Infrastructure and Strategic Asset Allocation: Is Infrastructure an Asset Class?

Sponsored by:
FAF Advisors, Inc.
First American Funds

Written by:
Thomas Idzorek, CFA, CIO & Director of Research
Christopher Armstrong, CFA, Senior Consultant

January 2009

ibbotson
a Morningstar company

Contents

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Abstract

This paper studies the role of infrastructure in a strategic asset allocation.[1] It addresses two critical questions: 1) is infrastructure an asset class; and 2) if so, what might be an appropriate asset allocation range. Infrastructure represents a logical grouping of assets that share similar characteristics and collectively have an inherent, non-skill-based return. As such, we believe infrastructure is an asset class and should be considered for inclusion in the strategic asset allocation opportunity set. We believe for asset allocation purposes investors should adopt a relatively narrow definition of infrastructure that we call *unique infrastructure*. Though adding infrastructure to a diversified portfolio led to only a marginal improvement in the efficient frontier, unconstrained historical and forward-looking optimizations resulted in significant infrastructure allocations. For an investor with robust opportunity sets, including private equity, global real estate and commodities, the unconstrained forward-looking optimizations result in allocations ranging from 0 to 6%.

[1] The research was conducted by Ibbotson Associates and sponsored by First American Funds/FAF Advisors.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Executive Summary

This paper begins with an attempt to answer whether or not infrastructure is an asset class, and to address all of the nuances associated with this question. We examine the risk and return characteristics of infrastructure using a variety of the new infrastructure indices. We perform a historical mean-variance analysis with and without infrastructure included in the opportunity set, and compare the differences. Finally, we perform a forward-looking analysis using a reasonable set of forward-looking return expectations.

The infrastructure asset class represents a logical grouping of assets that share similar characteristics and collectively have an inherent, non-skill-based return. As such, we believe infrastructure is an asset class and should be part of the strategic asset allocation opportunity set. Unfortunately, most broad definitions of the infrastructure asset class overlap with other asset classes. Based on our belief that strategic asset allocation opportunity sets should be non-overlapping and mutually exclusive, we believe, for asset allocation purposes, investors should adopt a relatively narrow definition of infrastructure that we call *unique infrastructure*. Unique infrastructure refers to the direct infrastructure assets that are not already considered part of the other established asset classes, most notably public equity, private equity, or commercial real estate.

There are no indices that measure the risk and return characteristics of unique infrastructure; thus, we use a variety of different listed infrastructure composite indices to proxy the infrastructure asset class. The use of listed infrastructure indices to proxy the unique infrastructure asset class is analogous to the use of listed commercial real estate indices (e.g. the NAREIT) to proxy direct commercial real estate. Despite concerns regarding the use of listed indices to represent unique infrastructure, we found, empirically, that the listed infrastructure asset class proxies seem to offer a unique investment opportunity. Since direct investment in infrastructure is not a viable option for most investors, we believe a number of investors will choose to gain exposure to infrastructure using listed infrastructure stocks, just as they have used REITs to gain exposure to real estate.

Even with relatively large differences in industry and regional exposures across the major listed infrastructure indices, the historical returns had fairly similar characteristics. The most significant point of distinction among the indices is the amount of utility exposure, ranging from a low of 33% to a high of 89%. Recognizing that different investors will define

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

infrastructure differently, we create three separate asset class index composites with "low," "average," and "high" levels of utility exposure. Each infrastructure composite has quarterly data starting in 1990 and ending in 2007. Over this time period, infrastructure produced returns that were similar to those of U.S. equities, but with slightly less risk. The infrastructure asset class proxies are most correlated with U.S. equities, non-U.S. developed equities, and global real estate.

We begin the asset allocation analysis with a historical perspective. In a series of traditional mean-variance optimizations based on historical capital market assumptions, including infrastructure in the opportunity set results in a slight improvement in the efficiency of the resulting asset allocations. The improvement was greatest in the heart of the efficient frontier. The maximum improvement above the base case optimization mixes relative to the three optimizations with infrastructure was around 18 basis points. Despite the small improvement in the efficiency of the historical efficient frontiers, the efficient asset allocation mixes contained rather large allocations to infrastructure, indicating that infrastructure was a beneficial addition to the opportunity set. The primary sources of the infrastructure allocations appear to be non-U.S. bonds and global high yield.

The historical optimizations tell us what was optimum over one particular historical time period. However, the extreme nature of these asset allocations is inappropriate when developing forward-looking asset allocation models or guidelines. There are two primary causes of the extreme asset allocations observed in the historical analysis, 1) over short-term historical time periods, some asset classes usually have glaringly superior risk-adjusted returns, and 2) traditional mean-variance optimization treats the capital market assumptions as if they were known with certainty.

To address these shortcomings of historical optimization and to gain insight into target allocations to infrastructure, we use a forward-looking optimization process. We complete a series of optimizations using a set of reasonable forward-looking capital market assumptions that reflect future risk and return tradeoffs, and we use a resampled mean-variance optimizer designed for forward-looking optimizations. To estimate forward-looking expected returns, we use the Capital Asset Price Model (CAPM). To apply the CAPM, we created a working version of the CAPM's market portfolio that included infrastructure. We estimated infrastructure's role in the market portfolio at approximately 1.5%.

In the forward-looking optimizations, adding infrastructure did not lead to a meaningful improvement in the efficient frontier as the four frontiers are almost on top of one another. Nevertheless, as we saw with the historical optimizations, there are surprisingly large allocations to infrastructure. The allocations to infrastructure ranged from 0% to nearly 6%. The sources of the infrastructure allocations varied across the efficient frontier with allocations coming from a broad mix of bonds and equities, including U.S. stocks, non-U.S. stocks, non-U.S. bonds and real estate. A strategic allocation to infrastructure supports the Ibbotson mantra to diversify, diversify, diversify!

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.
ibbotson

Introduction

Is "infrastructure" an asset class or is it simply a new way of grouping together investments that are generally considered to be part of other asset classes?

The answer to this question determines whether or not infrastructure should be part of the opportunity set of available asset classes that are considered when forming a strategic asset allocation policy. This paper begins with an attempt to answer whether or not infrastructure is an asset class and to address all of the nuances associated with this question. Proceeding under the assumption that some investors will find that infrastructure is an asset class, we examine the risk and return characteristics of infrastructure using a variety of the new infrastructure indices. We perform a historical mean-variance analysis with and without infrastructure included in the opportunity set and compare the differences. Finally, we perform a forward-looking analysis using a reasonable set of forward-looking return expectations -- with and without infrastructure included in the opportunity set -- and compare the differences.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Defining Infrastructure

Strategic asset allocation, or the beta decision as it is often called, is the process of determining your long-term exposures to the various asset classes in your opportunity set. The strategic asset allocation decision is separated from the product implementation decision, (often called the alpha decision). When it comes to the strategic asset allocation decision, the Ibbotson mantra is diversify, diversify, diversify!

All else being equal, we believe a good opportunity set should include as many of the asset classes that make up the unobservable global “market portfolio” of modern portfolio theory’s capital asset pricing model. According to modern portfolio theory, the all-inclusive market portfolio has the best risk and return tradeoff of any possible portfolio and as such it serves as a wonderful starting reference portfolio for making asset allocation decisions. Thus, as we begin the process of thinking about the role of infrastructure in a strategic asset allocation, we start by looking at the market portfolio.

Unfortunately, two problems arise immediately. First, the composition of the market portfolio is unknown, so we must develop a working version of the market portfolio -- a version that includes infrastructure assets. And second, as we develop a working version of the market portfolio, we must overcome the lack of precise definitions on what constitutes an asset class.

A good working version of the market portfolio, as well as a good opportunity set of asset classes, should be non-overlapping and mutually exclusive. In other words, the ideal opportunity set includes all asset classes, all individual building blocks are assigned to an asset class, and none of the individual investment building blocks are counted more than once. From a practical perspective, it is fairly easy to define traditional stock and bond asset classes that meet these criteria and fit neatly into a standard asset class classification scheme. Non-stock and non-bond building blocks are more challenging. In light of this, let’s now turn to infrastructure and our starting question: Is ”infrastructure“ an asset class or is it simply a new way of grouping together investments that are generally considered to be part of other asset classes? A common description of infrastructure might read something like this:

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Infrastructure is the physical assets, facilities, and systems that enable society to function. It includes the transportation (roads, bridges, tunnels, airports, railroads, ports, etc.), energy and utilities (power generation, fuels, water systems, etc.), communication (line-based networks, air-based networks), and social (schools, hospitals, prisons, other public buildings) assets of society. These are long-lived, real assets that are costly and time-consuming to replace, often without immediate substitutes, that typically generate relatively stable cash flows that increase with inflation.

In our opinion, asset classes are logical groupings of the individual building blocks (e.g. individual stocks, individual bonds, etc.) that collectively form the unobservable market portfolio. Additionally, asset classes should have an inherent non-skill-based return, which distinguishes them from investment product strategies like hedge funds that are not asset classes.

Depending upon the ownership structure and other characteristics of these assets in the infrastructure definition, the assets might be categorized as a public company, a private company, direct commercial real estate, or infrastructure. Returning to our earlier point that asset classes are logical groupings of assets that share similar characteristics (e.g. risk, return, correlation, legal structure, etc.) the grouping together of these various transportation, energy and utilities, communication, and social assets into a broad asset class identified as "infrastructure" is perfectly logical. The key problem is this broad, very inclusive definition of the infrastructure asset class, when coupled with the traditional way in which asset allocators define the other asset classes, leads to an overlapping opportunity set in which some individual assets could be included in multiple asset classes. A typical asset allocation will include an allocation to public and private equities, as well as commercial real estate reflecting the tendency to base asset class definitions more heavily on legal ownership structures rather than the actual assets.

In order to create a mutually exclusive, non-overlapping opportunity set, we believe asset allocators should adopt a relatively limited definition of infrastructure that we call *unique infrastructure*. Unique infrastructure refers to the direct infrastructure assets that are <u>not</u> already considered part of the other established asset classes, most notably public equity, private equity, or commercial real estate. It is unique infrastructure that is most likely missing from investors' current portfolios and most likely in expectation to further diversify a portfolio, improving the portfolio's risk and return characteristics. Additionally, it is unique infrastructure that is most likely missing from most working definitions of the all-inclusive global market portfolio that all investors should at some level be using as a rough guide in the construction of their asset allocation models. Practically speaking, there are no benchmarks that measure unique infrastructure. The best we can do is to try to determine if the investment characteristics of infrastructure are unique enough from an asset allocation perspective to warrant an asset allocation.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

While it is the addition of unique infrastructure that investors should be seeking, practically speaking, there are no benchmarks that directly measure the performance of unique infrastructure as we have defined it, and there are no investment products that make this specific investment easy. As is always the case, practitioners operate in the real world.

The three primary methods of gaining exposure to infrastructure assets are:

1. **Direct** –This form of investment in infrastructure assets is the purest form of exposure. It typically requires significant amounts of capital for a single purchase; thus, the creation of a diversified portfolio of infrastructure assets that will track the performance of the unique infrastructure asset class is only possible for the very largest investors. Most direct investments in infrastructure assets will not be adequately diversified across a large number of assets, subjecting the investor to large amounts of investment-specific risk. Infrastructure assets are often highly regulated, so direct investments also carry a large amount of regulatory risk. The primary advantage of a direct investment is control, while the primary disadvantages are a lack of diversification, enormous capital requirements, concentrated regulatory risk and lack of liquidity. Control is only an advantage if you have the expertise to effectively manage the assets. While a direct investment is theoretically the best representation of unique infrastructure, it is not a viable option for most investors.

2. **Private Equity Funds/Partnerships** –These invest directly in infrastructure assets on behalf of their shareholders or partners. The pooling of money from multiple investors should lead to a more diversified portfolio of infrastructure assets with smaller capital requirements per investor. Liquidity issues remain, although private equity funds should typically provide greater liquidity than direct infrastructure investments. Like direct infrastructure, this type of investment can have more concentrated regulatory risk. It also often involves significant leverage and risks that are bundled with leverage.

3. **Listed Infrastructure Vehicles** –These are collections of publicly traded stocks whose business is directly related to infrastructure assets. The primary advantages of listed infrastructure vehicles are 1) they are traded on an exchange, 2) they are liquid, and 3) they have extensive financial reporting requirements regulated by the various stock exchanges. Since it is valued daily by the markets, it can also trade at a premium or discount to the underlying value of the assets, which creates opportunities for active management of a portfolio. The primary disadvantage with this type of investment is the publicly traded stocks that make up the listed infrastructure vehicle may be already part of the investor's equity portfolio. Another aspect of this type of infrastructure investment is that infrastructure assets are sometimes just one piece of a larger conglomerate's operations, particularly on a global basis.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole
or in part, without the prior written consent of Ibbotson Associates, is prohibited.

While there are no indices that directly measure what we are calling unique infrastructure, there are several relatively new indices or benchmarks designed to track the performance of the increasing number of infrastructure-related investment products. The degree to which these indices accurately reflect the risk and return characteristics of unique infrastructure is unknown. Conceptually, the use of listed infrastructure indices to proxy the unique infrastructure asset class is analogous to the use of listed commercial real estate indices (e.g. the NAREIT) to proxy the direct commercial real estate, a practice advocated by a number of authors.[2]

Here we provide a quick introduction to the majority of the new listed infrastructure benchmarks:

- **Dow Jones Brookfield Global Infrastructure Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of global listed infrastructure. The Index was started in 2008 and has a back-filled history to 2003.

- **Macquarie Global Infrastructure Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of globally listed infrastructure. The Index was started in 2006 and has a back-filled history to 2000.

- **MSCI All Country World (ACWI) Infrastructure Sector Capped Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of globally listed infrastructure. This index is a modified version of the standard infrastructure index that caps Communication and Utility sectors at 33% and applies the remaining 33% to Pipelines, Transportation and Social sectors. The Index was started in 2008 and has a back-filled history to 1999.

- **S&P Global Infrastructure Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of globally listed infrastructure. The Index uses a modified market capitalization-weighting scheme designed to reduce single stock concentrations, and balances exposures across what they identify as two macro infrastructure clusters: a utilities/transportation cluster and an energy cluster. The Index was started in 2007 and has back-filled history to 2001.

- **UBS Global Infrastructure & Utilities Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of globally listed infrastructure. The Index was started in 2006 and has a back-filled history to 1990. It is divided into several sub-components including:

[2] See Hudson-Wilson, Fabozzi, and Gordon [2003], Pagliari, Scherer, and Monopoli [2005], Frost, Schioldager, and Hammond [2005], and Wilson and Harbaugh [2006].

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

UBS Global Infrastructure Index –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of non-utility related global listed infrastructure (transportation & communication).

UBS Global Utilities Index –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of global utility companies (excluding sub-sector generation utilities).

- **UBS Global 50/50 Infrastructure & Utilities Index** –This is a free float-adjusted, market capitalization-weighted index designed to track the performance of 100 global infrastructure-related securities, split evenly between utilities and infrastructure. The Index was started in 2006 and has back-filled history to 1995.

Below, we summarize some of the important characteristics of the primary indices. Table 1 shows the estimated exposure to the common infrastructure industry classifications. The most significant point of distinction among the indices is the amount of utility exposure, ranging from a low of 33% to a high of 89%. The Dow Jones Brookfield Index has a balance among most industries, while both the Macquarie Global Infrastructure and the UBS Global Infrastructure and Utilities Indexes have significant utility exposure. Interestingly, the MSCI ACWI Sector Capped Index has the greatest communications exposure while the S&P series is the only index with no exposure to the communications sector. Although social infrastructure is commonly considered part of the overall infrastructure universe, the MSCI series is the sole index with an allocation to the sector.

Table 1: Industry Exposures

Industry Composition	Dow Jones Brookfield	Macquarie	MSCI ACWI Sector Capped	S&P	UBS Global 50/50 Infrastructure & Utilities	UBS Global Infrastructure & Utilities
Pipelines	27	6	15	26	3	6*
Utilities	36	89	33	38	48	85*
Communication	11	2	33	0	19	3
Transportation	22	3	15	36	29	5
Social	0	0	4	0	0	0
Diversified	4	0	0	0	1	0

Source: Dow Jones, FTSE, MSCI, S&P, UBS

*Estimate

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Table 2 presents the different geographical exposures of the indices. The Dow Jones Brookfield Global Infrastructure Index has the largest North American and United Kingdom exposure, while the UBS Global 50/50 Infrastructure & Utilities Index has the largest Continental Europe exposure.

Table 2: Geographical Exposures

Geographical Breakdown	Dow Jones Brookfield	Macquarie	MSCI ACWI Sector Capped	S&P	UBS Global 50/50 Infrastructure & Utilities	UBS Global Infrastructure & Utilities
North America	45	40	NA	36	31	41
United Kingdom	19	9	NA	5	6	8
Continental Europe	21	36	NA	36	49	37
Japan	1	9	NA	6	4	8
Asia ex-Japan	11	5	NA	14	10	6
Latin America	2	1	NA	2	0	0
Middle East/Africa	1	0	NA	1	0	0

Source: Dow Jones, FTSE, S&P, UBS

Table 3 presents the annualized risk and return characteristics for the six main indices using all available historical data. Later, we incorporate all eight indices in the optimization analysis to create alternative histories for infrastructure proxies of varying degrees of utility exposure. Despite the different sub-infrastructure class industry and geographical exposures, over the three- and five-year time period, the risk and return characteristics are surprisingly similar. The effect of the technology/media/telecommunications (TMT) bubble is evident in the seven-year and inception numbers for the MSCI series, as the returns are comparably lower than the other longer-dated series that have lower communications exposure. The larger allocations to the communications sector are likely the result of a broader definition of communications that includes the majority of the telecommunications sector.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Table 3: Benchmark Historical Risk and Return Characteristics

(December 31, 2007)

	Dow Jones Brookfield	Macquarie	MSCI ACWI Sector Capped	S&P	UBS Global 50/50 Infrastructure & Utilities	UBS Global Infrastructure & Utilities
Inception	Jan-03	Jul-00	Jan-99	Nov-01	Jan-95	Jan-90
Performance						
3 Year	20.82%	24.82%	19.65%	25.49%	23.61%	23.83%
5 Year	24.77%	27.32%	21.45%	29.34%	28.38%	26.40%
7 Year	NA	15.41%	9.37%	NA	14.55%	12.22%
10 Year	NA	NA	NA	NA	12.16%	12.31%
Inception	24.77%	16.96%	7.81%	23.05%	10.27%	10.65%
Risk						
3 Year	10.93%	10.74%	9.59%	11.82%	11.19%	10.68%
5 Year	11.83%	12.15%	10.54%	12.70%	12.46%	12.08%
7 Year	NA	13.86%	11.68%	NA	14.87%	14.09%
10 Year	NA	NA	NA	NA	13.89%	13.47%
Inception	11.83%	14.00%	11.84%	13.30%	14.62%	12.81%
Sharpe Ratio						
3 Year	0.49	0.62	0.51	0.58	0.56	0.59
5 Year	0.60	0.65	0.56	0.68	0.67	0.63
7 Year	NA	0.29	0.18	NA	0.26	0.22
10 Year	NA	NA	NA	NA	0.20	0.21
Inception	0.60	0.32	0.12	0.50	0.14	0.17

Source: Morningstar EnCorr

Again, among the various indices, the most significant difference is the amount of utility exposure. Unlike traditional equity indices with common established industry classifications, no distinct infrastructure classification is associated with global stocks. Therefore, the composition of an index can vary widely, depending on the criteria the index providers use. While some may argue that many utility or telecommunication stocks are not infrastructure-related, many of them will possess several of the main attributes that characterize infrastructure investments, such as long-lived assets, regulated rates, and/or monopolistic nature.

Recognizing that different investors will define the infrastructure asset class differently, as we move forward, we will use three distinct infrastructure asset class proxies that one might think of as having low, average, and high utility exposures.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

1. IA Listed Infrastructure Composite 1 (Low Utilities)
2. IA Listed Infrastructure Composite 2 (Average Utilities)
3. IA Listed Infrastructure Composite 3 (High Utilities)

IA Listed Infrastructure Composite 1 (Low Utilities)–This composite index is designed to represent a universe of infrastructure-related securities with a low weighting to utilities. It is equally weighted between the DJ Brookfield, MSCI and S&P indices, and a fixed blend (65/35) of UBS Infrastructure and Utility sub-indices. The blended sub-indices were used to maintain a weighting consistent with the other indices while providing an extended history. Table 4 below outlines the historical constituents of the composite:

Table 4: Composite 1 (Low Utilities) Composition

Date Range	DJ Brookfield	MSCI	S&P	UBS Infr.	UBS Util.
Jan 1990 to Dec 1998	0%	0%	0%	65%	35%
Jan 1999 to Oct 2001	0%	50%	0%	17%	33%
Nov 2001 to Dec 2002	0%	33%	33%	12%	22%
Jan 2003 to Present	25%	25%	25%	9%	16%

IA Listed Infrastructure Composite 2 (Average Utilities)–This composite index represents an even balance between utility and non-utility infrastructure-related stocks. It contains the full history of the UBS Global 50/50 Infrastructure and Utilities backfilled with an equally weighted blend of the UBS Utility and Infrastructure sub-indices. Table 5 below outlines the historical constituents of the composite:

Table 5: Composite 2 (Average Utilities) Composition

Date Range	UBS 50/50 I&U	UBS Infr.	UBS Util.
Jan 1990 to Dec 1994	0%	50%	50%
Jan 1995 to Present	100%	0%	0%

IA Listed Infrastructure Composite 3 (High Utilities)–This composite index is designed to represent a universe of infrastructure-related securities with a high weighting to utilities. It is equally weighted between the Macquarie and UBS Infrastructure and Utility indices, whose construction criteria result in approximately 90% Utility allocations. Table 6 below outlines the historical constituents of the composite.

Table 6: Composite 3 (High Utilities) Composition

Date Range	Macquarie	UBS I&U
Jan 1990 to Jun 2000	0%	100%
Jul 2000 to Present	50%	50%

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

The majority of listed infrastructure stocks are a part of the broader global equity universe, if not completely represented. Both the S&P and UBS series (which are both calculated by S&P) draw their universe from the S&P/Citigroup BMI World Index, while the MSCI Infrastructure series is determined by the MSCI AC World Index. The Macquarie Global Infrastructure Index is constructed from the members of the FTSE Global Equity Index Series. In a purely passive setting, the infrastructure universe overlaps completely with global equity. Furthermore, we found very little overlap between the constituents of the three listed infrastructure indices and the listed real estate and listed private equity indices.

Despite the overlap with the broader equity universe, listed infrastructure representation is quite low (4-5%), and its diversification benefits cannot necessarily be obtained at levels consistent with current market capitalization. The question is, are there benefits, from an asset allocation perspective, to including an asset allocation to infrastructure investments? To answer this important question, we proceed with a series of optimizations with and without infrastructure.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Historical Analysis

We begin by identifying the asset classes and the asset class proxies that we use to create our working version of the market portfolio, and hence, our strategic asset allocation opportunity set (see Table 7). These asset class proxies enable us to study the historical return characteristics of the asset classes. Please notice that this is a very inclusive opportunity set, reflecting the notion that most investors who are considering an asset allocation to infrastructure will likely already have a robust opportunity set.

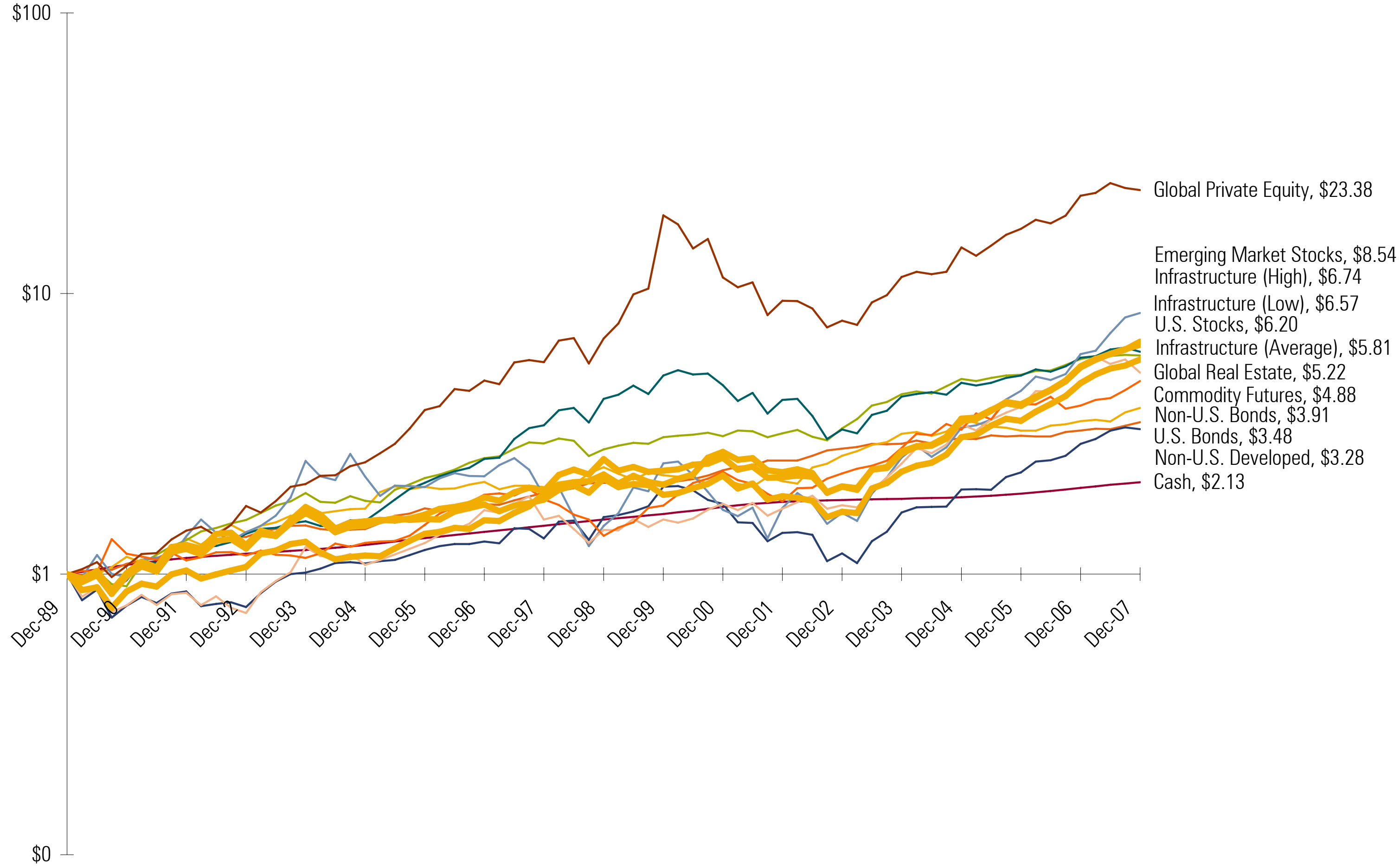
Table 7: Opportunity Set

Asset Class	**Asset Class Proxy**
Cash	Citigroup U.S. 3 Month T-bill
U.S. Bonds	Barclays Capital U.S. Aggregate Bond
Non-U.S. Bonds	IA Global ex. U.S. Bond Composite
Global High Yield	Barclays Capital Global High Yield
U.S. Stocks	Russell 3000
Non-U.S. Developed Stocks	MSCI World ex U.S.
Emerging Market Stocks	IA Emerging Markets Composite
Global Real Estate	FTSE EPRA/NAREIT Global Real Estate
Commodity Futures	IA Commodity Composite Index
Global Private Equity	IA Global Private Equity Composite
Infrastructure (Low Utilities)	IA Listed Infrastructure Composite 1 (Low Utilities)
Infrastructure (Average Utilities)	IA Listed Infrastructure Composite 2 (Average Utilities)
Infrastructure (High Utilities)	IA Listed Infrastructure Composite 3 (High Utilities)

Figure 1 shows the growth of a $1 investment in each of these asset classes. The relatively high degree of correlation between the three infrastructure proxies (thicker lines in Figure 1) is evident. From a pure total return perspective, over this particular time period, global private equity stands out as the best performing asset class. In general, the more equity-like asset classes outperformed the bond-like asset classes.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Figure 1: Growth of $



Source: Morningstar EnCorr

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Next, in Table 8, we identify the historical returns and standard deviations of the asset class using quarterly returns from 1990 to 2007. Seemingly, this was a particularly weak historical period for non-U.S. developed stock relative to other historical periods. The three infrastructure asset class proxies all had similar risk and return characteristics, with a slight risk-adjusted performance edge going to the IA Listed Infrastructure Composite (High Utilities).

Table 8: Historical Return Statistics 1990 - 2007

Asset Class	Arithmetic Return	Compound Annual Return	Standard Deviation	Sharpe Ratio
Cash	4.28%	4.28%	0.89%	0.00
U.S. Bonds	7.26%	7.17%	4.36%	0.35
Non-U.S. Bonds	8.36%	7.87%	10.47%	0.20
Global High Yield	10.99%	10.49%	10.58%	0.32
U.S. Stocks	11.93%	10.67%	16.72%	0.24
Non-U.S. Developed Stocks	8.38%	6.83%	18.27%	0.11
Emerging Market Stocks	16.35%	12.65%	29.77%	0.21
Global Real Estate	11.26%	9.62%	19.09%	0.19
Commodity Futures	10.22%	9.20%	15.31%	0.20
Global Private Equity	22.96%	19.14%	33.05%	0.30
Infrastructure (Low Utilities)	12.09%	11.02%	15.55%	0.26
Infrastructure (Average Utilities)	11.33%	10.27%	15.49%	0.23
Infrastructure (High Utilities)	12.12%	11.18%	14.48%	0.28

Source: Morningstar EnCorr

Table 9 presents the correlations. 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.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc.
The information contained in this paper is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Table 9: Correlations

Asset Class	Cash	U.S. Bonds	Non-U.S. Bonds	Global High Yield	U.S. Stocks	Non-U.S. Developed Stocks	Emerging Market Stocks	Global Real Estate	Commodity Futures	Global Private Equity	Infra-structure (Low Utilities)	Infra-structure (Average Utilities)	Infra-structure (High Utilities)
Cash	1.00	0.21	-0.08	-0.11	0.03	-0.20	-0.22	-0.25	-0.07	-0.02	-0.08	-0.12	-0.08
U.S. Bonds	0.21	1.00	0.57	0.11	-0.06	-0.09	-0.30	0.09	-0.22	-0.21	0.19	0.22	0.26
Non-U.S. Bonds	-0.08	0.57	1.00	-0.14	-0.08	0.17	-0.19	0.14	-0.03	-0.16	0.29	0.30	0.15
Global High Yield	-0.11	0.11	-0.14	1.00	0.64	0.48	0.59	0.54	-0.17	0.42	0.45	0.44	0.44
U.S. Stocks	0.03	-0.06	-0.08	0.64	1.00	0.79	0.59	0.55	-0.29	0.71	0.61	0.57	0.61
Non-U.S. Developed Stocks	-0.20	-0.09	0.17	0.48	0.79	1.00	0.59	0.69	-0.16	0.62	0.70	0.67	0.63
Emerging Market Stocks	-0.22	-0.30	-0.19	0.59	0.59	0.59	1.00	0.59	-0.08	0.56	0.41	0.37	0.30
Global Real Estate	-0.25	0.09	0.14	0.54	0.55	0.69	0.59	1.00	-0.10	0.35	0.69	0.66	0.61
Commodity Futures	-0.07	-0.22	-0.03	-0.17	-0.29	-0.16	-0.08	-0.10	1.00	-0.16	-0.20	-0.19	-0.20
Global Private Equity	-0.02	-0.21	-0.16	0.42	0.71	0.62	0.56	0.35	-0.16	1.00	0.29	0.20	0.28
Infrastructure (Low Utilities)	-0.08	0.19	0.29	0.45	0.61	0.70	0.41	0.69	-0.20	0.29	1.00	0.94	0.79
Infrastructure (Avg. Utilities)	-0.12	0.22	0.30	0.44	0.57	0.67	0.37	0.66	-0.19	0.20	0.94	1.00	0.84
Infrastructure (High Utilities)	-0.08	0.26	0.15	0.44	0.61	0.63	0.30	0.61	-0.20	0.28	0.79	0.84	1.00

Source: Morningstar EnCorr

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

The three infrastructure asset class proxies are most correlated with U.S. equities, non-U.S. developed equities, and global real estate. In contrast with the risk and return characteristics in which all three infrastructure proxies had similar characteristics, there are some surprisingly large differences among their correlations with each other. Over this particular historical period, commodities had a negative correlation with all of the other asset classes in the opportunity set.

Given our relatively large opportunity set and our concern that the selected infrastructure asset class proxies overlap with other elements of our opportunity set, one potential concern is the suitability of our correlation matrix for numerical optimizations. As the quality of the correlation matrix deteriorates, the optimum asset allocation solutions become extremely sensitive to small changes in our capital market assumptions. This occurs when it is nearly possible to reproduce one of the asset classes with a linear combination of other asset classes. One measure of the quality of a matrix is the conditional number of the matrix.[3] In our case, the correlation matrix with the various infrastructure asset class proxies was always below 7, indicating a healthy or well-conditioned correlation matrix. As a general rule of thumb, matrices with a condition number lower than 20 are considered healthy.

Another method to address our concern that the selected infrastructure asset class proxies overlap with other elements of our opportunity set is to perform a returns-based style analysis (see Sharpe [1988, 1992]) that attempts to explain the variability of the historical returns of the infrastructure asset class (the dependant variable) using the historical returns of the other asset classes in the opportunity set (the independent explanatory variables). In this case, a low R-square indicates that infrastructure returns are unique and not fully explained by the returns of the other asset classes. The results of the returns-based style analysis are presented in Table 10. Here, we see that the R-square of three analyses are relatively low and the exposures are fairly intuitive. So, despite our concerns for developing a mutually exclusive opportunity set, empirically, our various listed infrastructure asset class proxies seem to offer a unique investment opportunity.

Table 10: Returns-Based Style Analysis of Infrastructure

	Cash	U.S. Bonds	Non-U.S. Bonds	Global High Yield	U.S. Stocks	Non-U.S. Developed Stocks	Emerging Market Stocks	Global Real Estate	Comm Futures	Global Private Equity	R Squared
Infrastructure (Low Utilities)	0.00	2.68	27.60	0.00	21.80	17.47	0.00	30.45	0.00	0.00	62.96
Infrastructure (Avg. Utilities)	0.00	7.81	26.77	0.00	19.61	17.47	0.00	28.34	0.00	0.00	57.93
Infrastructure (High Utilities)	0.00	40.42	0.00	0.00	22.90	16.41	0.00	20.27	0.00	0.00	54.36

Source: Morningstar EnCorr

[3]The condition number is the square root of the ratio of the maximum eigenvalue divided by the minimum eigenvalue.

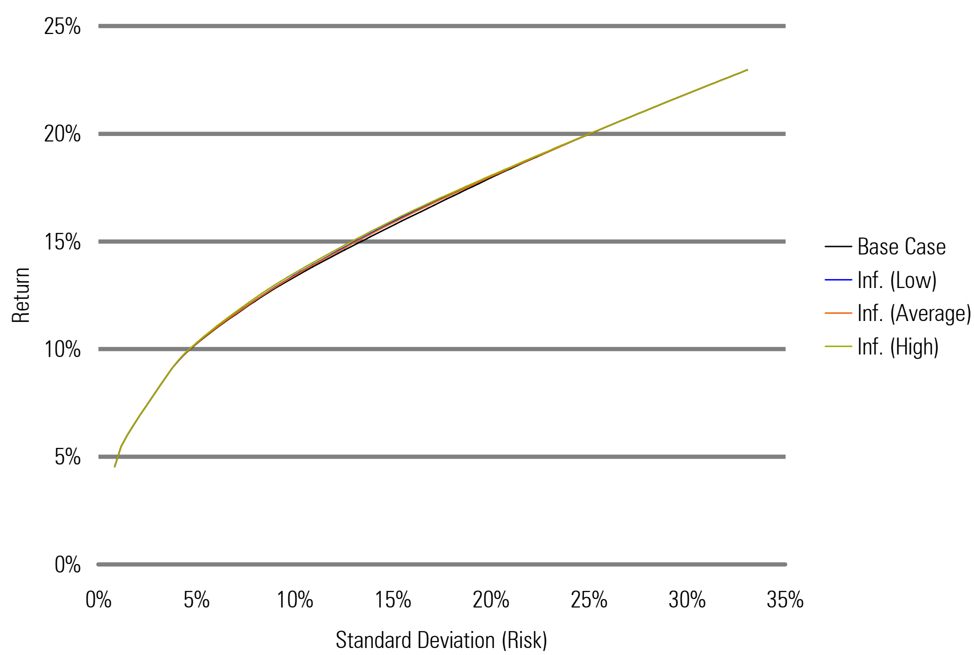
©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

Historical Optimizations

Using the three different infrastructure asset class proxies developed earlier – Infrastructure (Low Utilities), Infrastructure (Average Utilities), and Infrastructure (High Utilities), we performed four traditional Markowitz mean-variance optimizations. In the first optimization, infrastructure was excluded from the opportunity set. In the ensuing three optimizations, we include one of the three different infrastructure proxies. The resulting historical efficient frontiers are presented in Figure 2.

Figure 2: Historical Efficient Frontiers



Source: Morningstar EnCorr

Including infrastructure in the opportunity results in a slight improvement in the efficiency of the resulting asset allocations. The improvement was greatest in the heart of the efficient frontier, where standard deviations ranged from around 10% to 18%. The maximum improvement above the base case optimization mixes relative to the three optimizations with infrastructure included were 16, 13, and 24 basis points respectively, for the Infrastructure (Low Utilities), Infrastructure (Average Utilities), and Infrastructure (High Utilities) asset class proxies. It may seem unexpected that the addition of Infrastructure

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

(Low Utilities) and Infrastructure (High Utilities) to the opportunity set resulted in larger maximum improvements than the addition of Infrastructure (Average Utilities). We attribute this to the slightly higher historical returns of these two infrastructure asset class proxies; please recall from the earlier description of the asset class proxies that the composition of our infrastructure indices is quite different.

The relatively small improvement from including infrastructure in the opportunity set is logical. Arguably, investors considering a strategic asset allocation to infrastructure already have a very robust opportunity set. In this case, adding an 11th asset class to a base case opportunity set of 10 asset classes should only result in a minor improvement in the efficiency of the asset allocations.

Despite the small improvement in the efficiency of the historical efficient frontiers, the efficient asset allocation mixes contained rather large allocations to infrastructure. Panels A, B, C, and D of Figure 3 present efficient frontier asset allocation area graphs. Each asset allocation area graph displays the asset allocation mixes from one of the four efficient frontiers. The horizontal axis represents standard deviation. Each vertical cross-section along the horizontal axis displays an asset allocation mix from the corresponding efficient frontier. The vertical cross-section at the far left identifies the asset allocation with the lowest standard deviation, while the vertical cross-section at the far right identifies the asset allocation with the highest return.

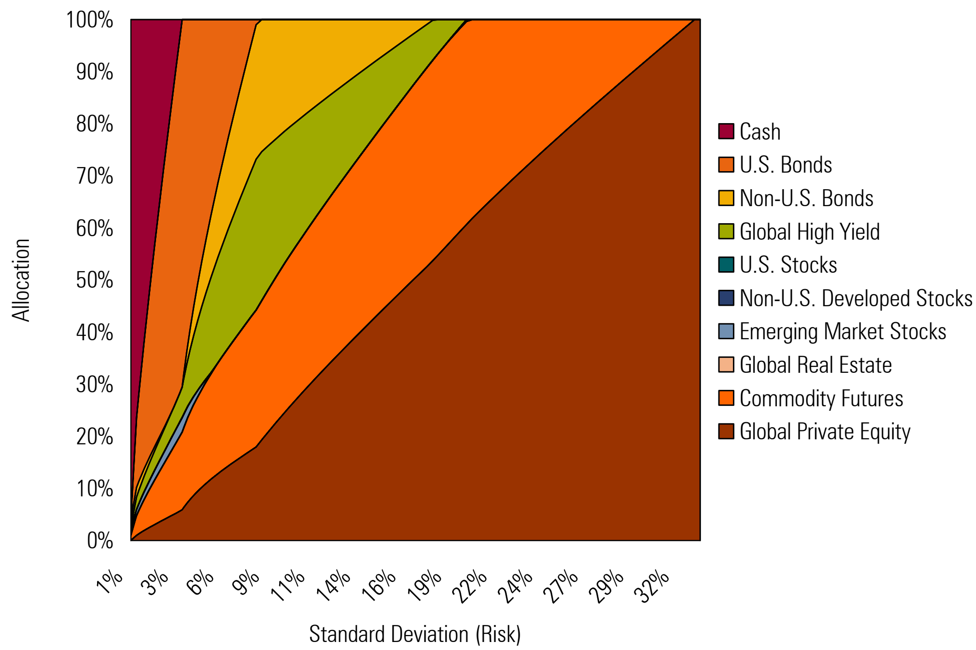
In all of the panels, the lowest risk asset allocation is predominantly cash and the highest return asset allocation is 100% global private equity – the asset class that happened to have the highest return during this particular historical time period. Surprisingly, many of the middle vertical cross-sections contain substantial infrastructure allocations. These allocations peaked at nearly 29%. Another surprise was the predominant funding source of the large infrastructure allocations. The primary sources of the infrastructure allocations appear to be non-U.S. bonds and global high yield bonds (notice the substantial decrease in these two asset classes relative to the base case area graph as the allocations to infrastructure peak).

Recognizing that the asset allocation area graphs are somewhat difficult to analyze, we identified three efficient frontier asset allocation mixes with standard deviation levels of 4%, 8%, and 12%, respectively. For these three risk levels that we loosely refer to as conservative, moderate, and aggressive, we identify the corresponding asset allocation mix from the base case optimization that excluded infrastructure and the average corresponding asset allocation mix from the three optimizations that included infrastructure. In addition to the individual asset allocations, we created three broad groups. Cash, U.S. bonds, non-U.S. bonds, and global high yield bonds are grouped as bonds. U.S. stocks, non-U.S. developed stocks, emerging market stocks, and global private equities are grouped as equities. Global real estate, commodities, and infrastructure are grouped as other.

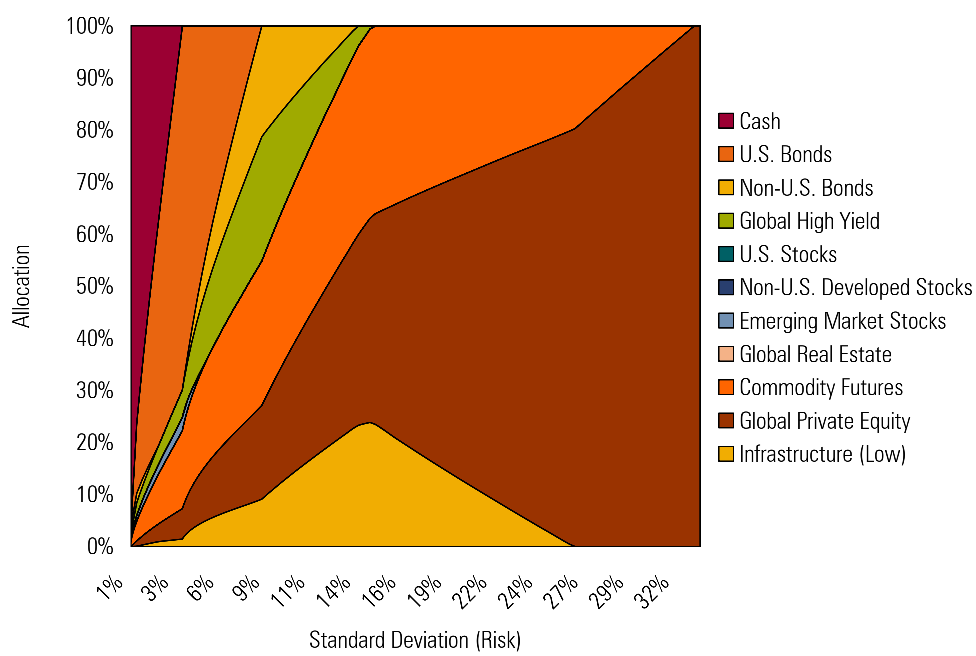
©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Figure 3: Historical Efficient Frontier Asset Allocation Area Graphs

Panel A – Base Case

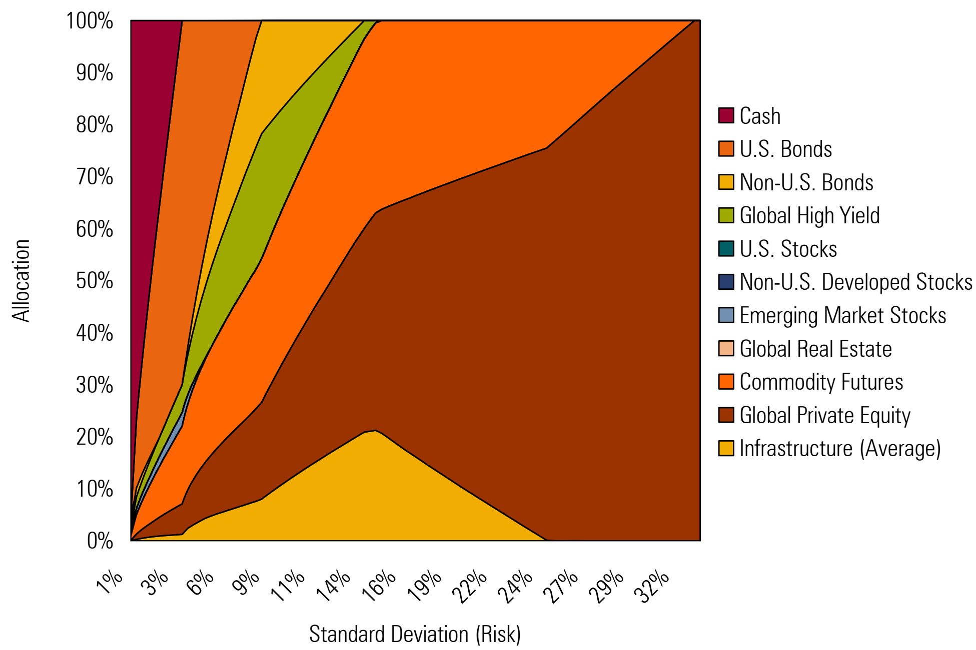


Panel B – Infrastructure (Low Utilities)

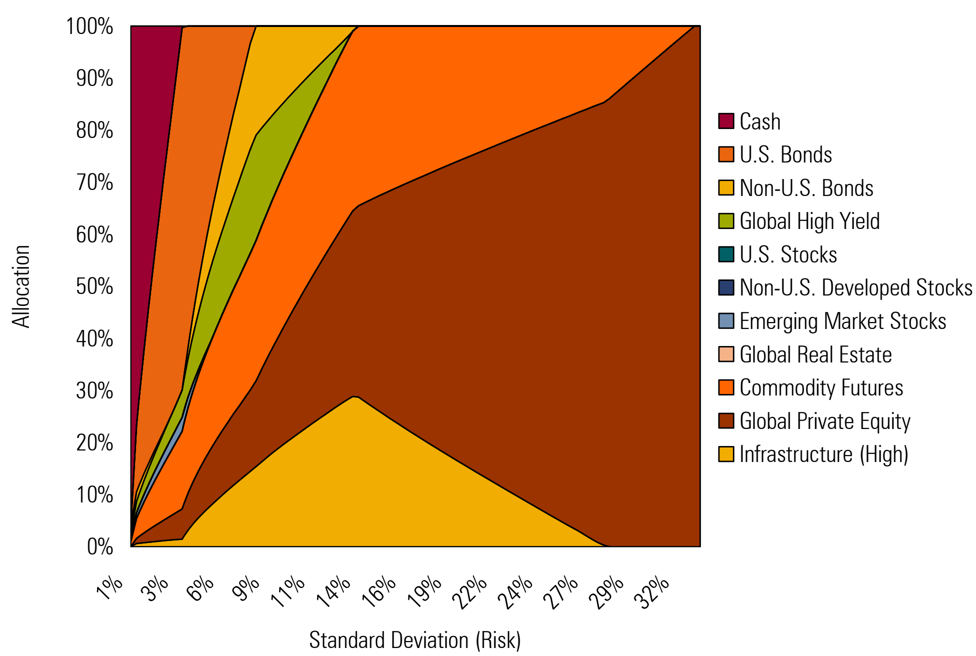


©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Panel C – Infrastructure (Average Utilities)



Panel D – Infrastructure (High Utilities)



Source: Morningstar EnCorr

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Table 11: Historical Asset Allocation Mixes

Asset Class	**Conservative 4% Standard Deviation**		**Moderate 8% Standard Deviation**		**Aggressive 12% Standard Deviation**	
	Base Case	With Infrastructure	Base Case	With Infrastructure	Base Case	With Infrastructure
Cash	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
U.S. Bonds	64.5%	64.5%	0.9%	2.3%	0.0%	0.0%
Non-U.S. Bonds	2.1%	1.0%	25.8%	20.6%	14.5%	6.7%
Global High Yield	8.2%	6.9%	29.0%	22.2%	19.5%	8.5%
U.S. Stocks	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Non-U.S. Developed Stocks	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Emerging Market Stocks	2.3%	2.1%	0.0%	0.0%	0.0%	0.0%
Global Real Estate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Commodity Futures	15.9%	16.1%	26.3%	27.0%	31.9%	33.2%
Global Private Equity	7.1%	6.9%	18.1%	17.2%	34.1%	31.2%
Infrastructure		2.4%		10.6%		20.3%
Bonds	74.8%	72.5%	55.7%	45.2%	34.0%	15.2%
Equities	9.3%	9.0%	18.0%	17.2%	34.1%	31.3%
Other	15.9%	18.5%	26.3%	37.6%	31.9%	53.5%
Return	9.37%	9.38%	12.23%	12.31%	14.34%	14.48%

Source: Morningstar EnCorr

As always, careful interpretations and inferences from *unconstrained* optimizations need to be made. The historical optimizations identify the asset allocation mixes that would have been optimal over the particular historical period used to measure the returns, standard deviations, and correlations. As we have just seen, the asset allocations load up on the best performing asset classes over this particular historical period and ignore the asset classes that did not perform as well. The relatively *small* improvement in efficient frontiers coupled with the relatively *large* allocations to infrastructure highlight what is often viewed as a negative characteristic of traditional mean-variance optimization – that mean-variance efficient asset allocations are often highly concentrated in a small subset of the asset classes being optimized. In this case, the optimizer has loaded up on infrastructure to eek out a few more basis points of return.

The highly concentrated asset allocations that result from historical capital market assumptions coupled with traditional mean-variance optimization are perfectly fine when one is seeking to answer questions about a particular historical time period, most notably, what were the optimal allocations in the past? In a forward-looking context, these extreme asset allocations should be avoided. It is better to use forward-looking estimates coupled with an optimizer that recognizes that these forward-looking estimates are not known with certainty and that small efficiency gains are not arbitrage opportunities.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Forward-Looking Analysis

There are two primary causes of the extreme asset allocations observed in the historical analysis, 1) over short-term historical time periods, some asset classes usually have glaringly superior risk-adjusted returns, and 2) traditional mean-variance optimization treats the capital market assumptions as if they were known with certainty; thus, the optimizer invests as much as possible in those assets with superior risk-adjusted returns. Over relatively short time periods, it is nearly impossible to accurately predict which asset classes will be the best performers. However, over a longer, strategic time period, one should expect the returns of the different asset classes to reflect their inherent risk. To gain insight into forward-looking asset allocations to infrastructure, we complete a series of optimizations using a set of reasonable, forward-looking capital market assumptions that reflect both future risk and return tradeoffs. We also use a resampled mean-variance optimizer specifically designed to carry out forward-looking optimizations.

Let's start with the optimizer and how it incorporates uncertainty into the optimization process. In a forward-looking context, capital market assumptions are estimates. The true capital market assumptions are not known with certainty; therefore, it is more appropriate to use an optimizer that accounts for the uncertainty in the estimated capital market assumptions. Conceptually, resampled mean-variance optimization is like a giant scenario test in which multiple small adjustments to the starting capital market assumptions are made, and the resulting asset allocations from all of the different scenarios are averaged.

Rather than using ad hoc methods for creating multiple scenarios (e.g. moving the expected return of asset A up by 50 basis points and that of asset B down by 25 basis points), Monte Carlo simulation is used to simulate the returns of each of the asset classes. The Monte Carlo simulation is based on a forward-looking set of capital market assumptions, so, as one would expect, the simulated returns have similar return, risk, and correlation characteristics. From a set of simulated returns, a new set of "simulated" capital market assumptions is created and then run through a traditional mean-variance optimizer. From this intermediate efficient frontier, the resulting asset allocations are then saved. This process of generating simulated returns, calculating capital market assumptions based on the simulated returns, running a traditional mean-variance optimization based on each new set of simulated capital market assumptions, and then saving the resulting asset allocations is repeated thousands of times. Of course, each time the Monte Carlo simulation generates simulated returns for each asset class, the results are slightly different, and thus the composition of each of the intermediate efficient frontiers

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

is different. Each intermediate traditional mean-variance optimization identifies the optimal asset allocations for one of the endless numbers of potential future scenarios implied by the starting set of capital market assumptions. The final resampled efficient frontier represents an average of the thousands of intermediate traditional mean-variance optimizations, and thus, is sometimes interpreted as the best solution for all of the possible future scenarios implied by the starting capital market assumptions.

In addition to using an optimizer that accounts for uncertainty, we want to use a reasonable set of forward-looking capital market assumptions that might be viewed as the market's consensus returns. To estimate forward-looking expected returns we use the Sharpe-Lintner-Mossin-Treynor Capital Asset Price Model (CAPM). More specifically, we use the reverse optimization version of the CAPM developed in Sharpe [1974], which is a direct extension of Sharpe [1964]. According to the CAPM, investors demand compensation, or more precisely, the *expectation* of compensation for what is often called beta, market, or systematic risk. It is beta risk that results in a return premium above and beyond the return on the risk-free asset. Thus, under the CAPM, the total expected return of an asset is equal to the risk-free rate of return plus the beta of the asset relative to the market portfolio multiplied by the market risk premium.

In order to apply the reverse optimization version of the CAPM, we must create a working version of the all-inclusive market portfolio based on the constituents of our opportunity set. The market size or capitalization for most of the traditional stock and bond asset classes can be easily inferred from the value of the different indices that are used as asset class proxies. In previous Ibbotson research, we have estimated the market size/capitalization/relevance of many of the less traditional asset classes, such as commodities, real estate, and private equity.[4] We must now do the same for infrastructure.

Determining the relevant market capitalization, and hence, the role of less traditional asset classes in the all-inclusive market portfolio, is quite subjective. We believe different practitioners could certainly reach substantially different estimates of the composition of the market portfolio. As we attempt to estimate the market capitalization of infrastructure, we must keep in mind our earlier definition of unique infrastructure as we seek to build a mutually exclusive opportunity set.

Let's start with the easy numbers. Table 12 summarizes the market capitalizations of the various indices that track listed infrastructure.

[4] For those asset classes without an observable market value, there is considerable uncertainty around their role in the market portfolio. In this paper, we use the techniques outlined in Idzorek [2007a], Idzorek, Barad, and Meier [2007], and Idzorek [2007b] to estimate the size of commodities, global real estate, and global private equity. The assumptions regarding the size of these asset classes have a meaningful impact on the composition of the market portfolio.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

Table 12: Market Capitalizations of Listed Infrastructure Benchmarks

Index	Value in US$ (billions)	Date	Source
Dow Jones Brookfield	NA	NA	NA
Macquarie Global 100 Infrastructure	$1,428.24	9/30/2008	Morningstar
MSCI AC World Sector Capped	NA	NA	NA
S&P Global Infrastructure	$1,074.20	9/30/2008	SSGA
UBS Global Utilities	$1,303.21	9/30/2008	UBS
UBS Global Infrastructure	$ 163.34	9/30/2008	UBS
UBS Global Infrastructure & Utilities	$1,466.55	9/30/2008	UBS

Source: Dow Jones, FTSE, MSCI, S&P, UBS

While we believe these indices can serve as useful asset class proxies, the market capitalization of these indices is of little use to us. Recall from our earlier discussion that we believe strategic asset allocation decision should focus on what we call unique infrastructure – the direct infrastructure assets that are not already considered part of the other established asset classes, most notably public equity, private equity, or commercial real estate. The vast majority of the listed infrastructure index constituents are also constituents of the other public equity indices in the opportunity set.

Although some reasonable attempts have been made to quantify the value of all infrastructure; none of them, unfortunately, focus on unique infrastructure. Starting with the BEA's 2004 estimated value of all U.S. public and private infrastructure of $5.65 trillion, Mansour and Nadji [2006] estimate that 53% is owned by the public sector and 47% is owned in the private sector. Patel [2008] attempts to estimate the size of the global infrastructure market that has not yet been privatized, with estimates ranging from $18.9 trillion to $21.6 trillion. As these publicly owned infrastructure assets are not currently available for purchase, they are not part of our estimate of the size of unique infrastructure.

Chambers [2007], citing data from the Bureau of Economic Analysis (BEA), estimates the value of private infrastructure at $3.0 trillion, although it is unclear exactly how the author is defining private infrastructure. The most applicable numbers come from Keating [2008], which estimates the total available infrastructure investment opportunity set to be valued at more than $2.5 trillion with listed infrastructure accounting for $2.1 trillion, private equity around $300 billion, and, most importantly, direct unique infrastructure around $200 billion.

It is important to note that estimates of required investments as well as estimates of yet to be privatized infrastructure (i.e. infrastructure that is unavailable for purchase) have no bearing on the estimate of the current size of the available asset class. We believe quantifying the value of unique infrastructure remains an important endeavor for future research. For now, we proceed with an estimate of $1.25 trillion, which implies a weight in the market portfolio of approximately 1.46%. All else equal, a lower estimate would reduce the allocations to infrastructure and vice versa.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

For each of the assets in our opportunity set, Table 13 presents our estimate of the market value and its corresponding weight in the working definition of the market portfolio implied by our opportunity set. There are four slightly different definitions of the market portfolio – the base case definition without infrastructure and the three definitions based on the three different infrastructure asset class proxies. Each of the infrastructure proxies leads to slightly different definition of the market portfolio, so they also lead to slightly different forward-looking returns.

Table 13: Working Version of Market Portfolio

Asset Class	Market Values (billions)	Weights (Base Case)	Weights (With Infra-structure)
Cash	$ 919.5	1.09%	1.08%
U.S. Bonds	$ 10,791.5	12.83%	12.65%
Non-U.S. Bonds	$ 17,023.0	20.24%	19.95%
Global High Yield	$ 884.9	1.05%	1.04%
U.S. Stocks	$ 13,788.5	16.40%	16.16%
Non-U.S. Developed Stocks	$ 15,796.0	18.78%	18.51%
Emerging Market Stocks	$ 3,440.7	4.09%	4.03%
Global Real Estate	$ 10,122.7	12.04%	11.86%
Commodity Futures	$ 9,625.0	11.45%	11.28%
Global Private Equity	$ 1,700.0	2.02%	1.99%
Infrastructure (Low Utilities)	$ 1,250.0	N/A	1.46%
Infrastructure (Avg. Utilities)	$ 1,250.0	N/A	1.46%
Infrastructure (High Utilities)	$ 1,250.0	N/A	1.46%

Having defined four working versions of the market portfolio that include infrastructure, we can now develop four CAPM-based estimates of expected returns. Each set of expected returns is calibrated so that the expected total return on U.S. equities equals 9.98%, where 4.34% is the current yield of the 20-year U.S. Treasury bond and 5.64% is Ibbotson's current long-term forward-looking risk premium on U.S. equities. Due to space considerations and the similarity of the of the four sets of expected returns, we present the CAPM expected returns associated with our definition of the market portfolio that includes Infrastructure (Average Utilities) in Table 14.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

Table 14: CAPM Expected Returns

Asset Class	Risk-Free Rate		Beta Relative to Market Portfolio		Market Risk Premium		CAPM Return
Cash	4.34%	+	-0.02	x	3.86%	=	4.27%
U.S. Bonds	4.34%	+	0.04	x	3.86%	=	4.48%
Non-U.S. Bonds	4.34%	+	0.35	x	3.86%	=	5.68%
Global High Yield	4.34%	+	0.67	x	3.86%	=	6.91%
U.S. Stocks	4.34%	+	1.46	x	3.86%	=	9.98%
Non-U.S. Developed Stocks	4.34%	+	1.84	x	3.86%	=	11.46%
Emerging Market Stocks	4.34%	+	2.13	x	3.86%	=	12.56%
Global Real Estate	4.34%	+	1.69	x	3.86%	=	10.88%
Commodity Futures	4.34%	+	-0.05	x	3.86%	=	4.15%
Global Private Equity	4.34%	+	2.19	x	3.86%	=	12.78%
Infrastructure (Avg. Utilities)	4.34%	+	1.22	x	3.86%	=	9.04%

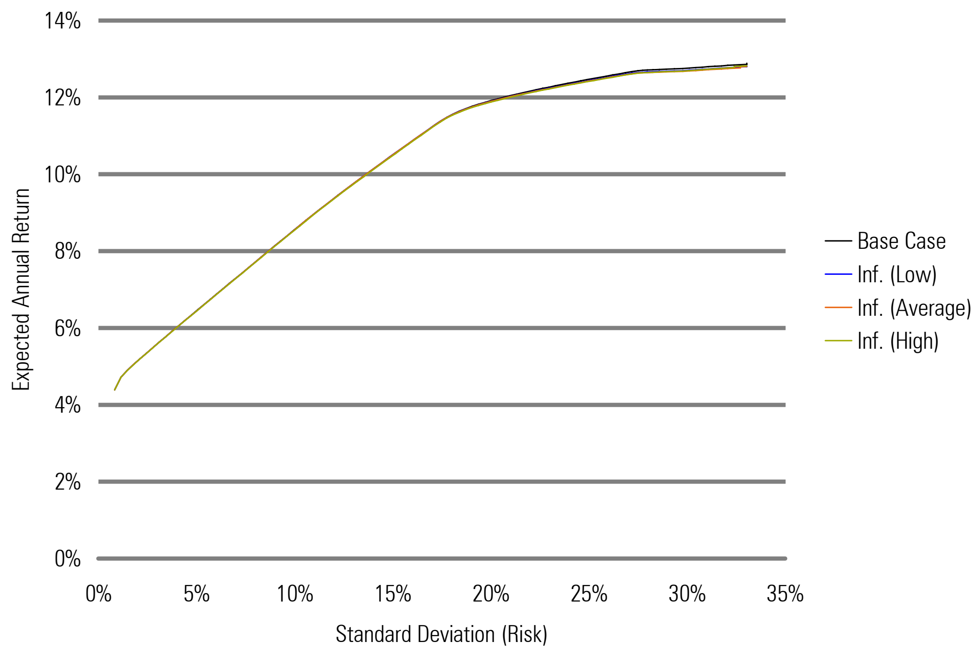
Source: Morningstar EnCorr

By coupling the forward-looking CAPM expected returns presented in Table 14 (as well as the three slightly different sets of CAPM returns that are not shown) with the appropriate historical standard deviations from Table 8 and the historical correlations from Table 9, we arrive at four new sets of forward-looking capital market assumptions. Using these four sets of forward-looking capital market assumptions and our resampled mean-variance optimizer, we carried out four forward-looking optimizations. The forward-looking efficient frontiers are presented in Figure 4.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson

Figure 4: Forward-Looking Efficient Frontiers



Source: Morningstar EnCorr

In the forward-looking optimizations, adding infrastructure did not lead to a meaningful improvement in the efficient frontier, as the four frontiers are nearly on top of one another. Nevertheless, as we saw with the historical optimizations, there are surprisingly large allocations to infrastructure. Panels A, B, C, and D of Figure 5 present the efficient frontier asset allocation area graphs from the forward-looking optimizations.

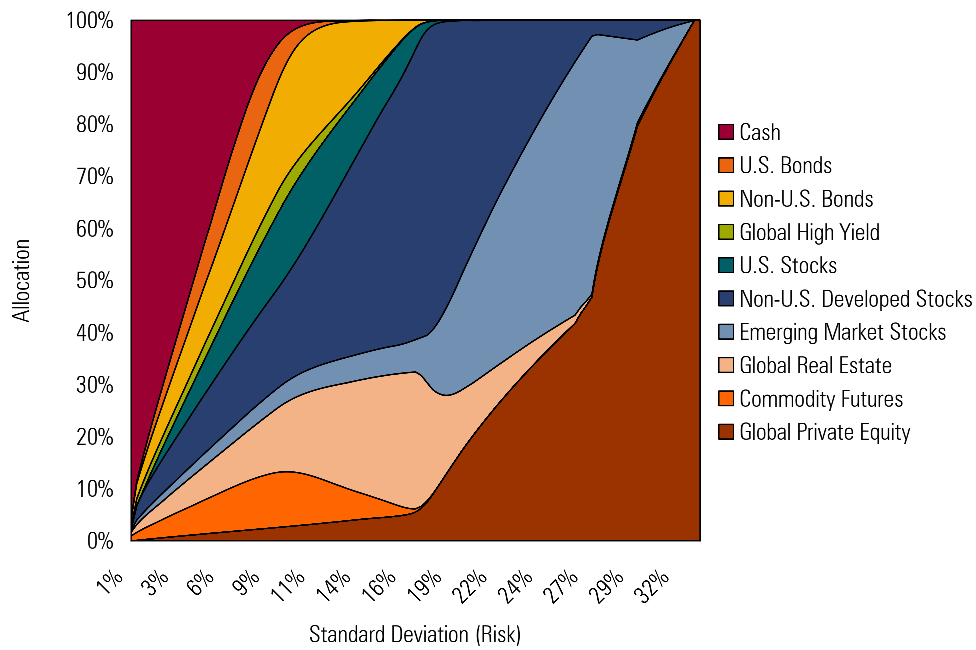
How is it possible to obtain efficient frontiers that are virtually identical in risk and return space yet have substantially different asset allocations, most notably, the large allocations to infrastructure? This is a fairly common observation that occurs because there are multiple asset allocations that have virtually the same level of efficiency. Of course, to an optimizer, a fraction of a basis point is still an improvement. In this case, within the resampled mean-variance optimization during the Monte Carlo simulation procedure, there were a number of instances when the characteristics (return, risk, and standard deviation) were attractive enough to warrant an allocation in the intermediate traditional mean-variance optimizations.

The most striking difference between the historical asset allocation graphs (Panels A, B, C, and D of Figure 3) and the forward-looking asset allocation graphs (Panels A, B, C, and D of Figure 5) is the level of diversification. The forward-looking asset allocations include all of the assets in the opportunity set.

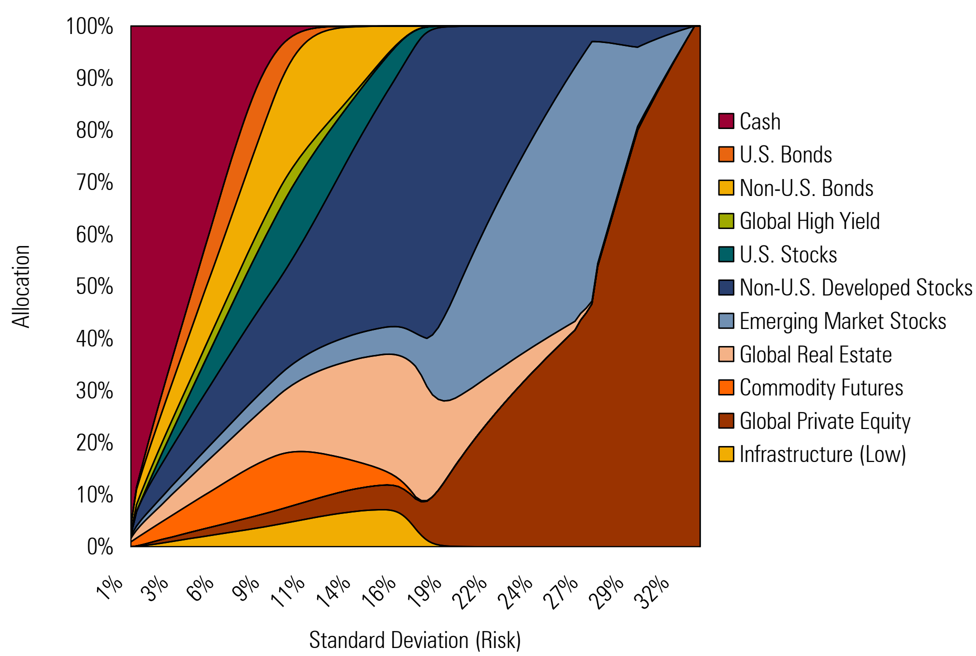
©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Figure 5: Forward-Looking Efficient Frontier Asset Allocation Area Graphs

Panel A – Base Case

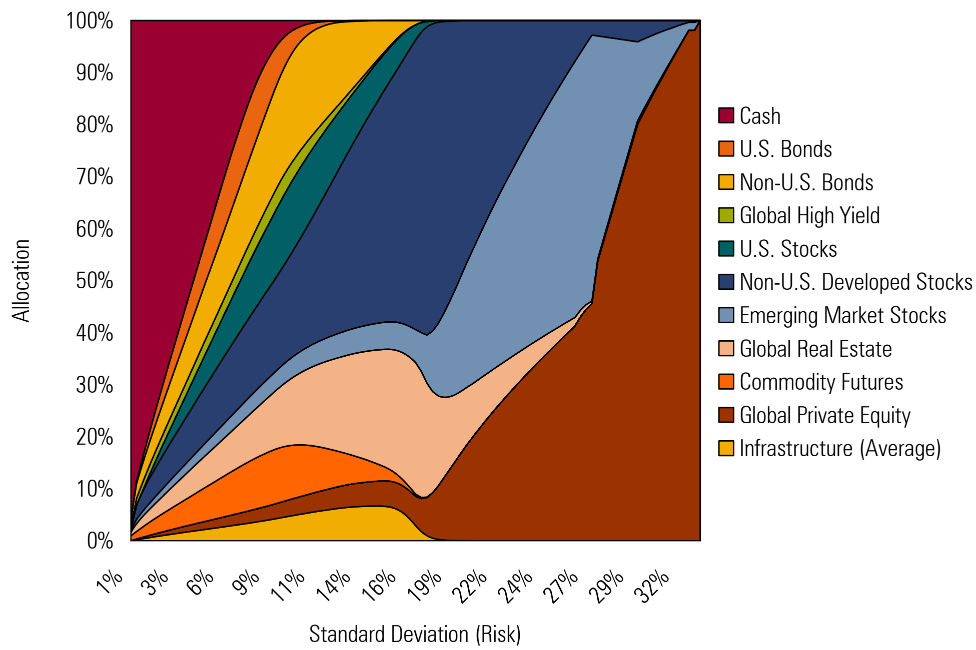


Panel B – Infrastructure (Low Utilities)

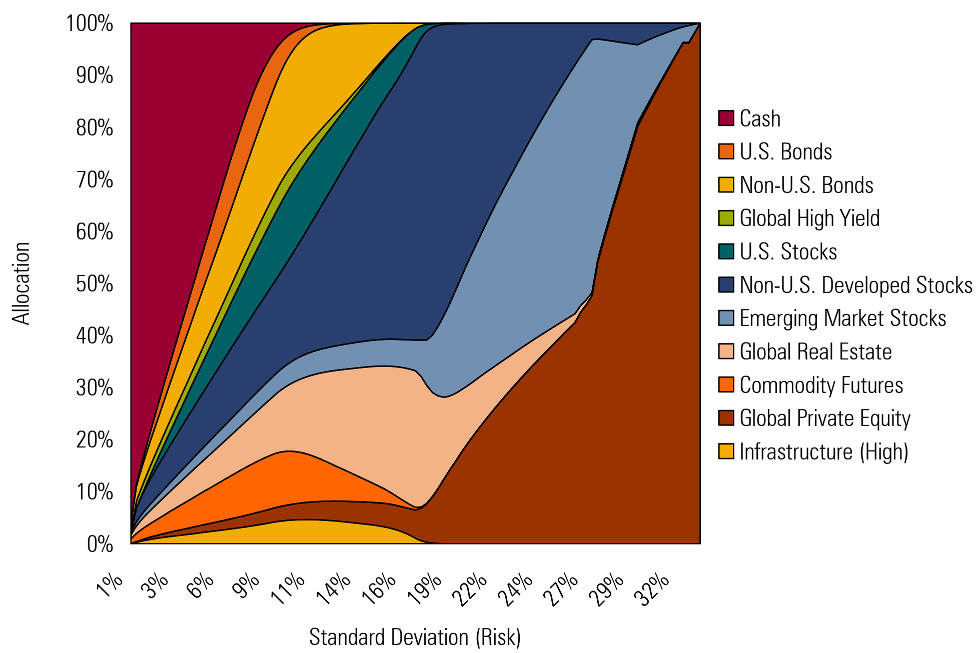


©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Panel C – Infrastructure (Average Utilities)



Panel D – Infrastructure (High Utilities)



Source: Morningstar EnCorr

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

As we did during the historical analysis, in Table 15 we identified specific asset allocations based on risk that we loosely refer to as Conservative, Moderate, and Aggressive. In a forward-looking context, these asset allocation mixes are far more reasonable than the historical asset allocation mixes. Nevertheless, practitioners should not blindly follow the asset allocations from an unconstrained optimizer. The results should be carefully studied to help improve one's current models and guidelines.

Many of the allocations reflect the weights of our "global" working version of the market portfolio. For example, in contrast to typical U.S. asset allocation models that reflect a significant U.S. home country bias, these asset allocations contain larger allocations to non-U.S. stocks and bonds, reflecting the fact that the supply of non-U.S. stocks and bonds greatly exceeds the supply of U.S. stocks and bonds.

Although it varies slightly across the three risk-based mixes, the allocations to infrastructure are sourced from similar mixes of bonds, equity, and real estate with proportions of approximately 30%, 50%, and 20%, respectively. The percentage allocated from equity is split among U.S. and non-U.S. stocks, with slightly larger allocations from U.S. stocks. Within bonds, the majority of the infrastructure allocations are sourced from non-U.S. bonds (70-80%) while global high yield accounts for the remainder.

Table 15: Forward-Looking Asset Allocation Mixes

Asset Class	**Conservative 4% Standard Deviation**		**Moderate 8% Standard Deviation**		**Aggressive 12% Standard Deviation**	
	Base Case	With Infrastructure	Base Case	With Infrastructure	Base Case	With Infrastructure
Cash	54.6%	54.6%	12.1%	12.1%	0.1%	0.1%
U.S. Bonds	6.2%	6.0%	10.9%	10.6%	0.6%	0.7%
Non-U.S. Bonds	9.1%	8.9%	17.9%	17.4%	18.9%	18.3%
Global High Yield	2.5%	2.4%	4.0%	3.7%	2.0%	2.0%
U.S. Stocks	4.8%	4.3%	12.3%	11.3%	13.5%	12.2%
Non-U.S. Developed Stocks	9.3%	8.9%	16.8%	16.0%	30.5%	28.3%
Emerging Market Stocks	2.0%	2.0%	3.5%	3.5%	4.7%	4.5%
Global Real Estate	5.2%	4.9%	10.3%	9.5%	18.4%	16.8%
Commodity Futures	5.2%	5.2%	9.9%	9.8%	7.7%	7.8%
Global Private Equity	1.1%	1.1%	2.2%	2.4%	3.6%	3.8%
Infrastructure		1.6%		3.6%		5.5%
Bonds	72.4%	71.9%	44.9%	43.9%	21.6%	21.1%
Equities	17.1%	16.4%	34.9%	33.2%	52.3%	48.8%
Other	10.5%	11.7%	20.2%	22.9%	26.1%	30.1%
Return	6.02%	6.02%	7.71%	7.71%	9.37%	9.37%

Source: Morningstar EnCorr

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Other Considerations & Implications

One of our core beliefs is that expanding the opportunity set of available asset classes should improve the long-term risk and return characteristics of strategic asset allocation models. When developing an asset allocation policy, one should look to the all-inclusive global market portfolio for general guidance. As the composition of the market portfolio evolves, so does its guidance. In coming years, governments around the world may be inclined to privatize additional infrastructure assets. As this happens, the role of the unique infrastructure that is available for purchase will increase and we would expect to see average strategic asset allocations to unique infrastructure rise.

Moving from the asset allocation (or beta) decision to the product implementation (or alpha) decision, we believe investors will face a tough choice that affects the beta decision. Investors without access to unique infrastructure must make one of two choices: 1) exclude infrastructure from their strategic asset allocation opportunity sets, or 2) include infrastructure in their strategic asset allocation opportunity sets and then implement the target allocation with the best available implementation vehicle, which is likely to be a collection of listed infrastructure companies.

Conceptually, this is the same difficult decision that is made for private equity, commercial real estate, and to a lesser degree, commodities, where investors sometimes include an asset allocation to commodities that they implement with a collection of "natural resource" listed companies. Most investors do not have access to true private equity and direct real estate. Today, it is relatively common for investors without access to direct real estate to include an allocation to the real estate asset class that they then implement with listed commercial real estate companies (e.g. real estate investment trusts, or REITs). We believe a number of investors will emulate the real estate/REIT model, implementing private equity and infrastructure asset class targets with collections of listed companies deemed to be suitable substitutes for the true exposures they are seeking.

As non-institutional investors seeking to follow the investment strategies of Yale and Harvard have raced to include asset classes like commercial real estate, private equity, and now infrastructure implemented through listed equities, they could potentially distort capital markets. The widespread adoption of what we call macro-inconsistent implementation strategies could have implications that are not yet well understood. By design, strategic asset allocations are long-term investments and to some degree the money that is parked in these investment solutions represents a semi-permanent demand

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

for the securities that are used to implement these models. Should a large number of investors include a strategic asset allocation to unique infrastructure that is implemented with listed infrastructure, this could result in a long-run supply and demand imbalance. There is a limit to the degree to which investors can sell off core equity holdings to purchase individual sectors of the whole.

We should highlight that investors may choose to implement the target strategic asset allocation with investments in listed infrastructure companies that greatly exceed the unique infrastructure target asset allocation. There are two primary reasons for this. First, some investors prefer to use focused sector managers rather than more traditional style-oriented managers. Second, from a tactical or thematic perspective, investors believe that the need for infrastructure improvements will lead to superior risk-adjusted excess returns.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Conclusions

We believe infrastructure is indeed an asset class. The infrastructure asset class represents a logical grouping of assets that share similar characteristics that collectively have an inherent, non-skill-based return. As such, we believe infrastructure is an asset class and should be part of the strategic asset allocation opportunity set. Unfortunately, most broad definitions of the infrastructure asset class overlap with other asset classes. We believe asset allocators should adopt a relatively narrow definition of the infrastructure asset class for strategic asset allocation purposes that centers on unique infrastructure. However, we recognize that most investors cannot access direct infrastructure, the type of investment that most closely replicates the theoretical definition of unique infrastructure.

We used a variety of listed infrastructure composite indices to proxy the infrastructure asset class. The use of listed infrastructure indices to proxy the unique infrastructure asset class is analogous to the use of listed commercial real estate indices (e.g. the NAREIT) to proxy the direct commercial real estate. Despite our initial concerns regarding the use of listed infrastructure indices to proxy the unique infrastructure asset class, we found empirically that the various listed infrastructure asset class proxies seem to offer a unique investment opportunity. We also believe a number of investors will choose to gain exposure to infrastructure using the best available implementation vehicle, listed infrastructure stocks, just as they have used REITs to gain exposure to real estate.

In a series of traditional mean-variance optimization based on historical capital market assumptions, including infrastructure in the opportunity results in a slight improvement in the efficiency of the resulting asset allocations. The improvement was greatest in the heart of the efficient frontier. The maximum improvement above the base case optimization mixes relative to the three optimizations with infrastructure was around 18 basis points. Despite the small improvement in the efficiency of the historical efficient frontiers, the efficient asset allocation mixes contained rather large allocations to infrastructure. The primary sources of the infrastructure allocations appear to be non-U.S. bonds and global high yield bonds.

In a series of forward-looking optimizations based on forward-looking capital market assumptions and a resampled mean-variance optimizer, adding infrastructure did not lead to a meaningful improvement in the efficient frontier, as the four frontiers are virtually on top of one another. Nevertheless, as we saw with the historical optimizations, there are surprisingly large allocations to infrastructure. The allocations to infrastructure ranged from

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

0% to nearly 6%. The sources of the infrastructure allocations varied across the efficient frontier with allocations coming from a broad mix of bonds and equities, including U.S. stocks, non-U.S. stocks, non-US bonds and real estate.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Notes and Acknowledgements

Correspondence should be sent to:
Ibbotson Associates, Inc.
22 West Washington Street
Chicago, IL 60602
312 696 6700
312 696 6701 fax
ibbotson.com

Acknowledgements:
We want to thank FAF Advisors for supporting this work. Additional assistance and support was provided Alexa Auerbach, Asieh Mansour, Jaimala Patel, and Pankaj Srivastav. All errors and omissions remain those of the authors.

Important Notice:
This paper is not studying the characteristics of any particular investment product. As is common with asset allocation studies, reasonable indices are used as proxies to help understand the characteristics of returns.

About Ibbotson Associates
Ibbotson Associates is a leading independent asset allocation provider offering investment advisory services, retirement advice programs, and customized research. Ibbotson applies academic research to create real-world solutions for financial institutions. Our clients include many of the top brokerage firms, insurance companies, banks, asset managers, and retirement plan providers. Ibbotson was founded in 1977 and is a Morningstar company.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

References

Black, Fischer, and Robert Litterman. (1992). "Global Portfolio Optimization." Financial Analysts Journal, September/October, 28-43.

Campbell, John, and Luis Viceira. (2002). Strategic Asset Allocation: Portfolio Choice for Long-Term Investors. New York: Oxford University Press.

Ibbotson, Roger G., and Peng Chen. (2003). "Long-Run Stock Returns: Participating in the Real Economy." *Financial Analysts Journal*, January/February, 88-89. *

Idzorek, Thomas M. (2007a). "Commodities and Strategic Asset Allocation," in *Intelligent Commodity Investing*, edited by Hilary Till and Joseph Eagleeye.

Idzorek, Thomas M. (2007b). "Private Equity and Strategic Asset Allocation." Ibbotson Associates Research Report.

Idzorek, Thomas. (2008). "Lifetime Asset Allocations: Methodologies for Target Maturity Funds." Ibbotson Associates Research Report. http://corporate.morningstar.com/ib/asp/detail.aspx?xmlfile=1409.xml

Idzorek, Thomas, Mike Barad, and Steve Meier. (2007). "Global Commercial Real Estate." *The Journal of Portfolio Management*. Special Real Estate Issue, 37 – 53.

Keating, Edward. (2008). "Global Infrastructure – A 'New' Alternative Asset Class." Lazard Asset Management.

Lintner, John. (1965). "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets." *Review of Economics and Statistics*, February, 13-37.

Mossin, Jan. (1966). "Equilibrium in a Capital Asset Market." *Econometrica*, October, 768-783.

Sharpe, William F. (1964). "Capital Asset Prices: A Theory of Market Equilibrium." *Journal of Finance*, September, 425-442.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

Sharpe, William F. (1974). "Imputing Expected Security Returns from Portfolio Composition." *Journal of Financial and Quantitative Analysis*, June, 463-472.

Sharpe, William F. (1988). "Determining a Fund's Effective Asset Mix." Investment Management Review, December, 59-69.

Sharpe, William F. (1992). "Asset Allocation: Management Style and Performance Measurement." The Journal of Portfolio Management, Winter, 7-19.

Stafford, Craig, and Han Xu. (2008). "Global Infrastructure & Utilities Monthly." UBS Investment Research, September 5.

Treynor, Jack L. (1961). "Market Value, Time, and Risk." Unpublished Manuscript dated August 8, 1961.

Treynor, Jack L. (1962). "Toward a Theory of Market Value of Risky Assets." Unpublished Manuscript dated Fall 1962.

©2009 Ibbotson Associates, Inc. All rights reserved. Ibbotson Associates, Inc. is a registered investment advisor and wholly owned subsidiary of Morningstar, Inc. The information contained in this presentation is the proprietary material of Ibbotson Associates. Reproduction, transcription or other use, by any means, in whole or in part, without the prior written consent of Ibbotson Associates, is prohibited.

ibbotson