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Real Estate Betas and the Implications for Asset Allocation

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Real estate is an important asset class, prevalent in the investment portfolios of both institutional and private investors. For many institutional investors, real estate is the largest alternative asset class. For some private investors, real estate may compose their entire investment portfolio. Real estate was recently elevated from the financials sector to its own dedicated sector in the Global Industry Classification System.[1] Investors are increasingly turning to illiquid real estate in their search for yield. Real estate seems to offer appealing investment features, including high risk-adjusted return and diversification benefits. Some investors consider real estate to be a hard asset and inflation hedge.

Does the real estate asset class offer different return and risk behaviors than conventional stocks and bonds? The answer to this question is critical to uncovering the true diversification benefit of real estate within otherwise diversified, multi-asset portfolios. Standard asset allocation relies on a framework of conventional asset classes: stocks, bonds, real estate, and so forth. However, factor-based asset allocation recognizes that different asset classes often share overlapping risks, and the return and risk behaviors of asset classes are largely driven by their exposures to a smaller set of systematic risk factors.

Fama and French [1993] showed empirically that stock and bond returns are driven by five common risk factors. They found that two systematic risk factors (term and default) explain fixed-income returns and three systematic risk factors (market, size, and value) explain equity returns. Factors are key to empirical asset pricing and therefore are crucial to a deeper understanding of asset allocation, portfolio construction, and manager performance. Ideally, priced factors satisfy three criteria for these purposes. First, they are a compensated form of risk, offering a statistically significant average return premium over their history.[2] Second, they are largely independent of each other (i.e., uncorrelated) so that each factor is a relatively unique and different source of return. Finally, because the assets that compose a factor co-move, factors explain the return variation of diversified portfolios. They contribute to a portfolio's explained return and risk. From an asset allocation perspective, these criteria represent the purest definition of a true asset class. The five Fama–French factors generally satisfy our criteria, although the default risk of bonds is related to the market risk of equities. Ooi, Wang, and Webb [2009] investigated the idiosyncratic risk of REIT returns relative to the Fama–French three-factor model and defined idiosyncratic risk as the standard deviation of the regression residual. We use a modified version of the Fama–French five-factor model to evaluate how the return and risk of publicly traded equity REITs are explained by the common stock and bond factors of Fama and French.[3] The five systematic risk factors fully explain the compensated portion of REIT returns, and the residual return variation is uncompensated, idiosyncratic real estate sector risk.

Because there is no real-time market price for illiquid private assets, returns are appraisal-based and subject to manager judgment. Barkham and Geltner [1995] unsmoothed appraisal-based real estate returns (without assuming true returns are efficient) and found that REIT returns lead private real estate returns. Anson [2013] evaluated the Cambridge Private Equity Index and showed that reported private equity returns reflect contemporaneous and prior public equity returns. Specifically, he found that exposure to prior public equity returns (lagged betas) is statistically significant for up to four prior quarters. Peng [2016] estimated Fama–French and other risk factor loadings at the property level.

We employ lagged REIT betas and lagged factor benchmark betas to evaluate whether private real estate offers a unique source of compensated return and risk, separate and distinct from the factor and sector returns available from public REITs. We find that current and lagged REIT betas and factor benchmark betas explain the entire return premium of private real estate, suggesting that private real estate does not offer a unique source of compensated return that differs from its exposure to systematic risk factors.

Our contribution to the literature provides a more complete understanding of the return and risk behaviors of the real estate asset class from the total portfolio perspective, illuminating what the real estate asset class contributes to improve an otherwise diversified, multi-asset investment portfolio. REIT returns are explained by a rich mix of compensated risk factors plus uncompensated and idiosyncratic real estate sector risk. Private real estate returns are explained by the same risk factors and sector risk, plus uncompensated and idiosyncratic misappraisal risk. It is the rich mix of compensated risk factors contained within real estate that can improve otherwise diversified, multi-asset portfolios. We discuss the implications for asset allocation from the perspectives of traditional mean–variance optimization of asset classes, the capital asset pricing model (CAPM) with efficient markets, and factor-based asset allocation. Although we focus on real estate, the concepts and methods apply to all asset classes within a portfolio.

REAL ESTATE BETAS

We use three real estate indexes to represent the real estate asset class. Public equity REITs are traded investment vehicles that own leveraged portfolios of stable, rent-generating properties. The FTSE NAREIT Equity REITs Index contains 157 publicly traded REITs (as of 2016) that span commercial real estate in the United States, excluding timber and infrastructure REITs. The NCREIF Property Index (NPI) is the industry-standard private market index for core real estate. NPI returns are appraisal-based, unleveraged, and gross of fees. The index is constructed from data collected from 79 data contributors (as of 2015). We also evaluated the NCREIF Open-End Diversified Core Equity Index (ODCE), which is constructed from data provided by 33 open-end commingled funds (as of 2015) pursuing a core strategy.[4] NPI and ODCE show substantially similar results, so for brevity, we include ODCE only when differences are notable. The Cambridge Real Estate Index is compiled from about 860 value-added and opportunistic private real estate funds formed between 1986 and 2015 that report net of fees. Value-added and opportunistic private real estate strategies generally pursue riskier real estate opportunities and/or employ more leverage than core private real estate. The common inception of the three indexes is 1986, which provides 30 years of common real estate returns to evaluate through the end of 2015. Because NPI and Cambridge Real Estate report quarterly returns, we employ data at the quarterly frequency so that results are directly comparable across tests.

Beginning with market-priced equity REITs, we use a modified Fama–French five-factor model to evaluate REIT return behaviors per regression Equation (1):

$$RR_t - RF_t = \alpha + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 TERM_t + \beta_5 DEF_t + \varepsilon_t \quad (1)$$

where RR_t is the return of real estate; RF_t is the return of one-month Treasury bills; MKT_t is the return of the Fama–French market factor; SMB_t is the return of the Fama–French size factor; HML_t is the return of the Fama–French value factor; $TERM_t$ is the return of a modified Fama–French term factor; and DEF_t is the return of a modified Fama–French default factor.

Lee [2009] modified the Fama–French term and default factors to better capture default risk. We make a similar modification. The *term factor* is defined as the return of the Barclays U.S. Treasury Index minus the return of one-month Treasury bills. The *default factor* is defined as the return of the Barclays U.S. Corporate High Yield Index minus the return of the Barclays U.S. Treasury Index.

We estimate factor betas by regressing the quarterly returns of the FTSE NAREIT Equity REITs Index against the modified Fama–French five-factor model from January 1986 to December 2015. Exhibit 1 shows the results of the regression, with alpha annualized and *t*-statistics below the alpha and beta estimates.[5]

All five factors have economically large and statistically significant factor betas. These betas are analogous to a balanced portfolio with approximately 60% allocated to small value stocks and the remainder allocated to long-term, high-yield bonds. Real estate is a hybrid asset class, showing return and risk behaviors common to both stocks and bonds.

The REIT alpha is statistically insignificant (indistinguishable from zero), indicating that the five factors explain the entire return premium. (A positive and statistically significant alpha would indicate the presence of a unique source of positive average excess return, separate and distinct from the returns of the five common risk factors.)

Next, we decompose excess REIT return and risk by factor. This decomposition is expressed as a percentage of total excess return and total excess variance. Returns are either explained by systematic risk factors common to stocks and bonds or residual idiosyncratic return variation unique to the real estate sector (orthogonal sector returns). Exhibit 2 shows how these factor betas and real estate sector returns contribute to REIT return and risk behaviors.

The largest contributor to excess REIT return is the market factor, followed by term and value factors. The largest contributor to excess REIT risk is

EXHIBIT 1
REIT Factor Betas

	Alpha	MKT	SMB	HML	TERM	DEF
	–2.15	0.58	0.38	0.72	1.04	0.45
t-stat	–0.95	6.93**	3.17**	8.01**	4.35**	3.30**
R^2	0.67					
Adj. R^2	0.66					

*** Significant at the 1% level.*

EXHIBIT 2
REIT Return and Risk Contribution by Factor

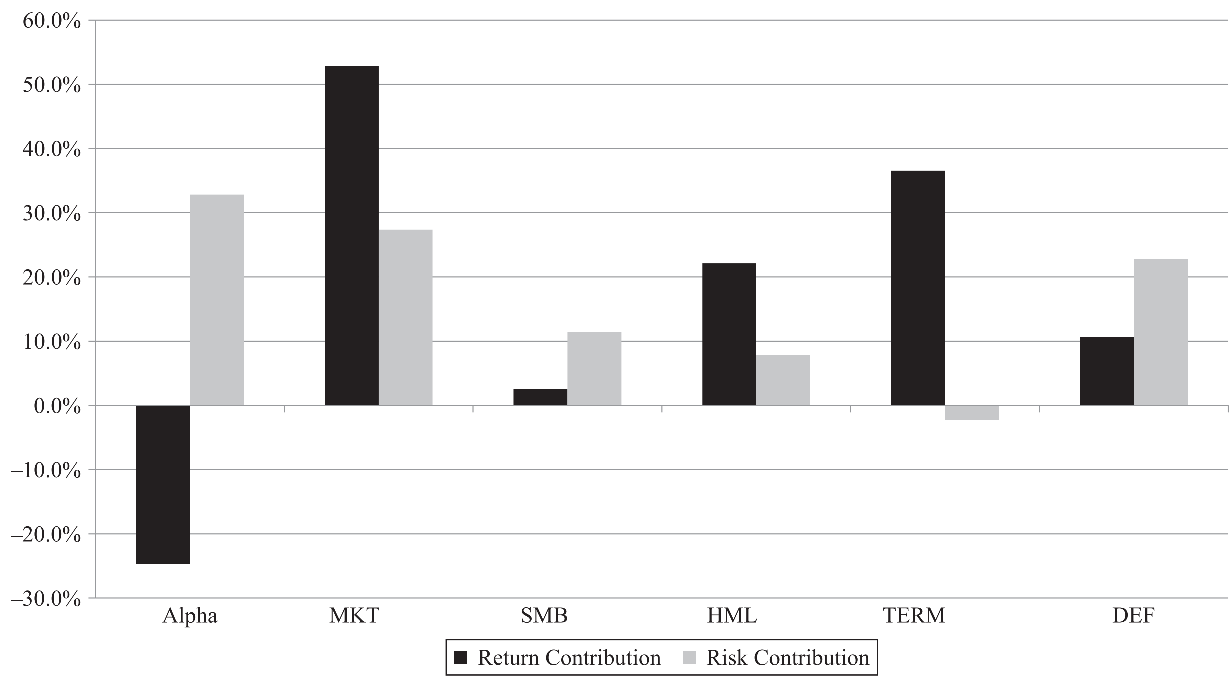


EXHIBIT 3
NPI REIT Betas

	Alpha	$REIT_t - RF_t$	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$	$t-7$	$t-8$
	0.09	0.05	0.04	0.07	0.06	0.08	0.06	0.05	0.04	0.04
t-stat	0.12	3.03**	2.64**	3.84**	3.51**	4.85**	3.56**	3.04**	2.10*	2.41*
R^2	0.48									
Adj. R^2	0.44									
Total Beta	0.50									

*** and * indicate significance at the 1% and 5% level, respectively.*

idiosyncratic real estate sector risk (alpha), followed by market risk and default risk. Two-thirds of the risk is explained by compensated factor risk and one-third by uncompensated sector risk (this result is also evidenced by the R^2 in Exhibit 1). Notably, all five risk factors contribute positive return to REITs, whereas real estate sector risk does not contribute a positive return, while contributing to risk.

The bottom line is that the compensated portion of public REIT returns is fully explained by systematic risk factors common to both stocks and bonds, and the residual risk is idiosyncratic and uncompensated real estate sector risk. REIT return and risk comprise systematic and compensated factor returns and idiosyncratic and uncompensated sector returns. These results suggest that REITs are no different from any other industry sector, with the notable exception of their hybrid (stock–bond-like) nature and rich factor mix.

We rearrange Equation (1) to formalize this framework for evaluating real estate return and risk from a factor-based perspective in Equation (2). The excess return variation of REITs is explained by a systematic factor return component ($\beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 TERM_t + \beta_5 DEF_t$) and an idiosyncratic real estate sector return component ($\alpha + \varepsilon_t$).

$$RR_t - RF_t = (\beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 TERM_t + \beta_5 DEF_t) + (\alpha + \varepsilon_t) \quad (2)$$

With one more rearrangement, we construct the returns of a factor benchmark for real estate (RB_t) in Equation (3), which captures the pure systematic factor returns of REITs (plus the risk-free return) but excludes idiosyncratic real estate sector risk. One can construct such a portfolio of diversified stocks and bonds via factors, with perhaps some leverage to achieve the targeted betas, which we take from Exhibit 1.

$$RB_t = RF_t + \beta_1 MKT_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 TERM_t + \beta_5 DEF_t \quad (3)$$

The underlying assets of REITs and privately held real estate are fundamentally the same, but private real estate is appraisal-based. We next evaluate private real estate returns by employing stepdown regressions of current and lagged REIT betas on the quarterly returns of NPI and Cambridge Real Estate from 1986 to 2015, per Equation (4). This extracts compensated factor returns and uncompensated real estate sector returns—which are market priced—from serially correlated private real estate returns to see if private real estate offers a unique source of compensated return not captured by factor returns.[6]

$$RR_t - RF_t = \alpha + \beta_t(REIT_t - RF_t) + \beta_{t-1}(REIT_{t-1} - RF_{t-1}) + \cdots + \beta_{t-n}(REIT_{t-n} - RF_{t-n}) + \varepsilon_t \quad (4)$$

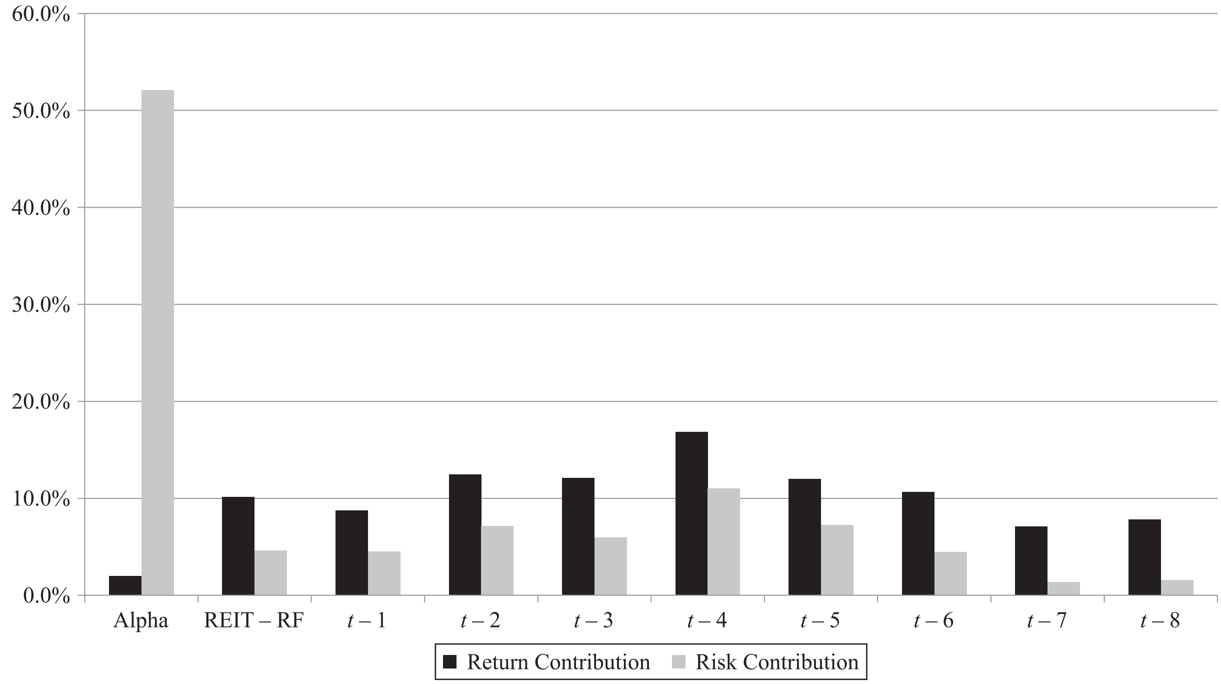
where n is the earliest prior return period (quarter) in the time series that retains a statistically significant lagged beta.

Exhibit 3 shows the results of the stepdown lagged beta regression for NPI from 1986 to 2015, with alpha annualized and *t*-statistics below the alpha and beta estimates.

Lagged public REIT betas are statistically significant for up to eight prior quarters of public REIT returns. Appraisal-based valuation artificially smooths the reported returns so that two past full years of prior REIT returns are required to explain current

Exhibit 4

NPI Return and Risk Contribution by REIT Beta



NPI returns. (Due to the large number of lagged REIT betas, we do not have sufficient quarterly returns to test lagged Fama–French risk factors, but we can employ lagged factor benchmark returns.) The total REIT beta for NPI sums to 0.50, which is consistent with an unleveraged return series. In comparison, ODCE is modestly leveraged and the total REIT beta sums to 0.65.

The alpha is statistically insignificant, indicating that the current and lagged REIT betas—which contain compensated factor risk (and uncompensated sector risk)—explain the entire return premium. (Again, a positive and statistically significant alpha would indicate the presence of a unique source of positive average excess return, separate and distinct from REIT returns.) Although the current REIT beta and eight lagged betas explain only 48% of the excess variance, the remaining 52% is uncompensated, idiosyncratic risk. In the case of NPI, this residual idiosyncratic risk likely is not real estate sector risk or missing factor risk. First, market-priced real estate sector risk is already removed by the current and lagged REIT betas. Second, there is no meaningful alpha over 30 years, suggesting it is not missing factor risk. Finally, this residual return variation remains serially correlated, which suggests it is an artifact of the appraisal process that is not removed by lagged betas. These features lead us to characterize this residual idiosyncratic risk as the *misappraisal risk* of imprecise valuations in an informationally inefficient market. Misappraisal risk differs from time-lagged market risk, which can result from backward-looking appraisals and reporting lags. We therefore identify this specific idiosyncratic risk as misappraisal risk, but we acknowledge there are other possible interpretations. For example, if private real estate markets were informationally efficient, this risk could be interpreted as a type of private real estate subsector risk inherent to private real estate markets but not to public REITs.[7] Another possibility is that NPI contains a different relative mix of factor betas than do REITs, even though the underlying assets are fundamentally the same. In this case, some of the residual idiosyncratic return might be soaked up with a more precise factor mix.

Exhibit 4 shows how the current and lagged REIT betas contribute to the excess return and risk of NPI. The largest positive contributor to NPI excess return is the $t - 4$ lagged beta (fourth prior quarter), which contributes even more return than the current REIT beta. The largest contributor to excess risk is the residual

EXHIBIT 5
Cambridge REIT Betas

	Alpha	$REIT_t - RF_t$	$t-1$	$t-2$	$t-3$	$t-4$	$t-5$	$t-6$
	–1.74	0.13	0.08	0.10	0.11	0.14	0.08	0.11
t-stat	–1.15	3.76**	2.17*	2.85**	2.95**	3.92**	2.15*	3.03**
R^2	0.38							
Adj. R^2	0.34							
Total Beta	0.74							

*** and * indicate significance at the 1% and 5% level, respectively.*

idiosyncratic risk of misappraisals (alpha). If we proportionally attribute the factor and sector returns embedded in REITs to NPI, we estimate that 32% of the risk of NPI is explained by compensated factor risk, 16% by sector risk, and 52% by misappraisal risk. This estimated mix is further supported by a regression of NPI against current and eight lagged factor benchmark returns, which indicates that 34% of the risk is explained by compensated factor returns. The total beta sums to 0.49 (versus 0.50), and the alpha remains statistically insignificant.

Exhibit 5 shows that the lagged public REIT betas for the Cambridge Real Estate Index are statistically significant for up to six prior quarters of public REIT returns. The total REIT beta sums to 0.74, which reflects the higher risk and leverage of value-added/opportunistic real estate compared with the unleveraged core real estate in NPI.

The alpha for the Cambridge Real Estate Index is statistically insignificant, indicating that the compensated factor returns embedded in current and lagged REIT betas also explain the entire return premium for value-added/opportunistic real estate. Although the current REIT beta and six lagged betas explain only 38% of the excess variance, the remaining 62% is uncompensated, idiosyncratic risk. As with NPI, this residual risk has the same features that identify it with misappraisal risk, although other interpretations are possible, as we previously noted.

Exhibit 6 shows how the current and lagged REIT betas contribute to the return and risk of the Cambridge Real Estate Index. The largest positive contributors to value-added/opportunistic private real estate return are the current public REIT beta and the $t-4$ lagged beta. (The $t-4$ betas for both NPI and Cambridge Real Estate are relatively large, which is consistent with a more rigorous annual valuation.) The largest contributor to risk is residual idiosyncratic risk (alpha), again showing that misappraisals contribute to risk. If we proportionally attribute the factor and sector returns embedded in REITs to Cambridge Real Estate, we estimate that 25% of the risk of Cambridge Real Estate is explained by compensated factor risk, 12% by sector risk, and 62% by misappraisal risk. This estimated mix is further supported by a regression of Cambridge Real Estate against current and six lagged factor benchmark returns, which indicates that 24% of the risk is explained by compensated factor returns. The total beta sums to 0.68 (versus 0.74), and the alpha remains statistically insignificant.

In summary, compensated NPI returns are replicable with a portfolio composed of half REITs and half cash. Compensated Cambridge Real Estate Index returns are replicable with a portfolio composed of approximately three-quarters REITs and one-quarter cash. Finally, compensated REIT returns are replicable with a portfolio composed of five systematic risk factors common to stocks and bonds.

IMPLICATIONS FOR ASSET ALLOCATION

Markowitz [1952] laid the foundation for modern portfolio theory by showing that portfolios can be improved by adding uncorrelated sources of return. The result is higher portfolio Sharpe ratios—less risk for the same amount of return or, conversely, more return for the same amount of risk. This is the benefit of diversification, and it is commonly viewed from the perspective of asset classes. As we have noted, however, risk factors represent the purest definition of a true asset class, and they largely drive asset class return and risk behaviors. Because factors are uncorrelated sources of positive average excess return, it is the addition of new factors or finding the optimal mix of factor betas that

Exhibit 6
Cambridge Return and Risk Contribution by REIT Beta

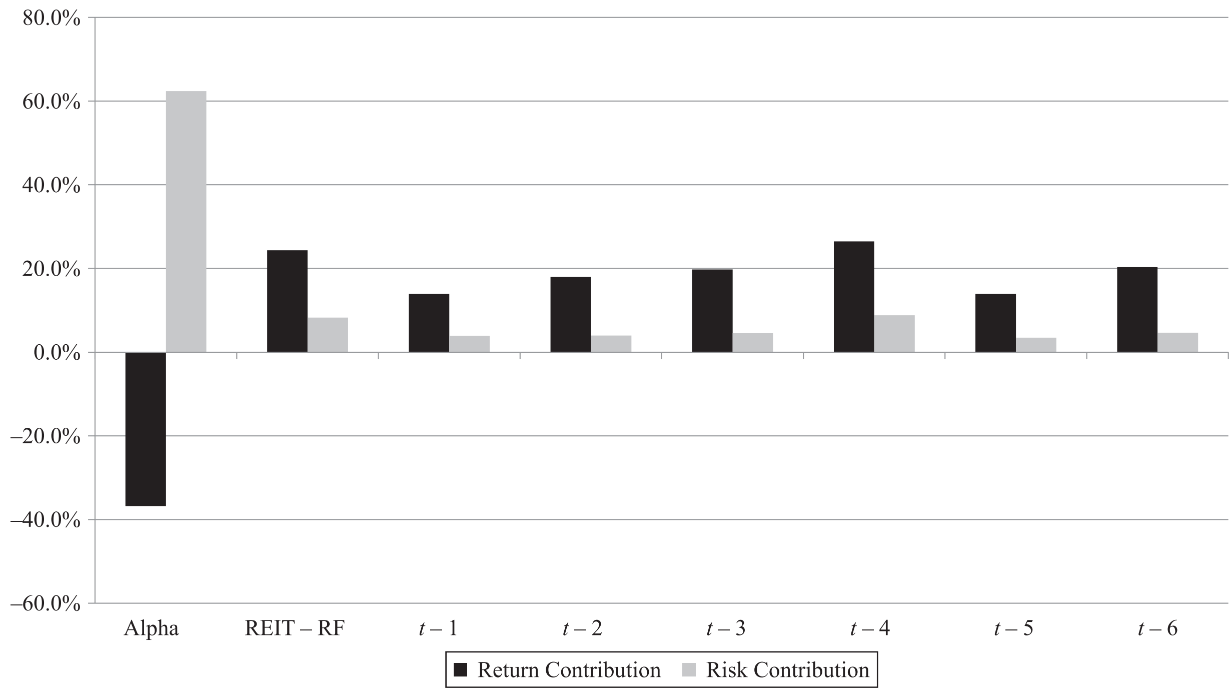


Exhibit 7
Reported Return and Risk Parameters (1986–2015)

			Correlation Matrix					
	Mean Return	Standard Deviation	Russell 3000	FTSE NAREIT Equity REITs	NPI	Cambridge Real Estate	BC U.S. Agg. Bond	30-Day T-Bills
Russell 3000	11.31	16.73	1.00					
FTSE NAREIT	12.11	18.76	0.61	1.00				
NPI	7.78	4.40	0.10	0.15	1.00			
Cambridge RE	8.13	8.78	0.19	0.27	0.83	1.00		
BC US Agg.	6.67	4.26	–0.10	0.10	–0.15	–0.06	1.00	
T-Bills	3.39	1.25	0.05	–0.06	0.07	0.14	0.28	1.00

can improve a preexisting asset allocation. Furthermore, because most asset allocations are dominated by generic allocations to stocks, bonds, and cash—representing only market and term factors—there is scope to improve these portfolios by adding other factors or by optimizing the factor mix.

From the previous section, we found that real estate return and risk behaviors can be explained by three components: systematic factor returns, real estate sector returns, and return variation from misappraisals. Systematic factor returns comprise a set of uncorrelated factors with compensated return premiums: market, size, value, term, and default. In contrast, idiosyncratic real estate sector returns and misappraisals contribute to risk but not return.

Exhibit 7 shows mean returns, standard deviations, and the correlation matrix calculated from reported quarterly returns for public equity (Russell 3000), public equity REITs (FTSE NAREIT Equity REITs), the two private real estate indexes (NPI and Cambridge Real Estate), U.S. bonds (Barclays U.S. Aggregate), and cash (Ibbotson 30-day Treasury bills) since common inception.

Investors often cite appealing risk characteristics and meaningful diversification as the reason for adding real estate to stock–bond portfolios. The observed standard deviations of the two private real estate indexes are far lower than the standard deviation of public equity REITs (and public equity). The correlations between the two private real estate indexes and public equity REITs (and public equity) are low, whereas public equity REITs and public equity are moderately correlated. The correlation between the two private real estate indexes is high. Taking these parameters at face value, private real estate appears to offer appealing risk characteristics and to be a meaningful diversifier of public equity; the same risk characteristics and diversification benefit do not appear to be available from public equity REITs.

However, this observation is inconsistent with our results from the previous section, which showed that all of the compensated return of real estate (public and private) is explained by the compensated factor betas contained in REITs. Compensated factor risk can positively contribute to a diversified portfolio, whereas uncompensated real estate sector and misappraisal risks typically do not.

With regard to the private real estate indexes, return smoothing from the appraisal process results in artificially low observed correlations, and the interaction of multiple lagged betas—with their uncorrelated sequential quarterly returns—produces an artificial diversification benefit that mutes variance. Fisher, Geltner, and Webb [1994] compared and contrasted five methods of unsmoothing real estate returns. They noted that the interpretation of reported returns depends on the assumptions that underpin the unsmoothing procedure. One common assumption, based on efficient markets theory, is that serial returns should be uncorrelated, and therefore unsmoothing procedures should remove all serial correlation. However, they recognized that private real estate markets may not be as informationally efficient as public securities markets. Getmansky, Lo, and Makarov [2004] introduced an econometric model of serial correlation and used it to unsmooth hedge fund returns, noting that it can be applied to real estate and other illiquid assets. It relies on the efficient markets assumption and is perhaps the standard model among financial economists.

Our objective is not to contribute to the unsmoothing literature per se, but to investigate and understand the factor betas that drive real estate returns and the implications for asset allocation. Motivated by our factor-based evaluation framework in Equation (2), but applied to lagged REIT betas in Equation (4), the excess return variation of illiquid private real estate is explained by its current and lagged REIT betas (which contain market-priced factor and sector risks) plus the residual idiosyncratic return component (misappraisal risk). We can rearrange Equation (4) to create a delagged return series by transferring the lagged betas to the current beta, while preserving the residual idiosyncratic return $(\alpha + \varepsilon_t)$ per Equation (5). This unsmoothing procedure employs the transparent economic variable (genuine market returns) that is largely being smoothed, while preserving the character of the idiosyncratic return. Getmansky, Lo, and Makarov noted that this approach provides consistent estimates and is a useful approximation of unsmoothed returns.

The issue is that the $(\alpha + \varepsilon_t)$ return component may still be serial correlated, and we have already confirmed this is true for both NPI and Cambridge Real Estate over the 1986 to 2015 period. If private real estate markets are informationally efficient, Equation (5) would not completely unsmooth returns and would underestimate true variance. As Fisher, Geltner, and Webb recognized, however, private real estate markets may not be as informationally efficient as public securities markets, which would make Equation (5) a very close approximation of true returns.[8] Regardless, our primary motivation for using Equation (5) is to unsmooth returns with a method that precisely aligns with our factor-based analytical framework for further testing.

$$RD_t = RF_t + \left(\sum_{\beta=\beta_t}^{\beta_{t-n}} \beta \right) (REIT_t - RF_t) + (\alpha + \varepsilon_t) \qquad (5)$$

where RD_t is the delagged return of real estate.

In comparison to Exhibit 7, Exhibit 8 shows standard deviations and correlations based on delagged private real estate returns over the same 1986–2015 common time period. This adjustment produces higher historical standard deviations and correlations for private real estate than is observed in the reported returns of Exhibit 7. The delagged standard deviations of NPI and Cambridge Real Estate are approximately two times larger. The delagged correlations of the two private real estate indexes approach 1.0 with publicly traded equity REITs and are high relative to the factor benchmark.

Exhibit 8

Delagged Return and Risk Parameters (1986–2015)

	Mean Return	Standard Deviation	Correlation Matrix: Russell 3000	FTSE NAREIT Equity REITs	Factor Bmk.	NPI	Cambridge Real Estate	BC U.S. Agg. Bond	30-Day T-Bills
Russell 3000	11.31	16.73	1.00						
FTSE NAREIT	12.11	18.76	0.61	1.00					
Factor Bmk.	14.26	15.41	0.73	0.82	1.00				
NPI	7.79	9.80	0.58	0.94	0.74	1.00			
Cambridge RE	8.12	15.62	0.56	0.90	0.72	0.95	1.00		
BC U.S. Agg.	6.67	4.26	–0.10	0.10	0.13	0.05	0.08	1.00	
T-Bills	3.39	1.25	0.05	–0.06	–0.01	–0.01	0.05	0.28	1.00

We next take the return and risk parameters in Exhibit 8 and conduct a long-only, but otherwise unconstrained, mean–variance optimization. The purpose of this test is to conduct a horserace to determine which of the four proxies for real estate—REITs, NPI, Cambridge, or the factor benchmark—dominates the real estate allocation along the efficient frontier. Exhibit 9 shows the allocations of five equidistant portfolios spanning an efficient frontier comprising 100 portfolios—from P1 (minimum variance) to P100 (maximum return). The factor benchmark dominates the other real estate indexes along the efficient frontier. REITs, NPI, and Cambridge Real Estate achieve no material allocation in the presence of the factor benchmark for real estate. In contrast, NPI and REITs load along the frontier when the parameters in Exhibit 7 are used in the absence of the factor benchmark.

This result is not solely due to the higher mean return of real estate's factor benchmark. We can increase the mean return for REITs to match the 14.26% mean return of the factor benchmark because REITs have precisely a 1.0 beta versus the factor benchmark and the –2.15% alpha of REITs is statistically insignificant (indistinguishable from zero). Similarly, we can beta-adjust the mean returns for NPI (0.50 total beta) and Cambridge Real Estate (0.74 total beta) up to 8.77% and 11.46%, respectively. The optimization using these modified mean return inputs produces materially the same results; the factor benchmark dominates the real estate allocation along the efficient frontier.[9]

Portfolio Sharpe ratios are increased with the addition of absent factors, or with a more optimal factor mix. The factor benchmark contributes the compensated risk of uncorrelated, individual factors contained within real estate without contributing uncompensated sector or misappraisal risk. Some of the factors—size, value, and default—are not otherwise represented in the optimized set of asset classes. Thus, it is the addition of these absent factors (particularly value and default) that primarily improves portfolio Sharpe ratios relative to portfolios of generic stocks, bonds, and cash—whether implemented through a real estate allocation or a factor-based solution of stocks and bonds.

The mix of factor betas in the factor benchmark is a constant mix that represents real estate. The maximum Sharpe portfolio (P25) in Exhibit 9 is partially constrained by this constant mix. The optimal mix of factor betas for the entire portfolio may be different when factors are optimized independently. A more optimal mix of factor betas also improves portfolio Sharpe ratios. The table in Exhibit 10 compares the mixes of factor betas and their respective Sharpe ratios for the factor benchmark of real estate, P25, and the optimal mix of factor betas over the 1986 to 2015 period. The optimal mix offers the highest Sharpe ratio, and its mix of factor betas differs slightly from P25.[10]

Because the attractive factor returns within real estate are available from common stocks and bonds, how might we consider a real estate allocation, if at all? This takes us full circle to factor-based asset allocation, in which the optimal portfolio is achieved with factor-tilted portfolios of common stocks and bonds. If employing a factor-based approach to asset allocation, real estate would not be considered a separate source of return (i.e., an independent risk premium or factor). Instead, the optimal portfolio would be achieved by optimizing the set of individual factors using forward-looking return and risk parameters, and the investor

EXHIBIT 9
Real Estate on the Efficient Frontier

	Min. Var. P1	Max. Sharpe P25	P50	P75	Max. Return P100
Russell 3000	0.0%	5.7%	0.0%	0.0%	0.0%
FTSE NAREIT	0.0%	0.0%	0.0%	0.0%	0.0%
Factor Benchmark	0.0%	14.5%	50.0%	75.6%	100.0%
NPI	1.7%	0.0%	0.0%	0.0%	0.0%
Cambridge RE	0.0%	0.0%	0.0%	0.0%	0.0%
BC U.S. Agg.	0.2%	79.8%	50.0%	24.4%	0.0%
T-Bills	98.0%	0.0%	0.0%	0.0%	0.0%

would select his or her preferred portfolio of factor betas from the efficient frontier of risk factors. Or, more optimally, the investor could leverage or deleverage (i.e., combine with cash) the maximum Sharpe mix of factor betas from the efficient frontier of risk factors to achieve the desired return with the least amount of risk, effectively rising above the frontier.[11]

However, full-blown factor-based asset allocation can present operational and governance issues. First, factors remain somewhat esoteric to many professional investors, and expertise is required for efficient implementation. Second, certain factor exposures can require leverage and short positions, which are common portfolio-level constraints. Finally, the economic theory supporting the persistence of size and value premiums is perhaps not as strong as it is for market, term, and default factors, which are more clearly risk-based premiums. Holistic, factor-based asset allocation can be difficult to implement in practice.

Another issue with a purely factor-based approach is that real estate equity and debt are clearly capital assets with market values in the real economy. From the perspective of Sharpe's [1964] CAPM and efficient markets theory, investors engage in optimizing behavior until an equilibrium is reached—as represented by the market portfolio of capital assets. The optimal real estate allocation can be viewed within the context of its equilibrium weight within the total market portfolio of risky capital assets. Although the CAPM is an incomplete model, the proportional weight of real estate within the market portfolio provides a theoretically and empirically sound benchmark for a real estate allocation.

Doeswijk, Lam, and Swinkels [2014] constructed the global multi-asset market portfolio from the market

EXHIBIT 10
Optimal Factor Mix (1986–2015)

	MKT	SMB	HML	TERM	DEF	Sharpe Ratio
Factor Benchmark	0.58	0.38	0.72	1.04	0.45	0.70
P25	0.14	0.03	0.11	0.86	0.16	0.98
Optimal Mix	0.14	–0.02	0.10	0.66	0.08	0.99

values of global public equities, private equity, real estate, high-yield bonds, emerging market debt, investment-grade credits, government bonds, and inflation-linked bonds.[12] They estimated that investable commercial real estate equity (public and private) represents approximately 5% of the global multi-asset market portfolio. This translates to approximately 10% of the market portfolio of risky assets dominated by market beta (i.e., excluding investment-grade credits, government bonds, and inflation-linked bonds). Of course, there is also real estate debt (which exceeds real estate equity), but that is captured in the market value of fixed-income assets (e.g., mortgage-backed securities).

If investors prefer to use their own return and risk forecasts for real estate and other conventional asset classes in a mean–variance optimization, they should understand and manage the overall factor risk in the portfolio. This includes mapping real estate and other asset classes to their underlying mix of factor betas and then summing these betas to the portfolio level for testing and monitoring. The historical standard deviations and correlations of private real estate should be adjusted for lagged betas when using this information to guide forward-looking risk parameters. In addition, asset class return forecasts should consider return forecasts for the individual factors because exposures to these factors drive the compensated portion of return—the expected return—for all asset classes when their alphas are indistinguishable from zero.

This brings us to the question of whether alpha from manager skill in real estate should be added to the return forecasts used in mean–variance optimization. The performance literature primarily employs Fama–French market, size, and value factors to evaluate skill among active equity managers.[13] Because real estate also contains term and default risks, we test the alphas of all live and dead active real estate mutual funds in the Morningstar database from 1986 to 2015 with the five-factor model in Equation (1).[14] The average alpha is negative, and we found fewer active real estate funds with statistically significant positive alphas than would have been predicted by chance. These results suggest that alpha should not be added to the return forecasts for public real estate, and we found no evidence of alpha, on average, among private real estate funds when adjusting for lagged betas. The net-of-fee returns of the Cambridge Real Estate Index (and the gross-of-fee returns of ODCE) produce negative but statistically insignificant alpha over the 1986 to 2015 time period. True alpha may reside with a select subset of skilled private real estate managers, but rigorous peer-reviewed research on the performance of private real estate managers is lacking, and we leave that to future research.

CONCLUSION

The compensated portion of public REIT returns is explained by a rich factor mix that is analogous to a portfolio composed of approximately 60% small value stocks and 40% long-term high-yield bonds. The compensated portion of private real estate returns is fully explained by current and lagged exposures to these factor returns. Perhaps it is this risk-tilted, hybrid (i.e., stock–bond-like) nature that explains why some investors are comfortable with relatively large and concentrated real estate exposures. However, it is the common factor returns contained in real estate returns that can improve the Sharpe ratios of stock–bond portfolios, and these factor returns can be owned in factor-tilted, stock-bond portfolios with less risk—specifically, without idiosyncratic sector and misappraisal risks. We discussed the implications for asset allocation from the perspectives of traditional mean–variance optimization of asset classes, the CAPM with efficient markets, and factor-based asset allocation. Investors interested in the diversification benefits of real estate should carefully consider the best way to incorporate these factor returns into their total portfolio given their own investment objectives, investment policy, and governance constraints—whether through REITs, private real estate funds, or the holistic implementation of factor-based asset allocation.

We focused on real estate because it has many interesting features, including a rich factor mix, illiquidity, and prevalence in investors' portfolios. However, these factor-based concepts and methods apply to all asset classes and the total portfolio, providing greater transparency into the sources of return and risk for improved portfolio management.

ENDNOTES

[1]The real estate sector includes equity real estate investment trusts (REITs) but excludes mortgage REITs, which remain in the financials sector.

[2]A nonpriced factor would not meet this criterion, but it could still be important to asset pricing.

[3]Researchers have identified more than five factors, but these five explain the large majority of conventional asset class returns.

[4]ODCE returns are modestly leveraged and gross of fees.

[5]A regression using monthly returns produces similar overall results, but with higher beta *t*-statistics because more observations are used.

[6]The quarterly returns of public REITs show no serial correlation.

[7]Under this assumption, the idiosyncratic return should not be serially correlated, so the unsmoothing procedure would remove it.

[8]In comparison to autoregressive unsmoothing procedures, the delagged beta approach tends to produce higher correlations, suggesting it is more connected to the true return-generating process, even though it may not remove all serial correlation.

[9]The lowest-risk portfolios retain a small allocation to NPI.

[10]Unlike asset class weights, factor betas do not need to sum to 1.0 because they capture varying degrees of exposure.

[11]As with Sharpe's [1964] CAPM, this assumes investors can borrow at the risk-free rate or sufficiently close to it to be an attractive strategy relative to the portfolios of factor betas available from the efficient frontier.

[12]The authors excluded hedge funds and other trading strategies that would otherwise double count market values.

[13]See Fama and French [2010], for example.

[14]These regressions use monthly returns, and funds in the sample have a minimum of 24 months of returns.

REFERENCES

Anson, M. "Performance Measurement in Private Equity: Another Look at the Lagged Beta Effect." *The Journal of Private Equity*, Vol. 17, No. 1 (2013), pp. 29-44.

Barkham, R., and D. Geltner. "Price Discovery in American and British Property Markets." *Real Estate Economics*, Vol. 23, No. 1 (1995), pp. 21-44.

Doeswijk, R., T. Lam, and L. Swinkels. "The Global Multi-Asset Market Portfolio, 1959–2012." *Financial Analysts Journal*, Vol. 70, No. 2 (2014), pp. 26-41.

Fama, E., and K. French. "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, Vol. 33, No. 1 (1993), pp. 3-56.

——. "Luck versus Skill in the Cross Section of Mutual Fund Returns." *The Journal of Finance*, Vol. 65, No. 5 (2010), pp. 1915-1947.

Fisher, J., D. Geltner, and R.B. Webb. "Value Indices of Commercial Real Estate: A Comparison of Index Construction Methods." *Journal of Real Estate Finance and Economics*, Vol. 9, No. 2 (1994), pp. 137-164.

Getmansky, M., A. Lo, and I. Makarov. "An Econometric Model of Serial Correlation and Illiquidity in Hedge Fund Returns." *Journal of Financial Economics*, 74 (2004), pp. 529-609.

Lee, M. "Is There Skill among Bond Managers?" White paper, Dimensional Fund Advisors, December 2009.

Markowitz, H. "Portfolio Selection." *The Journal of Finance*, Vol. 7, No. 1 (1952), pp. 77-91.

Ooi, J., J. Wang, and J. Webb. "Idiosyncratic Risk and REIT Returns." *Journal of Real Estate Finance and Economics*, Vol. 38, No. 4 (2009), pp. 420-442.

Peng, L. "The Risk and Return of Commercial Real Estate: A Property Level Analysis." *Real Estate Economics*, Vol. 44, No. 3 (2016), pp. 555-583.

Sharpe, W. "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk." *The Journal of Finance*, Vol. 19, No. 3 (1964), pp. 425-442.