	-3.441	-2.881	-3.441	-2.881
1% critical value	-4.022	-3.475	-4.022	-3.475

* denotes significance at the 5% level
** denotes significance at the 1% level

Table 2: Deepness and steepness tests

	Coefficient			
	$D(y)$	$ST(\Delta y)$	$D(i)$	$ST(\Delta i)$
	-.4456	.2250	.2056	.1912
Kernel and Bandwidth	Asymptotic standard error (p-value)			
Parzen	$D(y)$	$ST(\Delta y)$	$D(i)$	$ST(\Delta i)$
38	.3234 (.170)	.1595 (.160)	.3548 (.563)	.2778 (.496)
51	.2820 (.116)	.1142 (.051)*	.2681 (.444)	.2791 (.494)
Tukey				
38	.2722 (.104)	.0880 (.012)**	.2259 (.364)	.2801 (.496)
51	.2373 (.062)*	.0937 (.017)**	.2056 (.319)	.2756 (.484)

* denotes significance at the 10% level
** denotes significance at the 5% level

The results of the deepness and steepness tests are presented in table 2. Along with the calculated deepness and steepness statistics, table 2 reports the associated asymptotic standard errors and asymptotic marginal significance levels (p-values). Considering the results for Australian output, the tests show strong evidence of asymmetry in the form of peaks being approached more rapidly than slumps, with the steepness statistic being positive and significant at high levels of confidence. The negative deepness statistic, though not as significant as the steepness statistic, does provide some further evidence of asymmetry, this time in the form of slumps being deeper than peaks are tall. This is in contrast to the results of Speight and MacMillan (1998) for the UK, where no evidence of asymmetry of either form is found for GDP.[5]

The results for Australian investment are straightforward to interpret as, although both of the statistics are positive, they are not significant. These findings for Australia contrast with those for the UK provided by Cook (1998). In empirically evaluating the predictions of Gale's (1996) theoretical model of investment, Cook (1998) uncovered evidence of positive steepness in UK private sector investment, supporting Gale's theory. The Australian data does not provide such support, with no significant evidence of asymmetry.

These conflicting results for Australia and the UK are more striking than those for consumers' expenditure, as the difference is not simply over the form of asymmetry exhibited, but rather whether it exists at all.

4. Conclusions

In this note the variation in asymmetric behaviour across economies has been addressed via an analysis of Australian GDP and private sector investment, and a comparison of the results derived with those already known for the UK. Whereas the results of Cook (1999) and Holly and Stannett (1995) for consumers' expenditure showed cross-country variation in asymmetric behaviour in terms of the forms of asymmetry exhibited, the results presented above go one stage further. Rather than uncovering differences in the form of asymmetry present, the results for Australia and the UK show conflicting conclusions over whether asymmetry is actually present or not in output and investment. The presence of asymmetric behaviour has obvious implications for not only econometric modelling, which is dominated by linear, symmetric specifications, but also for macroeconomic policy analysis. With asymmetric adjustment detected, policy analysis must recognise both state and shock dependence, with adjustment occurring at different speeds and to differing extents depending on whether the economy is in a recessionary or recovery phase when a shock occurs, and whether this shock is expansionary or contractionary. Thus, for example, with asymmetry in GDP, expenditure multipliers will vary according to the phase of the business cycle. The results discussed above show that the issue of asymmetry is relevant for Australian GDP and UK investment where adjustment is more rapid in recovery periods than in recessions. No evidence of asymmetry is detected in Australian investment or UK GDP.

Endnotes

1. University of Coventry. I am grateful to Sean Holly and Paul Turner for many helpful discussions on related work. I would also like to thanks Peter Reynolds for numerous suggestions which have led to an improvement in the presentation of this paper. The usual disclaimer applies.

2. For a more complete discussion of consistent variance-covariance matrix estimators see Andrews (1991), Andrews and Monahan (1992), Newey and West (1987,1994), and Pesaran and Pesaran (1997). In this paper the Newey-West standard errors were calculated using *Microfit 4.0* (Pesaran and Pesaran, 1997).

3. Datastream codes: AUGDP...D, AUPRVCAPD.

4. Following conventional procedures, the ADF tests for the levels, but not the differences, contained a linear trend term to increase the power to reject the unit

root hypothesis.

5. Although unreported for the sake of brevity, the conclusions drawn by Speight and MacMillan (1998) for UK GDP were replicated here over a more recent and extended data series.

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