Commercial Real Estate: The Role of Global Listed Real Estate Equities in a Strategic Asset Allocation

Prepared for
The National Association of Real Estate Investment Trusts®

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November 2, 2006

Acknowledgements:
We want to thank NAREIT for supporting this work; research consultant Janis Zvingelis, Ph.D., for research assistance, Mike Grupe for his insights, and the NAREIT® staff for providing data. Additional assistance was provided by David Geltner, Joanne Rios, Annette Larson, Lorene Kennard, Michael Giliberto, Luigi Cerreta, Michele Gambera, and Alexa Auerbach. All errors and omission remain those of the authors.

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Executive Summary

Commercial real estate equity has become an increasingly popular and accessible asset class for investment in the United States over the last 10 years, due in large part to the proliferation and success of real estate investment trusts (REITs). Today, REITs and similar securitized products are becoming more available across the globe. In particular, the transparent tax treatment of REITs gives investors access to the same cash flow characteristics that previously were only available to *direct* commercial real estate equity investors. The introduction and growth of REITs and listed real estate stocks worldwide has created new investment opportunities for strategic asset allocation policy makers. We focus on the *equity* commercial real estate asset class and its two sub-classes, private [direct] commercial real estate equity and public [indirect] commercial real estate *equity*, and we use global REIT and listed real estate indices to proxy the commercial real estate asset class.

When developing 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 a large number of investors, REITs and listed real estate stocks are the only reasonable way to gain exposure to the commercial real estate equity asset class. Advantages of REITs and listed real estate stocks over *direct* real estate include liquidity, corporate transparency and governance, real-time pricing, and lower transactions costs.

We analyzed the historical performance of six traditional asset classes plus North American, European, and Asian real estate from 1990 to 2005. Over 11 different levels of risk, as measured by the standard deviation of annual portfolio returns, ranging from 5% to 15%, the addition of these three asset sub-classes to the opportunity set improved efficient asset allocation returns by an average of 182 basis points! The vast majority of this benefit is attributed to the outstanding performance of North American real estate.

When one is trying to create a robust forward-looking asset allocation policy, it does not make sense to only use the results of a short-term historical optimization, which often excludes important asset classes. Just as equity and bond investments should be diversified internationally, so should real estate investments. Because our historical data only extend back to 1990, we also examine two different methods of forward-looking analysis that provide an alternative perspective—the capital asset pricing model (CAPM) and the Black-Litterman model. Forward-looking capital market assumptions were used with *resampled* mean-variance optimization to create forward-looking asset allocations. From this alternative perspective, all of the asset classes in the opportunity set, now including European and Asian commercial real estate, receive allocations across the risk spectrum. We believe the total real estate asset allocation should be diversified internationally and implemented with a mixture of REITs and listed real estate stocks as well as direct real estate in which the relative weightings mirror market capitalization-based weights.

Introduction

Previous Ibbotson research demonstrated the benefits of including real estate investment trusts (REITs) among the universe of investable assets. The purpose of this paper is to examine within a strategic asset allocation setting the role of global commercial real estate investment through global REITs and listed property companies.

Most strategic asset allocations have consisted 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 to the current opportunity set of asset classes provide the largest benefit. Unfortunately, there is little agreement on the role of other asset classes in a strategic asset allocation. Prior to 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 lost sight of the importance of commercial real estate, but commercial real estate is a "traditional" asset class and belongs in the investor's opportunity set.

For years, many institutional investors have included a policy or 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 REITs and listed real estate stocks has created confusion for strategic policy makers 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 gives investors access to the same cash flow characteristics that previously were only available to *direct* commercial real estate investors. Today, the growth of global REITs and listed real estate stocks provides investors around the world with access to commercial real estate investment, which should provide investors with new diversification and return enhancement opportunities. Nevertheless, the dramatic growth of REITs and listed real estate also creates new questions for asset allocators as the definition of "real estate investing" evolves.

In Section 1 we examine the commercial real estate asset class and its various components. We identify REITs and listed real estate stocks as an accessible and viable method of obtaining exposure to commercial real estate. Our analysis focuses on the FTSE EPRA/NAREIT Global Real Estate Index® and its regional sub-indices. Section 1 also identifies 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.

Section 2 analyzes the historical performance of the asset classes in the opportunity set. Using the traditional Markowitz's asset allocation model (see Markowitz [1952, 1959]) we determine the asset allocations that would have been optimal in the *past*.[1]

In Section 3, we develop two forward-looking sets of capital market assumptions to determine possible forward-looking asset allocations. The first set of forward-looking capital market assumptions is based on the Sharpe-Lintner-Mossin-Treynor Capital Asset Price Model (CAPM). The second set of forward-looking capital market assumptions is based on a sophisticated robust asset allocation technique: the Black-Litterman asset allocation model (see Black and Litterman [1992]). Using the Black-Litterman model, the CAPM expected returns are blended 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. Additionally, we use an enhanced version of the Markowitz framework, called *resampled* mean-variance optimization (or *resampled* MVO), which expressly acknowledges that the capital market assumptions driving the model are not known with certainty in a forward-looking context.[2]

1 Bruno de Finetti also deserves substantial credit for developing much of the mean-variance framework in work that predated that of Markowitz (see Rubinstein [2006], Markowitz [2006], Barone [2006], and de Finetti [1940]).

2 Ibbotson's proprietary version of *resampled* MVO grew out of the pioneering work of Jobson and Korkie [1980, 1981], Jorion [1992], DiBartolomeo [1993], and Michaud [1998].

Section 1: Commercial Real Estate, REITs, and the Opportunity Set

Commercial Real Estate

Real estate is an extremely diverse asset class that can be broadly segmented into two largely unrelated types: residential real estate and commercial real estate.[3] Strategic asset allocation decisions generally focus on exposure to commercial real estate, although residential real estate often is the single largest investment, albeit highly leveraged, for most individual investors. The role of residential real estate in a strategic asset allocation is usually an individual investor concern that is often a byproduct of the investor's housing choice. Residential real estate is beyond the scope of this article, although mortgages backed by residential real estate are a relatively large part of the broad fixed income markets.

Commercial real estate is part of a growing family of asset classes that are thought of as real return assets. Other real return assets include Treasury Inflation-Protected Securities (TIPS) and commodities, all of which are thought to provide a hedge against inflation.[4]

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 commercial real estate market worldwide at approximately $14 trillion. A number of 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[5]

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

3 The seemingly tight connection between residential real estate and commercial real estate that exists in the minds of some investors seems like a topic ripe for behavior finance.

4 Greer and Yocham [2006] provides an overview of the role of real return asset in a portfolio.

5 See for example, Hudson-Wilson and Harbaugh [2006] and Hudson-Wilson, Fabozzi, and Gordon [2003]. We should also not that Hudson-Wilson, Fabozzi, and Gordon [2003] attempts to develop a composite index to measure the performance of the four commercial real estate segments.

Private (direct) commercial real estate *debt* is only available 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 prevalent 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 and is a component of most aggregate fixed income indices (see Gendron and Berkley [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, Gatzlaff, Geltner, and Haurin [2003] or Fisher, Geltner, and Pollakowski [2005]. Appraisal based indices, such as the NCREIF, suffer from excessive smoothing and serial correlation. The refined transaction-based indices 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 for which there are a variety of publicly available indices to measure performance.

In this article we focus on the *equity* commercial real estate asset class and its two sub-classes, private [direct] commercial real estate equity and public [indirect] commercial real estate equity, and we use global REIT and listed real estate indices to proxy the commercial real estate asset class.

Not long ago, only the largest investors had access to the commercial real estate market. Since then, the introduction and subsequent growth of REITs, most notably in the United States, have given all investors access to diversified commercial real estate. REITs in the United States were created in 1960 when President Eisenhower signed into law the Cigar Excise Tax Extension, which included the "Real Estate Investment Trust" provision.

REITs are publicly traded companies that own, and in most cases, operate investment-grade commercial real estate such as office buildings, apartments, shopping centers, hotels, and warehouses. To qualify as a REIT under the Internal Revenue Code, a company must operate in the real estate business. In particular, a company must invest at least 75% of its total assets in qualifying real estate assets and derive at least 75% of its gross income from rents from real

property or interest on mortgages on real property. In addition, a REIT must distribute annually to its shareholders at least 90% of its taxable income in the form of dividends. In return, the company is permitted to deduct from its corporate taxable income each dollar of dividends distributed. As a result, most REITs remit at least 100% of their taxable income to their shareholders and therefore owe no corporate tax. Thus, shareholders benefit from a single level of taxation (or tax transparency) on corporate earnings and pay taxes on the dividends and on any capital gains received.

In recent years, REITs and REIT-like corporate entities have been introduced in many other countries throughout the world and have experienced exceptional growth.

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 so. Still, the remaining 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] argues that there are performance differences that go beyond performance measurement.

Feldman [2003] studies the relationship between *direct* real estate and *indirect* real estate (REITs) using the two *direct* real estate indices developed by Fisher, Gatzlaff, Geltner, and Haurin [2003].[6] It finds that REIT performance is statistically indistinguishable from the two *direct* real estate indices at conventional significance levels. However, the correlation coefficients between the REIT index and the two *direct* real estate indices were only 0.08 and 0.31, suggesting that these indices 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 we

[6] These are enhanced versions of the NCREIF Property Index.

believe the split between *direct* real estate and *indirect* real estate should not necessarily be made entirely by an optimizer given the amount of uncertainty in forward-looking capital market assumptions.

Fisher, Geltner, and Pollakowski [2005] refines the *direct* real estate index construction methodology proposed in earlier research and performs a series of optimizations using a relatively standard opportunity set and various combinations of REIT and *direct* real estate proxies. No matter which real estate proxy they used, real estate played a prominent role in the optimal asset allocation based on the *traditional* mean-variance optimization approach. Of note, the correlation coefficients between REITs and the enhanced *direct* real estate index proxies remained low, at 0.13 and 0.15, respectively.

Hudson-Wilson, Fabozzi, and Gordon [2003] finds 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-public debt, -public equity, -private debt, and -private equity with 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 in this article, Pagliari, Scherer, and Monopoli [2005], among others, finds that there are not 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* real estate as well as *indirect* real estate. Hudson-Wilson and Harbaugh [2006] asks "…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 proceed using public (indirect) commercial equity indices to proxy total commercial real estate *equity*.

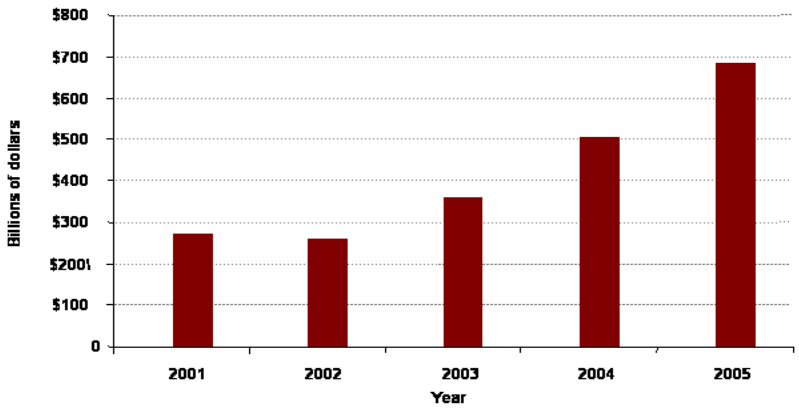
Over long time horizons, direct commercial real estate investments and *indirect* commercial real estate investments should yield similar results because the underlying investments are largely the same. During shorter periods, structural differences may create performance disparities that will remain difficult to measure with precision given the performance

measurement issues with respect to *direct* real estate.[7] While REITs currently represent a moderate percentage of total commercial real estate investment, investor demand for REITs is causing an intra-asset class shift from *direct* real estate to *indirect* real estate.

Global Listed Real Estate Investment

Over the last 30 years, the United States and Australia have provided the majority of investment opportunities for REITs and publicly traded real estate companies. However, 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 introduction of REIT-like companies around the world is chronicled in Conner and Liang [2006]. The dramatic increase in the amount of money invested in global REITs and listed real estate equities is evident in Figure 1. Between January 2002 and June 2006, the free float equity market capitalization of global REITs and listed real estate equities grew from $280 billion to $720 billion, a compound annualized increase of 23%. REITs and listed real estate companies comprise an asset class that is now available to investors around the globe.

Figure 1: Free Float Market Capitalization of Global REITs and Listed Real Estate Equities



Source: FTSE EPRA/NAREIT Global Real Estate Index

[7] Works such as Fisher, Gatzlaff, Geltner, and Haurin [2003] and Fisher, Geltner, and Pollakowski [2005] go a long way toward addressing performance measurement issues associated with *direct* real estate indices. Interested readers can download some of these improved *direct* real estate indices from the MIT Center for Real Estate (http://web.mit.edu/cre/).

In the United States, there are three types of REITs: equity REITs, mortgage REITs, and hybrid equity-mortgage REITs. Equity REITs own and operate income-producing real estate. Mortgage REITs invest in loans secured by residential or commercial real estate or in residential or commercial mortgage-backed securities, but do not generally own or operate real estate. As the name suggests, a handful of so-called hybrid REITs both own properties and invest in the secured or securitized debt of other real estate owners and operators. REITs also are classified by property sectors, of which the largest are office buildings, apartments, regional malls, shopping centers, and industrial facilities.

The last 15 years has seen a dramatic increase in the U.S. REIT industry, with publicly traded equity market capitalization growing from approximately $20 billion in 1992 to around $370 billion as of June 30, 2006. The investable equity market capitalization of the largest U.S. REIT (Simon Property Group) was $18.3 billion as of June 30, 2006.

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 indices, 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 also were members of the Russell 3000.[8] 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. And for 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 Index.

Investments in products that track these broad equity market indices imply an investment allocation to the REITs and listed real estate companies that are part of these indices and should be accounted for 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 indices, then a separate

[8] Our analysis was based on constituent data provided by NAREIT and Morningstar, Inc. At the time of the analysis, 121 of the 124 US REITs in the FTSE EPRA/NAREIT Global Real Estate Index were members of the Russell 3000. Regarding the three non-overlapping constituents, two of three REITs had recently been purchased by private firms and had not yet been removed from our FTSE EPRA/NAREIT constituent list, and the third was scheduled to be added to the Russell 3000 during the June / July Russell rebalancing.

and distinct 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. However, in the absence of a distinct commercial real estate allocation, either through direct investments or through listed real estate equities, an investor is unlikely to achieve an appropriate allocation to commercial real estate by relying entirely on the REIT and listed real estate constituents included in broad equity indices.

Table 1 lists the equity indices 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 of the indices, the approximate market capitalization of the REITs and listed real estate stocks in each of the indices, 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. REITs and listed real estate stocks represent a very small percentage of the total market capitalization of the S&P 500 and the MSCI EAFE indices, and slightly higher percentages of the value-oriented indices.

Table 1: REITs and Listed Real Estate Stocks Included in Major Equity Indices
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. Among the Russell indices, no attempt was made to adjust for REITs that are partially assigned to both a growth and value index; thus, the approximate market capitalization of REITs in the Russell indices is biased upward.

The percentages in the right-hand column of Table 1 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 having a distinct allocation to REITs plus a large allocation to the Russell 2000 Value Index may have a somewhat larger overall exposure to commercial real estate and lower overall exposure to other equities than they realize. Likewise, investors having only an allocation to the S&P 500 or to either of the Russell growth indices are likely to have a much smaller overall exposure to commercial real estate than they realize. Second, the overlap between all of the equity market proxies and the REIT-specific indices raises issues of multiple exposures to a set of companies. Given the propensity of asset allocators to have 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.

The total return from an investment in equity REITs comes from the distribution of collected rents through dividend payments plus long-term stock price appreciation. Because U.S. REITs are required to distribute at least 90% of their taxable income annually in the form of dividends, approximately 60% of the total return from U.S. REITs over the past 20 years has come from such dividends. The distribution requirements for non-U.S. REITs are governed by the respective laws in different countries, but most are at least 80%.

During prosperous economic times, rental income is typically strong, and property owners enjoy pricing power as leases renew. Long-term leases also protect property owners from income decreases during recessions. Given that dividends are known with some certainty in advance, the current yield of REITs can be calculated by dividing the dividend by the current stock price. Thus, some income-oriented investors have viewed REITs as an alternative to fixed income investments, even though they are legally equities and even though the dividends typically grow over time.

Some investors compare fixed income yields with REIT dividend yields as a measure of relative value. In particular, institutional investors looking to fund long-term liabilities often have used investments in income-producing properties in a manner similar to that of long-term bonds. The cash flow characteristics of income-producing properties can be similar to those of a long bond, or even better, an inflation-linked bond, both of which help meet long-term liabilities. Other investors assess relative value by comparing the price multiples of REITs with the price multiples of other equities.

As with any investment, the current market price of REIT equities can be interpreted as the market's estimated present value of expected cash flows. However, the current price of all listed equities (including listed REITs) is a function of supply and demand. It is likely that the recent propensity of investors, especially large institutions, to reduce allocations to traditional asset classes in favor of dedicated commercial real estate investments (often implemented with REITs) increases the overall demand for REIT equities. Presumably, market forces are at work to transform more *direct* real estate investments into securitized REIT-like investments to help meet growing investor real estate allocations and balance supply and demand.

Like most publicly traded companies, REITs and listed real estate companies finance their property portfolios with a diversified capital structure of debt and equity, implying the use of some leverage. In recent years, equity REITs on average have maintained a ratio of debt divided by total market capitalization of between 40% and 50%—currently in the lower part of that range. Such use of leverage is more conservative than typical leverage ratios of privately owned real estate and reduces the interest rate risk of most equity REITs. Nevertheless, declining interest rates tend to reduce borrowing costs of most REITs, while rising interest rates tend to increase borrowing costs, thereby affecting profitability. In general, lower *real* interest rates arguably have decreased the cost of capital for all real estate investors and contributed to the general increase in property values. The increase in property values increases the value of a REIT's assets (properties), the market's assessment of the REIT's future cash flows, and ultimately, the market capitalization of REITs and listed real estate companies.

The Opportunity Set

A critical element of any asset allocation study is the identification of the relevant opportunity set of investable asset classes. The asset classes used in this study 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. Table 2 lists the asset classes and the asset class proxies used to represent each asset class in the analysis. We will refer to the first six asset classes as "traditional" asset classes because they are a more granular version of the asset classes that have come to dominate most asset allocation strategies, namely, stocks, bonds, and bills (cash). Real estate is treated as a distinct asset class because its high-income yields arguably create a hybrid investment that combines attributes of both stocks and bonds, and its investment returns reflect those hybrid characteristics. For most U.S. investors, referring to non-U.S. bonds as a traditional asset class is a bit of a stretch; however, 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.

Table 2: 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

In subsequent discussion, we will use the asset class names in Table 2 when referring to the asset classes. Global Real Estate is proxied by the FTSE EPRA/NAREIT Global Real Estate Index and its three regional sub-indices. For those who are interested, Frost, Schioldager, and Hammond [2005] provides a comprehensive review of the various real estate indices. In general, the FTSE EPRA/NAREIT Global Real Estate Index received high marks.

FTSE EPRA/NAREIT Global Real Estate Index

The FTSE EPRA/NAREIT Global Real Estate Index is a market capitalization weighted index representing all "qualifying" real estate stocks world wide. As of June 30, 2006, the index included 321 REITs and listed real estate companies from 20 countries and Hong Kong with an aggregate market capitalization of approximately $720 billion. The index consists of three regional sub-indices: North America (including the United States and Canada), Asia (including Australia, Japan, Hong Kong, Singapore, and New Zealand), and Europe (including the United Kingdom, Netherlands, France, Sweden, Spain, Austria, Switzerland, Germany, Belgium, Italy, Finland, Denmark, Poland, and Greece). As of June 30, North America's contribution to the index was about half (47.6%), with 31.4% coming from Asia, and 21.0% from Europe. The United States represented 92.7% of the North American index while Canada represented 7.3%. Japan, Australia, and Hong Kong represented 36.6%, 32.7%, and 25.0%, respectively, of the Asian index. The United Kingdom represented the lion's share (47.1%) of the European index, followed by France and the Netherlands at 11.4% and 11.3%, respectively.

Companies must meet several criteria to qualify for the index. They must be listed on an official exchange, meet defined geographic and financial standards for each series, and be able to demonstrate that a majority of earnings or a large percentage of assets is the result of relevant real estate activity. The index defines relevant real estate activities as the ownership, trading, and development of income-producing real estate.[9]

9 For additional details, see Ground Rules for the Management of the FTSE EPRA/NAREIT Global Real Estate Index® Version 2.3, April 2006.

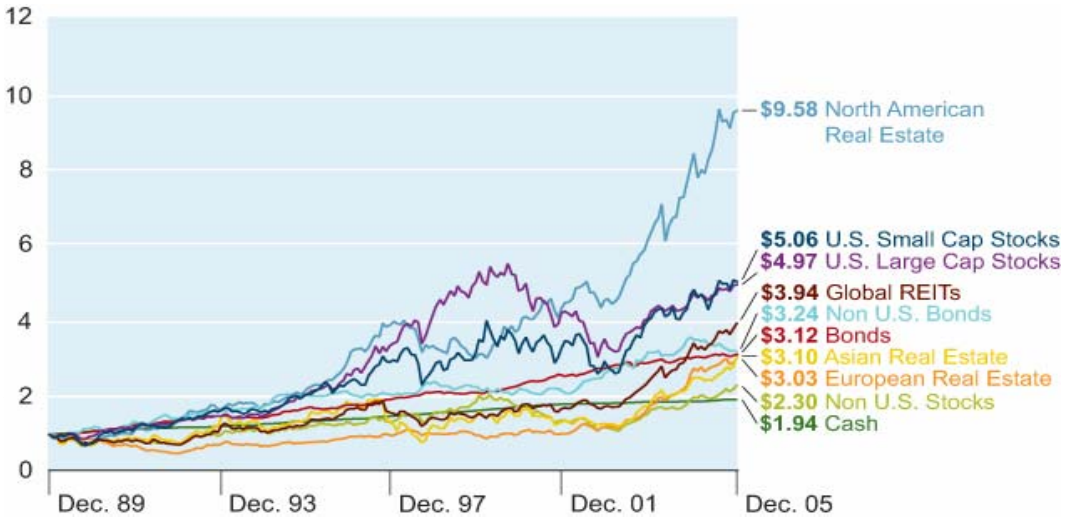
Section 2: Historical Analysis

Having defined asset class proxies for all of the asset classes in our opportunity set, we proceed with a historical analysis in which 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 will identify specific asset allocations that would have been optimal in the *past*.

Historical Performance

Figure 2 shows the growth of a one dollar investment in each of the asset classes 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. The speculative episode in U.S. large-cap stocks is evident in the late 1990s, and it is clear that, by the end of 2005, U.S. large-cap stocks still had not recovered all of their losses. The decline of U.S. large-cap stock share prices, which began in early 2000, nearly coincides with the tremendous performance of North American real estate. Figure 2 also demonstrates that, over short time periods, it is nearly impossible to predict which asset class will be the best performer. There are clearly upside and downside risks for non-diversified asset allocations, and we caution investors not to focus on the recent out-performance or under-performance of individual asset classes but to maintain diversified allocations across all asset classes and to rebalance those allocations in a disciplined manner as necessary.

Figure 2: Growth of a $1 Investment, December 1989 – December 2005



Based on annual data, the historical returns and standard deviations of the asset classes included in the opportunity set are presented in Table 3. 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%.

Table 3: Historical Returns, Standard Deviations, and Sharpe Ratios, 1990 – 2005 (in USD)

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

Some of the more abnormal numbers in Table 3 deserve further comment. Relative to U.S. large-cap stocks and U.S. small-cap stocks, this was not a particularly strong period for non-U.S. stocks. At the other end of the return spectrum, it can be argued that the increased scrutiny brought to bear on publicly traded real estate companies in North America as *direct* real estate investments increasingly have been securitized, led to gradual efficiency gains that in turn contributed to the out-performance of historical real estate returns over the period of observation. 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 United Kingdom had not yet adopted a transparent REIT like structure that would encourage private companies to go public.[10] Finally, the standard

[10] At the time of this writing, REITs are scheduled to become legal corporate entities in the United Kingdom on January 1, 2007.

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. Additionally, Asian currency markets may have been abnormally volatile over the time period studied. 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 composite or total variability when combined in the 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 more volatile equities.

Table 4 summarizes historical correlation coefficients of all asset classes in the opportunity set for the period 1990 to 2005. The data illustrate that global real estate in most cases has had low correlation coefficients with the traditional asset classes. In particular, global real estate has had low or negative correlations with U.S. large-cap stocks, U.S. small-cap stocks, and U.S. bonds. Furthermore, European real estate has had very low or negative correlations with all U.S. asset classes.

Table 4: Correlations, 1990 – 2005

	Cash	U.S. Bonds	Non-U.S. Bonds	U.S. Large-Cap Stocks	U.S. Small-Cap Stocks	Non-U.S. Stocks	Global Real Estate	North American 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

Among the three traditional *equity* asset classes—U.S. large-cap stocks, U.S. small-cap stocks, and international stocks—the correlations range from .64 to .76. The average correlation of the three equity asset classes was .68. For the three sub-asset classes of global real estate—North American, European, and Asian—the correlations range from .30 to .68. The average correlation of the three sub-asset classes of global real estate was .47. 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 sub-asset classes. Likewise, it is reasonable to postulate that real estate investors should achieve additional diversification benefits by diversifying across the three global real estate sub-asset classes, something that can be achieved with separate allocations to the sub-asset classes or a single allocation to global REITs and listed real estate. Somewhat puzzling is the fact that, of the three global real estate regional sub-asset classes, North American real estate has the lowest correlation (0.56) with global real estate 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.-centric 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.-centric asset allocations.

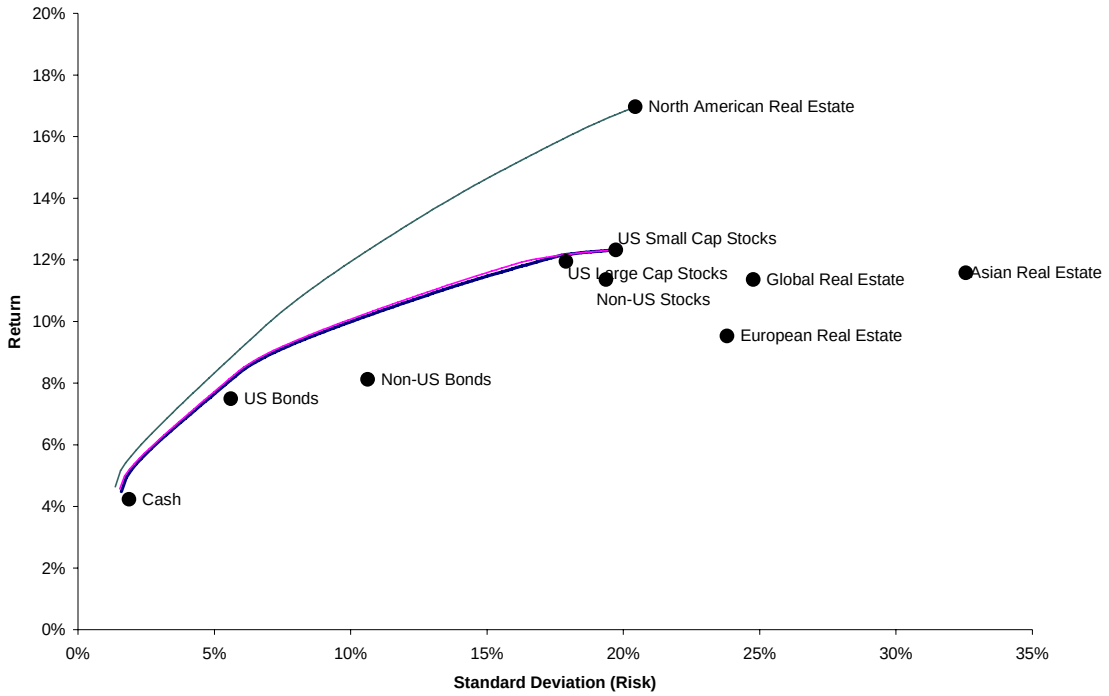
The correlations listed in Table 4 also reflect in part the extent of overlap between the constituents of the listed real estate indices and the traditional equity indices. For example, the Russell 2000 index includes a relatively high proportion of U.S. REITs, and the correlation between North American real estate and U.S. small-cap stocks is a relatively high .71.

Historical Efficient Asset Allocations With and Without Global REITs

The above 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 Table 3 and the historical correlations in Table 4, we can determine the historical efficient frontier. The historical efficient frontier identifies the asset allocation that would have been optimal in the *past*.

Figure 3 displays the results of three optimizations. In the first optimization (lowest frontier in blue), only the six traditional asset classes are included in the opportunity set. In the second optimization (middle frontier in red), we have added global real estate to the opportunity set. In the third optimization (highest frontier in green), we replaced global real estate with the three sub-asset classes that form global real estate: North American real estate, European real estate, and Asian real estate.

Figure 3: Historical Efficient Frontiers



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 offset the exceptional performance of North American real estate, resulting in a composite (global real estate) with equity-like returns and high volatility. Thus, adding global real estate as a whole improved performance of the efficient asset allocation only slightly.

Replacing global real estate with its three sub-indices—North American, European, and Asian real estate—improved the performance of the efficient allocations significantly because investments may now be allocated to each regional sub-index separately.

Table 5 quantifies the benefits of expanding the opportunity set. For each of the three efficient frontiers in Figure 5 we list efficient asset allocation returns corresponding to discrete standard deviation levels across the risk spectrum.

Table 5: Return Improvement with Global Real Estate

Standard Deviation (%)	Traditional Asset Classes	Traditional Asset Classes + Global Real Estate	Traditional Asset Classes + North American Real Estate + European Real Estate + Asian Real Estate
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%

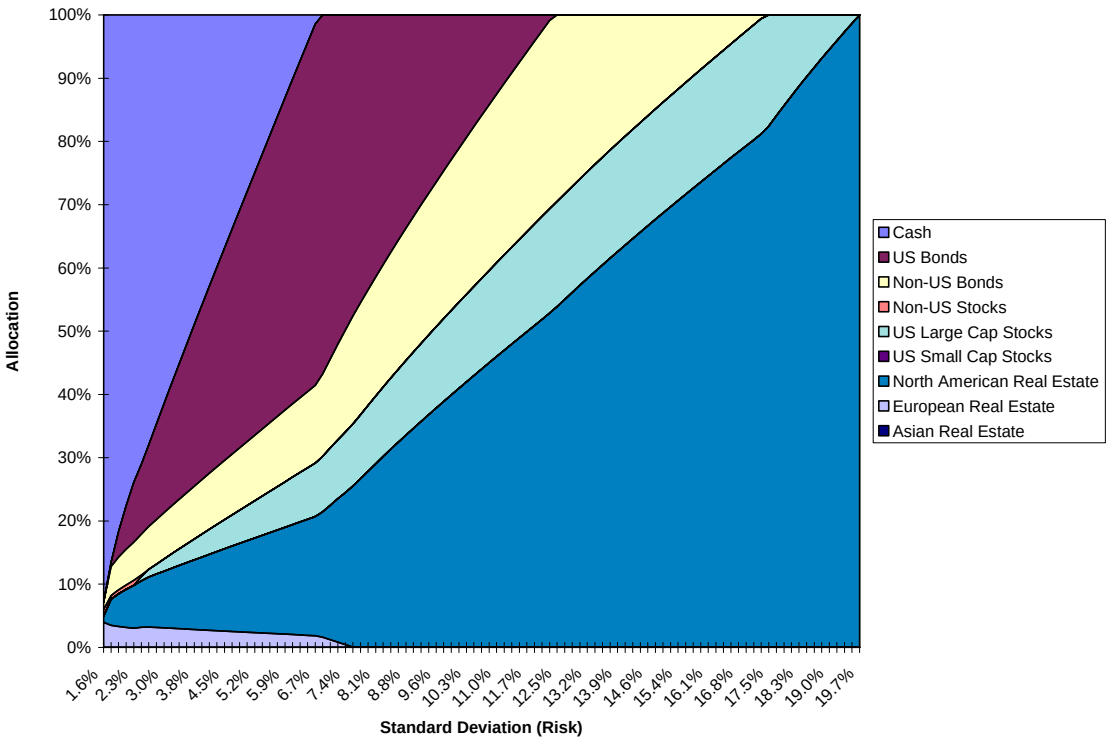
Including global real estate in the opportunity set improved efficient asset allocation returns by an average of nine basis points over 11 different asset allocation standard deviation points ranging from 5% to 15%.

However, replacing global real estate in the opportunity set with the three sub-indices—North American, European, and Asian real estate—improved efficient asset allocation returns by an average of 182 basis points!

Efficient frontier area graphs display the composition of the efficient asset allocations across the entire risk spectrum. Figure 4 shows the asset allocations based on the efficient frontier in which North American real estate, European real estate, and Asian real estate are included with the six traditional asset classes in the opportunity set. Risk is measured by the standard deviation of annual portfolio returns and is shown on the horizontal axis. The vertical cross sections identify the composition of the efficient asset allocations at all levels of risk.

At the lowest risk level, the minimum variance asset allocation contains 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 contains 100% North American real estate. For the 1990 to 2005 period, with calendar-year rebalancing, *ceteris paribus*, Figure 4 identifies the best possible performing asset allocations for each of the possible risk levels.

Figure 4: Historical Asset Allocation Area Graph



Non-U.S. stocks receive a very small allocation in some of the lower risk asset allocation while U.S. small-cap stocks and Asian real estate are entirely omitted from the asset allocations that were optimal over this historical period. With hindsight, this is perfectly acceptable. If, on the other hand, one is trying to create a robust forward-looking asset allocation policy, excluding allocations to 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.

Section 3: Forward-Looking Analysis

Robust, forward-looking asset allocations should diversify an investor's holdings across the asset classes in the opportunity set and do so in a manner that is based on sound portfolio theory. However, 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 were known with 100% certainty. In the historical analysis of Section 2, 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 *past* performance of the optimal asset allocations.

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] estimates that *traditional* mean-variance optimization is 11 times more sensitive to estimation error in returns relative to estimation error in risk (variance) and two times more sensitive to estimation error in risk (variance) relative to estimation error in covariances (which also applies to correlations).

Because of these issues, 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.

In addition to using *resampled* mean-variance optimization, we will use a forward-looking model of expected returns. The global listed 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. As a result, we use the CAPM, which is one of the cornerstones of modern portfolio theory. More precisely, we use the specialized version of the CAPM from Sharpe [1974] that is often referred to as reverse optimization. In order 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.

In our final analysis, we use a Bayesian asset allocation model called the Black-Litterman model, which generally leads to well-diversified asset allocations. Using the Black-Litterman

model, we combine the CAPM expected returns with the historical returns to create a mixed estimate of expected returns.

The Role of Real Estate in the Market Portfolio

> "*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*."
>
> *- Hudson-Wilson, Fabozzi, and Gordon [2003]*

Geltner and Miller [2001], Feldman [2003], Hudson-Wilson, Fabozzi, and Gordon [2003], and most recently, Dopfel [2006] touch on the role of real estate in the market portfolio. With the CAPM, the market-neutral weight of any asset is proportional to the 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 sub-indices are readily available, based on our previous analysis of commercial real estate, we are using REIT and listed real estate stock indices as a proxy for the broader asset class of commercial real estate equity and the regional sub-asset classes. However, unlike global REITs and listed real estate stocks, estimates of the market capitalization of investment-grade *private* commercial real estate are not universally accepted. 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 implement their targets more heavily weighted with REIT 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 in which the relative weightings mirror market capitalization-based weights.

Miles and Tolleson [1997] is one of the most detailed attempts to determine the sizes of the major components of the U.S.-investable universe, including the size of investment-grade real estate. Hudson-Wilson, Fabozzi, and Gordon [2003] estimates real estate's role in the market portfolio at 8.3% based on 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] estimates the market value of commercial

real estate for 50 countries using a top-down approach based on individual country gross domestic product (GDP) and GDP per capita. The Liang and Gordon 2003 estimate of $12.5 trillion is frequently cited. Conner and Liang [2005] updates the Liang and Gordon figure to $14.1 trillion. Most of these estimates are for the total of the four commercial real estate quadrants identified earlier.

We believe the most robust and applicable figures for the U.S. may come from Michael Giliberto's group at J.P. Morgan Asset Management Real Estate, which we identify as J.P. Morgan Asset Management Real Estate [2006]. As of March 1, 2006, they estimate the total value of U.S. commercial real estate at $6.7 trillion. 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	
a. 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 what they identify as *Direct Real Estate*. Recall that we have combined the two *equity* commercial real estate asset sub-classes as a member of our opportunity set and believe that a large portion of public real estate debt is included in the fixed-income asset classes.[11] Below, 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.

[11] As of September 30, 2006, the total market value of the Lehman Brothers U.S. Aggregate Bond Index was $8,679 billion, including $409 billion or 4.71% of commercial mortgage-backed securities.

For the asset classes in our opportunity set, Table 6 contains our estimate of their respective weights in the market portfolio. The column labeled "Market Capitalization (Estimate 1)" contains rounded values based on the appropriate index proxy or a very similar index proxy. Dividing each of the individual market capitalizations by the total leads to one possible definition of the market portfolio, albeit a definition in which REITs and listed real estate stocks represent a small fraction of the total market portfolio. However, in keeping with our earlier statement that REITs and listed real estate stocks are effective proxies for both public and private equity commercial real estate, we form an alternative definition of the market portfolio using market capitalization estimates for all equity commercial real estate. The column labeled "Market Capitalization (Estimate 2)" contains 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.

Table 6: 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%

At the beginning of 2006, *Pensions & Investments* estimated the average real estate asset allocation of the 200 largest U.S.-defined benefit plans was 4.2%, a figure that is considerably lower than the 8.31% based on a market capitalization weighting approach. Defined benefit plans are some of the more adherent practitioners of modern portfolio theory; thus, the large

discrepancy between the average reported real estate allocation and the market capitalization weight is somewhat of a puzzle.[12]

Both of the weighting schemes in Table 6 provide different definitions of the market portfolio. Moving forward, we proceed with "Market Capitalization (Estimate 2)."

CAPM Forward-Looking Efficient Asset Allocations

In this section we create forward-looking efficient asset allocations in which 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].[13] Under the CAPM model, assets that make the market portfolio more volatile must also offer above-average expected returns to compensate investors for the added systematic risk.

Based on the definition of the market portfolio, an assumed long-term risk-free rate of 5.25% (reflective of yields at the time of writing), and the U.S. large-cap stock equity premium of 6.05%, the market equilibrium consensus returns based on the CAPM are presented in the second column of Table 7.

[12] Geltner and Millar [2001] discusses this conundrum and provides an overview of the literature related to the pension fund investment puzzle. Part of the conundrum may be due to the bad practice of including debt and equity in the total estimate. We would argue that a large portion of real estate debt is included in the fixed income benchmarks and should be considered part of the fixed income asset class rather than the real estate asset class.

[13] The application of the CAPM to an opportunity set that includes real estate has become the textbook approach to developing capital market assumptions as evidenced by Geltner and Millar [2001]. Geltner and Millar [2001] chronicles the application of the CAPM to real estate.

Table 7: 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%

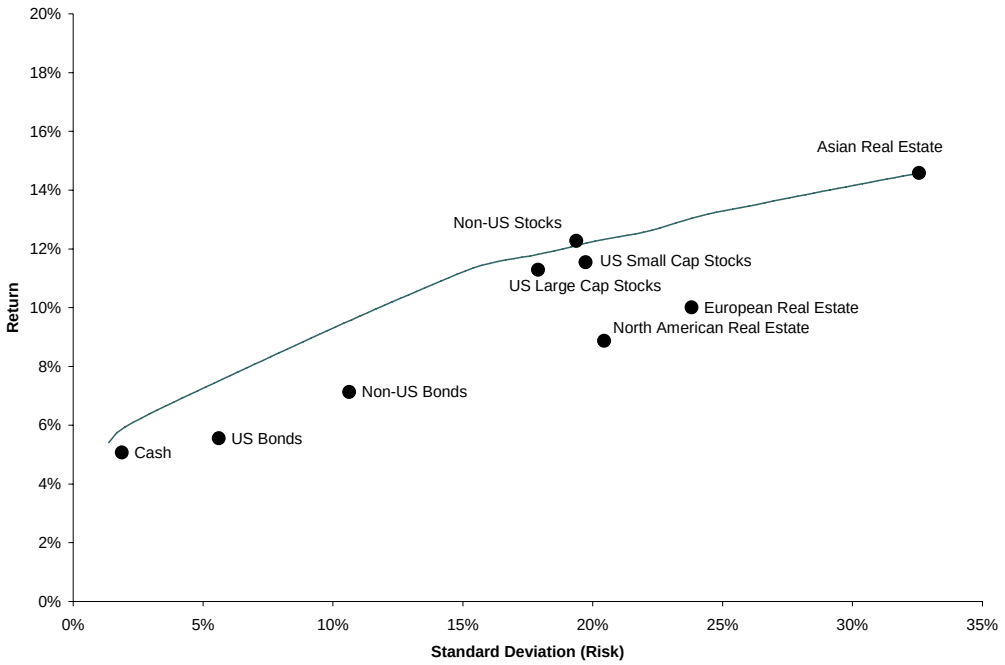
For comparison purposes, we've also included the historical arithmetic returns as well as the difference between the CAPM returns and the historical arithmetic returns. Clearly there are some substantial differences, particularly for non-U.S. stocks and North American real estate. For North American real estate, the large difference between the CAPM return and the historical arithmetic return is striking. We offer two possible explanations for this large difference. First, the nearly 17% historical average annual return is simply tremendous and 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 yield appreciable operating efficiencies that elevate investment returns to listed real estate over the period of transition but should not be expected to persist indefinitely. A limitation of the CAPM returns is that they cannot account for idiosyncratic asset class specific transforming events that are largely uncorrelated with systematic market behavior.

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

We should also note that for simplicity we have applied the traditional CAPM in which 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 decrease the volatility of the asset class and, consequently, the risk-based return forecasts of the non-U.S. asset classes. Relative to North American real estate, European real estate and Asian real estate have expected percentage point premia of 1.14% and 5.71%, respectively. Using a very different approach based on country-specific credit ratings and hurdle rates, Liang and Gordon [2003] finds that Asian commercial real estate should offer a significant premium above North American and European commercial real estate.

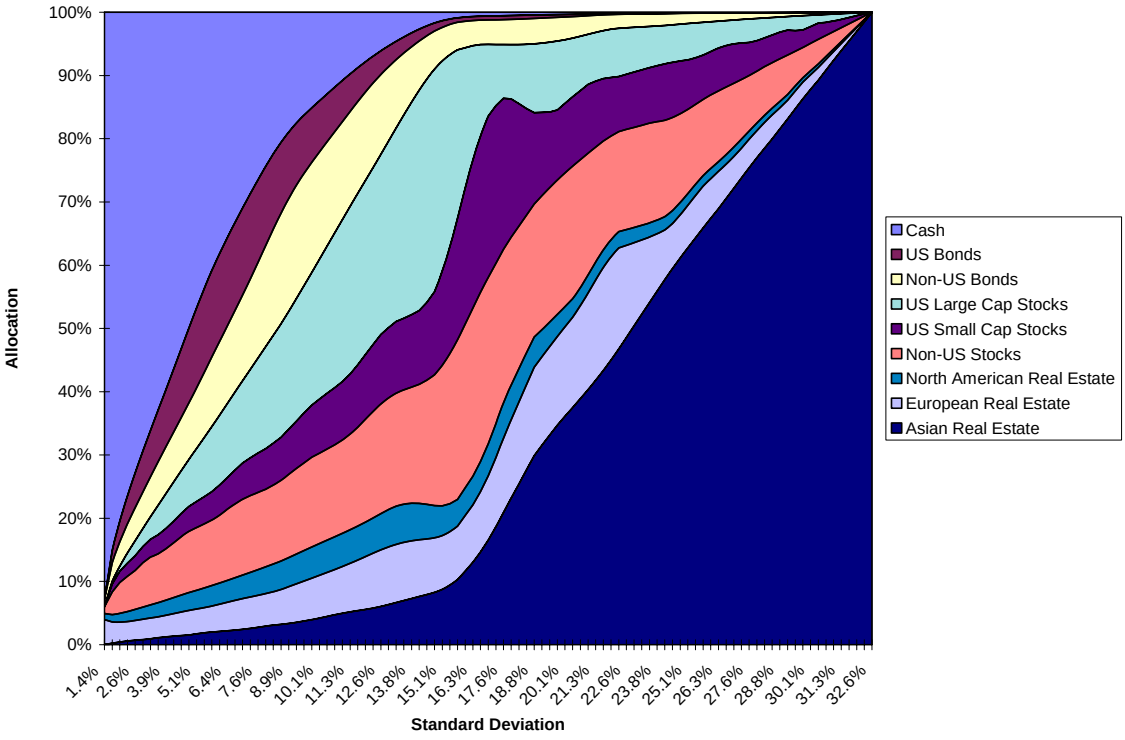
Using the CAPM forward-looking returns in Table 7, the standard deviations from Table 3, and the correlations from Table 4, we calculate the *forward-looking* efficient frontier using *resampled* mean-variance optimization.

Figure 5: CAPM Efficient Frontier Using Resampled Mean-Variance Optimization



At first glance there is nothing particularly noteworthy about this efficient frontier. However, efficient frontier graphs mask the asset allocations that lead to the various points across the efficient frontier. So, as we did 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 (see Figure 6).

Figure 6: CAPM Asset Allocation Area Graph



The differences between the historical asset allocation area graph (Figure 4) and the forward-looking asset allocation area graph (Figure 6) are quite dramatic, both of which 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 mid-point 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. Thus, we focus our analysis on the left-hand side of Figures 5 and 6. More specifically, we've identified three possible model asset allocations designated Conservative, Moderate, and Aggressive with expected risk levels of 5%, 10%, and 15%, respectively.

Table 8: 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

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 of the previous analysis with the historical returns. Table 9 contains the Black-Litterman model expected returns.[14]

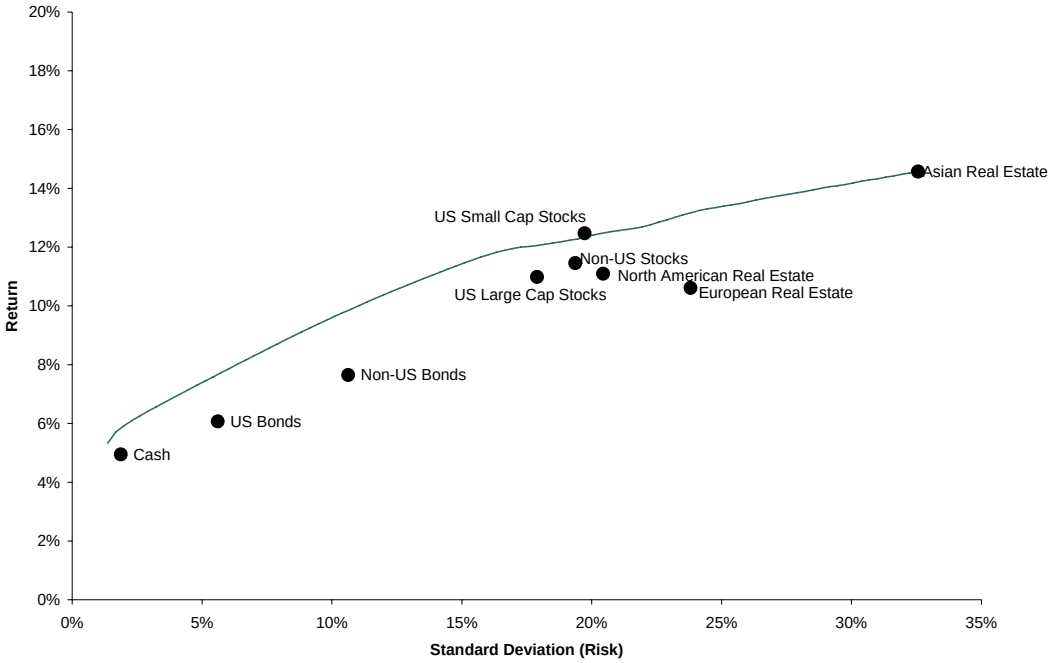
Table 9: Black-Litterman Expected Returns

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%

Using the Black-Litterman forward-looking returns from Table 9, 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 (see Figure 7). As before, we use *resampled* mean-variance optimization.

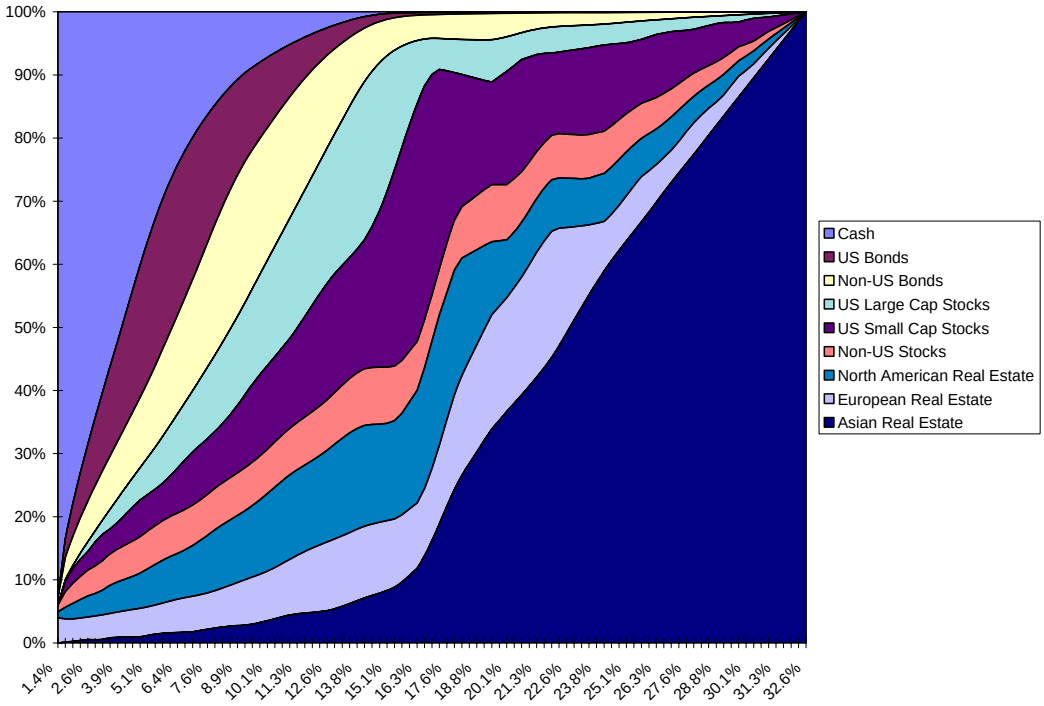
[14] The Black-Litterman combined expected returns were calculated using the Morningstar / Ibbotson EnCorr software, in which each of the historical returns were entered as an absolute view with a confidence level of 25% (see Idzorek [2006] for more details).

Figure 7: Black-Litterman Efficient Frontier Using Resampled Mean-Variance Optimization



The underlying efficient asset allocations that produce the efficient frontier shown in Figure 7 are displayed in Figure 8. Again, for totality 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.

Figure 8: Black-Litterman Asset Allocation Area Graph



As before, we focus our analysis on the left-hand side of the efficient frontier and the efficient frontier asset allocation area graph. Again, we've identified three possible model asset allocations designated Conservative, Moderate, and Aggressive with expected risk levels of 5%, 10%, and 15%, respectively.

Table 10: Black-Litterman Forward-Looking Asset Allocations

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

The Conservative asset allocation is approximately 71% fixed-income, 17% equities, and 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.

Relative to the CAPM-based asset allocations, the Black-Litterman-based asset allocations have larger allocations to worldwide commercial real estate equities and smaller allocations to non-U.S. stocks. 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 historical time period. Among the three real estate asset classes, the Black-Litterman-based allocations favor North American real estate and European real estate relative to the CAPM-based asset allocations.

Some Words of Caution

First, 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] indicates that asset allocations based on *resampled* mean-variance optimization are likely to outperform asset allocations based only on *traditional* mean-variance optimization.

Second, because Global REITs and listed real estate stocks still represent a small portion of worldwide commercial real estate equity investments, our use of listed real estate stock returns to represent the long-term investment performance of *all* commercial real estate equity investments may be questioned. As Hudson-Wilson and Harbaugh [2006] notes, the degree to which REITs and listed real estate stock returns accurately represent investment performance in the larger real estate market is an empirical question. However, as the percentage of total commercial real estate investment represented by REITs and listed real estate stocks increases, using REITs and listed real estate stock returns as a proxy for all commercial real estate investment will only become more appropriate and representative.

Third, we believe almost all investors should own REITs and listed real estate stocks; however, 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, explicit allocation to REITs and listed real estate stocks is unnecessary. However, this statement only applies 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. For investors *without* appropriate *direct* real estate asset allocations (a condition that describes most investors), a separate asset allocation to commercial real estate proxied and implemented with exposure to REITs and listed real estate stocks worldwide seems to be the best alternative. We should also note that even for investors who meet the two conditions, from a tactical and operational perspective, the advantages of REITs and listed real estate stocks (e.g., liquidity, corporate governance, real-time pricing and lower transaction costs) over *direct* real estate make them important investment options.

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 of the major asset classes that make up the unobservable market portfolio, including those asset classes not considered in this study such as TIPS, commodities, convertible bonds, emerging market stocks, emerging market bonds, high-yield bonds, etc. All else equal, expanding the opportunity set to include additional asset classes will tend to decrease the total allocation to the asset classes considered in this study.

Sixth, the Black-Litterman-based asset allocations are also market-oriented asset allocations that are augmented with information contained in the historical returns. Like the CAPM-based asset allocations, a different definition of the market portfolio will result in different asset allocations. The size of the Black-Litterman-based asset allocation is largely affected by the short-term historical returns that are blended with the CAPM returns, although the degree to which the allocations are affected is 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. As such, the asset allocations from *resampled* mean-variance optimization are those that are expected to perform best given the uncertainty of future outcomes. Nevertheless, actual asset allocation should be customized based on the investor's unique circumstances.

Conclusions

Commercial real estate investment is a large part of the investable universe that should be included in all investors' opportunity sets even though the role of commercial real estate in the market portfolio is not yet well understood. When developing 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 a large number of 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.

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

In a historical context, the inclusion of North American real estate in the opportunity set of investable assets leads to dramatic improvements in risk-adjusted performance. Over the historical time period reviewed in this study, the same is not true for European real estate or Asian real estate. However, this observation does not mean that these asset classes should be excluded from an investor's asset allocation. Just as equity and fixed-income investors should diversify across their respective investable 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.

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