Global Commercial Real Estate

A strategic asset allocation study.

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For years, many institutional investors have included a strategic asset allocation to commercial real estate. Historically, this meant a *direct* investment in commercial real estate—physical property ownership, but the introduction and subsequent popularity of real estate investment trusts and listed real estate stocks has created confusion for strategic policymakers that we believe is largely unrecognized.

REITs are publicly traded real estate companies that provide almost all investors access, albeit *indirectly*, to commercial real estate. The transparent tax treatment of REITs allows investors access to the same cash flow characteristics that were once available only to *direct* commercial real estate investors. Today, global REITs and listed real estate stocks make commercial real estate available to investors around the world. Changes in the market also create new questions for asset allocators, as the definition of real estate investing evolves.

We examine the role of global commercial real estate in a strategic asset allocation setting. Most strategic asset allocations consist primarily of allocations to the three traditional asset classes—stocks, bonds, and cash. Expanding the investable universe beyond these three asset classes typically improves the risk-return characteristics of a strategic asset allocation. Asset classes with low correlations with the current opportunity set of asset classes typically provide the greatest benefit. Unfortunately, few agree on the role of other asset classes in a strategic asset allocation.

Before the development of large stock and bond capital markets during the last century, real estate (or property, as it was called then) dominated most strategic asset allocations. Modern asset allocators may have temporarily

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lost sight of the importance of commercial real estate, but commercial real estate is a traditional asset class that belongs in the investor's opportunity set.

We first examine the commercial real estate asset class and its various components. We identify REITs and listed real estate stocks as a viable method of obtaining exposure to commercial real estate. Our analysis focuses on the FTSE EPRA/NAREIT Global Real Estate Index® and its regional subindexes. Here we also identify the relevant set of asset classes in the opportunity set, their respective asset class index proxies, and the approximate size of the asset classes in the global market portfolio.

Next, we analyze the historical performance of the asset classes in the opportunity set. Using the traditional Markowitz [1952 and 1959] asset allocation model, we determine the asset allocations that would once have been optimal.

Finally, we develop two forward-looking sets of capital market assumptions to determine possible forward-looking asset allocations. The first set is based on the Sharpe-Lintner-Mossin-Treynor capital asset pricing model (CAPM). The second set is based on a robust asset allocation technique: the Black-Litterman [1992] asset allocation model. In this case, we blend the CAPM expected returns with the historical returns to produce a mixed estimate of expected returns. The CAPM approach and the Black-Litterman approach help mitigate problems associated with input estimation error, thereby leading to more diversified forward-looking asset allocations.

We also use an enhanced version of the Markowitz framework, called resampled mean-variance optimization, which expressly acknowledges that the capital market assumptions driving the model are not known with certainty looking ahead.

COMMERCIAL REAL ESTATE, REITS, AND THE OPPORTUNITY SET

Prudential Real Estate Investors (see Conner and Liang [2005]) and the European Public Real Estate Association (EPRA) (see Hughes and Arissen [2005]) estimate the total value of the investable commercial real estate market worldwide at approximately $14 trillion. Several authors segment commercial real estate into four broad segments or quadrants:*

- Private (direct) commercial real estate: Debt.
- Public (indirect) commercial real estate: Debt.
- Private (direct) commercial real estate: Equity.
- Public (indirect) commercial real estate: Equity.

No single real-time index measures the collective performance of all four segments.

Private (direct) commercial real estate debt is available only to the largest investors, although smaller investors may obtain some exposure through the stocks of mortgage REITs, commercial banks, and other specialty finance companies. The Giliberto-Levy Commercial Mortgage Performance Index is the most common index for measuring the performance of private (direct) commercial real estate debt.

Public (indirect) commercial real estate debt, primarily commercial mortgage-backed securities (CMBS), was added to the Lehman Brothers US Aggregate Index in 1999. It is a component of most aggregate fixed-income indexes (see Berkley and Gendron [2002]).

Private (direct) commercial real estate equity is typically measured using the National Council of Real Estate Investment Fiduciaries (NCREIF) property index or a refined transaction-based index such as those proposed in Fisher et al.[2003] or Fisher, Geltner, and Pollakowski [2005]. Appraisal-based indexes such as the NCREIF suffer from excessive smoothing and serial correlation. The refined transaction-based indexes try to mitigate these issues.

Public (indirect) commercial real estate equity is available to almost all investors through equity REITs and other listed real estate companies, where we have a variety of publicly available indexes to measure performance.

Our focus is the *equity* commercial real estate asset class and its two subclasses, private (direct) commercial real estate equity and public (indirect) commercial real estate equity, and we use global REIT and listed real estate indexes to proxy the asset class.

Although all investors may not yet agree that direct commercial real estate investments and indirect commercial real estate investments (REITs) provide the same risk-reward exposure to commercial real estate, a growing body of research indicates that investment returns from the two markets are either the same or nearly the same. Still, some residual ambiguity coupled with investors' growing preference for, and access to, indirect commercial real estate equity has created some lingering confusion among asset allocators.

Advantages of direct real estate investment include direct control, the ability to select individual properties, greater capacity (size), and, for taxable individual investors,

some potential tax-timing benefits. Advantages of REITs and listed real estate include investor access, lower costs (for most investors), liquidity, independent analysis, corporate governance, and real-time pricing in public capital markets.

Even though the underlying assets are the same, Conner and Falzon [2004] argue that there are performance differences that go beyond performance measurement.

Feldman [2003] studies the relation between direct real estate and indirect real estate (REITs) using the two refined transaction-based direct real estate indexes developed by Fisher et al.[2003]. He finds that REIT performance is statistically indistinguishable from the two direct real estate indexes at conventional significance levels, except that the correlation coefficients between the REIT index and the two direct real estate indexes suggest that the indexes are less than perfect substitutes for one another.

Feldman [2003] concludes that direct real estate and REITs are complementary investments that together should play a large role in strategic asset allocations. We share this view, but think the split between direct and indirect real estate should not necessarily be made entirely by an optimizer, given the extent of uncertainty in forward-looking capital market assumptions.

Fisher, Geltner, and Pollakowski [2005] refine the direct real estate index construction methodology proposed in earlier research to perform a series of optimizations using a relatively standard opportunity set and various combinations of REIT and direct real estate proxies. Whatever the real estate proxy, real estate plays a prominent role in the optimal asset allocation based on the traditional mean-variance optimization approach.

Hudson-Wilson, Fabozzi, and Gordon [2003] find that, despite various private or public labels associated with different commercial real estate investments, the same set of common factors influences their returns. Using a market capitalization-weighted composite of commercial real estate with public debt, with public equity, with private debt, and with private equity and an opportunity set that includes cash, bonds, and equities, mean-variance optimization leads to large allocations to commercial real estate.

Perhaps most important for the approach that we take, Pagliari, Scherer, and Monopoli [2005], among others, find that there are no statistically meaningful differences in the means and volatilities of public and private real estate equities, thereby suggesting a "seamless real estate market in which public- and private-market investments display a long-run synchronicity." Like Frost, Schioldager, and Hammond [2005], we conclude that REITs can be viewed as a proxy for direct as well as indirect real estate. Hudson-Wilson and Harbaugh [2006] ask, "why not use the better real estate equity quadrant index to measure performance of the less well-measured equity quadrant?" We agree with this sentiment and use public (indirect) commercial equity indexes to proxy for *total* commercial real estate equity.

Over long time horizons, direct and indirect commercial real estate investments should yield similar results because the underlying investments are largely the same. Over shorter periods, structural differences may create performance disparities that will remain difficult to measure precisely, given the performance measurement issues with respect to direct real estate. While REITs today represent a modest percentage of total commercial real estate investment, investor demand for REITs is causing an intra-asset class shift from direct to indirect real estate.

Global Listed Real Estate Investment

In the last 30 years, the United States and Australia have provided the majority of investment opportunities for REITs and publicly traded real estate companies. The introduction of REIT-like companies around the world is chronicled in Conner and Liang [2006]. REITs today operate in more than 20 countries, and listed real estate companies operate in many more, resulting in significant worldwide growth of publicly traded real estate equity market capitalization (see Bergsman [2005]).

The dramatic increase in the amount of money invested in global REITs and listed real estate equities is evident in Exhibit 1. From December 2001 through December 2006, the free float equity market capitalization of global REITs and listed real estate equities grew from $270.7 billion to $686.6 billion. REITs and listed real estate companies represent an asset class that is now available to investors around the globe.

Like other publicly traded companies, REITs and listed real estate companies are actively traded on the major stock exchanges. The largest REITs are constituents of the broad equity market indexes, such as the Russell 3000 or the MSCI EAFE. As of April 2006, nearly 100% of U.S.-domiciled REITs and listed real estate companies in the FTSE EPRA/NAREIT Global Real Estate Index were in the Russell 3000. Of European REITs and listed real estate companies in the FTSE EPRA/NAREIT Global Real Estate Index, nearly 25% were constituents of the MSCI EAFE Index. Of Asian REITs and listed real estate companies in the FTSE EPRA/NAREIT Global Real Estate Index, more than 53% were included in the MSCI EAFE.

Investments in products that track these broad equity market indexes imply an investment allocation to the REITs and listed real estate companies that are part of these indexes and should be taken into account when developing an overall allocation to commercial real estate equities. If an investor already has fulfilled an allocation to commercial real estate through a combination of direct investment vehicles and well-diversified stock indexes, a separate allocation to REITs and listed real estate equities could create an overweighted position in real estate, relative to a market capitalization-weighted portfolio, and an underweighted position in other equities.

Exhibit 2 lists the equity indexes in the opportunity set as well as the Russell 1000 Value Index and Russell 1000 Growth Index. The table identifies the numbers of REITs and listed real estate stocks in each index, the approximate market capitalization of the REITs and listed real estate stocks in each index, the market capitalization of the index, and the percentage of the market capitalization of each index that is represented by REITs and listed real estate stocks.

The percentages in the last column of Exhibit 2 raise two concerns. First, because traditional equity market asset class proxies have varying proportions of REITs, a fact that may not be well-known to investors, some asset allocators may be unaware of their true asset allocations to REITs, as well as to other equities. For example, investors with a distinct allocation to REITs plus a large allocation to the Russell 2000 Value Index may have a greater overall exposure to commercial real estate and a lower overall exposure to other equities than they realize.

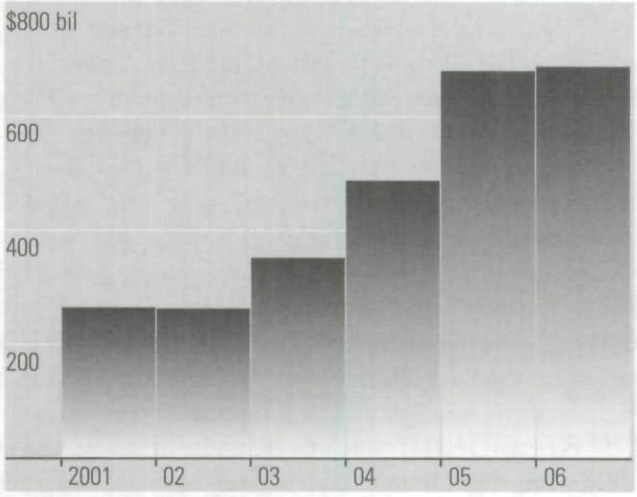
Second, the overlap between all the equity market proxies and the REIT-specific indexes raises issues of multiple exposures to a set of companies. Given the propensity of asset allocators to specify a distinct allocation to commercial real estate, asset allocation transparency would be improved if index providers supplemented their popular equity benchmarks with ex-REIT or ex-listed real estate versions.

Opportunity Set

A critical element of any asset allocation study is identification of the relevant opportunity set of investable asset classes. The asset classes we use include cash, U.S. bonds, non-U.S. bonds, U.S. large-cap stocks, U.S. small-cap stocks, non-U.S. stocks, and global real estate equities. Exhibit 3 lists the asset classes and the asset class proxies used to represent each asset class in the analysis.

EXHIBIT 1

Free Float Market Capitalization of Global REITs and Listed Real Estate Equities



Source: FTSE EPRA/NAREIT Global Real Estate Index

EXHIBIT 2

REITs and Listed Real Estate Stocks in Major Equity Indexes as of June 30, 2006

Asset Class Proxy	Total Number of REITs and Listed Real Estate Stocks	Approximate Market Capitalization of REITs and Listed Real Estate Stocks in Index	Market Capitalization of Index	Percentage of Market Capitalization Represented by REITs and Listed Real Estate Stocks
S&P 500	11	$98	$11,529	0.85%
Russell 1000 Value	42	$185	$6,470	2.86%
Russell 1000 Growth	12	$32	$6,264	0.51%
Russell 2000 Value	67	$52	$639	8.08%
Russell 2000 Growth	28	$11	$642	1.79%
MSCI EAFE	64	$242	$11,167	2.16%

Index constituent data were provided by NAREIT and Morningstar, Inc. No attempt is made to adjust the Russell indexes for REITs that are partially assigned to both growth and value index; thus, the approximate market capitalization of REITs in the Russell indexes is biased upward.

We will refer to the first six asset classes as *traditional* asset classes; they are a more specific version of the asset classes that have come to dominate most asset allocation strategies, namely, stocks, bonds, and bills (cash). For most U.S. investors, referring to non-U.S. bonds as a traditional asset class is a bit of a stretch, although for non-U.S. investors it certainly is an important asset class. Thus, given the large size of non-U.S. bonds in the capital markets, it should be part of investors' opportunity sets.

In subsequent discussion, we use the asset class names in Exhibit 3. Frost, Schioldager, and Hammond [2005] provide a comprehensive review of the various real estate indexes.

FTSE EPRA/NAREIT Global Real Estate Index

Throughout this study, global real estate is proxied by the FTSE EPRA/NAREIT Global Real Estate Index and its three regional subindexes. It is a market capitalization-weighted index representing all qualifying real estate stocks worldwide. As of June 30, 2006, the index included 321 REITs and listed real estate companies in 20 countries and Hong Kong with an aggregate market capitalization of approximately $720 billion.

The index consists of three regional subindexes: North America, Asia, and Europe (see Exhibit 4).

HISTORICAL ANALYSIS

In our historical analysis, we focus on returns, standard deviations, and correlations. In addition to providing insights with respect to the historical performance of the asset classes, the returns, standard deviations, and correlations form a historical set of capital market assumptions. When coupled with a traditional mean-variance optimization, these assumptions identify the asset allocations that would have been optimal in the past.

Historical Performance

Exhibit 5 shows the growth of a one dollar investment in each asset class from the end of 1989 to the end of 2005, the longest period for which all proxies are available. The performance of North American real estate is truly impressive over this time period. Exhibit 5 also demonstrates that, over short time periods, it is nearly impossible to predict which asset class will be the best performer.

EXHIBIT 3
Opportunity Set

Asset Classes	Asset Class Proxies
Cash	Citigroup U.S. Domestic 3-Month T-Bill
U.S. Bonds	Lehman Brothers U.S. Aggregate Bond
Non-U.S. Bonds	Citigroup World BIG x-U.S. Index (1999–2005)
	Citigroup Non-U.S. Dollar World Government Bond Index (1990–1998)
U.S. Large-Cap Stocks	S&P 500
U.S. Small-Cap Stocks	Russell 2000
Non-U.S. Stocks	MSCI EAFE
Global Real Estate	FTSE EPRA/NAREIT Global Real Estate Index
North American Real Estate	FTSE EPRA/NAREIT Global Real Estate Index North America Series
European Real Estate	FTSE EPRA/NAREIT Global Real Estate Index Europe Series
Asian Real Estate	FTSE EPRA/NAREIT Global Real Estate Index North Asia Series

EXHIBIT 4
FTSE EPRA/NAREIT Global Real Estate Index Consitutents

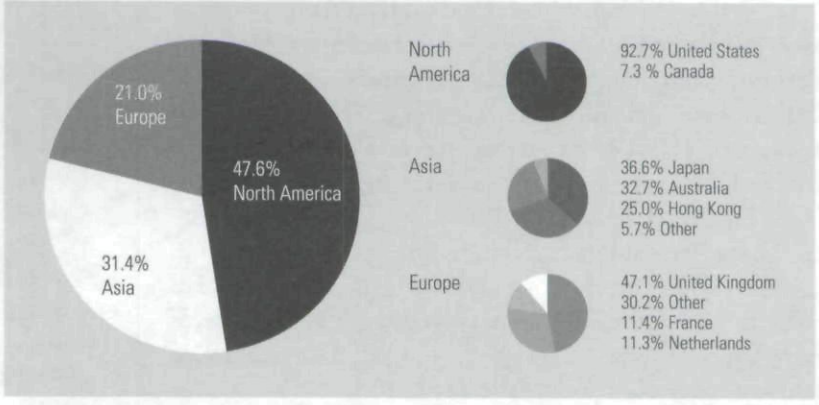
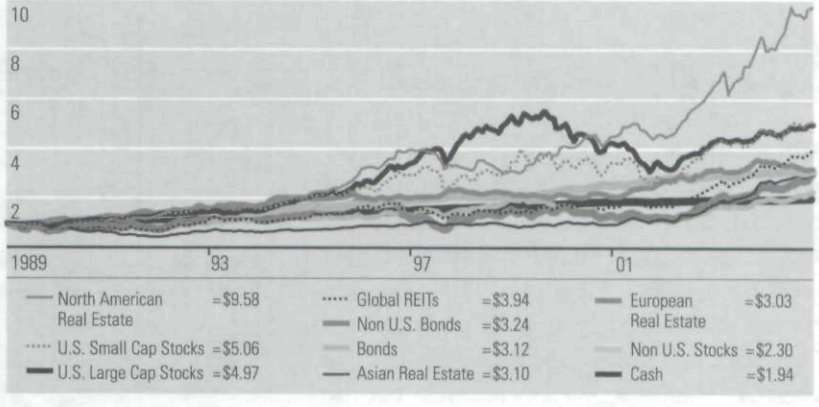


EXHIBIT 5
Growth of a $1 Investment, December 1989-December 2005



Historical returns and standard deviations of the asset classes in the opportunity set are presented in Exhibit 6. Over the last 16 years, North American real estate was the highest-returning asset class with an average annual arithmetic return of nearly 17%. North American real estate, U.S. bonds, and U.S. large-cap stocks had the highest Sharpe ratios over the 16 years, while non-U.S. stocks, European real estate, and Asian real estate had the lowest Sharpe ratios. Asian real estate was the most volatile, with an annual standard deviation of 32.56%.

Some of the statistics in Exhibit 6 deserve further comment. Compared to U.S. stocks, this was not a particularly strong period for non-U.S. stocks. For the exceptional returns of North American real estate, it can be argued that the increased scrutiny brought to bear on publicly traded real estate companies in North America with the increasing securitization of direct real estate investments has led to gradual efficiency gains that in turn contributed to the outperformance of historical real estate returns over the period.

Perhaps European real estate has lagged the two more well-established REIT and listed real estate regions for a similar reason. The United Kingdom represents approximately half of European real estate, but the U.K. didn't adopt a transparent REIT-like structure that would encourage private companies to go public until the beginning of 2007.

Finally, the standard deviation of Asian real estate may have been abnormally high during this time period. One would expect the formative years of a new asset class to be more volatile, and Asian currency markets may have been abnormally volatile over the period. Asian real estate is more diversified today; the market has a better understanding of the asset class; and fewer currency events may lead to reduced volatility in the future.

A core theme of modern portfolio theory is that asset classes should be viewed in a portfolio or asset allocation context. It is the interaction or, more precisely, the degree to which asset class returns do not move together that provides diversification. When assets are less than perfectly correlated, their combined variability in a portfolio is less than the sum of the individual volatilities of each asset class. Even volatile asset classes can reduce overall portfolio volatility if they have low positive correlation or negative correlation with other asset classes. The classic example of diversification is that the volatility of an all-bond asset allocation can be reduced by adding a small allocation to equities.

Exhibit 7 summarizes historical correlation coefficients of all asset classes in the opportunity set for 1990–2005. The data illustrate that global real estate in most cases has had low or negative correlation coefficients with the traditional asset classes, particularly with U.S. large-cap stocks, U.S. small-cap stocks, and U.S. bonds. European real estate has had very low or negative correlations with all U.S. asset classes.

Among the three traditional equity asset classes—U.S. large-cap stocks, U.S. small-cap stocks, and international stocks—the correlations range from 0.64 to 0.76. For the three subasset classes of global real estate—North

EXHIBIT 6
Historical Returns, Standard Deviations, and Sharpe Ratios, 1990-2005

Asset Class	Arithmetic Annual Return	Compounded Annual Return	Standard Deviation	Sharpe Ratio
Cash	4.23%	4.22%	1.88%	0.06
U.S. Bonds	7.50%	7.36%	5.61%	0.60
Non-U.S. Bonds	8.13%	7.63%	10.62%	0.38
U.S. Large-Cap Stocks	11.95%	10.54%	17.89%	0.44
U.S. Small-Cap Stocks	12.32%	10.67%	19.72%	0.42
Non-U.S. Stocks	6.82%	5.12%	19.37%	0.14
Global Real Estate	11.36%	8.95%	24.77%	0.29
North American Real Estate	16.97%	15.17%	20.44%	0.63
European Real Estate	9.53%	7.17%	23.81%	0.23
Asian Real Estate	11.58%	7.34%	32.56%	0.23

EXHIBIT 7
Correlations, 1990-2005

	Cash	U.S. Bonds	Non-U.S. Bonds	U.S. Lrge Cap Stocks	U.S. Sml Cap Stocks	Non-U.S. Stocks	Global Real Estate	N. Amer. Real Estate	European Real Estate	Asian Real Estate
Cash	1.00	0.34	–0.17	0.16	–0.19	–0.41	–0.48	–0.26	–0.62	–0.40
U.S. Bonds	0.34	1.00	0.43	0.17	0.14	–0.26	0.04	0.20	–0.09	0.00
Non-U.S. Bonds	–0.17	0.43	1.00	0.13	0.07	0.17	0.21	–0.01	0.33	0.21
U.S. Large-Cap Stocks	0.16	0.17	0.13	1.00	0.76	0.64	0.22	0.34	0.06	0.31
U.S. Small-Cap Stocks	–0.19	0.14	0.07	0.76	1.00	0.64	0.48	0.71	0.17	0.53
Non-U.S. Stocks	–0.41	–0.26	0.17	0.64	0.64	1.00	0.66	0.28	0.56	0.76
Global Real Estate	–0.48	0.04	0.21	0.22	0.48	0.66	1.00	0.56	0.83	0.94
North American Real Estate	–0.26	0.20	–0.01	0.34	0.71	0.28	0.56	1.00	0.30	0.44
European Real Estate	–0.62	–0.09	0.33	0.06	0.17	0.56	0.83	0.30	1.00	0.68
Asian Real Estate	–0.40	0.00	0.21	0.31	0.53	0.76	0.94	0.44	0.68	1.00

American, European, and Asian—the correlations range from 0.30 to 0.68.

Despite the relatively high intra-equity correlations, it is widely accepted that the equity portion of a well-diversified asset allocation should be diversified among the equity subasset classes. It is also reasonable to postulate that real estate investors should achieve additional diversification benefits by diversifying across the three global real estate subasset classes, something that can be achieved with separate allocations to the subasset classes or a single allocation to global real estate.

Somewhat puzzling is the fact that, of the three global real estate regional subasset classes, North American real estate has the lowest correlation with global real estate (0.56), even though North America is the largest constituent of the overall group. One possible explanation for this is that of the three constituents, the European and Asian series are more closely correlated with each other and collectively represent more than half of the global index.

In general, global real estate has lower correlations with the four traditional U.S. asset classes than North American real estate. This suggests that global real estate is a better diversifier for U.S.-centered asset allocations. North American real estate has lower correlations with non-U.S. bonds and non-U.S. stocks than does global, European, or Asian real estate. This suggests that North American real estate is a better diversifier for non-U.S.-centered asset allocations.

The correlations in Exhibit 7 also reflect in part the extent of overlap between the constituents of the listed real estate indexes and the traditional equity indexes. For example, the Russell 2000 index includes a relatively high proportion of U.S. REITs, and the correlation between North American real estate and U.S. small-cap stocks is a relatively high 0.71.

Historical Efficient Asset Allocations With and Without Global Real Estate

Our historical analysis provides the three investment attributes for the asset classes that drive the Markowitz traditional mean-variance optimization. Using the historical arithmetic returns and standard deviations in Exhibit 6 and the historical correlations in Exhibit 7, we can determine the historical efficient frontier, which identifies the asset allocation that would have been optimal in the past.

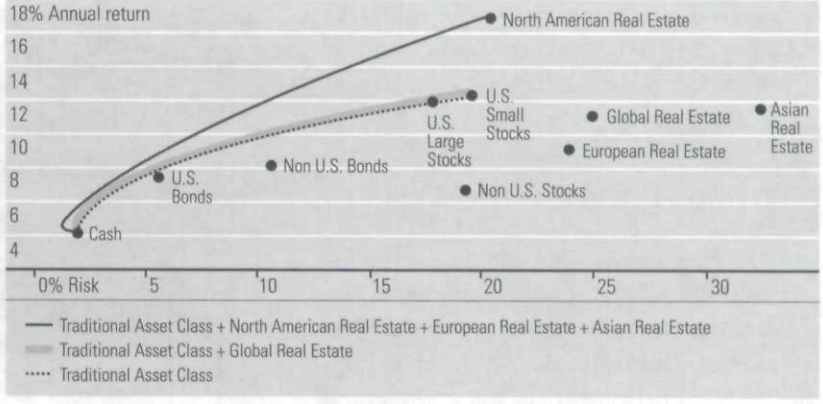
Exhibit 8 displays the results of three optimizations. In the first optimization (lowest frontier), only the six traditional asset classes are included in the opportunity set. In the second optimization (middle frontier), we add global real estate to the opportunity set. In the third optimization (highest frontier), we replace global real estate with the three subasset classes that form global real estate: North American real estate, European real estate, and Asian real estate.

The two lower efficient frontiers are nearly indistinguishable. The relatively low average annual return of European real estate coupled with the high standard deviation of returns from Asian real estate offsets the exceptional performance of North American real estate, resulting in a composite with equity-like returns and high volatility. Thus, adding global real estate as a whole improves the performance of the efficient asset allocation only slightly.

Replacing global real estate with its three subindexes—North American, European, and Asian real estate—improves the performance of the efficient allocations significantly because investments may now be allocated to each regional subindex separately.

Exhibit 9 quantifies the benefits of expanding the opportunity set. For each of the three efficient frontiers in Exhibit 8, we list efficient asset allocation returns corresponding to discrete standard deviation levels across the risk spectrum. Including global real estate in the opportunity set improves efficient asset allocation returns by an average of nine basis points over 11 different asset allocation standard deviation points ranging from 5% to 15%.

EXHIBIT 8
Historical Efficient Frontiers



Then, replacing global real estate in the opportunity set with the three subindexes—North American, European, and Asian real estate—improves efficient asset allocation returns by an average of 182 basis points. This benefit is primarily the result of the outstanding relative historical returns of North American real estate.

Exhibit 10 shows the asset allocations based on the efficient frontier that includes North American real estate, European real estate, and Asian real estate with the six traditional asset classes in the opportunity set. Risk, measured by the standard deviation of annual portfolio returns, is shown on the horizontal axis. The vertical cross sections identify the composition of the efficient asset allocations at all levels of risk.

For the 1990-2005 period, with calendar year rebalancing, ceteris paribus, Exhibit 10 identifies the best possible performing asset allocations for each risk level. At the lowest risk level, the minimum-variance asset allocation is approximately 93% cash, 1% non-U.S. bonds, 1% non-U.S. stocks, 1% North American real estate, and 4% European real estate. At the highest risk level, the maximum return asset allocation is 100% North American real estate.

Non-U.S. stocks receive a very small allocation in some of the lower-risk asset allocations, while U.S. small-cap stocks and Asian real estate are entirely absent from the asset allocations that were optimal over this historical period. With hindsight (or perfect foresight), this is perfectly acceptable. If, on the other hand, one is trying to create a robust forward-looking asset allocation policy, excluding non-U.S. stocks, U.S. small-cap stocks, and Asian real estate across the risk spectrum does not seem wise. In a forward-looking context, a more robust or balanced approach to diversification is required.

FORWARD-LOOKING ANALYSIS

Robust and forward-looking asset allocations should diversify an investor's holdings across the asset classes in the opportunity set in a manner that is based on sound portfolio theory. Yet portfolio theory as represented by the traditional Markowitz optimization approach rarely leads to robust forward-looking asset allocations, especially when the capital market assumptions are based on short-term historical returns.

The *traditional* mean-variance optimization approach treats the capital market assumptions as if they are known with 100% certainty. In the historical analysis, we knew the capital market assumptions with 100% certainty and were able to determine the asset allocations that were optimal in the *past*. We saw that the inclusion of North American real estate in the opportunity set dramatically improved the past performance of the optimal asset allocations.

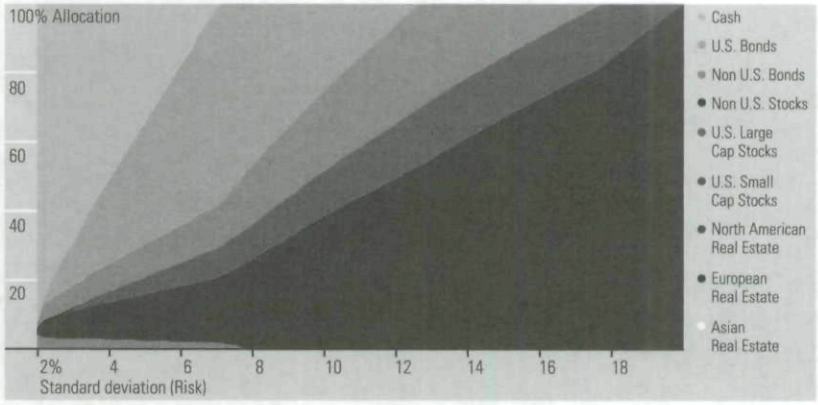
EXHIBIT 9

Return Improvement with Global Real Estate

Standard Deviation (%)	Traditional Asset Classes	Traditional Asset Classes + Global RE	Traditional Asset Classes + North American RE + European RE + Asian RE
5%	7.66%	7.73%	8.33%
6%	8.39%	8.47%	9.15%
7%	8.91%	8.99%	9.96%
8%	9.31%	9.39%	10.69%
9%	9.66%	9.75%	11.34%
10%	9.99%	10.08%	11.94%
11%	10.31%	10.40%	12.52%
12%	10.61%	10.71%	13.08%
13%	10.91%	11.01%	13.63%
14%	11.20%	11.31%	14.15%
15%	11.47%	11.59%	14.64%
Average Return	9.86%	9.95%	11.77%
Average Improvement		0.09%	1.82%

EXHIBIT 10

Historical Asset Allocation Area Graph



But in a forward-looking context, the capital market assumptions are forecasts; therefore, they are not known with 100% certainty. It is well documented in the literature that traditional mean-variance optimization is very sensitive to small changes and errors in the capital market assumptions. Chopra and Ziemba [1993] estimate that traditional mean-variance optimization is 11 times more sensitive to estimation error in returns than to estimation error in risk (variance) and 2 times more sensitive to estimation error in risk (variance) than to estimation error in covariances (which also applies to correlations).

With these issues in mind, we use an enhanced optimization technique called resampled mean-variance optimization that recognizes capital market assumptions are not known with certainty. Resampled mean-variance optimization is a more robust asset allocation procedure that combines traditional mean-variance optimization with Monte Carlo simulation.

We also use a forward-looking model of expected returns. The global real estate asset class proxies have data that begin in 1990, but unfortunately short-term historical returns are often regarded as some of the worst predictors of future performance. Thus we use the capital asset pricing model, one of the cornerstones of modern portfolio theory. To develop a forward-looking set of expected returns using the CAPM, we must create a working version of the unobservable all-inclusive market portfolio—a version that includes commercial real estate.

In our final analysis, we use a Bayesian asset allocation model called the Black-Litterman model, which generally leads to well-diversified asset allocations. We then combine the CAPM expected returns with the historical returns to create a mixed estimate of expected returns.

Role of Real Estate in the Market Portfolio

Hudson-Wilson, Fabozzi, and Gordon [2003] advise that:

The starting point should be to include real estate and the other assets at their market weights, and then to adjust the weights in order to best achieve investment objectives.

Geltner and Miller [2001], Feldman [2003], and most recently Dopfel [2006] also touch on the role of real estate in the market portfolio. According to the CAPM, the market-neutral weight of any asset is proportional to its market capitalization relative to the world's total market capitalization.

While the market values of the FTSE EPRA/NAREIT Global Real Estate Index and the three regional subindexes are readily available, this is not true for the broader global commercial real estate asset class. And estimates of the market capitalization of investment-grade direct commercial real estate are not universally accepted.

Miles and Tolleson [1997] provide one of the most detailed attempts to determine the size of the major components of the U.S.-investable universe, including investment-grade real estate. Hudson-Wilson, Fabozzi, and Gordon [2003] estimate the role of real estate in the market portfolio at 8.3%, according to data from the Roulac Capital Flows Database published in *Investment Property*, and the Federal Reserve Board. Dopfel [2006] uses the average asset allocation of the 200 largest U.S.-defined-benefit plans.

Finally, focusing strictly on global commercial real estate, Liang and Gordon [2003] estimate the market value of commercial real estate for 50 countries using a top-down approach based on individual country gross domestic product and GDP per capita. Their estimate of $12.5 trillion is frequently cited. Conner and Liang [2005] update the Liang and Gordon figure to $14.1 trillion. Most of these estimates are for the total of the four commercial real estate segments we are using.

We believe the most applicable figures for the U.S. may come from J.P. Morgan Asset Management Real Estate, in "Real Estate Universe" [2006]. As of March 1, 2006, it estimates the total value of U.S. commercial real estate at $6.7 trillion. For the U.S., the details for the four commercial real estate quadrants are:

1. Private (direct) Commercial Real Estate: Debt
   a. Mezzanine — $90 to $170 billion
   b. Commercial Mortgages — $1.6 trillion
2. Public (indirect) Commercial Real Estate: Debt
   a. Commercial Mortgage-Backed Securities — $709 billion
   b. Commercial Mortgages — $272 billion
3. Private (direct) Commercial Real Estate: Equity
   Direct Real Estate — $1.9 trillion
4. Public (indirect) Commercial Real Estate: Equity
   a. REITs — $383 billion
   b. Corporate-Owned Real Estate — $1.7 trillion

For our purposes, the interesting figure is the $1.9 trillion associated with direct real estate. Recall that we combine the two equity commercial real estate asset subclasses in our opportunity set and believe that a large

portion of public real estate debt is included in the fixed-income asset classes. Henceforth, we use the $1.9 trillion coupled with the $350 billion market capitalization for the FTSE EPRA/NAREIT Global Real Estate Index North America Series to estimate the market capitalization for investment-grade North American real estate equity at $2.25 trillion.

For the asset classes in our opportunity set, Exhibit 11 provides our estimate of respective weights in the market portfolio. The column labeled Market Capitalization (Estimate 1) shows rounded values based on the appropriate index proxy or a very similar index proxy. Dividing each individual market capitalization by the total leads to one possible definition of the market portfolio, although a definition in which global real estate represents a small fraction of the total market portfolio because this estimate is based on the market capitalizations of the indirect asset class proxies.

EXHIBIT 11
Market Capitalization Estimates

Asset Class	Market Capitalization (Estimate 1) In Billions	Weight in Market Portfolio (Estimate 1)	Market Capitalization (Estimate 2) In Billions	Weight in Market Portfolio (Estimate 2)
Cash	$584	1.13%	$584	1.05%
U.S. Bonds	$8,278	15.96%	$8,278	14.84%
Non-U.S. Bonds	$13,191	25.43%	$13,191	23.64%
U.S. Large-Cap Stocks	$12,734	24.55%	$12,734	22.82%
U.S. Small-Cap Stocks	$1,281	2.47%	$1,281	2.30%
Non-U.S. Stocks	$15,088	29.09%	$15,088	27.04%
Global Real Estate	$721	1.39%	$4,637	8.31%
North American Real Estate	$350	0.67%	$2,250	4.03%
European Real Estate	$144	0.28%	$929	1.66%
Asian Real Estate	$227	0.44%	$1,458	2.61%
Total	$51,876	100.00%	$55,792	100.00%

An alternative definition of the market portfolio uses market capitalization estimates for all equity commercial real estate. The column labeled Market Capitalization (Estimate 2) includes the $2.25 trillion estimate for North American real estate as well as estimates for European real estate and Asian real estate. The latter two estimates are based on the relative percentages of the FTSE EPRA/NAREIT Global Real Estate Index and the $2.25 trillion estimate for North American real estate. Henceforth we use Market Capitalization (Estimate 2) as our working definition of the market portfolio.

At the beginning of 2006, *Pensions & Investments* estimated the average real estate asset allocation of the 200 largest U.S. defined-benefit plans as 4.2%, a figure considerably lower than the 8.31% based on a market capitalization weighting approach. Defined-benefit plan managers represent some of the more traditional adherents of modern portfolio theory, so the large discrepancy between the average reported real estate allocation and the market capitalization weight is something of a puzzle.

EXHIBIT 12
CAPM Expected Returns and Historical Return Comparison

Asset Class	CAPM Return	Historical Arithmetic Return	CAPM Return less Historical Arithmetic Return
Cash	5.07%	4.23%	0.84%
U.S. Bonds	5.56%	7.50%	–1.94%
Non-U.S. Bonds	7.13%	8.13%	–1.00%
U.S. Large-Cap Stocks	11.30%	11.95%	–0.65%
U.S. Small-Cap Stocks	11.55%	12.32%	–0.77%
Non-U.S. Stocks	12.27%	6.82%	5.45%
North American Real Estate	8.87%	16.97%	–8.10%
European Real Estate	10.01%	9.53%	0.48%
Asian Real Estate	14.58%	11.58%	3.00%

CAPM Forward-Looking Efficient Asset Allocations

In our forward-looking efficient asset allocations the expected return estimates are based on the CAPM. More specifically, we use the reverse optimization procedure described in Sharpe [1974], which is a specialized version of Sharpe [1964]. Under the CAPM, assets that make the market portfolio more volatile must also offer above-average expected returns to compensate investors for the added systematic risk.

Exhibit 12 shows the market equilibrium consensus returns based on the CAPM assuming a long-term risk-free rate of 5.25% (reflective of yields at the time of this writing) and the U.S. large-cap stock equity premium of 6.05%. We also include the historical arithmetic return as well as the difference between the CAPM and historical

arithmetic returns. Clearly, there are some substantial differences, particularly for non-U.S. stocks and North American real estate.

For North American real estate, the large difference between the CAPM return and the historical arithmetic return is striking. We offer two possible explanations.

First, the nearly 17% historical average annual return may represent an unusually prosperous but transitory period for North American listed real estate. As suggested earlier, the structural transformation of property ownership and management from *direct* real estate investment to publicly traded securities may have yielded appreciable operating efficiencies that boosted investment returns to listed real estate over the period of transition, but should not be expected to persist indefinitely.

Second, the CAPM is far from perfect. There is a large body of literature addressing CAPM return anomalies. The most famous are the small-cap effect, the valuation effect, and the momentum effect. Perhaps North American real estate represents a similar or related anomaly, as it could be characterized as a small value-oriented asset class subject to periods of momentum.

Third, the excellent returns of REITs and listed equities representing North American real estate may have occurred partially because many asset allocators adopted macro-inconsistent asset allocation policies—reducing core equity allocations in favor of a dedicated allocation to REITs and listed equities.

We should also note that for simplicity we have applied the traditional CAPM, where currency risk is part of the total risk of the non-U.S. asset classes. Using U.S. dollar-hedged versions of the non-U.S. asset classes would reduce the volatility of the asset class and thus depress the risk-based return forecasts of the non-U.S. asset classes. Compared to North American real estate, European real estate and Asian real estate have expected premiums of 1.14 percentage points and 5.71 percentage points, respectively. Using a very different approach based on country-specific credit ratings and hurdle rates, Liang and Gordon [2003] find that Asian commercial real estate should offer a significant premium above North American and European commercial real estate.

Using the CAPM forward-looking returns in Exhibit 12, the standard deviations in Exhibit 6, and the correlations in Exhibit 7, we calculate the forward-looking efficient frontier using resampled mean-variance optimization (in Exhibit 13). At first glance, there is nothing particularly noteworthy about this efficient frontier. In fact, efficient frontier graphs mask the asset allocations that lead to the various points across the efficient frontier. So, as in the historical analysis, we use an efficient frontier area graph to display the composition of the efficient asset allocation across the entire risk spectrum in Exhibit 14.

EXHIBIT 13
CAPM Efficient Frontier Using *Resampled* Mean-Variance Optimization

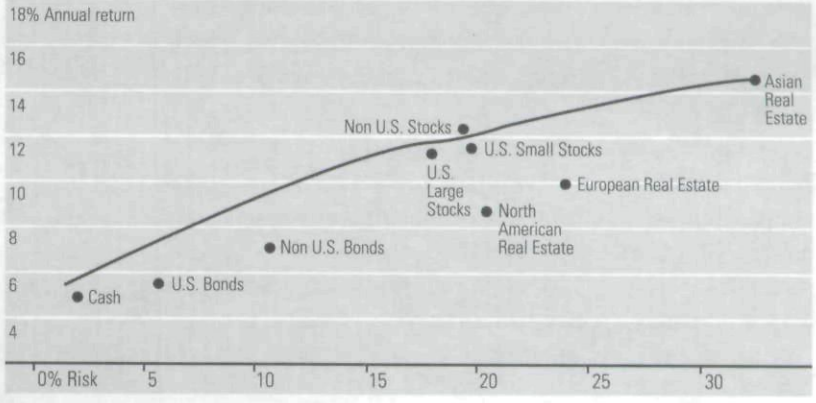
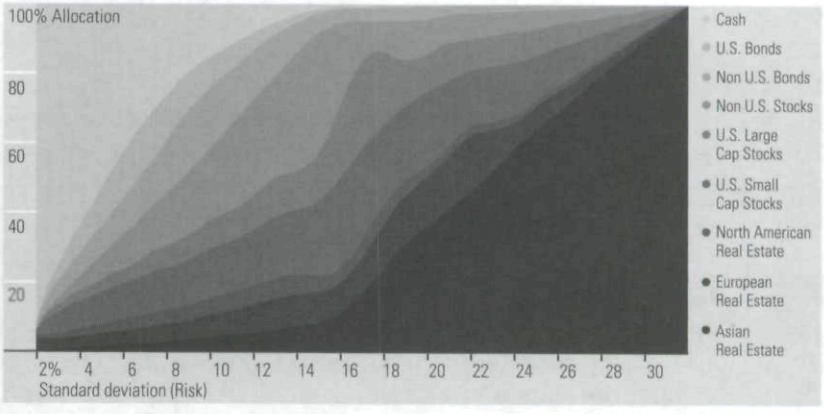


EXHIBIT 14
CAPM Asset Allocation Area Graph



The differences between the historical asset allocation area graph in Exhibit 10 and the forward-looking asset allocation area graph in Exhibit 14 are quite dramatic, even though both are based on an opportunity set that includes the six traditional asset classes as well as North American real estate, European real estate, and Asian real estate. All nine asset classes in the opportunity set receive meaningful allocations across the risk spectrum, without the need for artificial constraints.

In the absence of additional constraints, the efficient frontier culminates at the highest level of risk with the asset class with the highest expected return. Thus, at the highest level of risk, 100% is allocated to a single asset class. Around the midpoint of a typical efficient frontier, the allocations begin to become highly concentrated in the asset classes with the highest expected returns. For this reason, investors almost never select asset allocations from the riskier half of the efficient frontier, an area of the frontier that most investors should rightly ignore.

We focus our analysis on the left-hand side of Exhibits 13 and 14. In Exhibit 15 we identify three possible model asset allocations, called conservative, moderate, and aggressive, with expected risk levels of 5%, 10%, and 15%, respectively.

The conservative asset allocation is approximately 70% fixed-income, 22% equities, and 8% commercial real estate equities. The moderate asset allocation is approximately 40% fixed-income, 44% equities, and 16% commercial real estate equities. The aggressive asset allocation is approximately 8% fixed-income, 70% equities, and 22% commercial real estate equities.

Black-Litterman Forward-Looking Efficient Asset Allocations

In our final analysis, we use the Black-Litterman asset allocation model to create a forward-looking set of expected returns that combines the CAPM expected return with the historical returns. Exhibit 16 presents these expected returns.

With these returns coupled with the historical standard deviations and correlations, we can determine another possible forward-looking efficient frontier, a frontier that incorporates information from the CAPM expected returns as well as information embedded in the historical returns. This is in Exhibit 17. As before, we use resampled mean-variance optimization.

The underlying efficient asset allocations that produce the efficient frontier shown in Exhibit 17 are displayed in Exhibit 18. We show the asset allocation across the entire risk spectrum, although in practice investors typically use asset allocations only from the left half of the frontier.

As before, we focus our analysis on the left-hand side of the efficient frontier and the efficient frontier asset allocation area graph. Exhibit 19 identifies the three possible model asset allocations. The conservative asset allocation is approximately 71% fixed-income, 17% equities, and

EXHIBIT 15
CAPM Forward-Looking Asset Allocations

Asset Class	Conservative	Moderate	Aggressive
Cash	47.8%	14.4%	1.4%
U.S. Bonds	12.4%	8.3%	1.1%
Non-U.S. Bonds	9.4%	17.1%	5.5%
U.S. Large-Cap Stocks	8.1%	21.7%	33.9%
U.S. Small-Cap Stocks	4.0%	8.4	14.3%
Non-U.S. Stocks	9.8%	14.3%	21.8%
North American Real Estate	2.9%	5.0%	4.8%
European Real Estate	3.9%	6.7%	8.5%
Asian Real Estate	1.7%	4.1%	8.6%
Expected Return	7.3%	9.3%	11.2%
Standard Deviation	5.0%	10.0%	15.0%
Sharpe Ratio	0.40	0.41	0.40

EXHIBIT 16
Black-Litterman Expected Returns

Asset Class	Black-Litterman Returns
Cash	4.92%
U.S. Bonds	6.07%
Non-U.S. Bonds	7.68%
U.S. Large-Cap Stocks	10.94%
U.S. Small-Cap Stocks	12.51%
Non-U.S. Stocks	11.57%
North American Real Estate	11.30%
European Real Estate	11.05%
Asian Real Estate	14.94%

EXHIBIT 17

Black-Litterman Efficient Frontier Using *Resampled* Mean-Variance Optimization

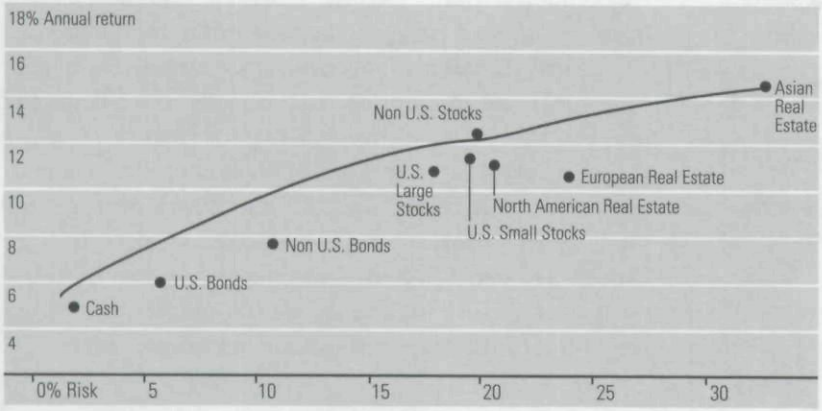
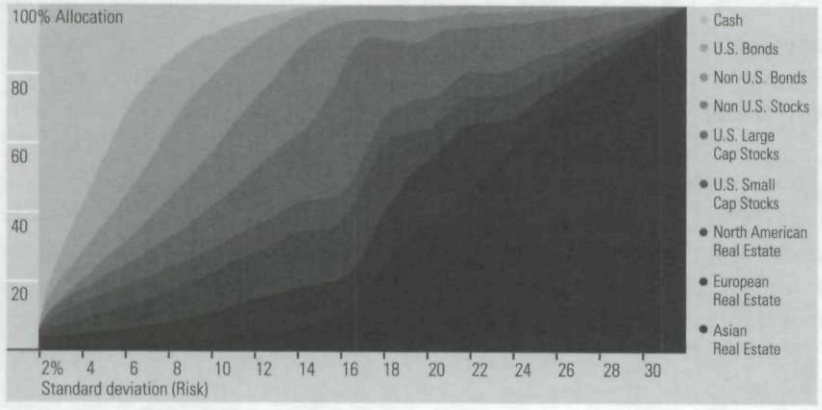


EXHIBIT 18

Black-Litterman Asset Allocation Area Graph



12% commercial real estate equities. The moderate asset allocation is approximately 40% fixed-income, 37% equities, and 23% commercial real estate equities. The aggressive asset allocation is approximately 7% fixed-income, 58% equities, and 35% commercial real estate equities.

The Black-Litterman-based model makes greater allocations to worldwide commercial real estate equities and smaller allocations to non-U.S. stocks than the CAPM. These changes are intuitive, given the strong historical performance of global REITs and listed real estate stocks and the relatively weak performance of non-U.S. stocks over this particular period. The Black-Litterman-based allocations favor North American real estate and European real estate over the CAPM-based asset allocations.

SOME WORDS OF CAUTION

We should note, first, that the two forward-looking sets of asset allocations represent only two possible asset allocation sets based on reasonable analytically based forward-looking expected returns. While it is unlikely that any forward-looking asset allocation will, in fact, prove to be the most efficient, Markowitz and Usmen [2003] indicate that asset allocations based on resampled mean-variance optimization are likely to outperform asset allocations based only on traditional mean-variance optimization. Common sense and professional judgment need to be applied to the optimization results, and practical institutional constraints may also be at work.

Second, as global REITs and listed real estate stocks still represent a small portion of worldwide commercial real estate equity investments, some may question our use of listed real estate stock returns to represent the long-term investment performance of all commercial real estate equity investments. As Hudson-Wilson and Harbaugh [2006] note, the degree to which REITs and listed real estate stock returns accurately represent investment performance in the broader real estate market is an empirical question. Yet, as total commercial real estate investment represented by REITs and listed real estate stocks becomes a higher percentage of the market, taking REITs and listed real estate stock returns as a proxy for all commercial real estate investment will become more appropriate.

Third, we believe almost all investors should own REITs and listed real estate stocks, but for investors who meet two conditions, a separate or distinct strategic asset allocation to REITs and listed real estate stocks may not be necessary. When an investor has 1) an appropriate *direct* real estate asset allocation and 2) an appropriate equity asset allocation that includes an implicit (typically market capitalization-weighted) allocation to REITs and listed real estate stocks, a separate and explicit allocation to REITs and listed real estate stocks is unnecessary.

This caveat applies only to a very small number of the largest and most sophisticated investors with access to *direct* real estate and the ability to diversify that investment.

EXHIBIT 19

Black-Litterman Forward-Looking Asset Allocation

Asset Class	Conservative	Moderate	Aggressive
Cash	37.6%	7.4%	0.3%
U.S. Bonds	21.8%	11.4%	0.9%
Non-U.S. Bonds	11.7%	21.2%	5.9%
U.S. Large-Cap Stocks	5.6%	16.4%	22.3%
U.S. Small-Cap Stocks	5.8%	13.2%	26.9%
Non-U.S. Stocks	5.9%	7.0%	9.0%
North American Real Estate	5.9%	12.1%	15.4%
European Real Estate	4.5%	7.8%	11.1%
Asian Real Estate	1.1%	3.4%	8.2%
Expected Return	7.4%	9.6%	11.4%
Standard Deviation	5.0%	10.0%	15.0%
Sharpe Ratio	0.43	0.44	0.41

For investors without appropriate *direct* real estate asset allocations (which is most investors), a separate asset allocation to commercial real estate implemented with exposure to REITs and listed real estate stocks worldwide seems to be the best alternative.

Fourth, the CAPM-based asset allocations are market-oriented asset allocations that are rooted in modern portfolio theory and do not include a U.S. or home bias. A different definition of the market portfolio will result in different asset allocations. It should be clear that there is considerable uncertainty regarding the role of commercial real estate in the market portfolio. In the equity world, index providers are working toward refining float-adjusted weighting methodologies. For commercial real estate, we are working toward ballpark estimates; clearly more work on this topic is needed.

Fifth, investors are well advised to expand their opportunity sets to include all the major asset classes that make up the unobservable market portfolio, including asset classes not considered in this study such as TIPS, commodities, convertible bonds, emerging market stocks, emerging market bonds, and high-yield bonds. All else equal, expanding the opportunity set to include additional asset classes will tend to reduce the total allocation to the asset classes we consider.

Sixth, the Black-Litterman-based asset allocations are also market-oriented asset allocations that are augmented with information in the historical returns. As in the CAPM-based asset allocations, a different definition of the market portfolio will result in different asset allocations. The Black-Litterman-based asset allocation is largely affected by the short-term historical returns that are blended with the CAPM returns, although its allocations are affected far less than most other approaches.

Finally, resampled mean-variance optimization helps to compensate for limited data periods and reflects the uncertainty of future investment performance by using different levels of asset returns, volatilities, and correlations of returns. Thus, the asset allocations from resampled mean-variance optimization are those that are expected to perform best, given the uncertainty of future outcomes. Actual asset allocation should be customized according to the investor's unique circumstances.

CONCLUSIONS

Commercial real estate investment is a large part of the investable universe to include in all investors' opportunity sets, even though the role of commercial real estate in the market portfolio is not yet well understood. As they develop a strategic asset allocation to commercial real estate, investors should consider REITs and listed real estate stocks as well as *direct* commercial real estate. For many investors, REITs and listed real estate stocks are the only reasonable way to gain exposure to the commercial real estate equity asset class. REITs and the worldwide growth of listed real estate stocks give all investors an effective and efficient method of obtaining exposure to commercial real estate equity.

The largest investors (large institutions) will likely implement their target allocations with a more heavily weighted *direct* commercial real estate investment program, while smaller investors will likely do it more with REITs and listed real estate stocks. Ideally, we believe the total real estate asset allocation should be implemented with a mixture of REITs and listed real estate stocks as well as *direct* real estate, where the relative weightings mirror market capitalization-based weights.

A shift is underway within the global commercial real estate asset class. The advantages of REITs and listed real estate stocks over *direct* real estate include liquidity, corporate transparency and governance, real-time pricing, and lower transaction costs. These advantages create a natural preference for REITs and listed real estate stocks, and over time a significant amount of *direct* real estate is likely to be securitized. As REITs and listed real estate stocks continue to grow worldwide, their share of the commercial real estate market will also grow,

and they will become more accepted as a method of obtaining exposure to the commercial real estate asset class.

Historically, the inclusion of North American real estate in the opportunity set of investable assets leads to dramatic improvements in risk-adjusted performance. While the same is not true for European real estate or Asian real estate, that does not mean these asset classes should be excluded from an investor's asset allocation. Just as equity and fixed-income investors should diversify across their respective universes, commercial real estate investors should diversify as well. Knowing that what was optimal in the *past* almost certainly will not be optimal in the *future* encourages us to look for sensible approaches to developing robust asset allocations.

In what is best described as a modern portfolio theory approach to asset allocation, CAPM-based and Black-Litterman-based forward-looking asset allocations diversify across all of the asset classes in the opportunity set.

ENDNOTE

*See, for example, Hudson-Wilson and Harbaugh [2006], and Hudson-Wilson, Fabozzi, and Gordon [2003]. Hudson-Wilson, Fabozzi, and Gordon [2003] attempt to develop a composite index to measure the performance of the four commercial real estate segments.

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