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The Role of Public Markets in International Real Estate Diversification

Brian A. Ciochetti
University of Texas-San Antonio, One UTSA Circle, San Antonio, TX, 78249, Email: Tony.Ciochetti@utsa.edu

Rose Neng Lai
University of Macau, Av. Da Universidade, Taipa, Macao SAR.
Email: roselai@umac.mo

James D. Shilling
DePaul University, 1 East Jackson Boulevard, Chicago, IL 60604,
Email: shilling@depaul.edu

This paper presents new evidence of the benefits of international real estate diversification using a rational, sentiment-based model of private and public equity securities. A sizable literature does exist on international real estate diversification. Our paper complements this literature by measuring the benefits of international real estate diversification in an equilibrium framework in which an immediate shock in one market may not cause an immediate effect in the other market. Yet, over time, the two markets will move back into equilibrium with one another, but not until capital flows from one market to the other. These capital flows impart a large local component into public and private real estate returns, thus suggesting international diversification benefits for property investors. Yet these benefits do not matter much to defined-benefit pension plans unless they are positively and significantly correlated with the plan's liabilities, and then only if the plan's liabilities are indexed to the cost of living either before or after retirement, or both. Our findings suggest that the sensitivity of real estate to national factors is large, while sensitivities to international influences are small.

Keywords

Private and Public Real Estate, Diversification Benefits, Pension Fund Liabilities

JEL Classification: G11, G12, G23

1. Introduction

In the last two decades, several studies have estimated the diversification gains to international real estate investors. The earlier researchers, for example, Case, Goetzmann, and Rouwenhorst (2000), Webb and Rubens (1995), and Ziobrowski and Curcio (1991), and more recently, Cheng and Glascock (2005), and Liow, Chen, and Liu (2011) have examined international real estate return comovements to measure the benefits of international diversification. Other papers, for example, those by Bardhan, Edelstein, and Tsang (2008), and Schindler (2009) estimate a model of international asset pricing and test whether the conditional expected return differential across countries is non-zero.[1] De Francesco (2010) finds that stocks of publicly-traded companies tend to move together in the same direction across countries. Moreover, he attributes a substantial amount of the correlation across world public real estate markets to the presence of exchange traded funds. In contrast, Case, Goetzmann, and Rouwenhorst (2000) attribute the high correlation across world real estate markets to the effects of changes in the GDP.

What this study uniquely adds to previous research is a new methodological approach to estimate the benefits of international diversification. There is evidence that prices in the public real estate market are bounded below by private real estate market value less the transaction costs associated with selling off assets and repurchasing shares; and above by private real estate market value plus the transaction costs associated with acquiring real estate assets from private holders (see Carlson, Titman, and Tiu (2010)). When there is excess demand in the public market and the price of shares is equal to its upper bound, then the market will be cleared by quantity adjustments. These quantity adjustments will reduce the market price of shares relative to the value of the real estate that the company holds. When there is an excess demand in the public market while the price of shares has not yet reached the upper bound, an upward price adjustment will result. When there is an excess

[1] One explanation for a non-zero conditional expected return differential across countries is the presence of a political risk premium. Other explanations include the possibility of taxes, transactions costs, and barriers to international investment for domestic investors that take the form of a fixed lump-sum dissipative, knowledge acquisition cost.

supply in the public market and the price of shares is equal to its lower bound, then the market can also be cleared by quantity adjustments. If there is an excess supply in the public market while the price has not yet reached the lower bound, then no quantity adjustment will take place while a downward price adjustment will occur. These price adjustments with no quantity adjustments mean there can be substantial differences at times between the market value of a public company and the value of the real estate that they hold, owing to changing sentiment. Eventually, however, as quantity adjustments occur, the returns of private and public real estate will converge.

Thus, the model in Carlson, Titman, and Tiu (2010) predicts that in order to explain the returns of private companies, one needs to add the public discount rate as an explanatory variable in a regression of private returns on public returns. Carlson, Titman, and Tiu (2010) are not observing international returns, but domestic returns on U.S. private and public real estate companies. With access to international data, we apply the Carlson, Titman, and Tiu (2010) model to 14 European countries, 3 Pacific Rim countries, and the United States (U.S.). The time period covered is from 1998 to 2012 for both the European and Pacific Rim countries and the U.S. Our key observation is that if different public real estate markets are fully integrated into a single multinational real estate market, then the public return in any country should be a linear function of the public return on the world market portfolio. Then, through local quantity adjustments in each country, private returns should have in common an international public return factor as well. Alternatively, public market segmentation by country implies that observed prices in the public and private domestic markets should reflect only the local market benchmark and that it is only the change in the local benchmark that generates a return effect. Finally, public and private markets might be completely segmented as well. Such market segmentation implies that the domestic rates of return in the private and public markets should not only be largely independent of one another, but also of the public returns in other countries.

These distinctions are important to test because questions are still abound, unanswered and pressing, that concern the importance of international real estate diversification in general and, more specifically, the importance of international real estate diversification when the home country represents a large component of global index, as is the case for the U.S. Our study is similar in spirit to a recent study by Hau (2011). However, the focus of the Hau study is different. The Hau study concentrates on domestic and foreign (non-real estate) stocks, while the present study focuses on private and public real estate companies. The Hau study tests four specific hypotheses: whether equity markets might be segmented along national markets, whether market segmentation may exist between developed and emerging markets, whether global market integration (in terms of risk pricing) is more pronounced for cross-listed emerging market stocks than those without a cross-listing, and whether markets are segmented along a liquidity dimension. The Hau study provides evidence of globally integrated risk-pricing, in that a country-based market segmentation hypothesis can be rejected because equity returns are best captured by global, not local, benchmarks.

A key result of the present study is that U.S., European, and Pacific Rim real estate investors gain much by international diversification, with the latter gaining somewhat more than U.S. investors. These results are in contrast with previous literature by Case, Goetzmann, and Rouwenhorst (2000), Webb and Rubens (1995), and Ziobrowski and Curcio (1991), who find that the benefits of international real estate diversification are surprisingly low. In contrast, prior studies by Eichholtz (1996), Eichholtz et al. (1998), Eichholtz, Gugler, and Kok (2011), and others demonstrate the importance of holding an internationally-diversified real estate portfolio. That is, these studies generally find that real estate markets are segmented across countries, and that domestic factors are much more important in explaining real estate returns than international factors. Most of these relevant works are of an earlier vintage, conducted prior to the expansion of public real estate markets. The richness of our data set allows us to split European countries along the line of Op't Veld (2005). We find that in tax-paying European countries, the market relatedness to the world factor is quite high, while in tax-transparent European countries, the market relatedness to the world factor is quite low. This result is likely due to the fact that in tax-paying European countries, publicly-traded real estate companies have characteristics of both stocks and real estate more so than in tax-transparent countries.

The remainder of this paper is organized into five sections. Section 2 describes the rational, sentiment-based model of private and public equity securities and outlines how we estimate the model. Section 3 describes on the real estate returns used to estimate the model and presents some of the summary statistics. Section 4 provides the evidence. Here, we pay special attention to the pricing of public companies in this model, and whether public real estate markets are globally integrated, and then whether over a long period of time, private real estate has the same return as public real estate. Section 5 examines the importance of a world versus a national market factor in explaining the pricing of private and public real estate companies and the implications thereof related to the benefits of international real estate diversification. Section 6 is a brief conclusion.

2. Test of Market Integration

This section develops the framework for our analysis of the benefits of international real estate diversification. Despite some important differences from the traditional way in which the benefits of international diversification are measured, our model nevertheless shares many features of the traditional model. The model is based on the theory in Carlson, Titman, and Tiu (2010). We shall not attempt a detailed discussion of the Carlson-Titman-Tiu theory, but instead, restrict ourselves to an outline of the theory which they envisage. The specific modeling assumptions are as follows.

- All real estate assets pay a continuous dividend at rate L_t, which follows the log-normal process:

$$dL_t/L_t = \mu_L dt + \sigma_L dW_t^L \tag{1}$$

  The parameters μ_L and σ_L are assumed constant.
- The private real estate sector is perfectly competitive. Furthermore, all privately-held assets earn a constant expected rate of return of r^* (equal to the opportunity cost of capital).
- All real estate assets are either held directly in the private market or indirectly through a public company.
- Shareholders earn at a public rate of return of r, which is assumed to evolve as

$$dr_t = \mu_r(r_t)dt + \sigma_r(r_t)\, dW_t^r + dD_t - dU_t \tag{2}$$

  The parameters μ_t and σ_t are assumed to be a function of r_t. Also, the strictly increasing processes dD_t and dU_t are intended to mimic changing sentiment in the equity markets. A positive shock from dU_t means a low public discount rate, which, in equilibrium, will cause values in the public market to rise. Similarly, a positive shock from dD_t will cause values in the public market to fall.
- As values in the public market rise, it will eventually become optimal for public companies to sell real estate and repurchase shares. Likewise, as values in the public market fall, it will become optimal for public companies to acquire real estate from private buyers.
- Not all of this occurs simultaneously, however. There are transaction costs of $c_{PR}L_t$ when assets are sold to public companies, and $c_{RP}L_t$ when assets are sold to private investors. All transaction costs are borne by the public company.
- These transaction costs create a region of inaction in which prices of public companies will expand as public companies wait until prices in the public market have fallen far enough to cause public companies to convert from public to private ownership, or prices in the public market have risen enough to cause private companies to convert from private to public ownership.
- In contrast, no transaction costs are incurred when privately held assets are sold to other private investors.
- The relevant discount rate earned by investors in public companies is

$$R(I_t) = \begin{cases} r_t, & \text{if } I_t = R \\ r^*, & \text{if } I_t = P \end{cases} \tag{3}$$

  Here I_t = P indicates privately held, while I_t = R indicates the publicly held.

- Eventually, the relevant discount rate in the public market will converge to equilibrium public discount rate r_t^{eq}, which evolves according to

$$dr_t^{eq} = \mu_r(r_t^{eq})dt + \sigma_r(r_t^{eq})dW_t^r + dD_t - dU_t \tag{4}$$

where the parameters μ_r and σ_r are assumed to be a function of r_t^{eq}. Values of r_t^{eq} satisfy $r_t^{eq} \in [\underline{r} + \mu_L, \overline{r} + \mu_L]$ for any t.

Given these assumptions, the market value, V_i, of an asset is

$$V^i(r,L) = supE[\int_0^{\theta} e^{-\int_0^{\theta} R_s(I_s)ds} L_t dt - e^{-\int_0^{\theta} R_s(I_s)ds} c_{i,j} L_\theta + \int_0^{\theta} e^{-\int_0^{\theta} R_s(I_s)ds} V^{I_\theta}(r_\theta, L_\theta) | (r_0 = r, L_0 = L)] \tag{5}$$

which is the present value of the cash flows of the property discounted by R_t, added to the present value of the proceeds when the asset switches its type from i to j at some future date θ, net of transaction costs.

Equilibrium in the Carlson-Titman-Tiu model occurs when the supply of private capital to the public sector and the demand for assets held by public companies maintain the public discount rate r_t in the interval $[\underline{r}, \overline{r}]$. In this case, the value of the privately held assets is

$$V^P(r,L) = \mathrm{L}/(r^* - \mu_L) \tag{6}$$

while the value of the publicly held assets is

$$V^P(r,L) = \mathrm{L}\hat{\phi}_R(r) \tag{7}$$

where the function $\hat{\phi}_R(r)$ satisfies

$$\frac{\sigma_r(r)^2}{2}\hat{\phi}_R''(r) + [\mu_r + \rho\sigma_L\sigma_r(r)]\hat{\phi}_R'(r) - r\hat{\phi}_R(r) + 1 = 0 \tag{8}$$

if $r \in [\underline{r}, \overline{r}]$. At $r = \overline{r}$, institutions purchase public assets and hold them privately. Consequently, the function $\hat{\phi}_R(r)$ simplifies to

$$\begin{aligned} 1/(r^* - \mu_L) &= \hat{\phi}_R(\overline{r}) - c_{PR} \\ \hat{\phi}_R'(\overline{r}) &= 0 \end{aligned} \tag{9}$$

Conversely, at $r = \underline{r}$, public companies acquire assets from private investors and hold them publicly. Consequently, the function $\hat{\phi}_R(r)$ simplifies to

$$\begin{aligned} \hat{\phi}_R(\overline{r}) &= 1/(r^* - \mu_L) - c_{RP} \\ \hat{\phi}_R'(\overline{r}) &= 0 \end{aligned} \tag{10}$$

In equilibrium, the returns to publicly and privately held assets are

$$dR_t^R = r_t^{eq} dt + (\sigma_L dW_t^L + \sigma_r (r^{eq} - \mu_L)\frac{\hat{\phi}_1'(r_t^{eq})}{\hat{\phi}_1(r_t^{eq})} dW_t^r$$
$$dR_t^P = r^* dt + \sigma_L dW_t^L \tag{11}$$

By taking the expected values of dR_t^R and dR_t^P, and writing $E[dR_t^P]$ and $E[dR_t^R]$for the expected values of the returns to privately and publicly held real estate, respectively, we have an expression that shows the relationship between the two assets

$$E[dR_t^P] = r^* dt + E[dR_t^R] - r_t^{eq} dt \tag{12}$$

which is to be expected since changing sentiment in the equity market can change $r_t^{eq} dt$, and changes in $r_t^{eq} dt$ can and do influence $E[dR_t^R]$.

The theory described above suggests that the link between the private and public real estate markets can be tested by estimating the following regression model:

$$dR_t^P = \beta_0 + \beta_1 dR_t^R - \beta_2 r_t^{eq} + \epsilon_t \tag{13}$$

where $\beta_0 = r^*$ and $\beta_1 = 1$ at times when conversions occur, but take on different values when shifts in sentiment raise or lower the cost of capital in the public market relative to the private market.

We proceed in the same way as Agmon (1973), Cohn and Pringle (1973), Solnik (1973), McDonald (1973), and others to examine the degree to which different national real estate markets are integrated into a single multinational real estate market. That is, we specify the following multifactor arbitrage pricing model for both the return on real estate and common stocks

$$\begin{aligned} dR_t^P &= \beta_0 + \beta_1(\gamma_0 + \gamma_1\, dF_t^W + \gamma_2\, dF_t^N + e_t) - \beta_2 r_t^{eq} + \epsilon_t \\ &= (\beta_0 + \beta_1\gamma_0) + \beta_1\gamma_1 dF_t^W + \beta_1\gamma_2 dF_t^N - \beta_2 r_t^{eq} + (\beta_1 e_t + \epsilon_t) \\ &= \pi_0 + \pi_1\, dF_t^W + \pi_2 dF_t^N - \pi_3 r_t^{eq} + u_t \end{aligned} \tag{14}$$

where dF_t^W is an orthogonal factor for the common underlying world real estate factor, and dF_t^{US} is an orthogonal factor for a residual national real estate factor obtained by regressing the computed national real estate index on the world real estate factor. In this alternative model, the coefficient on dF_t^W is now $\beta_1 \times \gamma_1$, not just γ_1. Similarly, the coefficient on dF_t^N is now $\beta_1 \times \gamma_2$.

Here, like Carlson Titman and Tiu (2010), we shall pay special attention to the weight that one can place on transaction-based returns in the public market versus appraisal-based returns in the private market. Existing studies show that returns on private real estate are typically smoothed up to four lags relative to the returns in the public market. This would suggest the employing of lags from lags 1 to 4 when estimating (14) while using quarterly data in the case of the U.S., and including one-year lags when estimating (14) with annual data in the case of non-U.S. countries.

3. The Data

Our public return data are return data for publicly listed property companies for 14 European countries, including Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom (UK), 3 Pacific Rim countries, including Australia, Japan, and South Korea, as well as the U.S. The return indices are value-weighted total return indices. The data for the U.S. were gathered from the FTSE/National Association of Real Estate Investment Trusts (FTSE/NAREIT). These observations are based on quarterly returns from 1998Q1 through 2012Q1. The publicly listed data for non-U.S. countries were gathered from the European Real Estate Association (EPRA). These observations are based on annual returns from 1998 through 2011. The returns are converted into dollar-equivalents by using official exchange rates. In addition to the return indices of the publicly listed property companies for the 17 countries, we have a value-weighted world index of publicly listed property companies calculated by the FTSE/NAREIT. The world index is in dollar terms and includes the largest and most liquid property companies and REIT securities from 16 developed European countries, including the UK, France, the Netherlands, Switzerland, Sweden, Germany, Belgium, Austria, Finland, Italy, Norway, Spain, Greece, Denmark, Ireland, and Portugal (listed in order of market value weighted average of the index),[2] 6 emerging European countries, including Austria, the Czech Republic, Hungary, Ireland, Poland, and Russia,[3] 6 developed Asian countries, including Australia, Hong Kong, Japan, Korea, New Zealand and Singapore,[4] 8 emerging Asian/Pacific countries, including China, India, Indonesia, Malaysia, Pakistan, the

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[2] The top 10 constituents in the Developed European REIT index include four retail companies, Corio in the Netherlands, Hammerson in the UK, the Capital Shopping Centers Group in the UK, and Klepierre in France; three diversified companies, Unibail-Rodamco in France, the Land Securities Group in the UK, and the British Land Co in the UK; Segro, a UK industrial company and Swiss Prime Site, a Switzerland office company.

[3] The number of constituents in the emerging European index is 74, with a total market capitalization of 228 billion euros and an average market capitalization of 3.1 billion euros.

[4] The top 10 constituents in the Developed Asian index include six diversified real estate companies, Sun Hung Kai Props in Hong Kong, Mitsubishi Estate, Mitsui Fudosan Co. and Sumitomo Realty & Development in Japan, and Wharf Holdings and Kang Lung Properties in Hong Kong; two retail companies, the Westfield Group and Westfield Retail Trust in Australia; and one office company, the Hong Kong Land Holdings in Hong Kong.

Philippines, Thailand, and Taiwan,[5] and 4 emerging Middle East/African countries, including Egypt, South Africa, Turkey, and the United Arab Emirates (UAE).[6]

Our private return data for the U.S. were gathered from the NCREIF from 1998Q1 through 2012Q1. The NCREIF returns are appraisal-based measures of the return on private equity real estate. The NCREIF returns are calculated by adding income returns to capital appreciation, where the former are calculated from the cash flows from actual rental collections, while the latter are calculated from the cash flow that would result from the disposition of the investment, that is, if the property were to be sold. As such, the latter are based on appraised property values rather than actual market values. The use of these appraised property values rather than actual market values generally leads to lagged and smoothed returns on private equity real estate vis-a-vis public real estate (see, for example, Geltner (1991)).

The private return data for non-U.S. countries were gathered from the IPD from 1998 through 2011. The IPD collects data on 62,000 directly owned properties in 25 different countries worldwide. The IPD indices are compiled from records of the private real estate firms that contribute data to the IPD. The indices are annual and formed by averaging across all properties located in a specific country. The data are collected in a similar way in each country, and based on the cash flows from actual rental collections and appraised property values. The IPD private equity returns are converted into dollar-equivalents by using official exchange rates.

For the U.S., the value of r_t^{eq} is measured by the return on the Fama-French SMB index (the return on a portfolio of small stocks less the return on a portfolio of large stocks). Carlson, Titman and Tiu (2010) use the same variable to measure r_t^{eq}. For non-U.S. countries, the indices used are market-value weighted stock price indices, which incorporate capital changes and cash dividends, as published in Bloomberg. The indices are converted into U.S. dollars by using official exchange rates.

One straightforward estimate of dF_t^W is the FTSE/NAREIT global public real estate market index. In the specific case of the U.S., the public returns on the domestic FTSE/NAREIT index are regressed on the returns on the

[5] The top 10 constituents in the emerging Asian/Pacific REIT index include six diversified companies, the DLF in India, Ayala Land in the Philippines, SP Setia in Malaysia, Lippo Karawaci in Indonesia, Unitech in India, and Yuexiu Property (Red Chip) in China; three residential companies, Land & Houses in Thailand, China Vanke (B) in China and Supalai PCL in Thailand; and SM Prime Hldgs, a Filipino retail company.

[6] The number of constituents in the emerging Middle East/African index is 18, with a total market capitalization of 11 billion euros and an average market capitalization of 622 million euros.

FTSE/NAREIT global public real estate market index to obtain the residual national factor, dF_t^N. For non-U.S. countries, we regress the returns on the different national EPRA indices on the return on the FTSE/NAREIT global public real estate market index to obtain the residual factor for a particular country.

Table 1 shows the means and standard deviations of the total return series for each type of real estate company, and the stock market total return series for the period 1998 through 2011. The average total returns for the 14-year period is -7.4 percent for public companies and 13.5 percent for private companies. At the same time, public companies were extremely volatile, with standard deviations that exceeded 50 percent in several cases. The volatility for private companies is generally between 15 to 25 percent in most cases.

Table 1 Summary Statistics of U.S. Dollar-Denominated Returns

	Public		Private		Equities	
Country	**Average**	**Std Dev**	**Average**	**Std Dev**	**Average**	**Std Dev**
Australia	4.98	71.77	26.77	51.71	25.59	70.27
Austria	-3.91	38.53	20.93	26.53	24.02	35.03
Belgium	-9.07	16.35	7.86	13.46	12.04	44.95
Denmark	35.22	68.57	15.21	19.21	1.41	9.24
Finland	-14.52	41.42	10.89	19.59	19.29	43.98
France	-17.07	29.10	12.05	22.23	11.49	31.48
Germany	-3.77	43.03	4.74	19.67	10.27	27.98
Ireland	-9.10	24.89	8.17	27.06	7.37	51.27
Italy	-5.19	52.26	-8.56	40.40	13.53	42.24
Japan	-12.10	37.38	12.96	15.20	17.36	27.73
Netherlands	-12.04	29.04	10.08	20.52	8.97	39.89
New Zealand	-5.54	29.21	18.69	29.65	13.21	34.31
Norway	-6.13	14.67	17.18	20.75	19.82	42.41
Spain	17.01	106.52	15.21	22.49	7.83	27.72
Sweden	-20.37	30.86	11.01	21.07	13.19	38.09
Switzerland	-11.42	14.21	16.14	13.51	13.10	47.47
UK	-8.02	37.74	7.08	22.55	15.03	55.19
U.S.	12.84	46.07	8.50	11.07	5.70	19.92

Figure 1 shows the trend in public real estate returns over the period 1998 through 2011 for each country. The boom in 2007 through early 2008 shows up clearly in most markets, as does the downturn in the markets during the late 2008 and early 2009 time periods. All public real estate markets suffered during this period. For example, REIT share prices in the U.S. declined 71 percent from the end of January 2007 to the end of February 2009. However, because REITs pay a high dividend, the decline in REIT share prices in the U.S. during this period was less than in otherwise equivalent asset classes that pay low dividends (see NAREIT (2012)).

Figure 1 Annual Public Returns for all Markets, 1998-2011

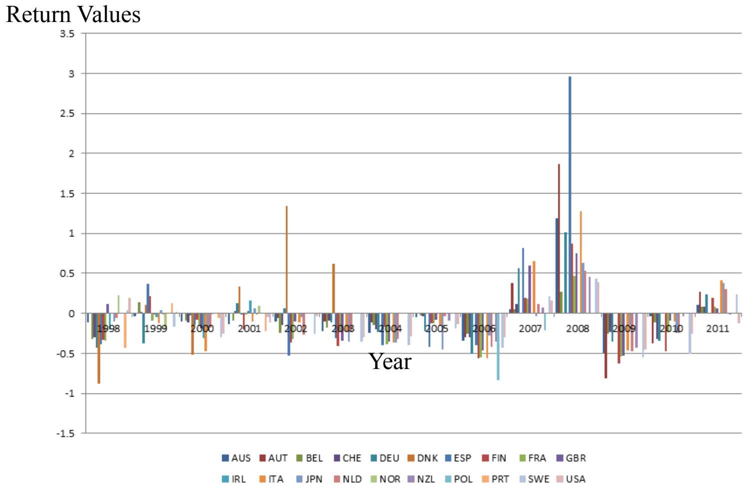
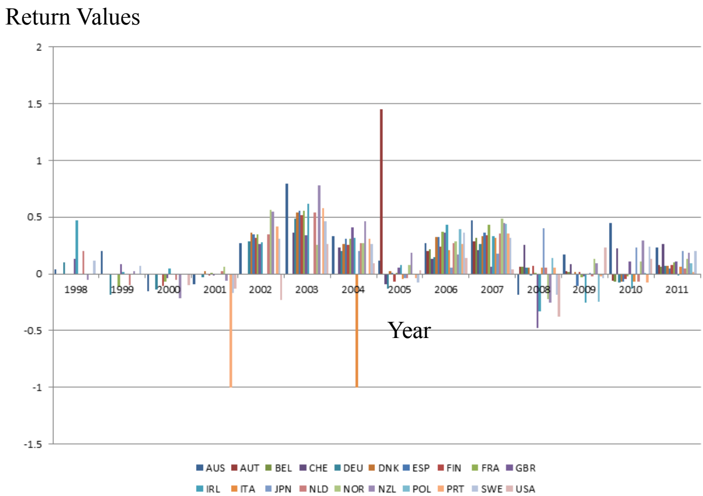


Figure 2 shows the dollar-denominated returns in the private real estate market for each country over the same time period. The fourteen-year period contains a boom period from 2002 through early 2008. Figure 2 shows an impressive annualized return of 28.2 percent over this period. This period also saw an impressive number of mergers and acquisitions of public real estate companies. For example, in 2002 in the U.S., the total value of public-REIT mergers and acquisitions was only $10 billion – with less than $2 billion coming from private equity firms. In contrast, in 2007, the total value of public-REIT mergers and acquisitions exceeded $85 billion – with more than two-thirds of this money coming from private equity firms. It is interesting that the last public-REIT in the U.S. to go private during this time period was the Equity Office Properties (EOP). EOP initially went from being privately to publicly owned in 1997. EOP then spent most of the 2000s as the poster child for public REITs. In 2008, with a portfolio of more than 590 buildings, which comprised over 105 million square feet of office space in 24 Metropolitan Statistical Areas (MSAs), EOP was the third largest publicly-traded REIT in the U.S. in terms of total asset size. EOP converted from public to private ownership in April 2008, a shift that is consistent with the theory presented above. That theory suggests that when prices are significantly higher in the private market than in the public market (as they were in late 2007 and early 2008), firms will shift from public to private market ownership.

Figure 2 Annual Private Returns for all Markets, 1998-2011.



4. Empirical Results

The results of estimating (13) are presented in Table 2. For these results, we proceed as follows. The parameters for the U.S. are estimated using quarterly data, while those for the European and Pacific Rim countries are estimated using annual data. The results are supportive of the model. For example, the coefficient estimate of dR_t^R is 0.552 for the U.S. and generally of the same magnitude as found by Carlson, Titman, and Tiu (2010). Keep in mind that there are times when public and private real estate returns should be highly correlated (e.g., when supply responses are expected to occur) and times where public and private real estate returns may be uncorrelated, depending on the level of demand relative to holdings of property in the REIT sector. Thus, the theory cautions against thinking estimates of β_1 in (13) should be close to 1.0.[7] The coefficient estimate of r_t^{eq} for the U.S. is negative and

[7] Also according to the theory, there may be periods in which dR_t^P may deviate from dR_t^R, and vice versa, or the change in dR_t^P or dR_t^R may be so small as to leave the market in a state of disequilibrium. In this case, values in the public market may respond to some lagged demand rather than the current demand and thus the equation in (13) should be fitted with lagged values. Of course, the issue is more extreme when appraised property values are used to measure dR_t^P. Interestingly enough, when quarterly lagged values of dR_t^R are entered separately on the right-hand side of (13) for the U.S., all the added lagged coefficients are positive and significant or nearly significant. Moreover, in this case, the theory tells us that the sum of the coefficients on dR_t^R is the most relevant variable (i.e., it is the best approximation of the effect of

statistically significant. Two remarks about this parameter estimate are worth mentioning. First, when the discount rate r_t^{eq} is low (i.e., investor sentiment is high), REITs should be trading at a premium relative to the real estate assets that they hold, which would mean dR_t^P ought to be greater than dR_t^R. This would suggest that an increase in r_t^{eq}, which lowers the value of a REIT, would be needed to establish an equilibrium. Second, when the discount rate r_t^{eq} is high (i.e., investor sentiment is low), REITs should be trading at a discount relative to the real estate assets that they hold, which would mean dR_t^R ought to be greater than dR_t^P. To restore equilibrium in this case, the discount rate r_t^{eq} would need to fall. When both dR_t^R and r_t^{eq} are included together on the right hand side of (13), the coefficient estimate on r_t^{eq} is what is needed, on average, to equate the values of dR_t^P and dR_t^R.

Table 2 Estimates of Carlson-Titman-Tiu Model of Private and Public Real Estate Returns

Variable	U.S.	All European Countries	Tax Paying European Countries	Tax Transparent European Countries	Pacific Rim Countries
Intercept	0.038	0.063	0.046	0.062	0.129
	(0.45)	(1.48)	(1.54)	(3.11)	(1.33)
dR_t^R	0.552	0.214	0.233	0.204	0.051
	(5.81)	(2.15)	(2.20)	(10.70)	(0.25)
r_t^{eq}	-0.035	0.428	0.483	0.985	0.475
	(-2.27)	(1.51)	(1.60)	(4.20)	(1.61)
R^2	0.282	0.441	0.470	0.992	0.318
MSE	0.0045	0.0076	0.0080	0.0002	0.0470

Note: The methodology employed to analyze the relationship between private and public real estate returns is based on Carlson, Titman, and Tiu (2010). The approach assumes private and public prices are linked by the fact that real estate flows from private to public ownership when price differences in these markets are sufficiently high.

The coefficient estimate of dR_t^R is 0.214 and statistically significant across all European countries. Of the 13 countries in Europe in our sample, 4 have tax transparent structures in place for listed property companies, while the other 9 do not. To test the importance of tax transparent versus tax paying markets, the European sample is broken down into two groups, tax transparent and tax paying countries. This breakdown follows the work of Op't Veld (2005). The coefficient estimate of dR_t^R for the tax-paying European countries is 0.233 and statistically significant, while that for tax transparent European countries

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dR_t^R on dR_t^P in (12)). While we do not report the results, the evidence does tell us that the long-run effect of dR_t^R on dR_t^P is generally between 0.56 and 0.82.

is 0.204 and statistically significant. The coefficient estimates of r_t^{eq} across all European countries and the two submarkets are positive, although not statistically significant. One would generally expect r_t^{eq} to be related to dR_t^P in the opposite way. However, it seems likely that the effects of changes in r_t^{eq} on dR_t^P are masked by the use of annual figures in all three of our European regressions.

One other significant result flows from this table. The coefficient estimate of dR_t^R is 0.051 and statistically insignificant in Pacific Rim countries. In addition, the variable r_t^{eq} has a marginally significant positive relation with dR_t^P in Pacific Rim countries. The coefficient estimate is 0.475. The results that the relation between dR_t^P and dR_t^R and between dR_t^P and r_t^{eq} are stronger for the U.S. and Europe than for the Pacific Rim may indicate that private and public real estate markets in the Pacific Rim are less effective in price discovery.

In Table 3, we use the common global real estate factor, dF_t^W, and the U.S. real estate factor, dF_t^N from 1998 through 2011 to test the extent to which different national public and private real estate markets are integrated into a single multinational real estate market. If investors care only about the mean and variance of the return on their invested wealth, and if barriers to international investments are small, all investors would hold (either through mutual funds or direct ownership of foreign shares) the world market portfolio of risky securities. Thus, one would expect the common world market portfolio to have important implications for the pricing of risk and the measurement of return in the public real estate market, and then, through local capital flows in and out of private and public markets, for the pricing of private real estate companies relative to public real estate companies.

The dependent variable in Table 3 is as in the previous regressions. Several interesting tendencies are apparent in the table. First, in the case of the U.S., the coefficient estimate of dF_t^W is 0.065 and statistically significant. Second, it appears that in this framework, there is an extremely strong national factor. The coefficient estimate of dF_t^N is 0.781 and statistically significant. Moreover, the results are robust when lagged values of dF_t^W and dF_t^N are separately added to the model. Third, the coefficient estimate of r_t^{eq} is -0.031 and statistically significant (and is of the expected sign).

We find similar estimates of dF_t^W and dF_t^N across all European countries. The coefficient estimate of dF_t^W is 0.092 and statistically insignificant. The coefficient estimate of dF_t^N is 0.212 and statistically significant. The coefficient estimate of r_t^{eq} is 0.412 and statistically insignificant. In contrast, for the nine tax-paying European countries, the coefficient estimate of dF_t^W is significantly positive, and its point estimate is quite high. On the contrary, the coefficient estimate of dF_t^N is -0.195 and statistically insignificant. For the four tax transparent European countries, the coefficient estimate of dF_t^W is 0.174 and marginally significant, while the coefficient estimate of dF_t^N is 0.167 and marginally significant. These estimates are different from those obtained for tax-paying European countries.

Table 3 Estimates of a Multi-Factor Structure of Returns within the Carlson-Titman-Tiu Model

Variable	U.S.	All European Countries	Tax Paying European Countries	Tax Transparent European Countries	Pacific Rim Countries
Intercept	-0.225	0.058	0.042	0.126	0.090
	(-3.26)	(1.06)	(1.22)	(4.03)	(0.96)
dF_t^W	0.065	0.090	0.989	0.174	-0.106
	(2.35)	(0.11)	(2.60)	(1.80)	(-0.48)
dF_t^N	0.781	0.212	-0.195	0.167	0.651
	(6.37)	(2.01)	(-1.00)	(1.76)	(1.40)
r_t^{eq}	-0.031	0.412	0.796	0.260	0.508
	(-2.05)	(1.30)	(3.98)	(3.00)	(1.86)
R^2	0.324	0.442	0.778	0.355	0.513
MSE	0.0042	0.0084	0.0036	0.028	0.041

Note: The methodology employed to analyze the relationship between private and public real estate returns is based on Carlson, Titman, and Tiu (2010). The approach assumes private and public prices are linked by the fact that real estate flows from private to public ownership when price differences in these markets are sufficiently high.

For the Pacific Rim countries, the coefficient estimate of dF_t^W is -0.106 and statistically insignificant, while the coefficient estimate of dF_t^N is 0.651 and marginally significant. The coefficient estimate of r_t^{eq} is 0.508 and marginally significant. The latter results are somewhat hard to interpret. We interpret the results to suggest that real estate markets in Pacific Rim countries are not well-integrated in the world capital or that private markets are not well integrated into public markets.

To summarize, the global factor, dF_t^W, does not seem to predict dR_t^P well in the U.S., across all European countries, on average, or in the Pacific Rim, which suggests that public real estate markets in these countries are not well-integrated. However, the model does capture some priced risks, in that there does appear to be a strong correspondence between dR_t^P and dF_t^N in the U.S. and across all European countries.

5. Some Interpretative Remarks

This paper has considered the hypothesis that prices in the public real estate market are bounded below by private real estate market value less the transaction costs associated with selling off assets and repurchasing shares and above by private real estate market value plus the transaction costs associated with acquiring real estate assets from private holders. The model assumes that private and public real estate markets will take some time before a new state of equilibrium is restored and that the means by which equilibrium is restored is through quantity adjustments. The evidence assembled in Table 2 is consistent with this hypothesis. Statistical tests demonstrated that the returns to privately and publicly held real estate are statistically positively related, while stock market returns have a negative (or statistically insignificant) effect on private real estate returns. These results hold for the U.S. as well as Europe and the Pacific Rim.

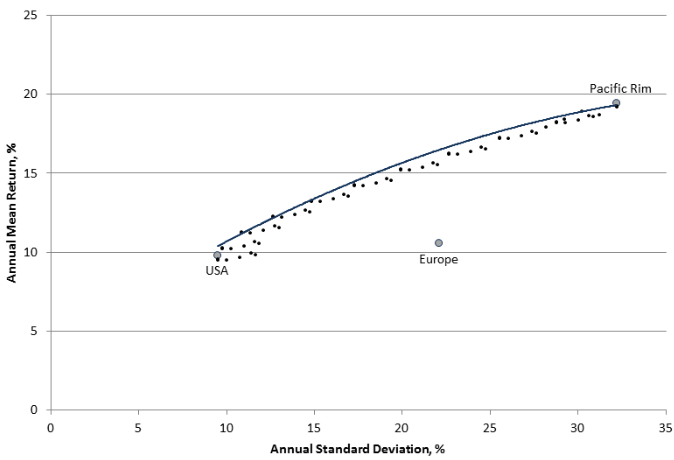
One tentative conclusion that can be drawn from the empirical tests is that, while public and private real estate markets may be buoyed by investor sentiment in the stock market in the short-run, prices and returns in the two markets all eventually converge (in a way that is consistent with the description in Carlson, Titman and Tiu (2010)). On the other hand, the data provide little support for the hypothesis of market integration along national markets. In the tests performed, a single global market benchmark has very little explanatory power over real estate returns in the U.S., across all European countries, and in the Pacific Rim. The U.S. ranks lowest in this respect. The Pacific Rim ranks highest in terms of the extent to which dR_t^P is correlated with dF_t^W. European countries lie between the two sets of nations.

The preceding suggests that real estate prices are locally and not globally determined. This result has implications for portfolio management. If investors fully diversify their real estate portfolios internationally, they are likely to reduce risk while smoothing investment returns by owning many real estate assets across a range of countries. To illustrate the gain from real estate diversification in this context, Table 4 reports the means and standard deviations of eight mean-variance-efficient portfolios. The returns are reported as total annualized percent returns, denominated in U.S. dollars. The correlation coefficients are conditional correlation coefficients. The latter are calculated from the coefficient estimates of how much dR_t^P will change in value for a 1.0 change in dF_t^W, dF_t^N, or r_t^{eq}, and from the assumption that the only reason real estate returns vary together is because of a common comovement with dF_t^W. All of the conditional correlations are close to zero. These low correlations suggest large potential diversification benefits for the international real estate investor.[8]

[8] For the three regions, the conditional correlation coefficients are:

The efficient portfolios in Table 4 display the following characteristics. At the low range of return and risk, the efficient portfolio is dominated by U.S. real estate. In the middle ranges of return and risk, the portfolio is evenly distributed among the U.S., Europe, and the Pacific Rim. At the high range of return and risk, the portfolio is dominated by Pacific Rim real estate. The results in Table 4 are also graphically illustrated by the solid line in Figure 3. At all levels of return and risk, some diversification of holdings by country can reduce risk without sacrificing return (as witnessed by the fact that portfolios to the right of the solid line are inefficient because some other portfolio would provide either a higher return with the same degree of risk or a lower risk for the same rate of return).

Figure 3 Efficient Global Portfolio Mixes



	U.S.	Europe	Pacific Rim
U.S.	1.000	-0.002	0.019
Europe	-0.002	1.000	-0.002
Pacific Rim	0.019	-0.002	1.000

All correlations are for annual observations.

Table 4 Efficient Portfolio Mixes by Country

	Portfolio (1)	Portfolio (2)	Portfolio (3)	Portfolio (4)	Portfolio (5)	Portfolio (6)	Portfolio (7)	Portfolio (8)
Average	0.0979	0.1050	0.1150	0.1250	0.1350	0.1550	0.1750	0.1947
Std Dev	0.0949	0.0974	0.1084	0.1260	0.1480	0.1988	0.2551	0.3217
Allocation								
U.S.	0.73	0.66	0.55	0.45	0.35	0.14	0	0
Europe	0.19	0.20	0.21	0.23	0.24	0.27	0.22	0
Pacific Rim	0.08	0.15	0.23	0.32	0.41	0.59	0.78	1.00

Note: The table lists the efficient global portfolios for each level of return and shows their risk levels. These portfolios are the ones that give the returns and standard deviations on the curve in Figure 3. The correlations in the returns across the three regions are calculated from the coefficient estimates in Table 3 and the assumption that the only reason real estate returns vary together is because of a common comovement with dF_t^W

6. Conclusion

This paper has presented new evidence on the benefits of international real estate diversification by using a rational, sentiment-based model of private and public equity securities. The model assumes that private and public real estate markets are partially segmented and it is local capital flows in and out of private and public markets that force the two markets to converge. As the two markets converge, private investors earn the same return on their investment as public investors who buy shares in a public company focused on the ownership of real estate. We ask in this framework, whether global market integration for publicly-traded companies occurs in parallel with these trends, thus causing both private and public real estate prices to be determined globally, not locally.

The evidence implies local arbitrage. There is substantial private index change for a large change in the public market index as well as for shifts in investor sentiment as measured by stock market returns. These results are consistent with the findings reported in Carlson, Titman and Tiu (2010). However, there is little evidence that global market integration for publicly-traded companies occurs in parallel with these trends. By far, national factors account for the bulk of the explained variance in private real estate returns in the study. In contrast, a world factor adds little to the total explained variance. The results support the view that diversifying across different countries can lower risk (to the extent to which the economies of the areas are independent of each other). The empirical results are presented based on a set of 14 European and 3 Pacific Rim market indices, and a U.S. index. The time period under examination is from 1998 to 2012. The estimates are fairly consistent across countries, despite the differences in the data sources and the sampling frequency of the data used.

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