ISSN 1836-8123

Griffith Business School

Discussion Papers | Finance

Are Real Estate Markets Integrated with the World Market?

Evidence from Casewise Bootstrap Analysis

Abdulnasser Hatemi-J and Eduardo Roca

No. 2011-11

Series Editor: Dr. Alexandr Akimov

Are Real Estate Markets Integrated with the World Market?

Evidence from Casewise Bootstrap Analysis

Abdulnasser Hatemi-J

Department of Economics and Finance, UAE University, P.O. Box 17555, Al Ain, UAE.

Tel: +71-3-7133213, Fax: +71-3-7624384

E-mail: AHatemi@uaeu.ac.ae

Eduardo Roca

Department of Accounting, Finance and Economics, Griffith University, Nathan, Queensland, Australia 4111

Tel: +61-7-38757583, Fax: +61-7-3875 3719

Email: E.Roca@griffith.edu.au

(corresponding author)

Abstract

We test the extent of integration with the world market of the real estate markets of Australia, Japan, the UK and the US. We also determine the impact of the recent US real estate market crisis on this integration. We calculate the beta for the real estate market of each country with regards to the world market through the application of case wise bootstrap analysis – a method that is robust to non-normality and increased volatility. We find that all four markets are integrated with the world market - with the US and the UK markets being the most internationally integrated and Australia, being the least. We also find that the US real estate market crisis made the US real estate market more integrated globally but resulted in the Japanese market becoming less integrated internationally. The crisis did not affect the world integration of the UK and Australian markets.

Running title: Impact of US Sub-Prime Crisis on World Integration of Real Estate Markets

JEL Classifications: F36, G15, C22

Keywords: Beta, Casewise Bootstrap; Real Estate; World stock market; US Subprime Crisis; Integration

1. Introduction

Over the last decade, real estate markets have experienced rapid globalisation (Bardhan and Kroll, 2007) mainly as a result of the internationalisation of real estate investments. Foreign investments have easily found their way into the real estate sectors of countries over the last ten years. During the period, 2001-2006, for example, cross border real estate investment tripled to a level of US$116 billion which represented 20 percent of all property investments globally (Hobbs, Chin and Topintzi, 2007). This globalisation of real estate investment has greatly been facilitated by the securitisation of real estate markets, particularly through the massive growth of real estate investment trusts and listed property trusts in the US, Australia, Japan, Korea, Singapore and Hong Kong (Liow 2007; Liow and Webb, 2006; Bond et. al., 2003). During the 7-year period from January 2000 to the end of March 2007, the value of listed property markets increased in value by 170% from $350 billion to $945 billion (Yunus, 2009). The globalisation of real estate markets have also arisen from the internationalisation of real estate service providers, the development of more transparent international benchmarks or standards in real estate across the globe such as the recently published Real Estate Transparency Index of Jones Lang LaSalle (JLL, 2008), the reduction of political barriers, and the liberalisation of capital markets which also give rise to new financial instruments which allow foreign investors similar or almost equal footing with local real estate investors (Eicholtz, et. al., 2009).

As a consequence of this globalisation, it is expected that real estate markets will have become integrated. This integration among markets can arbitrage away excess returns between markets and therefore lead to convergence in returns among real estate markets worldwide after adjusting for risk, including country and currency risks, as markets become more efficient due to the availability of more global information that allow investors to make better informed decisions. It is also expected that this integration will lead to increased co-movement of prices among real estate markets worldwide. However, the non-tradability of physical real estate may moderate this co-movement of prices between real estate markets. For example, Bardhan et. al., (2007) show that, as a result of this non-tradability, real estate markets do not respond rapidly to international shocks as the effect of these shocks would have to go indirectly through local domestic variables rather than directly to real estate markets. However, the advent of securitisation in the real estate markets across the world primarily through such vehicles as real estate investment trusts is now starting to overcome this limitation of non-tradability of real estate. Thus, it is not clear a priori as to whether the globalisation of real estate markets will lead these markets to be globally integrated.

There is therefore a need to empirically investigate this issue. Unfortunately, at present, only a very few studies have done this – that of Liow (2007), Goetzmann and Wachter (2001) and Ling and Naranjo (2002). Liow (2007) investigated the applicability of the international capital asset pricing model (ICAPM) in relation to the securitised real estate markets of Australia, Japan, the UK and Europe. This study used the world stock market and world real estate market as proxies for the world

market. It estimated conditional and time varying betas and found the average betas of the markets to be less than one. The results of the study showed that the world real estate market has a positive effect on the real estate markets of Asia-Pacific, Hong Kong, Singapore and Malaysia, and a negative effect on the real estate markets of Europe and the UK. It also concluded that the world real estate market, as compared to the world stock market, was a better proxy for the world market. Ling and Naranjo (2002) also studied securitised real estate markets while Goetzmann and Wachter (2001) examined direct real estate markets. The findings of their investigations also showed that real estate markets are significantly affected by the world market. Given the limited number of studies, there is therefore scope for further studies on this issue.

The issue of integration of real estate markets with the world market is one that has both theoretical and practical significance. If real estate markets are found to be significantly integrated with the world market, then the relevant model to use in the pricing of real estate investments would be an international asset pricing model since world systematic risk should be priced. This also implies that there is international contagion risk – that is, international events can spill over into domestic real estate markets. These have very significant implications for investors and policymakers particularly so that real estate markets are very fundamentally important to the economies of countries. The recent global financial crisis is a glaring testimony to this important role of real estate markets. If investors misprice real estate investments, then this can have negative consequences on other sectors of the economy and can also spill over internationally

In this paper, we provide more robust evidence on the integration of real estate markets with the world market. Specifically, we examine the extent of integration of the real estate markets of the US, the UK, Japan and Australia with the world market based on two world market indexes, i.e. world real estate and world stock market. We apply the ICAPM which we estimate through the use of a case-wise bootstrap analysis – a method that is robust to non-normality and increased volatility that characterizes the financial markets especially during periods of distress. The extent of integration of each market with the world market is indicated by the size of beta. Beta represents the world market risk for each market – i.e., the effect of the world market on the returns of each real estate market. If beta is found to be significant for a market, then this means that that market is integrated with the world market.

Our study differs with the few previous studies on the integration of real estate markets with the world market in several ways. Firstly, we use of a different estimation methodology – case wise bootstrapping, that provides a number of advantages. As previously mentioned, this method performs better than the standard methods particularly when the data are non-normal and heteroscedastic which is the case during the financial crisis. Secondly, we also utilised a more updated and longer data set for the countries covered in the study as compared to those used in previous investigations. Thirdly, we examine the impact of the US sub-prime crisis on the level of

integration of the US, UK, Japanese and Australian real estate markets with the world market. The impact of the recent crisis in the US real estate market on the global market risk for real estate markets is certainly an essential issue for investors given the magnitude of the crisis and the worldwide impact it had made. To our knowledge, this is the first study to examine this particular issue. Liow (2007) examined the impact of the Asian economic crisis on world beta for real estate. No study yet has investigated the effect of the US sub-prime crisis on the world systematic risk of real estate markets.

Our findings show that all four markets are integrated with the world market - with the US and UK markets being the most internationally integrated real estate markets and Australia being the least. Our results also demonstrate that the US sub-prime crisis has different effect on the real estate markets. We find that the US real estate market crisis made the US real estate market to be more integrated internationally but resulted in the Japanese market becoming less globally integrated. On the other hand, the crisis did not affect the extent of integration of the Australian and UK markets with the world market, whether it is with the world stock market or the world real estate market. These results imply that global market risk should be priced in real estate investments, and that international shocks such as the US sub-prime crisis have differential impact on different real estate markets.

The rest of the paper is organised in the following way. The next section discusses methodology while Section 3 presents the empirical findings. The summary and conclusions are provided in Section 4.

2. Methodology

2.1 International Beta as a Measure of Global Market Integration

In this paper, we investigate the extent of integration of real estate markets with the world market. We then determine the effect of the US real estate market crisis on this integration. In order to achieve these objectives, we estimate the beta for each real estate market in the context of an international capital asset pricing model (ICAPM). As discussed previously, beta is taken to represent the extent of integration of each real estate market with the world market. The beta coefficient of the ICAPM for a country's real estate market may be defined as the ratio of the covariance between the expected (excess) returns on the country's real estate market and the expected (excess) returns on the world market portfolio to the variance of the expected (excess) returns on the world market portfolio. Hence the term 'international beta' may be understood as an index of the systematic risk for a country's real estate market with respect to the world market.

2.2 Estimating Beta Based on Pairwise Bootstrap Approach

The method that we apply to estimate the ICAPM is a case-wise bootstrap approach that is suggested by Hatemi-J and Hacker (2005). This method is shown by the authors via simulation experiments to

perform accurately when the financial markets are under distress and the standard assumption of normal distribution and constant variance is not fulfilled. Calculations are implemented by using a statistical software component that is produced by Hacker and Hatemi-J (2009). We make use of the following regression for calculating the international beta in the presence of a potential break:

$$R_{it} = \alpha_{i0} + \alpha_{i1} D_{it} + \beta_{i0} R_{mt} + \beta_{i1} D_{it} R_{mt} + \varepsilon_{it}\,, \qquad (1)$$

The denotations are defined as the following:

$R_{i,t}$ is the return of the real estate market *i* at time *t*. R_{mt} is the world market turn. D_{it} is a dummy variable with value zero for the period before the crisis and one for the period after the crisis for each market. The stochastic error term ε_{it} does not have to be necessarily normally distributed with constant variance because the case-wise bootstrap method is robust to the non-existence of these statistical assumptions. If the estimated coefficient β_{i1} is statically significant it means that there is a shift in the world market risk for country *i*.

We define the following matrix denotation to describe the case-wise bootstrap method that is used to estimate and test the statistical significance of the coefficients α_{i0}, α_{i1}, β_{i0} and β_{i1} in model (1):

$$Y = BX + \varepsilon \qquad (2)$$

where

$$Y = \begin{bmatrix} R_{i1} \\ R_{i2} \\ \vdots \\ R_{iT} \end{bmatrix}_{\text{a } (T\times 1) \text{ vector,}} \qquad X = \begin{bmatrix} 1 & R_{m1} & D_1 & D_1 R_{m1} \\ 1 & R_{m2} & D_2 & D_2 R_{m2} \\ \vdots & \vdots & \vdots & \vdots \\ 1 & R_{mT} & D_T & D_T R_{mT} \end{bmatrix}_{\text{a } (T\times 4) \text{ matrix,}}$$

$$B = \begin{bmatrix} \alpha_{i0} & \alpha_{i1} & \beta_{i0} & \beta_{i1} \end{bmatrix}_{\text{a } (4\times 1) \text{ vector, and}} \qquad \varepsilon = \begin{bmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \\ \vdots \\ \varepsilon_{iT} \end{bmatrix}_{\text{a } (T\times 1) \text{ vector.}}$$

The parameter vector can be estimated by the ordinary least squares as the following:

$$\hat{B} = (X'X)^{-1} X'Y \quad (3)$$

The implementation of the casewise bootstrap method consists of the following steps:

1. Produce bootstrap variables Y^* and X^* via resampling with replacement, that is generate:

   $Y^* = \{Y_1^*, Y_2^*, \cdots, Y_T^*\}$, $Y_j^* \in Y \ \forall \ j$. Where $j = 1, \cdots, T$. Where *T* is the size of the bootstrap sample. Similarly

   $X^* = \{X_1^*, X_2^*, \cdots, X_T^*\}$, $X_j^* \in X \ \forall \ j$. Where $j = 1, \cdots, T$.

2. Estimate the parameter vector ($\hat{B}$) using bootstrap data as the following: $\hat{B} = \left(X^{*'} X^* \right)^{-1} X^{*'} Y^*$.

3. Replicate steps one and two *N* times. We repeat the simulations *N* =10000 times.

4. Finally, we acquire the casewise bootstrap coefficient vector $\hat{B}^*$ by taking the median of bootstrapped estimators. We use the median instead of the mean value because the median is robust to extreme values.

This case-wise bootstrap approach is also utilized to implement tests of statistical significance of each parameter as an element in the matrix $\hat{B}^*$. That is, the p-value for each null hypothesis in the form of $H_0 : rB = 0$ is obtained by the bootstrap approach. Here *r* is a four by one vector that classifies the restrictions implied by the null hypothesis. As an example, to test the null hypothesis $\alpha_{i1} = 0$ then $r = [\alpha_{i1} \quad 0 \quad 0 \quad 0]$. So as to find the p-value for this null hypothesis, we need to first rank the estimated for $\hat{B}^*$ as described previously. The bootstrap p-value for this hypothesis is then calculated as the following. In case the median for rB^* is a positive number, then the p-value is the percentage of elements in the bootstrap distribution for rB^* that are negative plus those that are greater than twice the median. However, in case the median for rB^* is less than zero, then the p-value is the percentage of elements in the bootstrap distribution for rB^* that are positive plus the percentage of elements in rB^* that are less than double the median. The cut-off point of two times the median of rB^* yields p-values that are equivalent to those symmetric two-sided tests in a traditional hypothesis testing approach according to Hatemi-J and Hacker (2005).

2.3 Measurement of Variables and Data

Real Estate Markets Covered in the Study

As already discussed, this paper investigates the integration the US, UK, Japanese and Australian real estate markets with the world market. These four countires have the largest and most developed securitised markets in the whole world (Liow, 2007; Schindler, 2011; Wilson and Zurbruegg, 2003; Steinert and Crowe; 2001). In terms of absolute value, the US has the largest securitised property market (known as Real Estate Investment Trusts or REITs), although, proportionately, the US securitised sector is smaller than some of the securitised property markets of Asia or Europe (Wilson and Zurbruegg, 2003). For instance, about 55% of all institutional grade real estate recorded in the Australian Property Council's database is listed, compared with similar listings for the US of 18%, the UK of 17% and Japan of 10%, as pointed out by Steinert and Crowe (2001). Thus, these four markets provide an excellent laboratory for the investigation of the issue of global integration of real estate markets.

World Market

The real estate literature is silent as to which proxy is more appropriate to represent the world market, although the Morgan Stanley Capital International (MSCI) world index has been commonly used in international stock (Fama and French, 1998) and international real estate pricing studies (Bond et al., 2003). We use two proxies for the world market: the MSCI world stock price index and the world real estate index. We need to use these two proxies because of the following results from the literature. Liow (2007) finds that the use of the conditional betas relative to the world real estate index is more favoured. As many real estate markets are still less integrated with the global stock market, international real estate investors may still find it more useful to employ a world real estate benchmark (instead of a world stock market benchmark) to assist in their global asset allocation decisions and performance measurement exercises. This is an important finding for the current debate about the relative importance of an appropriate global benchmark in international real estate security markets.

Real Estate Market Securities Data

Real estate serves an important avenue for portfolio diversification for investors due to its stable growth in value over time and its low correlation with traditional assets such as stocks and bonds across countries. Another attraction of real estate is that it acts as a hedge against inflation as documented, for instance, by Hudson et. al., (2005), Yunus, (2009 and Bond et. al., (2006) among others. However, physical real estate has the disadvantage of being "lumpy" and "relatively illiquid". The processing of transactions relating to investment in physical properties may drag on for six months to even one year (Bond and Hwang, 2004).

An alternative method for investing in real estate that overcomes these disadvantages of physical real estate is investing through real estate securities. As pointed out by Yunus (2009), since the advent of

securitization in the early 1960s and especially over the last decade, REITs (real estate investment trusts), REOCs (real estate operating companies) and private indirect vehicles have emerged as viable alternatives to domestic commercial real estate ownership, allowing more investors to get involved with real estate. The increase in demand for these securities by institutional investors has encouraged countries worldwide to introduce REIT-like securities which thereby enhance the growth of the securitised real estate markets. According to NAREIT, the global market capitalization of publicly listed property securities has grown by 170% from approximately $350 billion to $945 billion over the 7-year period during the period January 2000 and to March 2007. By 2010, the value of the real estate securities market has reached $1 trillion.

In this paper, we therefore focus on the securitised (equities) segment of the real estate market. By doing so, we are able to use higher frequency data than what can be obtained from the direct real estate market. This is advantageous in the investigation of market co-movements as these often occur in short time horizons. The data employed in this study consist of publicly traded real estate stock price indices, in US dollars, quoted on a weekly basis, from Datastream for the four real estate markets under study, namely the United States, United Kingdom, Japan and Australia —over the period 2010 2005 to 2010. "Datastream's Real Estate Index aims to represent securitized real estate markets. The Thomson Datastream database constitutes the universe from which the index is drawn. Companies included in the index represent around 75-80% of the total market capitalization. Suitability for inclusion in the index is determined by market value and availability of the data. There are no liquidity requirements as well as no adjustments for non-public holdings of shares or for cross-holdings. The index constituents are reviewed at a quarterly basis and re-set to represent the new top group of stocks by market value" (Serrano and Hoesli, 2009).

Period of Study and Structural Break

The sample period is during 2005-2010 using weekly data. The period of the structural break is chosen to be at August 1, 2007 because this was when the real estate problem developed into a crisis (Kiff and Mills, 2008 and Dell'Ariccia, et. al., 2008, and Frank and Hesse, 2009).

Although the beginnings of the crisis can actually be traced back to the middle of 2005 when home repayment delinquency rates actually started to pick up (Federal Reserve Bank of San Francisco 2008), it was not, however, until the summer of 2007 that this situation developed into a full-blown crisis.

Returns

Weekly real estate stock returns (R) are obtained by taking the logarithmic difference of the stock index (P) times 100. That is, $R_t=100 * (\log P_t - \log P_{t-1})$. The sample period covers 04/01/2005-09/03/2010 on weekly basis. The selected period for starting the potential effect of the US sub-prime crisis is the first of August 2007. Thus, the structural break is taking place at $2007:08:01$ in the estimations.

3. Empirical Results

3.1 Data Diagnostic Tests

The continuous return of each variable is tested for normality and ARCH effects. The results that are presented in Table 1 show that the null hypotheses of normality and no ARCH effects are strongly rejected for the entire sample. Consequently, since these desirable statistical assumptions are violated then the standard methods based on asymptotic distributions might not perform accurately in this case. The descriptive statistics are also calculated for the subsamples before and after the crisis. The results indicate that the return of each market is reduced for the period after the crisis compared to the period before the crisis and the volatility has also increased significantly in each market after the crisis. The diagnostic tests show once again that the data is not normally distributed and ARCH effects exist especially for the period after the crisis. Hence, it is important to make use of the casewise bootstrap method that is robust to the violations of normality and the existence of the ARCH effects for drawing valid empirical inference.

Table 1. Descriptive statistics and diagnostic tests

Country	Mean	SD	Max	Min	P-value of Normality Test	P-value of ARCH test
Entire Sample Period						
US	-0.0007	2.9171	142.1456	-16.5864	<0.00001	<0.00001
Japan	-0.0757	3.4488	9.4714	-16.2858	<0.00001	<0.00001
UK	-0.0332	3.7151	16.6904	-20.6981	<0.00001	<0.00001
Australia	-0.2186	4.8070	24.2696	-22.0227	<0.00001	<0.00001
World Stock	0.0305	2.6235	11.7940	-13.9773	<0.00001	<0.00001
World-Real State Stock	-0.0300	3.6235	14.4803	-15.8507	<0.00001	<0.00001
Before the Crisis						
US	0.1388	1.523	3.6446	-5.5263	0.00253	0.8608
Japan	0.1774	2.8463	8.3756	-7.7736	0.23714	0.8009
UK	0.2287	2.0006	4.9159	-8.1216	<0.00001	0.5025
Australia	0.4538	2.8705	2.5746	-3.3271	<0.00001	0.7041
World Stock	0.2206	1.5307	4.4899	-5.3326	<0.00001	0.0522
World-Real State Stock	0.2829	1.8559	4.7978	-5.3493	0.00400	0.1357

After the Crisis						
US	-0.1496	3.8596	14.1455	-16.5864	<0.00001	<0.00001
Japan	-0.3532	3.39645	9.4714	-16.2858	<0.00001	<0.00001
UK	-0.3042	4.8822	16.6904	-20.6981	<0.00001	0.00020
Australia	-0.0510	6.2047	24.2696	-22.0227	<0.00001	0.00010
World Stock	-0.1611	3.3641	11.7940	-13.9773	<0.00001	<0.00001
World-Real State Stock	-0.3408	4.7485	13.4803	-15.8507	0.00113	<0.00001

Note: The normality assumption is tested by the Jarque-Bera test. The ARCH effects are tested by using the Engle's LM test.

In order to make sure that the spurious regression problem does not exist, we also have conducted tests for unit roots. The estimation results of these tests are presented in Table 2, which indicate that the null hypothesis of one unit root is rejected in each case and each returns is a stationary process.

Table 2. Unit root test results.

Variable	H_0: I(1), H_1: I(0)
US	<0.00001
Japan	<0.00001
UK	<0.00001
Australia	<0.00001
World Stock	<0.00001
World-Real State Stock	<0.00001

The null hypothesis of one unit root in each variable is tested by the Phillips-Perron test. The p-value for each test is presented.

3.2 Estimation Results

The results of the estimation of the parameters are shown in Tables 3 and 4. The estimate for beta of the real estate market of each country is presented in Table 3 with regards to the world stock market and in Table 4 with regards to the world real estate market. All betas are statistically significant. It can be seen in both Tables that all betas are positive which means that all markets move positively with the world market. Both tables also indicate that the Australian market is the least integrated (lowest

beta) with the world market. The most globally integrated market is the UK, based on the world stock market, and the US, based on the world real estate market.

We find that the real estate markets have a beta of less than one with respect to the world stock market; however, this is not the case with respect to the world real estate index where the US and Japan have betas greater than one. This means that the real estate markets are more sensitive to the world real estate market movements than the world stock markets. This is understandable since the world real estate index is an industry index while the stock market index is a broader index. What is important is that all betas are significant before the crisis.

The crisis seems to have affected only the world systematic risk of the real estate markets of the US and Japan. It can be seen in Table 3 that the US real estate market beta increased and hence became more integrated with the world stock market after the US real estate crisis. Japan, on the other hand, became less globally integrated as indicated by the decreased in its beta after the crisis. The extent of integration with the world stock market of the Australian and UK real estate markets did not significantly change after the crisis. This means that the US real estate market has now become more sensitive to the movement of the world stock market but the Japanese market has become less.

Our results also confirm the findings of the literature cited earlier that world stock and real estate markets are segmented. The extent of integration of the real estate markets with respect to each of these two proxies is different. Each of the real estate markets exhibits a higher level of integration with the world real estate market as compared to the world stock market. However, the crisis affected the world integration of more markets in relation to the world stock market (US and Japan) than in relation to the world real estate market (only Japan).

Table 3. The results based on case-resampling bootstrap method. Betas based on the world-stock without risk-risk free rate.

Country	Intercept (α_0)	Change in Intercept (α_1)	Slope (β_0)	Change in Slope (β_1)
Australia	0.1294 (0.4682)	-0.7805 (0.1521)	0.2448 (0.0550)	0.3356 (0.1150)
Japan	0.2793 (0.3979)	-0.9037 (0.1587)	0.9551 (<0.0001)	-0.1473 (0.0220)
UK	-0.04849 (0.8180)	-0.3330 (0.5210)	0.9868 (<0.0001)	-0.04350 (0.8556)
US	0.0038 (0.9855)	-0.0948 (0.8518)	0.8741 (<0.0001)	0.5108 (0.0200)

Notes:

1. The parameters are estimated by case-resampling bootstrap method. The median values are presented.
2. The p-values that are based on the casewise bootstrap approach are presented in the parentheses.

Table 4. The results based on case-resampling bootstrap method. Beta based on world-real estate index, without risk-risk free rate.

Country	Intercept (α_0)	Change in Intercept (α_1)	Slope (β_0)	Change in Slope (β_1)
Australia	0.0684 (0.6753)	-0.5870 (0.2360)	0.4097 (0.0003)	0.18935 (0.2388)
Japan	0.1936 (0.5220)	-0.6843 (0.2463)	1.0403 (<0.0001)	-0.3317 (0.0963)
UK	-0.1141 (0.5492)	-0.1241 (0.7684)	0.9995 (<0.0001)	-0.1890 (0.1980)
US	-0.1036 (0.4400)	0.1911 (0.6802)	1.0696 (<0.0001)	0.0193 (0.8807)

Notes:

1. The parameters are estimated by case-resampling bootstrap method. The Median values are presented.
2. The p-values that are based on the casewise bootstrap approach are presented in the parentheses.

4. Conclusions

The aim of this paper is to calculate a measure of international market risk (international beta) and test whether this measure has changed due to the recent financial crisis starting in August 2007. This international beta is used as a proxy for the integration of a real estate market with the world market. A case-wise bootstrap method is used to estimate and test the statistical significance of the underlying parameters. This method works better than standard methods especially for the data that is generated during crisis with non-normality and increased time-varying volatility. Our sample real estate markets consist of those of Australia, Japan, the UK and the US. The betas are calculated for the real estate market of each country with regard to the world stock market and the world real

estate market. The estimated beta is statistically significant in all models for all countries. The US or the UK, depending on the world proxy used, is the most integrated, while Australia is the real estate market that is least integrated, with the world market. The results show that the US real estate market crisis had different impacts on the extent of real estate markets to the world market. The US real estate crisis made the US real estate market more globally integrated and the Japanese market less integrated. The real estate markets of Australia and the UK were not significantly affected. The results also indicate that the real estate markets and stock markets continue to be segmented since the world integration of each real estate market differs depending on the proxy for the world market that is used.

These results have important implications for investors and policymakers. Since real estate markets are significantly affected by the world market, international risk should therefore play an important role in the pricing of real estate securities. This also implies that international contagion risk exists among real estate markets, and therefore there is a necessity for international cooperation among financial regulators if this kind of risk is to be addressed.

References

Bardhan, A. and Kroll, C. (2007), Globalisation and the Real Estate Industry: Issues, Implications and Opportunities, paper prepared for the Sloan Industry Studies Annual Conference, Cambridge.

Bardhan, A., Edelstein, R. and Tsang, D. (2007). Global Financial Integration and Real Estate Security Returns, Electronic copy available at: http://ssrn.com/abstract=905313.

Bond S.A. and Patel, K. (2003) The conditional distribution of real estate returns: are higher moments time varying, *Journal of Real Estate Finance Economics*, 26:319–339.

Bond SA and Hwang S (2004) Liquidity risk and real estate: a quantitative approach to assessing risk, paper presented to the 2004 European Real Estate Society annual meeting. Milan, June 2004.

Bond, S.A., Dungey, M. and Fry, R. (2006). A Web of Shocks: Crises Across Asian Real Estate Markets, *Journal of Real Estate Financial Economics*, 32, 253-274.

Dell'Ariccia, G., D. Igan, and L. Laeven, 2008, "Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market, (unpublished; Washington: International Monetary Fund).

Eichholtz, P.M.A. and Kok, N. (2007) "The Eu Reit and the Internal Market for Real Estate," Brussels:

Eicholtz, P., Gugler, N., and Kok, N. (2009). Transparency, Integration, and the Costs of *International Real Estate Investment*, Electronic copy available at: http://ssrn.com/abstract=1346409.

Fama, E. and French, K.R. (1998) Value versus growth: the international evidence, *Journal of Federal Reserve Bank of San Francisco*.

Frank, N. and Hesse, H. (2009). Financial Spillovers to Emerging Markets During the Global Financial Crisis, Working Paper WP/09/104, International Monetary Fund.

Goetzmann, W.N. and Wachter, S.M. (2001) The global real estate crash: evidence from an international database, in A Global Perspective in Real Estate Cycles (edited by S. J. Brown and C. H. Liu), Kluwer Academic Publishers, Boston, MA, pp. 5–23.

Goetzmann, W.N. (1993) The Single Family Home in the Investment Portfolio. *Journal of Real Estate Finance and Economics*, 6, 3, 201–22.

Hacker R.S. and Hatemi-J A. (2009) ContagT: GAUSS module to implement a pairwise bootstrap test for contagion, Boston College Department of Economics, *Statistical Software Components*, number G00007.

Hatemi-J, A. and Hacker, R. S. (2005) An Alternative Method to Test for Contagion with an Application to the Asian Financial Crisis, *Applied Financial Economics Letters*, 1(6), 343-347.

Hobbs, P.; Chin, H. and Topintzi, E. (2007) "Global Real Estate Investment and Performance," London: RREEF Research

Hudson-Wilson, S.; Gordon J.N.; Fabozzi F.J., Anson, M. and Gilliberto, S.M. (2005) Why Real Estate? *The Journal of Portfolio Management,* 31, 5, 12-21.

Kaminsky, G.L. and Schmukler, S.L. (1999), "What triggers market jitters? A chronicle of the Asian crisis", *Journal of International Money and Finance*, 18, 537-60.

Kiff, J., and P. Mills, (2008), "Money for Nothing and Checks for Free: Recent Developments in U.S. Subprime Mortgage Markets," IMF Working Paper 07/188 (Washington: International Monetary Fund).

Ling, D.C. and Naranjo, A. (2002) Commercial real estate return performance: a cross-country analysis, *Journal of Real Estate Finance and Economics*, 24(1/2), 119–142.

Liow, K.H. and Sim, M.C. (2006) The Risk and return profile of Asian Real estate stocks, *Pacific Rim Property Research Journal*, 12(3), 283–310.

Liow, K.H. and Webb, J. (2005) Common factors in international securitized real estate markets, Working Paper, Department of Real Estate (National University of Singapore) and Department of Finance, Cleveland State University.

Liow, KH (2007), The Dynamics of Return Volatility and Systematic Risk in International Real Estate Security Markets, *Journal of Property Research*, 24, 1, 1-29.

Schindler, F. (2011). "Market efficiency in the emerging securitized real estate markets", *Journal of Real Estate Literature* (forthcoming).

Steinert, M. and Crowe, S. (2001) Global Real Estate Investment Characteristics, PortfolioAllocation and Future Trends, *Pacific Rim Property Research Journal*, 2001, 7(4), 223-239.

Wilson, P. and Zurbruegg, R. (2003) International Diversification of Real Estate Assets? Is It Worth It? Evidence from the Literature, *Journal of Real Estate Literature*, 11, 3, 259-277.

Yunus, N. (2009) Increasing Convergence between U.S. and International Securitised Property Markets: Evidence Based on Cointegration Tests, *Real Estate Economics*, 37, 3, 383-411.