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Modeling the Risk Characteristics of Real Estate Investments

Portfolio allocations to alternative investments have grown dramatically in recent years. They now represent a material component of both the expected return and risk of the average institutional portfolio. Given their illiquid nature, it is, however, difficult to quantify and hedge risk of most alternative investments. Inaccurate estimates of risks within these asset classes may result in inefficient diversification, sub-optimal portfolio allocations, and excessive tail risk exposures. We analyze the key risk factors that drive real estate returns and their correlation with other risky assets. We show that it is indispensable to account for the appraisal bias in common return indices. Overall we find that real estate investments have significant exposures to the equity market factor, real duration, credit spreads and liquidity factors. Our analysis contrasts private real estate investments (core, value-added and opportunistic) with public REITs.

Even CIOs and risk managers working for the largest and most sophisticated institutional investors face a challenge when developing risk estimates within alternative asset classes. Real estate investments constitute a particularly important alternative asset class. For example, some 93% of institutional investor portfolios held real estate investments in 2010, according to the Council of Institutional Investors 2010 Asset Allocation Survey. The following

questions are therefore of significant importance for investment managers who manage multi-asset class portfolios:

1) What are the true volatilities of public and private real estate investments?

2) What are the true correlations of private market real estate investments with the broad public equity markets?

3) How does the risk profile of private real estate differ from the risk profile of public real estate investments?

4) Which risk factors can be expected to drive real estate returns?

5) Should investors hedge the tail risk in private real estate exposure, and if so, how should this hedge be implemented?

6) Can the fundamental risk factors of private real estate be replicated in the public markets?

In an attempt to answer these questions, we apply the following approach:

I. First, we analyze the fundamentals of real estate investments to isolate the drivers of real estate net operating cash flows and the factors that influence market returns;

II. Next, we determine the specific risk factors that drive the volatility of different types of real estate investments, both public and private, as well as their correlation with other asset class returns;

III. Lastly, we quantify the relative impact of each risk factor and its contribution to potential performance and volatility.

Our initial findings indicate that both public and private real estate investment returns can be attributed to exposures to four main risk factors that cut across asset classes. These factors are real interest rates (duration risk), equity risk, credit spreads and liquidity risk. At times, a separate industry factor that is specific to the real estate sector also plays an important role. Our analysis indicates that the risk factor exposures of public and private real estate investments are very similar despite the low correlations of reported returns for such investments. The true relationship emerges once the "appraisal" biases embedded in the return statistics for private real estate are properly accounted for. We also show that the true correlation between both public and private real estate markets and equity markets is fairly high, varies over time, and has increased recently during and following the financial crisis.

We characterize the risk factor exposures of public market real estate investment trusts (REITs), as well as private real estate investments, which are classified into the commonly used sub-categories of core, value added, and opportunistic. We recognize that additional value may be realized by reclassifying these categories into specific sub-sectors such as retail, industrial, hospitality, etc. and making customized adjustments for degrees of leverage, but we prefer to begin with the more commonly used classifications to isolate the more generic risks of the asset class.

Introduction

Conventional measures of returns in public and private real estate suggest that the two types of real estate investments have very different risk and return profiles. When compared to REITs, private real estate appears to be much less volatile than its public counterpart, and it appears to have much lower correlation with other risk assets. This has caused many long-term investors to consider private real estate a more attractive investment than public real estate, because the perceived diversification benefit is larger and the risk/ return profile seems better. Over the past 20 years, returns for private real estate – at almost 7% – have come in a bit below its public counterpart, but with much lower volatility, as shown in Figure 1.

Figure 1: Annual investment returns for the Dow Jones U.S. REIT and NCREIF property indices (January 1989 – June 2011)		
	NCREIF Property	**DJ U.S. REIT**
Average return (%/ yr)	6.99%	11.53%
Volatility (%/ yr)	4.98%	21.16%
Sharpe ratio	0.52	0.34
Beta to S&P 500	0.05	0.77
Worst quarter	-8.29%	-39.95%

Source: PIMCO, NCREIF, Bloomberg (as of 30 June 2011)

The large differences between public and private real estate returns and risk measures, however, are puzzling given the similarities in underlying assets. In many cases, public and private real estate investments provide exposure to the same property market with very similar or highly correlated cash flows. The two investments are only distinct from the point of view of liquidity, tax structure, dividend distribution profile, and to some extent, leverage. We recognize that these characteristics can appeal to different investors, thereby creating potential distortions between public and private market valuations. However, we contend that the assets and claims on cash flows are fundamentally the same. Liquidity considerations aside, shouldn't investors always buy the lowest priced claim to the cash flows (which would tend to equalize the prices and valuations over time)? Does it then make economic sense or theoretical sense that the risk estimates for the two types of investments are so different?

Our estimated risk factor model is intuitive and explains both private real estate investments (core, value added, opportunistic) and public real estate in a consistent framework. Overall, we find that the risk characteristics (volatility and correlations) of public and private real estate are broadly similar. The returns are driven by the broad equity markets, credit spreads, real interest rates, liquidity factors and at times by a separate real estate industry factor. We find that the only significant difference between the risks and realized returns of public and private real estate is that private real estate investments have more liquidity risk factor exposure.

Public and private commercial real estate

The commercial real estate market in the United States is estimated at $4.0 trillion at year-end 2010, according to Institutional Real Estate, Inc. Returns are composed of current income from rents, net of operating and maintenance expenses, and the potential for capital gain driven by property price appreciation. There are primarily two ways to invest in commercial real estate: either through participation

in a private investment pool or though listed shares of real estate management companies or in the form of real estate investment trusts (REITs), as summarized in Figure 2.

Figure 2: Typical characteristics of public and private real estate investment vehicles		
	Private investment fund	**Public REITs**
Form of investment	Limited partner interest in a discretionary commingled private partnership	Listed shares on stock exchange
Management	Investment manager allocates funds to local operating company and manages with internal or external property management team	Real estate operating company (REOC) or third party property manager manages property portfolio
Clientele	Institutional investors	Institutional and retail investors
Time horizon	Typically 10 year life of fund; holding period in the range of 4-6 years	At the discretion of each investor
Source of returns	Capital gains (realizations) through sale of portfolio companies	Dividends and share price appreciation
Valuation	Pooled appraisals; based on capitalization rates of stabilized cash flows	Funds from operations (FFO) multiples; NAV / market capitalization
Liquidity	Limited to distributions made by general partner upon realizations of portfolio investments	Daily

Source: PIMCO

Private real estate can be divided into three broad investment styles: core, value-added and opportunistic. One of the key variables that defines designations is the different return targets that investors associate with each type of investment. Specifically, opportunistic funds have a much higher return target than value-added and core investment funds.

In an attempt to achieve higher levels of return for opportunistic portfolios, a higher degree of risk is taken at both the asset and capital structure levels. Opportunistic funds rely on a higher degree of leverage and invest in properties with more uncertain and cyclical cash flows, requiring a greater degree of asset stabilization, repositioning, or development by the investment manager than core and value-added real estate funds. In addition, opportunistic funds are generally motivated by the potential to resell the property at a higher price after a fairly short investment period. Because of the relatively short investment horizon, they are also typically financed with shorter-term liabilities. Core funds, on the other hand, typically utilize low leverage and invest in high-quality assets that have high occupancy rates and provide steady projected cash flows with limited fluctuations. Investors in core funds generally have a long-term investment horizon and are less exposed to temporary changes in discount rates (for instance, due to liquidity events) that may significantly affect the exit value of investments made by opportunistic funds with structures. The value-added funds fall somewhere in between core and opportunistic classifications in terms of their use of leverage, cash flow certainty and investment time horizon.

We can summarize the broad characteristics of each real estate investment style as follows:

- Core Real Estate Investments = Low Leverage/ Low Return Potential/ Low Risk/ Stable Cash Flows/ Low Manager Discretion

- Value-Added Investments = Medium Leverage/ Medium Return Potential/ Medium Risk/ Generally Stable Cash Flows/ Medium Manager Discretion

- Opportunistic Investments = High Leverage/ High Return Potential/ High Risk/ Volatile Cash Flows/ High Manager Discretion

Figure 3: Correlations and volatilities of real estate investments, stocks and bonds using traditional metrics

Period 1989-2011	Core	Value-added	Opportunistic	REITs	Stocks	Bonds
Private (core)	100.00%					
Private (value-added)	90.26%	100.00%				
Private (opportunistic)	82.21%	87.16%	100.00%			
Public (REITs)	20.57%	21.64%	33.14%	100.00%		
Stocks	11.62%	16.69%	27.88%	57.68%	100.00%	-6.04%
Bonds	-19.15%	-17.53%	-18.45%	10.15%	-6.04%	100.00%
Mean	1.73%	1.40%	5.12%	7.15%	6.31%	2.82%
Volatility	6.37%	8.78%	12.19%	21.49%	16.15%	4.20%
Sharpe ratio	27.13%	15.98%	42.01%	33.25%	39.06%	67.09%

Period 1989-2008	Core	Value-added	Opportunistic	REITs	Stocks	Bonds
Private (core)	100.00%					
Private (value-added)	80.90%	100.00%				
Private (opportunistic)	75.80%	85.77%	100.00%			
Public (REITs)	10.79%	17.16%	21.67%	100.00%		
Stocks	-1.47%	9.12%	12.19%	39.15%	100.00%	-6.01%
Bonds	-22.07%	-17.56%	-18.36%	14.42%	-6.01%	100.00%
Mean	3.44%	4.54%	8.49%	6.62%	6.65%	2.60%
Volatility	3.91%	5.41%	9.32%	15.70%	14.62%	4.23%
Sharpe ratio	88.03%	83.95%	91.03%	42.15%	45.48%	61.52%

Source: PIMCO, NCREIF, Bloomberg (January 1989 through June 2011)
Hypothetical example for illustrative purposes only.
Core, value-added and opportunistic are represented by the corresponding NCREIF Townsend Fund Index. REITs are represented by the Dow Jones U.S. REIT Index. Stocks are represented by the S&P 500 Index. Bonds are represented by the Barclays Capital U.S. Aggregate Bond Index.

Historical performance and risk statistics

For private real estate, we used the core, value-added and opportunistic fund total return indices that are compiled by the National Council of Real Estate Investment Fiduciaries (NCREIF). These are among the most commonly used return series that asset allocators use to model risk and correlations for private real estate investments. For public real estate investment we used the Dow Jones U.S. Select REIT Index. To represent equity returns and bond returns we used the S&P 500 Total Return Index and the Barclays Capital U.S. Aggregate Bond index.

The summary statistics for these conventional return measures that institutional investors and consultants often use are shown in Figure 3.

Based on the risk and return measures reported in Figure 3, which shows statistics both excluding and including the recent financial crisis, one would be inclined to conclude that private real estate exposure is likely to be superior to public real estate in an asset allocation context, since REITs appear to have higher correlations with the stock market than the private investment vehicles, much higher volatility and lower information ratios. This was particularly true before the recent crisis as is evident in the figures above. In addition, the figures suggest that public and private real estate have low correlation to each other. Not surprisingly, correlations are high between the different types of private real estate.

The statistics reported above are often used as an argument in favor of private real estate. It is often argued that REIT valuations are "too volatile" and that the negative market returns during the crisis were "excessive" relative to changes in "fundamental value." We believe that the REIT market provides a better current proxy for risk appetite as the changes in investors required rates of return are immediately reflected in the REIT prices unlike private real estate which is subject to appraisal lag. Private market returns did also show a significant impact from the credit crisis but the impact was muted by appraisal "smoothing." For this reason, reported private investment returns did not capture the full depth of the credit crisis. Yet it was the forced sellers of illiquid privately held assets that bore the full brunt of the crisis, typically losing substantially all of their equity investment as property owners were unable to secure financing packages. We do not intend to make any representation that public markets alternatives are "better" than private markets, only that the underlying risk factors are more similar than published return analysis would suggest.

Our modeling approach recognizes that there are difficulties in using appraisal-based return indices. We address this issue within our econometric model specification.

Risk factor based estimates of risk statistics and correlations

Risk factors are the fundamental drivers of asset class returns. The fundamental risk factor exposures of each asset class determine its risk characteristics, and its correlations with other asset classes. In general, we believe that a risk factor based approach to risk management is more intuitive than an asset class based approach, and may provide a more efficient "lens" through which one can diversify portfolios. When the portfolio's risk factor exposures are properly identified it is also easier to stress test it and conduct forward-looking scenario analysis.

The risk factors that we include in our analysis of real estate investments are chosen on the basis of an economic assessment of the factors that should drive real estate investments returns. We focus our risk modeling approach on potential exposures to five risk factors. Four of the risk factors are broad risk factors that genuinely cut across asset classes: equity beta, real duration, credit spread and a liquidity factor. The fifth factor is a sector-specific real estate industry factor, which captures return behavior that cannot be spanned by the first four factors, but is common across the real estate investment universe.

Intuitively, each of the four main factors that we include in the analysis must affect the returns of real estate investments, through their correlation with real estate discount rates or with projected cash flows (or both). The specific reasons for including each factor are provided below:

Equity beta: Like corporate earnings, the demand for commercial real estate properties, retail spending in shopping malls, and projected cash flows derived from real estate are linked to general economic growth. So we expect equity market earnings to be positively correlated with projected cash flows from real estate investments. At the same time, equity market returns reflect changes in how investors value and discount risky cash flows at a broad level. These changes should generally affect commercial real estate valuations.

Therefore we expect real estate, including private real estate, to exhibit a positive equity beta.

Credit spread: While changes in equity valuations should capture some of the common variation in discount rates across risky assets, one might suspect that credit spreads play a distinct role in real estate returns, due to the linkage between indices of relatively equal credit risk. Capitalization rates for private real estate tend to closely track corporate credit spreads with a typical illiquidity spread of 100-150 bps over BBB/Baa corporate bonds. (At times, this spread significantly deviates from historical norms and may provide a useful buy or sell signal to the market. For further discussions, please refer to "Beyond Real Estate: Real Asset Risk Factors" by Andrew Hoffmann, *PREA Quarterly* August 2011.) Short- to medium-duration real estate structures are exposed to refinancing risks and, due to this exposure, anticipated real estate returns can be particularly vulnerable to changes in the costs and availability of debt financing. Similarly, credit spread changes can be positively correlated to projected cash flows because corporate spreads typically are indicative of the overall creditworthiness of corporations and hence the ability to honor lease obligations, demand for office space by corporations, lease rates for industrial warehouses and so forth. Overall, we expect real estate to have positive corporate spread duration, even after controlling for equity market returns.

Real duration: Real estate investments provide real cash flows that are broadly insensitive to the level of inflation and nominal cash flows that track inflation over the medium to long term. Rent payments can, for instance, be modeled as cash flows that are similar to coupon payments on a risky inflation indexed bond because rent changes tend to reflect the general level of inflation. For this reason, we expect real estate investments to be particularly exposed to changes in real interest rates, and less sensitive to changes in nominal rates. It is, in our view, therefore more appropriate to use real rates in our regression-based risk factor model to estimate the incremental real rate duration of the investments. While the equity beta exposure that our model includes indirectly will capture some of the real yield exposure that a real estate investment intuitively should have (via discounting), we would expect real estate investments to have a material degree of incremental real duration relative to the broad equity market.

Liquidity factor: Given that private real estate and even some REITs are not liquid investments, we add Pastor and Stambaugh's (PS) liquidity factor to our model (for further information, please refer to "Liquidity Risk and Expected Stock Returns," *Journal of Political Economy* 111, 642-685). The PS factor mimics returns on stocks with large exposures to changes in aggregate liquidity. Just like equity returns might be affected by negative liquidity shocks, we would expect real estate returns to be affected to liquidity shocks through increased cost of capital and higher discount factors. Higher bid/ask spreads for illiquid assets tend to raise the liquidity factor risk in depressed market environments and it is this downside capture that we are most focused on quantifying. This is a "priced" factor that commands a risk premium or excess return over time, which long-term investors may capture by investing in private real estate.

Real estate industry factor: Certain parts of the real estate investment returns are not captured by traditional risk factors.

We include MSCI Barra's real estate industry factor in our model to account for potential industry-wide factors that are not explained by conventional risk factors.

The advantage of a multi-factor modeling approach is that it lets the data tell us what the total potential impact of each factor is on the real estate returns, without imposing a specific structure or a specific valuation model on each real estate investment that a structural pricing model would entail.

In the first step of our econometric analysis, we specify a standard multi-factor regression model for public REIT returns. Specifically, we estimate a model for public market REITs returns that relates the REIT index performance to the set of five factors that we identified above. The model has the form,

$$R_{r,t} = \alpha + \beta_q R_{q,t} + \beta_s R_{s,t} + \beta_L R_{L,t} + \beta_D R_{D,t} + \beta_I R_{I,t} + \varepsilon_t$$

where $R_{r,t}$ is the return to the real estate index, R_q is the return to equity, R_s is the Baa spread change, R_L is the return to liquidity factor, R_D is the real rate change, R_I is the return to the real estate industry factor, in period t.

This is standard multi-factor model specification for public real estate with five explanatory factors and is straightforward to estimate with ordinary least squares regression.

To account for the appraisal-based smoothing of private real estate returns over time, it is necessary to make some adjustments in an estimation process that acknowledges the difference between reported and implied returns. Specifically, the data generating process for the reported returns for private real estate can be written in the following form,

$$R_{reported,t} = \alpha + \sum_{j=0}^{J} \psi_j R_{true,t-j} + \varepsilon_t$$

where the $\psi_j's$ sum to one. The interpretation of this expression is that the reported return in a given period is a weighted average of the lagged values of the implied "market" returns for investments in private real estate, if a current market value for these investments in fact was calculated. We want to estimate the risk factor exposures of the "implied" returns to private real estate returns. If the implied return is driven by a set of factors that are similar to public real estate, the data generating process for the appraisal-based returns, is given by,

$$R_{reported,t} = \alpha + \sum_{j=0}^{J} \psi_j \left(\beta_q R_{q,t-j} + \beta_s R_{s,t-j} + \beta_L R_{L,t-j} + \beta_D R_{D,t-j} + \beta_I R_{I,t-j} + \varepsilon_{t-j} \right)$$

This expression suggests it is necessary to include lags of the explanatory factors in the regression model to accurately estimate the risk factor exposures of private real estate. A specification that does not include lags will be omitting important variables and, we are convinced, provide biased estimates of the total impact that each variable has on the real estate investment. Formally, the estimated regression model is in the following form,

$$R_{reported,t} = \alpha + \sum_{j=0}^{J} \left(\hat{a}_{q,j} R_{q,t-j} + \hat{a}_{s,j} R_{s,t-j} + \hat{a}_{L,j} R_{L,t-j} + \hat{a}_{D,j} R_{D,t-j} + \hat{a}_{I,j} R_{I,t-j} + \varepsilon_{t-j} \right)$$

The correct estimate of the implied exposures to each factor, $(\beta_q, \beta_S, \beta_L, \beta_D, \beta_I)$, is the sum of the estimated coefficients on the current and lagged factor returns. In the case of β_q, this can be derived as follows,

$$\sum_{j=0}^{J} \hat{a}_{q,j} = \sum_{j=0}^{J} (\psi_j \cdot \beta_q) = \beta_q \cdot \sum_{j=0}^{J} \psi_j = \beta_q$$

where the last equation follows from the fact that $\sum_{j=0}^{J} \psi_j = 1$.

Private and public real estate market returns

As mentioned, based on our knowledge of the drivers of cash flows for investments in both public and private real estate, we believe that private real estate returns to a large extent should be closely linked to public market returns. As described in the introduction, the cash flows associated with investments in both public and private real estate are in many cases similar. We therefore believe that private real estate should have exposures to a very similar mix of risk factors. Due to differences in the amount of leverage that is embedded in core, value-added and opportunistic investments, we would, on the other hand, expect some systematic differences in the magnitudes of the factor exposures for each of these investment types. Innovations in aggregate liquidity in particular may also have a disproportionate impact on the returns of private real estate investments relative to public real estate investments.

We therefore impose (and test) a set of linear restrictions on the regressions for private real estate returns. The restrictions force the factor loadings for core, value-added and opportunistic private real estate to be proportionate to the estimated public real estate factors, except for the liquidity factor exposures which remain unconstrained. We have found that the linear restrictions we impose are consistent with the results from a set of separate unconstrained regression models for private real estate returns. The empirical evidence thereby supports our conclusions and the imposed structure on the factor loadings. We have also found that a large proportion of private real estate returns can be explained by current and lagged REIT returns, which further supports our modeling assumptions and approach.

Figure 4 shows the estimated factor exposures for public real estate investments (REITs) and core, value-added and opportunistic private real estate investments. The estimated coefficients (the output of our analysis) are also quite intuitive, both in terms of their sign and their magnitude. Indeed, the signs all line up with our discussion of each factor and its potential correlation with real estate.

The equity market beta is positive and it ranges from 0.52 for core private real estate to 0.93 for opportunistic private real estate investments. In addition, both real duration and spread duration have a distinct and important impact on returns, with real duration ranging between two to four years of exposure, and credit spread exposures between four and seven years. Both public and private real estate investments have positive exposures to innovations in aggregate liquidity, but as suspected, innovations to the Pastor-Stambaugh liquidity factor have a larger impact on private real estate returns than REITs.

Figure 4: Risk factor model for public and private real estate

	Equity beta	Baa spread	Real duration	Liquidity factor	Real estate factor
Core	0.52	3.89	2.12	0.47	1.05
Value-added	0.72	5.34	2.92	0.55	1.45
Opportunistic	0.93	6.94	3.79	0.89	1.88
REITs	0.73	5.41	2.95	0.27	1.47
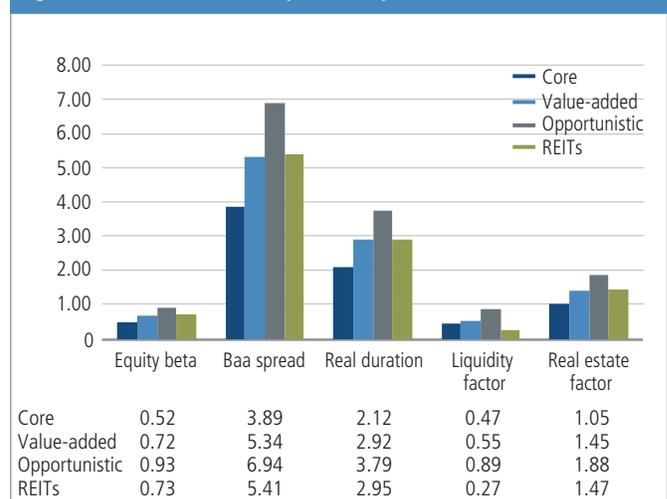
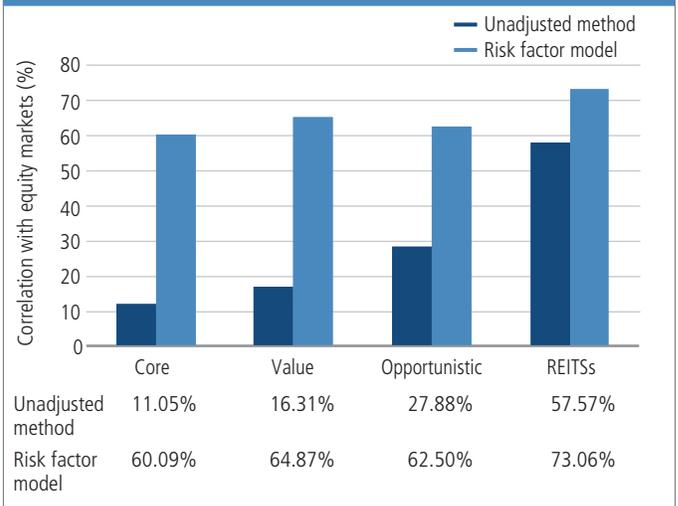Source: PIMCO, NCREIF, Bloomberg (as of 30 June, 2011)
Hypothetical example for illustrative purposes only.
Core, value-added, and opportunistic are represented by the corresponding NCREIF Townsend Fund Index. REITs are represented by the Dow Jones U.S. REIT Index.
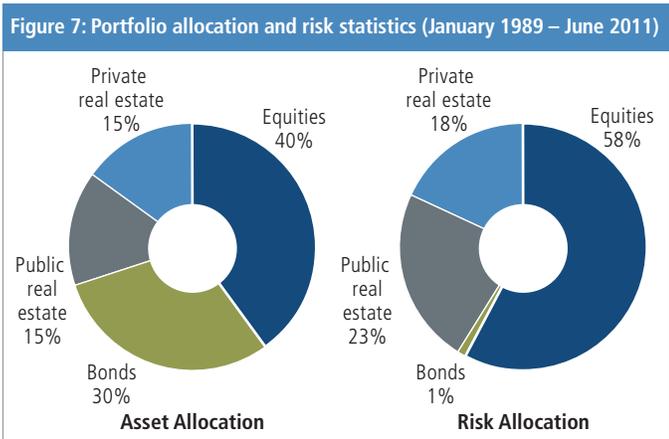
Several additional features of the estimation results are worth pointing out. Estimated risk factor loadings for value-added private equity are similar to those of REITs. This is reassuring since the two types of investments are known to be similar in terms of leverage and their investment opportunity set. This result provides additional confirmation that the estimation results appear sensible across the board.

The risk factor loadings also seem to capture the different leverage ratios/gearing that are typical for investments in core, value-added and opportunistic private real estate investments. The opportunistic real estate model has higher factor loadings than both core and value-added real estate investments and the ratio of the factor loadings seem to be

consistent with the differences in leverage employed by the different types of real estate.

We can use the risk factor model to estimate the implied volatilities and more appropriate measures of correlations between real estate and stocks and bonds. The resulting estimates of "implied" volatility and correlations are shown in Figure 5.

For private real estate, there are several noticeable differences between our "implied" risk and correlation estimates and those "unadjusted" estimates on published NCREIF index returns. To highlight these differences, we have graphed the volatility and correlation estimates from the two tables in

Figure 5: Risk factor model based correlations and volatilities						
Period 1989-2011	**Core**	**Value-added**	**Opportunistic**	**REITs**	**Stocks**	**Bonds**
Private (Core)	100.00%					
Private (value-added)	74.04%	100.00%				
Private (opportunistic)	74.43%	83.84%	100.00%			
Public (REITs)	68.09%	80.20%	75.60%	100.00%		
Stocks	60.09%	64.87%	62.50%	73.06%	100.00%	
Bonds	19.59%	6.32%	10.54%	0.06%	-5.95%	100.00%
Mean	1.57%	1.25%	5.00%	6.93%	6.11%	2.84%
Volatility	17.34%	22.69%	28.39%	22.29%	16.22%	4.23%
Sharpe ratio	9.05%	5.53%	17.61%	31.07%	37.70%	67.11%

Period 1989-2008	**Core**	**Value-added**	**Opportunistic**	**REITs**	**Stocks**	**Bonds**
Private (core)	100.00%					
Private (value-added)	63.40%	100.00%				
Private (opportunistic)	77.08%	72.12%	100.00%			
Public (REITs)	65.53%	73.40%	71.62%	100.00%		
Stocks	44.77%	58.14%	54.07%	59.95%	100.00%	
Bonds	3.48%	7.47%	15.11%	18.16%	-5.25%	100.00%
Mean	3.45%	4.62%	8.67%	6.63%	7.27%	2.56%
Volatility	15.36%	16.72%	23.04%	17.50%	14.46%	4.25%
Sharpe ratio	22.47%	27.63%	37.64%	37.88%	50.27%	60.13%

Source: PIMCO, NCREIF, Bloomberg (January 1989 through June 2011)
Hypothetical example for illustrative purposes only.
Core, value-added and opportunistic are represented by the corresponding NCREIF Townsend Fund Index. REITs are represented by the Dow Jones U.S. REIT Index. Stocks are represented by the S&P 500 Index. Bonds are represented by the Barclays Capital U.S. Aggregate Bond Index.

Figure 6: Unadjusted volatility estimate vs. implied volatility

	Core	Value	Opportunistic	REITSs
Unadjusted method	6.37%	8.78%	12.25%	25.59%
Risk factor model	17.34%	22.69%	28.39%	22.29%
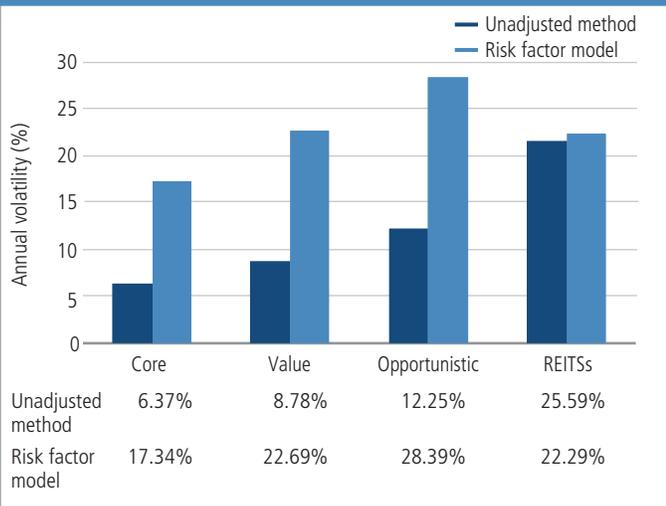
Unadjusted correlation estimate vs. implied correlation with equity markets

	Core	Value	Opportunistic	REITSs
Unadjusted method	11.05%	16.31%	27.88%	57.57%
Risk factor model	60.09%	64.87%	62.50%	73.06%

Source: PIMCO, NCREIF, Bloomberg (January 1989 through June 2011)
Hypothetical example for illustrative purposes only.
Core, value-added and opportunistic are represented by the corresponding NCREIF Townsend Fund Index. REITs are represented by the Dow Jones U.S. REIT Index.

Figure 6, which clearly shows that the appraisal-based returns have a large impact on both volatility and correlations. The bias is substantial and very significant in magnitude. In all cases, it can be seen that the implied volatility of the private real estate investments are roughly 2 to 2.5 times higher than the unadjusted method, once the appraisal bias is accounted for in the econometric modeling. In similar fashion, equity market correlation estimates increase from roughly 20% to about 60% in our risk factor model. Furthermore, private real estate correlation to equity is also much higher at around 60%, as opposed to roughly 20% using NCREIF return correlations.

Our results suggest asset allocation decisions based on conventional estimates of risk for real estate investments are

fraught with dangers. When using unadjusted historical return series, one would underestimate both the risk and portfolio level impact of these investments, particularly in down markets.

Consider two sets of risk estimates and risk decompositions for a simple asset allocation that includes bonds, equities and public and private real estate investments, as shown in Figure 7.

The first risk estimates are based on the unadjusted correlation and volatility assumptions that fail to take into account the impact the appraisal process has on real estate returns. The second set of risk estimates is based on our risk factor model.

Figure 7: Portfolio allocation and risk statistics (January 1989 – June 2011)

Asset Allocation
- Private real estate 15%
- Equities 40%
- Bonds 30%
- Public real estate 15%

Risk Allocation
- Private real estate 18%
- Equities 58%
- Bonds 1%
- Public real estate 23%

Hypothetical example for illustrative purposes only.
The above chart is a representation of a model portfolio which is provided for illustrative purposes and is not indicative of the past or future performance of any PIMCO product. Private Real Estate is represented by NCREIF Townsend Fund Index. Public Real Estate represented by the Dow Jones U.S. REIT Index. Equities are represented by the S&P 500 Index. Bonds are represented by the Barclays Capital U.S. Aggregate Bond Index.

| | 60-40 Portfolio | Model portfolio | |
		Unadjusted method	Risk factor model
Total volatility	10.19%	9.02%	11.08%
Beta to S&P 500	0.60	0.52	0.59

Source: PIMCO, Bloomberg (January 1989 through June 2011).
60-40 model portfolio is represented by 60% S&P 500 Index, 40% Barclays Capital U.S. Aggregate Bond Index

In our view, the estimates from our risk factor model provide a better representation of the risk characteristics associated with real estate investments than the unadjusted NCREIF index based estimates. The example shows that asset allocation decisions based on the unadjusted method will likely be sub-optimal relative to a given risk budget.

Conclusion: Real estate myths busted

We have analyzed the risk factors that drive real estate investment returns and used a five-factor model to estimate their risk and return characteristics. The same set of key risk factors drives both public and private real estate, although private real estate returns generally are more sensitive to innovations in market liquidity. Four of the factors that drive real estate investment returns are common factors that cut across asset classes and are present in many different types of investments, not just real estate. These are equity risk, credit spread risk, real duration risk and liquidity risk factors. The last factor is specific to real estate investments.

Our five-factor model allows us to challenge three common misconceptions:

I. Public and private real estate returns have low correlations to each other,

II. Private real estate volatility and risk is significantly lower than that of public real estate investments, and,

III. Real estate investments have low correlations to equity markets and may provide significant diversification in a multi-asset class portfolio.

These conclusions, in our view, are contentious because they generally are based on index returns that are derived from changes in appraised valuations, not from changes in market valuations or from actual transactions. The appraisal process introduces significant biases in the estimates of the volatility of private real estate and it obscures the implied correlations with public real estate as well as other asset classes. Our econometric factor modeling approach explicitly takes the

appraisal process into account, which allows us to identify the implied risk exposures and characteristics of private real estate.

After correcting for these biases, we conclude that:

I. The implied return correlations between public REITs and private real estate investments fell in the range of 60% to 80% from January 1989 through June 2011.

II. The volatility of private real estate is about 2.5 times higher than implied by unadjusted volatility estimates. Furthermore, the volatility of private real estate is generally comparable to the risk of public REIT investments.

III. The implied correlations of real estate with equity markets are much higher than appraisal-based returns suggest. The implied correlations from our risk factor model are between 60% and 73%.

These conclusions are in stark contrast with conventional wisdom. The notion that real estate investment returns are disconnected from general equity returns over time and provides incremental portfolio diversification without adding to tail risk and overall portfolio volatility is flawed – as the recent crisis has shown.

It is important to emphasize that our analysis does not imply valuations and prospective returns in real estate exposures cannot be attractive on a risk-adjusted basis. However, as the recent crisis has shown, real estate is not a free lunch. Investors should be cautious about the correlation assumptions that are used in construction of optimal real estate allocation, and in estimating tail risk.

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