CAN LARGE ECONOMIES DRIVE INTERNATIONAL REAL ESTATE MARKETS?

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ABSTRACT

There is continuing interest in the inter-relationships among real estate markets. This includes research suggesting that international linkages in real estate market returns are partly driven by the inter-relatedness between changes in local GDP and 'world' GDP. The current study continues this line of inquiry by examining securitised real estate market integration among six economies. By investigating long-run trends, this study suggests that not only are international real estate markets inter-linked, but that some large economies, such as the US and Japan, may have a significant influence over smaller markets. This in turn provides information that can be utilized by property investment managers for asset allocation and design.

Keywords: International real estate markets, integration, economic growth.

INTRODUCTION

Much attention has recently been placed upon 'globalisation' and the impact it has on national economies and financial markets. One aspect of this is that financial markets seem to be becoming more integrated. This can also imply that the driving forces behind these markets may also be global in nature. For the international real estate market, attention has recently been placed upon the impact of world economic growth. For example, recent research by Case, Goetzmann and Rouwenhorst (2000) and Quan and Titman (1999) has shown a linkage between real estate performance and general economic growth.

In this paper, we consider how economic fluctuations in large economies, such as the US and Japan, may influence smaller property markets in Australia, Singapore, the UK and France. This will not only help identify the inter-relatedness of property markets around the world, but also the role that large economies might play as potential driving factors influencing these markets. This, in-turn, can aid portfolio asset managers, as well as general property investors, to better understand real estate price movements and the underlying forces driving these. Moreover, by analyzing the impact that larger economies may have on other real estate markets, we can provide further information on the diversification benefits of holding portfolios of international property assets.

The outcomes from this study suggest that: (i) there are complex inter-relationships among international property markets; (ii) long-run relationships exist between the Gross Domestic Product of large economies and international property markets; and (iii) the US economy seems to exert a strong influence on other world real estate markets, while the Japanese economy shows to be less important.

The remainder of the paper is as follows. Section 2 briefly reviews the literature on international integration of property markets and the role of economic growth upon real estate markets. Section 3 describes the data and methodology used to analyse long-run market linkages in the presence of structural breaks. Section 4 then provides a discussion of the results and its implications for property analysts and investors before a conclusion is presented in section 5.

PREVIOUS RESEARCH ON REAL ESTATE INTEGRATION

The issue of market integration has long been examined for most financial markets. Work by Manning (2002) on stock markets; Tse, Lee and Booth (1996) on futures markets; as well as Phylaktis (1999) and Hsieh, Lin and Swanson (1999) on interest rates and money markets, respectively, have all shown financial markets have become more integrated over the course of the last decade. With increasing integration, the benefits associated with diversifying across national markets diminishes, as trends that affect one market begin to impact upon others.

Evidence, however, of integration in the global property market is a little scarcer. Primarily due to data limitations, there has been less exhaustive studies on international real estate linkages. For the research that has been conducted, the evidence would seem to suggest that property markets may still be more segmented than other financial instruments.

Studies focusing on property diversification have also been around for at least a decade. This includes earlier work by Giliberto (1990) and Asabere, Kleiman and McGowan (1991) which showed risk could be reduced by holding an internationally diversified property portfolio.

Even without developing and examining the performance of global property portfolios, research has shown the benefits of potential diversification simply by performing correlation analysis. Sweeney (1993) and Eichholtz and Lie (1995) all have shown that property returns are not necessarily highly correlated. Sweeney focused on prime office realty and Eichholtz and Lie looked at broader international property prices.

Now, even though there is evidence to highlight property markets may be somewhat more segmented than other financial markets, there is also research indicating that property markets have some level of integration, particularly in the long-run. This implies that although an investment manager can guarantee him/herself a degree of diversification in the short-term, real estate markets tend to follow similar trends over the long-run, leading to decreased diversification opportunities. Myer, Chaudhry and Webb (1997), using the Johansen co-integration methodology on appraisal based property series across three countries (US, Canada and the UK), found markets were inter-related in the long-run. These researchers also suggest that inflationary expectations provide a common linking factor between these markets. Another paper by Tarbert (1998) examined sectoral and regional diversification benefits within the UK using a multivariate Johansen framework. Her work explicitly notes that as correlations are inter-temporal, a more appropriate analysis in examining the benefits to diversification is to examine long-run trends within valuation-based property prices. Tarbert's results suggest some, but not all, property sectors are co-integrated across regions.

Further support to real estate markets being integrated is provided by Wilson and Okunev (1999) who also found evidence of integration between Australia, UK and the US. Moreover, in a study using direct property data, Ziobrowski and Curcio (1991) have indicated that one factor that can erode diversification benefits is currency risk. By examining the benefits to diversification from adding US property to British and Japanese investment portfolios, they found any gains made from diversification were eroded by currency risk. Interestingly, in further studies by Ziobrowski and Boyd (1991) and Ziobrowski and Ziobrowski (1993), even when currency risk was reduced through either leverage or the application of currency options, the benefits of diversification did not outweigh the costs from doing so.

Although the above studies are inconclusive in regards to the benefits from diversification, there is no doubt that most developed property markets are, one way or another, integrated to some degree. The question to ask is what could possibly be the driving forces connecting these markets? Although Myer, Chaudhry and Webb suggest inflationary expectations may explain common linkages and Ziobrowski and Curcio highlight currency factors, any real driving force that may impact several national markets must be a fundamental economic variable. Case, Goeztman and Rouwenhorsdt (2000) focus on an equally weighted index of global GDP. By analyzing appraisal based data for 22 countries, the authors commented that world real estate prices are indeed correlated and this was partly due to a common exposure to the world economy.

Furthermore, Quan and Titman (1999) also provide interesting support to this, as they noted in an international study of real estate markets that property market behavior could be partially explained by economic growth. This, in turn, will be invariably affected by world economic conditions.

This is not an unrealistic assertion. Property prices for any country will be heavily determined by the economy. For example, during an expansionary period, office realty prices will rise in line with the demand for additional space (assuming no `left over' supply). Furthermore, given the level of globalization and integration to which most developed nations are exposed, the world economy has a large role in determining national economic circumstances.

Large economies with strong international trade links such as the United States, Japan or even a `common market' economy such as the European Economic Union are likely to have a considerable impact upon world economic growth. Therefore, it is reasonable to suppose that economic changes within such economies will filter through to trading partners. More particularly, economic events, that have an impact on property markets in such economies, can also have some impact on international property markets through the shock effect of changes within the given economy being transmitted to external economies.

DATA AND METHODOLOGY

Six real estate markets from around the world are examined. The United States is included as it is the world's largest economy. Two countries represent European property markets (the UK and France). The United Kingdom is not only a major state in the EU, but is also an important player on the world economic stage, maintaining many of its historic trade and cultural links with the rest of the world. One might expect the UK economy (and its property markets via flow through effects) to respond to changes in the EU economy, to which it is closely tied, as well as to broader changes in the world economy. France, on the other hand, although very much a major part of the EU, has smaller trading relations with nations outside Europe[1]. This may mean France (and its property markets) might be more insulated from economic events outside the European Union and hence may only be affected indirectly by external economic shocks.

Three countries were selected from the Asia-Pacific region, these being Japan, Singapore and Australia. Despite its economic woes over the past decade, Japan is still the world's second largest economy and must clearly enter any analysis such as this as a leading economy. For Singapore, it not only is an original and important member of the ASEAN Group, but also a member of the East Asian Economy Growth Group loosely termed the 'Asian Tigers'. Singapore's

[1] As a proportion of GDP, its foreign direct investment is smaller to non-EU nations relative to the UK.

importance in the region cannot be understated, since this was one of the few economies in the region that did not need the assistance of the IMF during the Asian crisis.

While large in geographical terms, Australia is only a very small player on the world economic stage, but international trade is very important to the Australian economy. To put size into perspective, Australia's Gross Domestic Product is only about 5% that of US GDP. It is for these very reasons that Australia enters the analysis. As a small trading nation, it is reasonable to suppose that Australia's economy might be highly susceptible to movements in both the regional and world economies, and one might expect flow through effects to Australian property markets. The world's two largest economies are also Australia's major trading partners, one operating in relatively near proximity. In addition, Australia maintains cultural links to the United Kingdom, although its trade links are not as strong as in the past.

Therefore, as part of the six-country scenario, the economies of the United States and Japan are assumed to be major drivers of a `world' economy. The analysis is undertaken using quarterly data from the first period of 1980 to the final period in 2000, with the base set to the first period[2]. All property data was extracted from DataStream International and reflects securitised property prices. This overcomes certain problems associated with the alternative use of applying direct property series. Specifically, direct property series tend to suffer from appraisal smoothing and, while de-smoothing techniques have been developed, there is some degree of subjectivity involved in the procedures[3]. In addition, problems of lot size and liquidity in direct property markets requires data series of longer duration and higher frequency (to ascertain market integration) than are generally available for the markets under analysis in this study.

The major reason constraining the commencement date for the study was that some of the property indices before 1980 did not contain a sufficient number of funds[4]. Quarterly data on US and Japanese GDP was obtained from the International Monetary Fund *International Financial Statistics*. To consider the question of potential inter-relatedness, the scenario is developed from the standpoint of a US investor with an interest in the long-term repatriation of the invested funds. To cater for this situation, all the time series were exchange adjusted and expressed in real US dollars, with exchange rate data taken from Global Financial Data Ltd. This also limits the possibility of finding long-run relationships merely because of inflationary or currency factors. All analyses are undertaken at the quarterly frequency since GDP is only available at that

[2] Quarterly data was necessary due to frequency limitations with GDP.
[3] See Brown and Matysiak (2000), Chaplin (1997) and Chau, MacGregor and Schwann (1999) for examples.
[4] Many of the countries had less than five funds in each index before 1980.

frequency. As is common practice in reducing non-constant variance, analysis is undertaken on the natural logarithm of the data. With these notions in mind, descriptive statistics for each country are presented in the first part of Table 1.

Table 1: Descriptive statistics and unit root tests

PART (A)						
	US	*Australia*	*Singapore*	*Japan*	*UK*	*France*
Mean	4.86	4.71	3.75	-0.71	5.18	2.87
Median	5.01	4.76	3.75	-0.60	5.24	2.91
Maximum	5.75	5.17	4.80	0.39	5.67	3.31
Minimum	3.53	4.09	2.39	-1.90	4.57	2.17
Std.Dev.	0.56	0.28	0.57	0.67	0.31	0.29
Skewness	-0.67	-0.41	-0.001	-0.22	-0.42	-0.68
Kurtosis	2.54	2.21	2.64	1.90	2.07	2.66

PART (B)	(1)	(2)
Country	ZA t-statistic (model)	Date
US	-4.85 (C) -4.96 (B)	1989 Q3 1997 Q4
Australia	-4.62 (B) -4.54 (A) -14.64 (C)	1996 Q3 1997 Q2 1997 Q2
Singapore	-5.08 (C)	1997 Q1
Japan	-4.90 (A) -5.10 (C) -7.70 (B)	1989 Q4 1995 Q3 1996 Q2
UK	-4.53 (B) -4.57 (B)	1991 Q4 1999 Q2
France	-4.68 (A) -5.00 (B) -4.82 (C) -5.86 (B)	1984 Q3 1986 Q1 1990 Q2 1997 Q3
USGDP	-5.53 (A)	1990 Q2
Japan GDP	-4.82 (C) -5.60 (C) -4.45 (B)	1989 Q2 1995 Q2 1999 Q2

All descriptive statistics and ZA tests undertaken on the natural logarithm of the quarterly series. The 5% critical values given for the three ZA break models are: A = -4.80; B= -4.42; and C=-5.08. 10% critical values are: A= -4.48; B=-4.11; and C=-4.82.

To actually test for market linkages, there are several statistical techniques available. The most simplistic would be a correlation analysis of the different property series. The problem with this method is that correlation analysis is known to be inter-temporally unstable, implying that markets which seem to be highly uncorrelated in one period, may not be in another. Forbes and Rigobon (2002) have also shown that conventional cross-correlation coefficients of several markets can be biased upwards during a period of increased volatility in just one market. A common alternative is to conduct co-integration analysis. Co-integration focuses on the long-run relationships that may exist between various series over time. The Johansen (1988, 1991, 1995) technique is particularly popular due to its ability to analyse the number of co-integrative processes (rank) in a multivariate framework. The co-integrating rank is important in identifying the number of common trends that exist within a system. In fact, the number of common trends and stochastic processes in a system of *v* series are inter-related. Stock and Watson (1988) have shown that co-integrated variables share common stochastic trends. If the co-integrating rank of a system is $r = v\text{-}1$, then there is a single common trend (i.e. $v - r = 1$) driving all *v* series. The implication of this is that with a single common trend shared by all series, there are no benefits to diversification in the long-run as the markets are all inter-related.

The rank *r* is also known as the order of co-integration and is equal to the number of distinct co-integration vectors (co-integrating equations). In fact, in a vector autoregressive (VAR) model with *v* variables, there can at most be $r = v\text{-}1$ co-integrating vectors. The general autoregressive representation for a vector *Y*, which contains *v* variables (series), all of which are I(1)[5], can be expressed as:

$$Y_t = c + \sum_{i=1}^{k} \pi_i Y_{t-i} + \varepsilon_i \qquad (1)$$

where *c* is a constant term and π_i is a *v* x *v* matrix of parameters. The maximum lag of the system, *k*, is chosen so as to ensure that the residuals, ε_t, are white noise. This vector autoregressive system can also be re-arranged to yield an error correction model (ECM) representation:

$$\Delta Y_t = c + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \Pi Y_{t-k} + \varepsilon_i \qquad (2)$$

with $\Gamma_j = -(I - \sum_{i=1}^{j} \pi_i)$ and $\Pi = -(I - \sum_{i=1}^{k} \pi_i)$

[5] cf. Muscatelli and Hurn (1995).

where $\boldsymbol{I}$ is the identity matrix, Π is known as the long-run matrix, while Γ provides short run dynamics[6] . Since the variables ΔY_t and ΔY_{t-1} are I(0), while the Y_{t-k} variables are I(1), the system has the same degree of integration on both sides of the equality only if: (i) $\Pi = 0$, in which case, the Y variables are not co-integrated as there is no long run equilibrium relationship between them; or (ii) if the parameters of Π are such that ΠY_{t-k} is also I(0). This latter case applies when the Y variables are co-integrated and, in turn, implies that the rank, r, of the matrix Π should be less than the number of variables, v, in the vector Y (i.e. the matrix Π should not be full rank, $0<r<v$).

If $0<r<v$, then Π has what is referred to as rank deficiency and can be decomposed as $\Pi = \alpha\beta'$, where α and β are $(v \text{ x } r)$ parameter matrices. The matrix β contains the r co-integrating relations, with matrix α containing parameters measuring the speed of adjustment from long-run equilibrium (the matrix of weights with which each co-integrating vector enters the v equations of the vector auto regression). The decomposition is important since it permits testing various restrictions on α and β , so as to determine the relative importance of various property markets that might be part of a co-integrated system. For instance, if a speed of adjustment parameter is not significant for a country, then it indicates that the long-run trends affecting other markets may not actually be impacting this market. Also, the β parameters provide a weighting of the importance that each market has on any long-run trends. If one market is dominating the movement of others, then the β value can reveal this information.

Unfortunately, there is a potential difficulty from using the conventional Johansen approach over a long time-span as this study does. Between 1980 and 2000, many events will have had a major structural impact upon either individual or general property markets. For example, the recession that affected the US, Japanese and other world economies at the commencement of the nineties (and has more or less persisted with Japan throughout the nineties to the present) or the Asian Crisis of 1997 that affected a number of economies. These events may have lead to important structural changes to property market inter-relationships. That is, major economic events can cause market inter-relationships to change over time and any analysis needs to take this possibility into consideration. If structural breaks exist, the conventional Johansen analysis may not correctly identify the number of co-integrating equations that exist within the system – the existence of a break can yield an underestimate of the true rank of the system.

Several techniques aimed at incorporating the presence of an unknown structural break within a co-integrating relationship have been developed. For example, Gregory and Hansen (1996) have developed residual based tests along similar

[6] For a more detailed and relatively non-technical coverage of the Johansen methodology, the reader should refer to Hendry and Juselius (2000).

lines to the Zivot and Andrews (1992) unit root tests on univariate series. Analysis on the integration of property markets using this approach has been conducted by Wilson and Zurbruegg (2002) showing evidence that international real estate markets are co-integrated, once consideration is made for structural breaks. A drawback with the Gregory and Hansen approach, and which makes it unsuitable for the present analysis, is that the procedure cannot determine the rank of the system, and thereby the number of stochastic processes – the methodology is better suited to simply ascertaining the existence of co-integration in the presence of possible structural breaks. This was the avenue of research presented by Wilson and Zurbruegg (2002).

If there are several likely structural breaks in the deterministic trend within a co-integrating relationship, one possible alternative methodology to determine the rank of the system is the Johansen, Mosconi, Nielsen (2000) procedure (hereafter JMN). The testing procedure allows for a pre-specified number of breaks. A full exposition of the procedure can be found in JMN (2000) and an application of it in another research paper by Gerlach, Wilson and Zurbruegg (2003) also discuss its usage. Intuitively speaking, this model allows for structural breaks by placing dummies into the co-integrating equations to itemize the potential impact of the breaks. The model applied in this study is referred to as $H_c(r)$, which does not allow for a linear deterministic trend, although it does not exclude deterministic components within the co-integrating relations[7]. The co-integrating rank may be tested by modifying the procedures in Johansen (1988,1991), but the critical values are different. The new critical values are derived from the distribution discussed in Johansen, Mosconi and Nielsen (2000).

In order to determine the breakpoints for the model, an analysis of the data really needs to be conducted to show whether during the course of the sample period any events may have had an effect upon these property markets. Although JMN used prior knowledge of relevant historical events in their study to determine breaks, in this paper, we perform simple Zivot and Andrews (ZA) unit root tests on the univariate series. ZA tests are beneficial in these circumstances for two reasons. First, it is necessary to initially perform unit root tests to validate the use of co-integration analysis as the series should all be integrated to the same order[8]. Secondly, the benefit of using ZA tests are that they test for stationarity in the presence of a possible structural break. This provides a basis to determine if individual series have been affected by specific breaks and at approximately what time frame.

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[7] The cointegrating equation is described as $\Delta Y_t = \alpha(\beta' Y_{t-1} + \rho') + \varepsilon_t$ where ρ is a constant.

[8] Generally, with financial data this tends to imply series are difference stationary, (ie $I(1)$ processes).

EMPIRICAL RESULTS

Table 1 displays descriptive statistics along with the preliminary results from the aforementioned ZA tests. The descriptive statistics indicate the data are approximately normally distributed, since there is little difference in the mean and median for all series. There is practically no skewness and, apart from Japan, there is close to normal 'thickness' in the tails of the distributions. Zivot and Andrews specify three different types of break models in their tests, denoted A, B and C. These represent a crash model with no change in the overall trend of the variables, a change in the trend/growth rate of the variables but no change in levels, and finally a generalized model incorporating both scenarios. The ZA results for where breaks were detected in each of the three models have been tabulated. For some countries, there is more than one break-date per model. The reason for this is that every time the ZA test was conducted and a significant breakpoint detected, the analysis was run again from that date onwards to determine whether further breaks existed in the rest of the sample.

The ZA results presented in Table 1 show that for each country, significant breaks are evident in either one or more of the models. Moreover, there are some fairly common dates where nearly all the markets were affected. Specifically, common structural changes seemed to have occurred around 1989/1990 and then again around the period of 1997. In fact, with the exception of the UK, all the markets had either or both of these time periods listed as a significant break. Interestingly, these periods also coincided approximately with the recession that affected most countries commencing in early 1990 and with the Asian crisis that affected several countries about 1997. For this reason, and the fact that these events seemed to have influenced nearly all the countries in the sample, these particular dates are incorporated as common breakpoints for the JMN methodology as they coincide with known periods of some economic turmoil[9]. Similar dates were also applied in a study by Gerlach, Wilson and Zurbruegg (2003) when examining the impact of the 1997 financial crisis upon Asian real estate markets.

Are there common trends between national property markets?

In order to determine the impact that large property markets and economies like Japan and the US have upon the integration of world real estate markets, Table 2 provides a number of co-integration rank tests to determine how significant the impact these markets have in providing a mechanism for global property markets to be integrated. The first column in Table 2 shows the number of co-integrating equations present within the system when the US has not been included in the initial analysis of the system. Trace test statistics from using the JMN methodology are tabulated alongside the 5% critical values for the rejection of the

[9] The structural break dates were set as the final quarter of 1989 and the third quarter of 1997.

null hypothesis of there being r or less co-integrating equations. The trace statistics are calculated as:

$$\lambda_{Trace}(r) = -T \sum_{i=r+1} \log(1 - \lambda_i) \tag{3}$$

where λ_i is the i^{th} largest eigenvalue. Lag lengths for the procedures were determined by the Schwarz Information Criterion (SIC) on the undifferenced VAR (Schwarz, 1978), while ensuring all residual series from the VAR were uncorrelated. Column one in Table 2 shows that, without the US, world property markets seem to display a certain degree of freedom for independent movement, with three stochastic processes (two co-integrating vectors). Such an outcome indicates that there may be some opportunities present for those fund managers interested in diversifying risk through the purchase of international securitised real estate funds. However, it needs to be borne in mind that the presence of two co-integrating vectors here does suggest that the potential benefits from diversification are smaller than would be the case if there was no co-integration among these markets.

Table 2: Johansen Mosconi and Nielsen trace tests

	(1)		(2)		(3)		(4)		(5)	
	Exclude US		All Countries		Exclude JPN (&US)		Substitute US GDP		Substitute JPN GDP	
	λ_{Ttrace}	*5% CV*	λ_{Ttrace}	*5% CV*	$\lambda_{Ttrace\ T}$	*5% CV*	λ_{Ttrace}	*5% CV*	λ_{Ttrace}	*5% CV*
r=0	140.23	105.84	201.34	138.88	69.86	77.30	213.94	138.88	206.72	138.88
$r \le 1$	79.21	77.03	130.82	105.84	41.81	53.09	136.82	105.84	133.91	105.84
$r \le 2$	49.84	53.09	84.76	77.3	18.18	32.73	87.56	77.3	85.58	77.3
$r \le 3$	26.39	32.73	54.91	53.09	7.93	15.23	52.02	53.09	47.49	53.09
$r \le 4$	10.05	15.23	29.22	32.73			27.32	32.73	23.72	32.73
$r \le 5$			7.83	15.23			10.75	15.23	6.30	15.23

The results presented are the trace test results from the Johansen, Mosconi and Nielsen (2000) co-integration procedure. The critical values (CV) are determined from the distribution presented in JMN and the results tabulated assume the JMN $H_c(r)$ model.

Column two in Table 2 shows that, with the presence of the US property market, the number of co-integrating vectors jumps from two to four at the 5% critical level. Although this still indicates that property markets around the world have some independence in the long-run (with at least two stochastic processes at the 5% level), the US appears to contribute considerably to increasing the level of co-integration among world property markets. With the simple addition of only one extra country, the number of co-integrating vectors increases from two to four, suggesting a system that is more tightly `bound' to some long run equilibrium.

The United States is not the only major economy that may be instrumental in helping to tie world property markets together. Before the collapse of the Japanese economy in the early 90s, Japan had the most valuable real estate on earth, with property that was estimated to be worth twenty trillion US dollars (Edelstein and Paul, 2000). Putting this into perspective, Edelstein and Paul suggest that the sum of twenty trillion dollars represented about twenty percent of the world's wealth or about double the value of the world's equity markets. Before the collapse, Japanese property was worth about five times that of all real estate in the United States.

In column 3 of Table 2, we have examined our selected property system exclusive of the Japanese property market (and, obviously, we have also excluded the US property market since we know from above that the US appears to generate some kind of long-run binding force). In this reduced, four market property system, there are no co-integrating relationships. This is a very important outcome since it implies that there also appears to be some kind of tie between long run movements in the Japanese property market and other international property markets. Once both the US and Japan are no longer part of the system, property markets appear not to be linked together in a long run equilibrium relationship. Each country appears to follow its own stochastic trend – that is, there is no common trend among the remaining markets.

Are there economic drivers?

Given the relative sizes of the US and Japanese economies to the rest of the world, the impact that these economies can have upon real estate markets should be further investigated. To examine this, the fourth column in Table 2 contains the trace test results when the US property market series is replaced with US Gross Domestic Product. This will highlight the relative importance of the US economy, separate to that of the US property market. Now, columns two and four in Table 2 actually contain two borderline results at the 5% significance level – column 2 marginally includes four cointegrating vectors while column 4 marginally excludes four cointegrating vectors. If the trace test results are very close to the critical value, Juselius (1995) argues that the characteristic roots of the companion matrix can provide a useful guide as to the number of cointegrating processes within the system. Doing so, we find that there is more evidence[10] for incorporating a fourth cointegrating vector in both columns two and three than not

[10] Although not reported here, the companion matrix can be requested from the authors along with further statistical information applied in this paper.

and, accordingly, we decide to settle for four cointegrating vectors within the system. Thus, with four cointegrating equations in column three, the number of long-run relationships has not really changed much with the substitution of US Gross Domestic Product for US property.

Substitution of Japanese GDP for Japanese property does not have exactly the same outcome. Column five in Table 2 shows that if we include Japanese GDP in the system (noting that this now includes US property but excludes Japanese property), then the number of cointegrating equations definitely falls from four in column two to three in column five. While this suggests that the Japanese economy may form part of a co-integrated system, it also indicates that the influence of the Japanese economy on world real estate markets is not the same as that which comes from examining Japanese property prices. Nevertheless, the existence of three cointegrating equations does suggest the need to test that there can be some interaction between the long run equilibrium of at least some of the property markets and the Japanese economy.

Table 3: Sequential restriction tests

(1)	(2)		(3)		(4)		(5)	
	Exclude US		All Countries		Substitute USGDP		Substitute JPNGDP	
Country	$\chi^2(2)$	p-value	$\chi^2(4)$	p-value	$\chi^2(4)$	p-value	$\chi^2(3)$	p-value
USGDP					43.91	0.000		
JPNGDP							4.10	0.251
US			48.50	0.000			28.65	0.000
Australia	34.42	0.000	56.39	0.000	58.93	0.000	42.29	0.000
Singapore	7.95	0.018	29.17	0.000	45.11	0.000	13.55	0.004
Japan	36.83	0.000	60.65	0.000	64.60	0.000		
UK	18.02	0.000	36.04	0.000	54.84	0.000	37.08	0.000
France	26.41	0.000	37.94	0.000	43.74	0.000	15.63	0.001

The exclusion tests were based on there being r co integrating equations, determined in table 1 by the JMN trace tests at the 5% significance level. Critical values are distributed as $\chi^2(r)$.

Are some markets more important than others?

While Table 2 suggests the presence of a number of co-integrating vectors within the system of markets, it does not indicate which variables actually will form part of a co-integrating equation. One way to test this is to perform a sequential restriction (exclusion) test which checks the significance of the weighting from each series within the co-integrating equations. The third column in Table 3 provides sequential restriction test statistics to determine whether each property market is represented within the co-integrating vector. If it is not, then it does not contribute to the long trend within the system. The restriction tests operate on the matrix β from the decomposition of Π. The null hypothesis being tested is of the form $\beta_i=0$ for each $i=1...v$ series in β. This imposes linear restrictions by sequentially excluding variables from the co-integrating space. Johansen (1991, 1995) shows that the restrictions can be tested by a likelihood ratio test and the test statistic is distributed as χ^2.

From the exclusion tests, it would appear that all property markets form part of the co-integrating space at both the 1% and 5% levels (p-values in brackets). That is, all these markets contribute to long run trends within the system. Even when the United States is removed from the group (column two), all other property markets still form part of a co-integrated system, although with some minor changes in significance (e.g. Singapore is now only significant at the 5% critical value). To continue this analysis further, the results in Table 3 also take into consideration the potential impact of both the US and Japanese economies by presenting tests for exclusion when US GDP is substituted for US property and when Japanese GDP is substituted for Japanese property. In the case of US GDP, the outcomes show that all property markets, along with the US economy, form part of the co-integrating space at the 1% significance level. Hence, these results show that the US economy can as well demonstrate a number of co-integrating relationships with international real estate markets, as can the corresponding US property series, as shown by column four. The outcome indicates that US GDP is influencing long run trends.

Surprisingly, the same cannot be said for the Japanese economy. Column 5 in Table 3 clearly indicates that Japanese GDP does not form part of the co-integrating space – that is to say, the Japanese economy does not appear to be an influencing factor in world property markets. This is an interesting, but perhaps not entirely unexpected outcome when one considers the parlous state of the Japanese economy over at least half of the study period. Throughout the nineties, the Japanese economy has been on a non-growth path when most of the world's economies (and property markets) have been growing, despite occasional shake outs.

Are all property markets affected by common long-run trends?

Finally, if we are interested in the question of long run economic drivers, then we are interested in not only testing whether a particular market is part of any long-run trend (Table 3), but if it is itself affected by common trends. Such a test is for 'no levels feedback' (Hendry and Juselius, 2000). This is a test for what is labelled weak long-run exogeneity and the test operates on the matrix α from the Π decomposition earlier. Like the sequential restriction test, the null hypothesis being tested is of the form $\alpha_i=0$ for each i=1...v series when β_i is the variable of interest. For example, in Table 3, it was demonstrated that US GDP cannot be excluded from the co-integrating space – so it at least influences long run trends in the system. Now we are interested in the question of whether US GDP (or other variables) is influenced by any of the long-run common trends.

The outcomes from tests on the α_i coefficients when the US property market is included with other property markets are shown in column two of Table 4. The results demonstrate that events in each property market not only influence (Table 3), but are also influenced by long run trends (Table 4). This suggests that traders in securitised property markets are aware of, and react to, events in other real estate markets.

In column three of Table 4, we have substituted US GDP for US property to determine its significance and impact from the global property market. In the table, it can be seen that only in the case of US Gross Domestic Product can we not reject the hypothesis that the α_i coefficients are zero. In other words, in this group of countries, US GDP is not adjusting to the long-run relations – US GDP is not influenced by common trends in securitised property markets. This is a very clear indication that, while US GDP forms part of the co-integration system (Table 2) it influences (Table 3), but is not influenced by (Table 4) the other variables within that co-integrating space.

Table 4: Weak exogeneity tests

(1)	(2) All Countries		(3) Substitute USGDP		(4) Substitute JPNGDP	
Country	test-statistic	p-value	test-statistic	p-value	test-statistic	p-value
USGDP			6.30	0.178		
JPNGDP					12.48	0.006
US	26.31	0.000			12.52	0.006
Australia	18.58	0.001	22.70	0.000	9.51	0.023
Singapore	16.34	0.026	32.78	0.000	14.06	0.003
Japan	59.88	0.000	57.90	0.000		
UK	15.29	0.004	25.11	0.000	11.13	0.011
France	29.09	0.000	13.60	0.001	24.37	0.000

The weak exogeneity test is asymptotically distributed as χ^2 with degrees of freedom equal to the number of zero restrictions on the α-coefficients.

In column four of Table 4, a similar test for Japanese GDP rejects the null hypothesis that the α_i coefficients are zero at the 1% critical value. This is an important but unexpected result. The outcome suggests the Japanese economy forms part of a co-integrated system (Table 2), although the economy does not influence long run trends in world property markets (Table 3). Nevertheless, world property markets seem to have some feedback effect on the Japanese economy as the economy adjusts to these same long run trends (Table 4). Although this may initially look like a somewhat strange result, one obvious explanation is that the Japanese economy is not reacting directly to movements in securitised property markets, but rather to events that may have caused movements in world property markets. Since US GDP has already been shown to be a driver, the Japanese economy may simply be reacting to economic conditions that are being relayed indirectly through international securitised property markets. The end result, however, is that the impact of the Japanese economy upon real estate markets is negligible, unlike that of the US.

CONCLUSION

This paper has examined whether large economies can affect securitised property price behaviour. Research by such authors as Quan and Titman (1999) and Case, Goetzman and Rouwenhorst (2000) have shown that local plus global economic conditions can impact upon the performance of real estate markets. This study goes one step further to more explicitly determine the impact that large economies, such as Japan and the US, can have on international real estate markets.

By utilizing co-integration analysis to determine the long-run relationships that property markets from around the world have with each other, results have been able to show that not only are property markets inter-related over time, but also can be affected by the economic conditions prevalent in some large economies. Specifically, it was shown that when examining common trends between real estate markets, US GDP can play a significant role in determining long-run price behavior. The same cannot be said for Japan. The results indicated that the Japanese economy could not be seen as a driving force in world property markets, a surprising outcome given the general importance of Japan to the world economy. Although the Japanese real estate market itself may be influential, particularly in the Asia-Pacific region, the role the Japanese economy has on determining international real estate market trends is not particularly strong.

For the global property industry, the results in this paper can aid analysts to better understand price movements across the world. Not only do the results indicate that there are limitations to holding a diversified property portfolio over the long-run, but also consideration must be made for how economic conditions in one country may impact on real estate prices of another. Specifically, it would be wise for property analysts to consider economic growth prospects in the US when estimating domestic real estate returns.

This paper has not, however, analysed the degree by which economic factors from other countries affect local property prices. Specifically, by identifying further potential global and local economic drivers which influence real estate market returns, analysts can be more prepared to evaluate and understand possible demand for property assets. Such economic drivers will not simply be limited to general economic growth, such as GDP, but rather could also include macroeconomic determinants such as interest rates and inflation rates, among others. This paper only touches on this topic, although any future research on these issues will definitely be of invaluable benefit not only to academics, but also practitioners alike.

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