DO REAL ESTATE ASSETS MAINTAIN THEIR REAL VALUES? SOME AUSTRALIAN EVIDENCE

Guy Ta
Patrick J. Wilson
John Okunev

INTRODUCTION

Investors' objectives in property and real estate investments would have their prime focus on the returns of their investments based on some optimal expectation that their investments maintain their values over time when the rate of inflation varies. Hence, the inflation hedging characteristics of real estate and property investments play an important role in the investors selection of their portfolios.

This paper aims at analysing the inflation hedging characteristics of some selected real estate investments in the Sydney Metropolitan Area (SMA) as an indication of real estate investments in similar Australian metropolitan cities, and also of investments in property in general and in real estate securities for the period under observation in Australia.

SOME BACKGROUND

Of the literature in this area of study in Australia, there is scant treatment of the specific problem of inflation affecting real estate investment values. Urbanski's study[1] of asset price inflation in Australia is the closest to such treatment and is of most recent vintage. He uses a wealth-weighted index of the market prices of houses, commercial property and equities to measure asset price inflation in Australia. Employing this index over the past two decades Urbanski examines periodic cycles of asset price inflation in comparison with the fluctuations in the prices of goods and services in Australia. He generalises that the cycles of asset price inflation were of greater magnitude than those of the prices of goods and services. In other words, asset price movements have been much more volatile than consumer price index movements. A more interesting finding of Urbanski is that:

> *"There is little harmonisation of the price movements of the different asset classes and it is difficult to attribute asset price inflation in Australia during particular periods to a single factor - periods of asset price inflation have*

We are indebted to a number of colleagues and associates for assistance in data accumulation: Andrew Cameron (MIRVAC), Ross Graham, Raelene Weirwick and Julie McWhirter (EAC). This research has been supported by various UTS Research Grants.

occurred when more than one asset market experienced price rises at the same time."

Other Australian studies[2] of less recent origin concentrate on a slightly different aspect of inflation affecting the housing market in terms of its redistributive effect on home ownership with implications also to taxation policy. Penm and Terrell[3] test the hypothesis that housing activity provides a leading indicator to other general economic activity. Their results indicate that dwelling investment contains leading information for gross national expenditure. Housing activity is found to have a linkage to economic activity and the rest of the system. In this respect, their conclusions being different from those of previous studies[4] are attributable to their adoption of the method of unit root treatment and cointegration in the analysis of their data.

AN INVESTIGATION

In contrast to traditional theories, this paper does not have the objective of providing any insight into the behavioural aspect of the demand for real estate assets.[5] There have been arguments that inflation affects the behaviour of housing demand in an inverse manner in that increases in inflation and in inflationary expectations would reduce housing demand and ownership. This is because inflation would necessitate borrowers to go into greater mortgage debts in times of inflation.

This paper only aims at examining whether real estate prices and investment in real estate securities have maintained their values in the face of inflation. This brings into focus the issue of "real assets" in the form of real estate holdings or investment in real estate securities. "Real assets" can be defined as those that would increase in nominal value at the same pace or greater than the rate of inflation. Hence, the question: Are real estate investments (or investment in real estate securities) an investment in real assets ?

In very much the same manner as in financial asset investment, one can utilise the Fisher's hypothesis to test if the rate of return on real estate investments has maintained a 'real' rate of return. Fisher's hypothesis can be expressed thus:

$$i = f(p,r) \qquad [1]$$

where i the nominal rate of return of investment in real properties; p is the expected price rise (or fall) ; and r is the real rate of interest. This basic equation can be re-arranged and differentiated with respect to time (t), to yield the following equation:

$$i = r + \left(\frac{1}{p} * \frac{dp}{dt}\right) + r\left(\frac{1}{p} * \frac{dp}{dt}\right) \qquad [2]$$

From this equation one can formulate that there are two parts to this hypothesis; one that is expressing the real rate of return *r*, while the other the rate of change of (nominal) prices over time. Hence, the real rate of return is the nominal rate of return adjusted for the changes in prices (or inflation) over time. In the form of a behavioural equation, this may be expressed as:[6]

$$\begin{aligned} \textit{Rate of investment return}_t &= f(\textit{inflation}) \\ &= \alpha + \beta(\textit{inflation})_t + \mu_t \end{aligned} \qquad [3]$$

The intercept α can be considered to be the basic real rate of interest. This real rate is then adjusted by the 'risk' of the investment β through changes in prices, which can be captured by the inflation rate. The remainder term, μ is the usual stochastic error term.

> *"In this way, if prices increased, the nominal rate of interest would increase by the same proportion. Hence a 2% increase in prices should increase the nominal rate by 2%. The real rate(α) should remain unchanged. If the coefficient for the changes in prices is not equal to unity, then the proportional influence on the nominal rate is not direct and equal. Therefore, the price change coefficient should be close to unity to correspond with perfect foresight and knowledge."*[7]

Within the context of real estate investment, one can consider the previous two elements as highly applicable and relevant in determining the rate of return to real estate investment. The first element determines the rate of capital appreciation of property, while the second determines the rental income component of that time frame.

METHODOLOGICAL AND EMPIRICAL ISSUES

In the vast majority of current empirical work on financial and economic data, there has been an acceptance that these time series are characterised by unit root nonstationarities, thus rendering the classical *t* and *F*-tests inappropriate.[8] Recently developed tests by Fuller (1976), Dickey and Fuller (1981), Phillips (1987), and Perron (1988) to address the unit root problem of time series have been widely used. Basically, these tests examine if a time series is integrated of order one against the alternative of zero.

The methodological approach of this paper will be first to test for a unit root in all the series that it employs. Secondly, it will examine the multivariate cointegration procedure adopted by Johansen (1990) in order to establish the long run equilibrium position of these series. In particular, it will test the hypothesis that real estate investments and property trust investments keep up with the pace of inflation during the period under examination. Under the circumstance, such investments would be an inflation hedge in a portfolio of investors choice.

COINTEGRATION AND LONG RUN RELATIONSHIPS

If a time series is not stationary, then it has a unit root problem. However, if its first difference is stationary, then it is said to be integrated of order one, denoted by I(1). Furthermore, if there is a linear combination of two or more I(1) series that is itself stationary, then one can say that these series are cointegrated. If variables are cointegrated, then they cannot move 'too far' away from each other. On the other hand, if there is no cointegration among variables, then they have no long-run link; and they can wander arbitrarily far away from each other.

Engle and Granger (1987) imply from a cointegrated relationship or stationary linear combination (or cointegrating vector) the existence of an error correction of the form:

$$(1 - L)\,\Delta X_t = \rho Z_{t-1} + u_t \qquad [\ 4\ ]$$

where X is an $Nx1$ vector of $I(1)$ variables, Z represents the error correction term, L denotes the lag operator and u a vector of residuals.

Therefore, if variables are cointegrated through the error correction mechanism, then they have formed some long run equilibrium relationship. This is one of the two ways to test for cointegration.

A second and more recent technique of finding cointegration among variables is that of Johansen (1988) and Phillips and Durlauf (1986) who contest that the Engle-Granger two -step procedure has inherent deficiencies. More specifically,

> "*...the use of OLS to estimate a cointegration relationship for an N dimensioned vector does not clarify whether one is dealing with a unique cointegrating vector or simply a complex linear combination of all the distinct cointegrating vectors which exist within the system.*"[9]

The method of Johansen (1988, 1990) provides estimates of all the cointegrating vectors that exist within a vector of variables, thus fully capturing the underlying properties of the time series (of the data), and also provides a test statistic for the number of cointegrating vectors with an exact limiting distribution.

DATA OVERVIEW

Available Australian data to test the hypothesis mentioned in section 1 of this paper are obtained from various sources. A housing price index for the whole of Australia (and for each state) is compiled by DXDATA; specific apartment and housing price indice for Sydney Metropolitan Area (SMA) are obtained from the Real Estate Institute of Australia and Mirvac & Co. Data on inflation are represented by the CPI and the GDP deflator and are compiled by the Australian Bureau of Statistics.

The time series extends from 1971Q1 to 1994Q2 for most of the variables under study. However, some other series, like the Australian property trusts series do not have as long a time span as those of real estate series.

The first series, HI is the housing index in the SMA for the period 1970Q3-1994Q1. They are derived from the time series of housing prices in this category. The property index, PI shows combined property investment returns compiled from the proxy of time series of property prices for Australia during the same period. The apartment returns are the results of the calculation of specific apartment prices from the series API in SMA as compiled by Mirvac.

Investments in property trusts in Australia are represented by an index called Australian Property Trust Index (ATI) from which the returns are calculated.

There are two measures of inflation that are used interchangeably here. First is the commonly used Consumer Price Index, while the second is the GDP deflator. From Figure 4 this graph of both CPI and GDP deflator shows that there is virtually no significant between the two series.[10]

EMPIRICAL RESULTS

Before tests of cointegration can be undertaken it is essential to test if all variables are integrated to the same degree. Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) as well as Phillips-Perron (PP) unit root tests were undertaken on all variables. However, the PP unit root tests were preferred to the other two tests since (I) lagged terms for the variable of interest are set to zero, hence there is no loss of effective observations from the series and (ii) in the presence of heteroscedasticity, the PP-test is the more robust [Perron, (1988)]. The PP-tests are based on the following ADF regression, and the critical values are the same as those used for the ADF-tests:

$$\Delta V_t = \alpha_0 + \alpha_1 V_{(t-1)} + \alpha_2 T + \sum_{j=1}^{1} \Upsilon_j \Delta V_{(t-j)} + \varepsilon_t \qquad [5]$$

where: V is the variable of interest
T is a trend variable

but: 1 (the number of lags) is set equal to zero and a non-parametric correction is used for serial correlation.

The finding of a unit root in a time series indicates non-stationarity and differencing is required to achieve a stationary series. For cointegration tests to be valid each series in a cointegrating regression should be integrated of the same order. In both the PP and ADF unit root tests (logarithm of the price series) the unit root hypothesis can be rejected if the test statistic is smaller than the critical value.

FIGURE 1

HOUSING INDEX

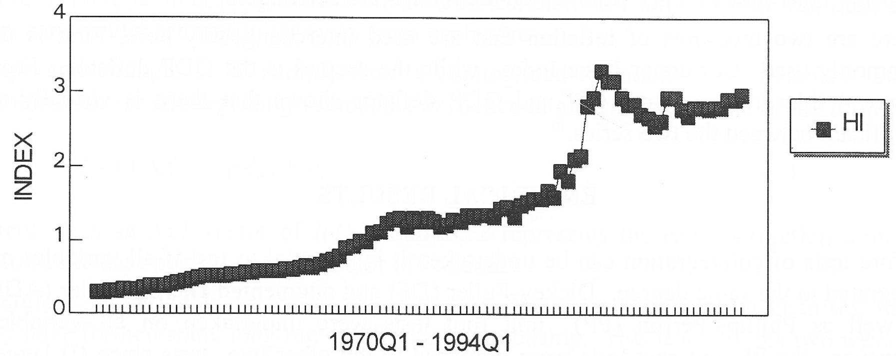


FIGURE 2

PROPERTY INDEX

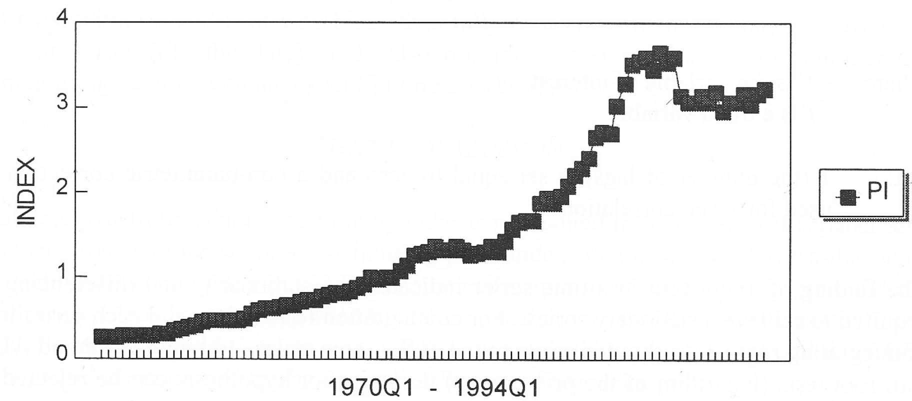


FIGURE 3

APARTMENT RETURNS

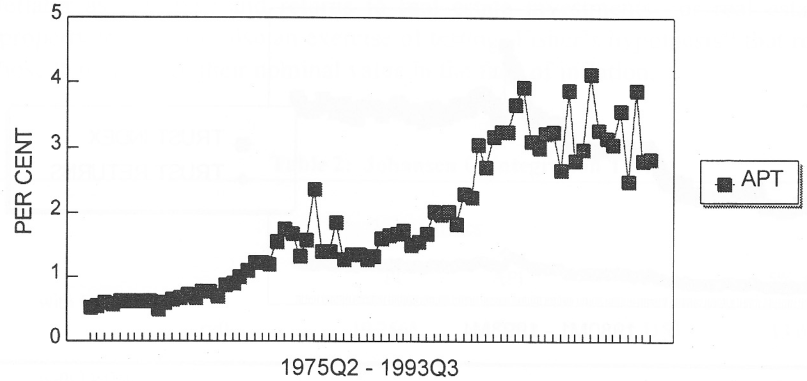
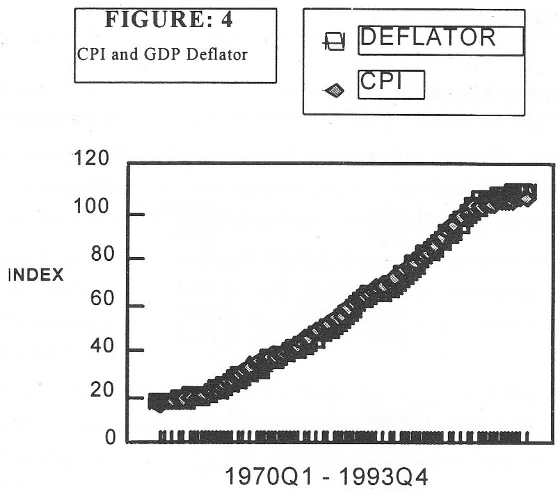
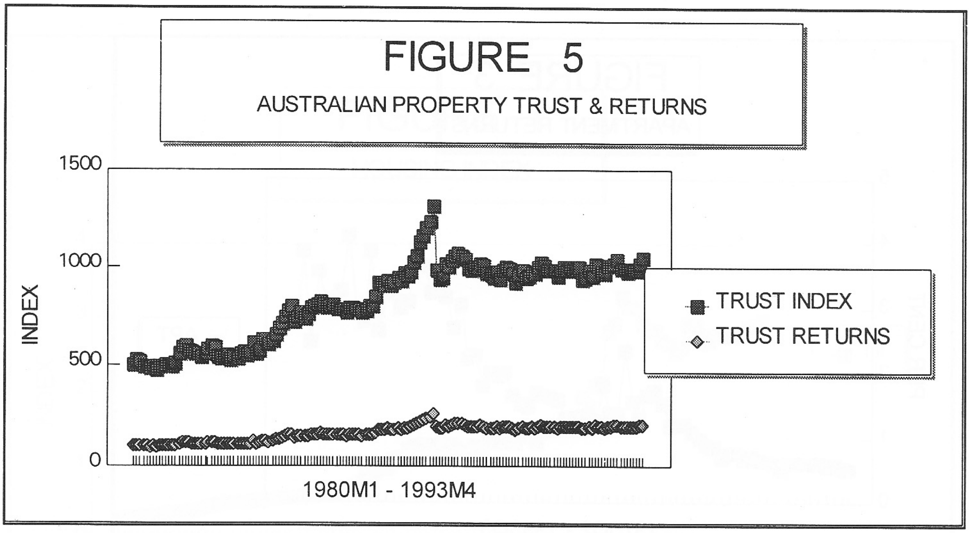


FIGURE: 4

CPI and GDP Deflator





The results on Table 1 below show the findings of unit root tests according to Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) measures for the data for Sydney and Australia.

At their level, data for all series are non-stationary on all tests of DF, ADF and PP. After differencing, the series are integrated to the same order so that further analysis for cointegration may be properly conducted.

Table 1: Unit Root Test

VARIABLES	DF	ADF	PP
1. HI	-1.3613	-1.4740	-.37304E-01
2. PI	-1.9413	-1.7795	.11576
3. API	-1.6606	-1.4304	-1.5253
4. ATI	-2.0301	-1.9996	-1.5084
5. CPI	-2.3794	.94433	1.9308
6. DEFLATOR	-1.1878	.2953	-1.2904
After Differencing			
9. HI	-11.3352	-4.8024	-26.574
10. PI	-8.2328	-5.4395	-30.518
11. API	-14.0161	-10.2237	-13.966
12. ATI	-7.3817	-8.7923	-130.030
15. CPI	-5.4507	-3.1612	-202.980
16. DEFLATOR	-8.0034	-4.0122	-24.552

[Critical values at 95% significance are -2.89, -2.9215 & -2.57 respectively for DF, ADF & PP tests]

It is quite clear from the results that the null hypothesis for the returns series of HI, PI and API cannot be rejected at their level, while that for their differences can be rejected.

Hence, to find cointegrated relationships among the above variables an alternative is to follow Johansen's procedure, as previously discussed.

In employing Johansen's procedure to test cointegration between inflation (or the GDP deflator as a proxy) and returns to real estate investments or real estate securities (property trusts), it is also an exercise of testing Fisher's hypothesis[11] that real assets are those that maintain their nominal value in the face of inflation.

Table 2: Johansen Cointegration Tests

		λ_{max} statistics			
	HI	PI	API	ATI	5% C.V.
with CPI					
	r=0	19.2565	16.9763	15.4153	13.0556* 14.069
with Deflator					
r=0	16.8358	16.0923	16.4737	15.7552	14.069
		TRACE statistics			
with CPI					
	r=0	20.8415	18.2886	16.3696	14.6274* 15.41
with Deflator					
	r=0	18.5082	18.8322	16.8768	18.7054 15.41

From Table 2, statistics for each of the variables for maximal eigenvalue, λ_{max} can be found in the first part of the Table, whereas the trace statistics are presented in the second half. The maximal eigenvalue statistic tests the restriction of no more than r cointegrating vectors against the alternative of r+1 such vectors. The trace statistic tests the restriction of no more than r cointegrating vectors against the alternative of $r=0$.

Each of the variables is tested for cointegration in the Johansen's procedure with both the inflation variable and the deflator variable. The null of the no cointegration hypothesis is denoted by $r=0$. The 5% critical values for both sets of statistics are 14.069 and 15.41.

There is clear evidence by both the λ_{max} and the trace statistic values for rejecting the null of no cointegration between HI, PI, and API with both CPI and the GDP deflator. On the other hand, the evidence does not lend to such a rejection for ATI with CPI. There is in all cases only one cointegrating vector between the variables and CPI or the deflator.

Therefore, one can see that real estate investments in the form of PI, a combined property investment returns in the whole of Australia, of HI and API for SMA indicated by maximal eigenvalue statistics and trace statistics being greater than the 5% critical value, have maintained their real values.

Investments in property trusts in Australia, however, have not proven to do have done the same, hence keeping in step with inflation for this period of time in Australia. It is interesting to note that when the GDP deflator is employed, these investments seem to give a different picture from the previous case.

SUMMARY AND CONCLUSIONS

Dickey-Fuller, Augmented Dickey-Fuller and Phillip-Perron measures were used to test for a unit root in series of real estate investments and investment in real estate securities in Australia. As expected the data in these series were all non-stationary at their level. However, when their differences were employed they become stationary.

To test the hypothesis whether these real estate investments or investments in real estate securities have a long-run equilibrium position with inflation, the Johansen method was adopted. The results of the Johansen's Likelihood Ratio procedure prove that the majority of real estate investments in SMA and in general property in Australia do have a long-run relationship with inflation. This can be interpreted as that these investments have yielded a return equal to or greater than the rate of inflation in Australia over the period of 1970 to 1994. Hence, Fisher's hypothesis is verified with this sample of data and their cointegration tests.

In contrast to the above affirmative findings in favour of Fisher's proposition, investments in real estate securities cannot boast of the same feat of keeping up with inflation.

This paper's findings may thus help to reinforce the view that real estates, being limited in supply, particularly in established metropolitan areas, may be an inflation hedge in investors' choice of their portfolio in their objective of achieving an optimal return, especially in times of varying rates of inflation.

This paper has not however dealt with the issues of the causes of the failure to maintain real values by real estate securities investments, nor the causes for the success of real estate investments in maintaining their real values over time in Australia. Hence, this may suggest that future research effort be focused toward this direction.

NOTES

[1]Urbanski, T. (1990), Asset Price Inflation, Treasury Research Paper No. 1, December.

[2]Anstie, R., Findlay, C. and Harper, I., (1983), "The Impact of Inflation and Taxation on Tenure Choice and the Redistributive Effects of Home-Mortgage Interest Regulation," Economic Record, Vol. 59, No. 165, pp. 105-110.; Britten-Jones & McKibbin, W.J., (1989), Tax Policy and Housing Investment in Australia, Reserve Bank of Australia, Research Discussion Paper RDP 8907.

[3]Penm, J.H. & Terrell, R. D. (1994), "Is Housing Activity a Leading Indicator," *Economic Record*, Vol. 70, No. 210, pp. 241-252.

[4]See Britten-Jones & McKibbin (1989), Anstie, Findlay & Harper (1983), Neville et all(1987) and Williams(1989).

[5]Follain, J.R. (1982), "Does Inflation Affect Real Behaviour: The Case of Housing," *Southern Economic Journal*, Vol. 48, pp. 570-582., among others, have explored this issue.

[6]From: Brown, P.M. (1990), "UK Residential Price Expectations and Inflation," *Land Development Studies*, 7, 57-67.

[7]ibid., Brown, P.M.

[8]Fuller (1985).

[9]MacDonald, R. and Power, D. (1993), "Stock Prices, Efficiency and Cointegration: The Case of the UK," *International Review of Economics and Finance*, 2(3), 251-265.

[10]Figures 1 to 5 provide graphical illustration of these series.

[11]That is, testing equation 3.

REFERENCES

Albon, R. & Piggot, J. (1983). " Housing Interest Rate Deregulation and the Campbell Report," *Economic Record*, Vol. 59, No. 164, 80-87.

Anstie, R., Findlay, C. & Harper, I. (1983). " The Impact of Inflation and Taxation on Tenure Choice and the Redistributive Effects of Home Mortgaged Interest Rate Regulation," *Economic Record*, Vol. 59, No. 165, 105-110.

Banerjee, A., Dolado, J.J., Galbraith,J.W. & Hendry, D.F. (1993). *Cointegration, Error Correction, and the Econometric Analysis of Non-Stationary Data*, Oxford University Press, Oxford.

Barkham, R.J. & Ward, C.W.R., (1995). " The Inflation Hedging Characteristics of Property and Property Securities in the UK," Paper presented at Annual Conference of the American Real Estate Society.

Britten-Jones, M. & McKibbin, W.J. (1989). Tax Policy and Housing Investment in Australia, Reserve Bank of Australia, Research Discussion Paper, RDP 8907.

Brown, P. M. (1990). "UK Residential Price Expectations and Inflation," *Land Development Studies*, Vol. 7, 57-67.

Cassidy, B. (1991). *The Redistributive Effects of Inflation*, Treasury Research Paper, No. 2, March.

Dickey, D.A. and Fuller, W.A. (1981). "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root, "*Econometrica*, 49, 1057-72.

Drake, L. (1993). " Modelling UK House Prices Using Cointegration: An Application of the Johansen Technique," *Applied Economics*, 25, 1225-1228.

Engle, R.F. & Granger, C.W. (1987). "Cointegration and error Correction: Representation, Estimation and Testing", *Econometrica*, 55, 251-76.

Engle, R.F. & Granger, C.W. (1991). *Long Run Economic Relationships: Readings in Cointegration*, Oxford University Press, Oxford.

Fahrer, J. & Rohling, T. (1992). Some Tests of Competition in the Australian Housing Loan Market, Reserve Bank of Australia, Research Discussion Paper, RDP 9202.

Follain, J.R. (1982). "Does Inflation Affect Real Behavior: The Case of Housing," *Southern Economic Journal*, Vol 48, 570-582.

Froot, K.A. (1995). "Hedging Portfolios with Real Assets," *Journal of Portfolio Management*, Vol. 21, No.24, 60-77.

Fuller, W.A. (1976). *Introduction to Statistical Time Series*, New York: Wiley.

Harper, I. (1994). Housing Finance in Australia, Working Paper No. 5, August, Graduate School of Management, University of Melbourne.

Johansen, S. (1988). "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamic and Control*, 12, 231-54.

Johansen, S. and Juselius, K. (1990). "Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Kearl, J.R. (1979). " Inflation, Mortgages, and Housing," *Journal of Political Economy*, Vol 87, 1115-38.

MacDonald, R. & Kearney, C. (1990). "Consumption, Cointegration and Rational Expectations: Some Australian Evidence," *Australian Economic Review*, Vol. 29, 40-52.

MacDonald, R. & Power, D. (1993). "Stock Prices, Efficiency and Cointegration: The Case of the UK," *International Review of Economics & Finance*, 2(3). 251-265.

Neville, J., Nam, T.B., Vipond, J. & Warren, N. (1987). "A Simple Model of Recent Changes in Residential Property Market," *Economic Record*, Vol 63, No. 182, 270-280.

Penm, J.H. & Terrell, R.D. (1994). " Is Housing Activity a Leading Indicator ?" *Economic Record*, Vol. 70, No.210, 241-252.

Perman, R. (1991). "Cointegration: An Introduction to the Literature," *Journal of Economic Studies*, Vol. 18, No.3, 3-30.

Perron, P. (1988) " Trends and Random Walks in Macroeconomic Time Series: Further Evidence From a New Approach," *Journal of Economic Dynamics and Control*, 12, 297-332.

Phillips, P.C.B. (1987). " Towards a Unified Asymptotic Theory for Autoregression," *Biometrika*, 74, 535-47.

Phillips, P.C.B. and Durlauf, S.N. (1986). " Multiple Time Series Regression with Integrated Processes," *Review of Economic Studies*, 53, 473-96.

Santoni, G.J. & Moehring, H.B. (1994). " Asset Returns and Measured Inflation," *Journal of Money, Credit, and Banking*, Vol. 26, No. 2, 232-248.

Williams, P. (1989). " The Housing Crisis," *Economic Papers*, Vol.8, No.3, 70-87.

Williams, R.A. (1984). " An Australian Housing Model," *Economic Record*, Vol. 60, No. 169, 143-155.

Urbanski, T. (1990). *Asset Price Inflation*, Treasury Research Paper No. 1, Canberra.