Morgan Stanley

Investing in Infrastructure: A Primer

INFRASTRUCTURE PAPER SERIES

No. 1 **Standard & Poor's Risk Solutions** 2006
Infrastructure Project Finance Defaults and Ratings Transitions Study—1992-2003
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High and stable cash flows with long durations, inflation protection potential, and low correlation to traditional asset classes are allowing infrastructure to take its place as an asset class in its own right.

Introduction

On November 4, 1977, a wealthy investor from the U.S. Midwest took the stand in a Buffalo, N.Y. courtroom to defend himself against charges of anti-competitive behavior following his acquisition of one of the town's two local newspapers, the *Buffalo Courier-News*. The rival newspaper's lawyer intensely probed his interest in another form of monopoly—toll bridges. His response is informative: "I have said in an inflationary world that a toll bridge would be a great thing to own…"

Warren Buffett was not asked nor did he feel obliged to mention that through an entity controlled by Berkshire Hathaway, he already owned 24% of the stock of the Detroit International Bridge Co., the owner of the Ambassador Bridge between Detroit and Windsor—at the time, the only toll bridge that was owned by stockholders in the United States.

The same characteristics that motivated Buffett in the 1970s to invest in infrastructure are attracting a new wave of institutional investors around the globe. These new investors are in addition to the institutional investors in Europe, Canada and Australia who have invested in the asset class for years. Infrastructure assets are in demand due primarily to their relative independence from business cycle risk and their historically stable operating cash flows correlated to inflation. The assets generally provide essential services, and are typically characterized as having large, upfront capital expenditures, high barriers to entry, and natural or regulated monopoly characteristics.

By virtue of its distinct investment characteristics, infrastructure should be considered an emerging asset class in its own right. Growing numbers of financial institutions are investing in infrastructure as they seek to diversify returns. For pension funds in particular, looking to solve pension deficit problems, infrastructure has the twin attractions of durations that are similar to their liability profiles and the capacity to put large sums of money to work. By investing relatively large sums of capital in infrastructure assets, pension fund trustees may make material advances towards reducing their deficits with a reasonable degree of certainty.

What is Infrastructure?

Infrastructure assets typically provide essential public goods or essential services to a broad range of users. However, infrastructure as an investment proposition could have a different meaning to different investors. While infrastructure as an asset class is often compared with private equity and real estate, it has distinct characteristics such as substantially longer duration, historically lower risk and less sensitivity to the business cycle. Depending on one's definition of infrastructure and the associated risk profile, internal rates of return have ranged from 9%–18%.[1] Returns depend on the specific characteristics of the asset, including its stage of development (mature or growing) or whether it is "Greenfield" (i.e., a project that needs to be constructed) or "Brownfield" (existing asset). The jurisdiction in which the investment is located could also impact the returns, with investments in emerging markets generally commanding a premium to investments in industrial economies.

In this paper, we define infrastructure assets as those assets typically demonstrating a number of the following characteristics:

- Essential to society or the economy;
- Long, useful lives;
- Monopoly/quasi-monopoly market position or high barriers to entry;
- Operate in regulated environments and/or exhibit resistance to business cyclicality;
- Produce stable, predictable cash flows, often linked to inflation; and
- Are difficult to replicate due to high construction costs and scarcity of resources (i.e., land, equipment and planning restrictions) such as large transportation projects (airports, rail systems, tunnels, etc.).

For purposes of this analysis, we split the asset class into four main categories: Transportation, Energy and Utilities, Communications and Social Infrastructure. Figure 1 provides examples of each category, however, there are other descriptions that can be adopted.

[1] Past performance is no guarantee of future results. The estimated returns or projections are provided by way of example only. There can be no assurance that estimated returns or projections can be realized or that actual returns or performance results will not be materially lower than those estimated herein. The expected returns do not reflect the performance of any Morgan Stanley Investment Management investment. The estimated returns or projections are based on the research, analysis and opinions of the authors and on Morgan Stanley's propriety models and various assumptions, and any changes to such models and assumptions could have a material impact on the returns set forth herein.

Figure 1: Examples of Infrastructure Assets

TRANSPORTATION	ENERGY AND UTILITIES	COMMUNICATIONS	SOCIAL INFRASTRUCTURE
Toll roads/tunnels/bridges	Oil and gas pipelines	Cable networks	Education facilities
Airports	Regulated electricity assets	Communications towers	Health care facilities
Ports	Transmission and distribution systems	Select satellite systems	
Rail and mass transit networks	Water treatment and distribution facilities		
Municipal parking facilities			

Source: Morgan Stanley Investment Management

It is important to understand the performance characteristics of infrastructure relative to other asset classes. While existing indices have difficulty capturing the array of infrastructure assets in the marketplace, it is instructive to apply return and risk measures to facilitate comparisons with established asset classes. We have used a business cycle model to analyze the optimal allocation of infrastructure relative to other asset classes in an Asset–Liability Framework.[1] Five asset classes are considered. The primary focus is the bond/equity allocation in the presence of infrastructure, but we have also included real estate and private equity as comparable asset classes which exhibit some similarities to those of infrastructure.

We may summarize the simulated asset classes as follows. Government bonds are mapped to a generic U.S. government bond index with a constant duration of five years. Domestic equities represent liquid U.S. equities, and are based on a long history of S&P 500 return data. Real estate is modeled as direct investment into the U.S. office sector. Calibration of the real estate model is informed by historical office real estate index values from the National Council of Real Estate Investment Fiduciaries. Private equity is modeled as U.S. private equity, heavily weighted towards venture capital. Historical data was examined from Cambridge Associates LLC.

The simulations were performed from the perspective of a U.S. investor, with all returns expressed in U.S. dollars. A total of 1,000 scenarios were run for a 15-year horizon resulting in the summary table provided in Figure 2.

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The returns for the infrastructure asset class are modeled on expected performance and represents a return net of fees and expenses that an investor would typically pay if investing through a fund vehicle. The correlation matrix is based on past performance across the sectors. For the particular case of the correlation coefficient between the infrastructure asset and other classes, we have made assumptions based on limited existing evidence which have been stress tested. Figure 2 provides an indication based on internal estimates of what we believe are expected returns and correlations across asset classes based on historical data.

Figure 2: Expected Returns and Correlations[1,2]

ASSET RETURNS	EXPECTED RETURN[3]	ANNUALIZED VOLATILITY[4]	WORST 5% RETURNS[5]		
Bonds (5-year duration)	5.2%	4.4%	3.1%		
Equities	8.1%	18.2%	1.1%		
Real estate	7.0%	9.5%	(1.3)%		
Infrastructure	9.3%	7.9%	(1.5)%		
Private equity	10.0%	30.2%	(7.3)%		
CORRELATIONS[6]	**BONDS**	**EQUITIES**	**REAL ESTATE**	**INFRASTRUCTURE**	**PRIVATE EQUITY**
Bonds	100%	11%	40%	20%	6%
Equities		100%	8%	15%	34%
Real estate			100%	21%	5%
Infrastructure				100%	12%
Private equity					100%

Source: Morgan Stanley Asset-Liability model
Data as of May 2007
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[2] Five asset classes were considered for this analysis. The primary focus is in the bond/equity allocation in the presence of infrastructure, but we have also included real estate and private equity as comparable asset classes that exhibit some similarities to those of infrastructure. The simulations were performed from the perspective of a U.S. investor, with all returns expressed in U.S. dollars.

[3] Expected return defined as the scenario average log geometric mean return over 15 years. There is no guarantee that the expected returns will be the actual returns. The expected returns do no reflect the performance of any Morgan Stanley Investment Management investment.

[4] Volatility defined as the scenario average annualized standard deviation of the path-wise quarterly returns.

[5] Worst 5% returns defined as the average log geometric mean return over 15 years observed in the worst 5% of scenarios (worst 50 scenarios out of 1,000). There is no guarantee that the Worst 5% Returns will be actual returns. The Worst 5% Returns do no reflect the performance of any Morgan Stanley Investment Management investment.

[6] Correlation defined as the scenario-wise correlation of 15 year log geometric mean returns between each pair of asset classes.

Figure 3: Summary of Default Results

CUMULATIVE DEFAULT RATES (%)		SAMPLE SIZE	1-YEAR	5-YEAR
Panel A:	**All Countries**			
Infrastructure projects	All	120	0.97	4.73
Corporate	All	1,227	2.02	8.16
Panel B:	**Emerging Countries (Number of Sample)**			
Infrastructure projects	All	26	2.73	14.69
Corporate	All	213	4.29	19.56
Panel C:	**Non-Emerging Countries (Number of Sample)**			
Infrastructure projects	All	94	0.25	1.23
Corporate	All	1,014	1.82	7.20

Source: S&P Risk Solutions calculation, November 2006

Our modeling analysis also includes an analysis of default rates for infrastructure investments. A recent Standard & Poor's study of infrastructure project finance defaults provides some evidence of the asset class' stability.[1] While the study focuses only on infrastructure project debt, it nonetheless sheds light on the inherent stability of infrastructure as an asset class. The sample data used for the study is composed of 120 rated infrastructure projects, of which 94 are located in industrial economies and 26 are in emerging market countries. The study compares the sample to the data set for corporates in the infrastructure sector, using 1,014 observations in industrial economies and 213 in emerging markets. The main findings of the study indicate that for infrastructure projects in industrial economies, the one-year and five-year cumulative default rates are 0.25% and 1.23% respectively, compared to the corporate one-year and five-year cumulative default rates of 1.82% and 7.20%, respectively. In emerging markets, the one-year and five-year cumulative default rates for infrastructure projects are 2.73% and 14.69% respectively, which are lower than the cumulative default rates for corporates (4.29% and 19.56%, respectively). Finally, infrastructure projects exhibit greater rating stability than corporates whether in industrial economies or emerging markets. Rating stability, also referred to as ratings transitions, measures the number of projects with a particular rating to be rated the same rating grade over a specified period: the higher the number, the lower the ratings volatility. Infrastructure projects had a 96.65% average ratings transition over the period 1992–2003, compared to corporate ratings in the infrastructure sector of 76.05%.

[1] See Infrastructure Paper No. 1, Standard & Poor's Risk Solutions (2006) "Infrastructure Project Finance Defaults and Ratings Transitions Study 1992-2003."

Infrastructure in an Asset Allocation Framework

Our asset-liability model indicates that including infrastructure investments with moderate returns and expected low correlations in a portfolio with other asset classes, improves the optimal risk-return tradeoff in a portfolio. Moreover, the high likelihood of stable returns that may be offered in most cases can provide the potential investor with some of the positive features of long-duration assets (cf. real estate, bonds). This makes the infrastructure asset class especially attractive to the long-term investor such as a pension fund or life insurance company. The downside risks are related to a few key factors:

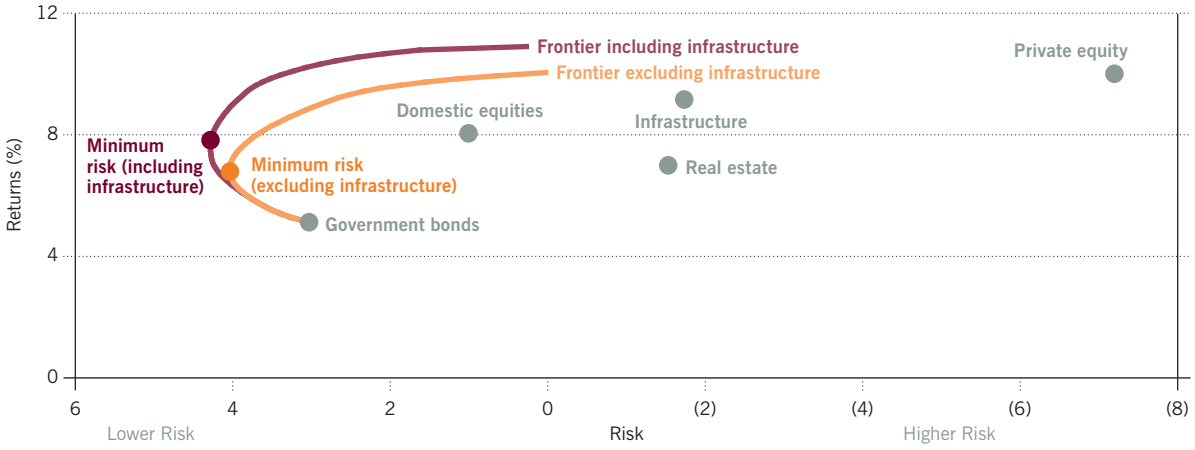
- The risk of an impaired exit valuation in depressed markets;
- The potential for realized revenue volumes to be significantly lower than those projected and/or cost overruns;
- The risk that the nature of the asset fundamentally changes during the life of the project (e.g., the state sponsor alters the terms of a concession);
- Macroeconomic factors such as low GDP growth or high nominal rates raising the average cost of funding; and
- The probability of default caused by any of these factors is provided by the S&P study.

The risk-return chart in Figure 4 shows how various individual asset classes perform, as well as the effect of combining the asset classes for an optimized set of asset allocations. The "efficient frontier" maps out portfolio mixes which offer the best diversification properties, and therefore the lowest risk, for a given return level. The orange line shows the effect of combining different asset classes to minimize risk for a given level of return, excluding infrastructure. The burgundy line shows the effect of adding infrastructure to the previous frontier. The difference between the burgundy and the orange lines is therefore the benefit available, in terms of increased return and decreased risk, from investing in infrastructure.

The minimum risk portfolios (illustrated by the burgundy and orange circles in Figure 4) indicate the portfolios that minimize downside risk on the frontiers with and without infrastructure, respectively. The lowest returning asset class (government bonds) does not have the lowest possible downside risk, because of the diversification benefits associated with combining different asset classes.

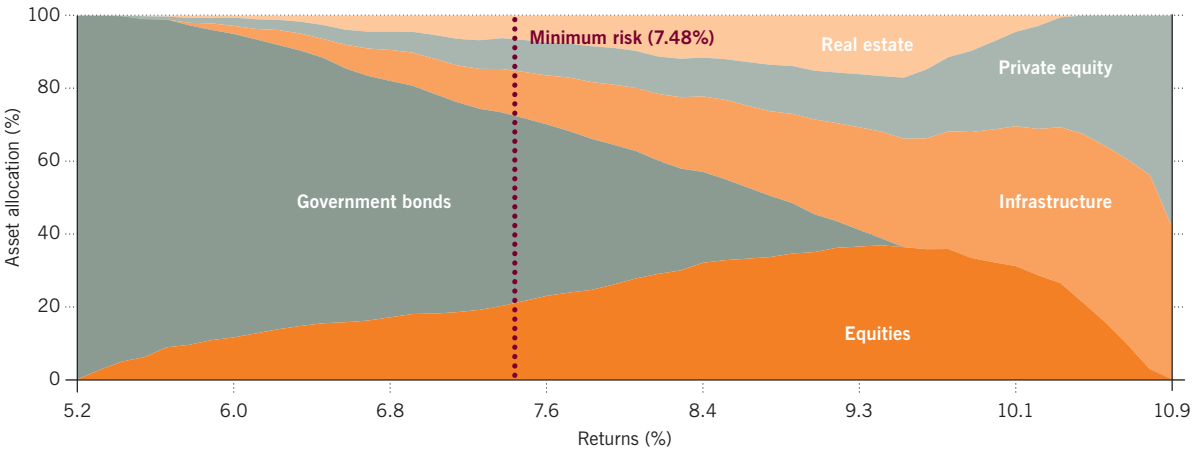
The heat map in Figure 5 shows the optimal portfolio allocations of five asset classes corresponding to the burgundy (efficient frontier) line in Figure 4. The horizontal axis on this heat map corresponds to the vertical (returns) axis in Figure 4. As we move along the frontier and increase expected return, the asset allocation shifts from 100% allocation to bonds towards an increased allocation to equities and alternatives. The dotted burgundy line shows the asset allocation corresponding to the minimum risk portfolios on the efficient frontier. The portfolio composition at the dotted line is well-diversified and consists of a balanced mix of the five different asset classes.

Figure 4: Efficient Frontier (Average Log Geometric Return; Risk = Return in Worst 5% of Scenarios)[1]



Source: Morgan Stanley Asset-Liability model
Data as of May 2007
Risk scale is inverted. Higher number implies lower risk

Figure 5: Asset Allocation Versus Return—Including Infrastructure[1]



Source: Morgan Stanley Asset-Liability model
Data as of May 2007

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Figure 6 shows risk and return characteristics for the five asset classes included on the efficient frontier chart in Figure 4, together with the corresponding asset allocations.

Although the minimum risk point is an allocation to infrastructure of around 12%, there appears to be a favorable risk-return tradeoff to increasing the allocation to 15%.

Figure 6: Efficient Frontier Analysis

	MINIMUM RISK (WITH INFRASTRUCTURE)	MINIMUM RISK (WITHOUT INFRASTRUCTURE)
Return and risk		
Return	7.48%	6.89%
Risk	4.27%	4.30%
Asset allocation		
Domestic equities	21.60%	22.20%
Government bonds	51.30%	62.00%
Infrastructure	12.20%	0.00%
Private equity	8.50%	7.10%
Real estate	6.30%	8.70%

Source: Morgan Stanley Asset-Liability model
Data as of May 2007

The Global Opportunity

The previous section indicates that an optimal portfolio allocation to infrastructure could be as much as 15% of the total portfolio. What are the opportunities available for investing in infrastructure?

The infrastructure asset class regained prominence in the 1980s when the United Kingdom and Australian governments began to privatize public sector utility companies and to seek private sector funds for further investment. These infrastructure assets generally had quasi-monopoly positions, and so the governments established regulators and pricing tariffs in order to protect the public. Straightforward privatization sales were soon followed by public-private partnerships (PPPs) in sectors as diverse as prisons, air traffic control and waste management. Investors were attracted by the same characteristics that they look for today—returns that remain reasonably stable regardless of the business cycle.

Countries in continental Europe, in particular France and Spain, also adopted a PPP framework but not to the same extent as the United Kingdom or Australia. Privately owned toll roads are commonplace in countries such as France, Portugal and Spain. The private sector is also involved in airport companies across Europe.

In the United States, a limited number of private sector consortiums own long-term concessions to operate transportation assets such as the Chicago Skyway, the Indiana Toll Road and the Chicago Downtown Parking System. Furthermore, specialist operating companies own concessions to operate many of the country's ports. Additionally, there is increasing private ownership of electric and water utilities. Because governments have typically tapped the municipal (tax-exempt) bond markets to finance infrastructure projects, the trend towards private investment in infrastructure has grown more slowly than in other industrial countries.

As investors realize the attractions of infrastructure assets, activity in the sector has increased accordingly. According to estimates by Standard & Poor's, some $145 billion was invested globally in the first 11 months of 2006—a 180% increase over 2000. Additionally, the ratings agency has identified up to $150 billion of equity funds waiting to be placed.

Set against this, we believe there is a substantial supply of investment opportunities. Governments all over the world must refurbish old infrastructure and build new facilities at a time when most are constrained by pressures to reduce debt and address budget deficits. We estimate, conservatively, that over the next 10 to 15 years, global infrastructure investment requirements may exceed several trillion dollars, with a significant share financed privately. At the same time, in mature markets where the private sector has been operating for some time, private companies continue to restructure balance sheets, divesting capital-intensive assets and therefore generating further investment opportunities.

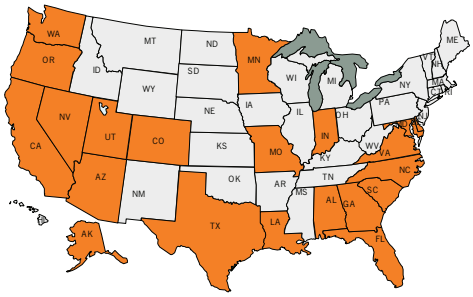
Continued global economic expansion is creating a huge need for infrastructure investment. In developed countries, there is a need to upgrade or replace aging infrastructure, especially roads, water and electricity generation. In developing countries, there is an acute demand for new infrastructure, especially for electricity generation, water and sanitation.

United States

In the United States, there is growing political acceptance of the need for private funding. Norman Mineta used his final speech as Transportation Secretary in summer 2006 to urge lawmakers and transportation policy leaders to continue to court private finance for public infrastructure investment. Public services are suffering from a legacy of under-investment in infrastructure assets such as roads, bridges, tunnels, mass transit networks and water treatment and distribution facilities. In 2005, the American Society of Civil Engineers estimated a total $1.6 trillion needed to be spent on the nation's bridges, roads, power plants, railways and water systems over the following five years alone to maintain existing assets and develop the systems necessary to accommodate a growing and changing U.S. population.[1]

It is estimated that 400 new power plants and 100,000 miles of electric transmission lines must be built by 2020 to meet demand, costing an average of $35 billion per year.[2] Under-investment in the drinking water and wastewater industry means that annual expenditures may have to nearly double in real terms.[3] Increasing environmental restrictions focusing on consumer quality and security are compounding the aging infrastructure problem. The Environmental Protection Agency forecasts $662 billion of capital needs for the sector between 2000 and 2019.[4]

In order to address the infrastructure funding gap, state governments and public agencies have begun looking to private sources of finance, including privatization and PPPs. For example, the federal government is committed to involving the private sector in transportation services and infrastructure investment to supplement federal, state and local expenditures.[5] Some 21 states have enacted legislation to facilitate PPPs and privatization of existing assets, while yet more are in the process of doing so. In addition, the federal government has extended programs for federal funding of transportation infrastructure, such as Transportation Infrastructure Finance and Innovation Act projects and Private Activity Bonds, to privately-financed concession-based projects.



States that have enacted or introduced PPP legislation as of 2006

Infrastructure Opportunities

Roads
- $100 billion of investments per year[6]

Electricity generation and transmission
- 400 new plants and 100,000 miles of transmission must be built by 2020 to meet demand representing $35 Billion per year of investment[2]

Water distribution and treatment
- $660 billion of capital needs from 2006–2019[4]

Public-private partnerships
- 21 states have enacted/introduced PPP legislation

[1] American Society of Civil Engineers, Report Card for America's Infrastructure, 2005.
[2] L. Makovitch, *Focus on Energy: CERAWEEK 2006,* Cambridge Energy Research Associates, Inc., 2006.
[3] U.S. Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure,* 2002.
[4] U.S. Environmental Protection Agency, Office of Water, *The Clean Water and Drinking Water Infrastructure Gap Analysis,* EPA816-R-02-020, 2002.
[5] Federal Highway Administration, *Report to Congress on Public-Private Partnerships,* 2004.
[6] Committee on Transportation and Infrastructure, U.S. Congress, 2007.

Europe

Europe, too, has an infrastructure in urgent need of maintenance and expansion. The most visible source of growth is the E.U.'s commitment to enhance its economic efficiency through promoting a series of infrastructure projects designed to foster cohesion and growth. These could result in the spending of more than €600 billion by 2020.[1] For example, the Trans-European Networks promote a series of energy and transportation projects across both old and new E.U. members. One such project is the Lyon to Turin transalpine link—a proposed 200km high-capacity rail link for passengers and freight that would cross the Alps. The majority of the target €13 billion cost is intended to be met by a PPP consortium.

With many years experience of private provision of infrastructure, European governments are now increasingly comfortable with the concept. Consequently, there have been several recent privatizations and more are expected. Examples of this include the full privatization of the French toll road operators ASF, SANEF and APRR in 2005, and the announced intention of the Federal Republic of Germany to dispose of its stakes in the Munich and Cologne-Bonn airports.

Energy-related infrastructure is also expected to lead to significant investments in Europe. In particular, environmental legislation in Germany, Denmark, Spain and the Netherlands has stimulated investment in renewable energy.[2] Portfolios of wind farms and solar power facilities have reached critical mass and attract the attention of large investors. At the same time, there continue to be new infrastructure projects in the oil and gas sector, such as in liquefied natural gas, as a result of the E.U. broadening its natural gas supplier base in order to ensure security of supply.

Central Europe, meanwhile, has large infrastructure needs. Assets inherited from the Communist Era were often designed for a planned economy with heavy industrial and military requirements, and are not suited to the market-based economies of today. As these countries have joined the E.U., some PPP-type financings have been introduced.

Countries that have recent PPP legislation/changes as of 2006

Infrastructure Opportunities

Infrastructure needs
- Historical under-investment
- Demographic trends
- Integration of European economies

Public budgetary constraints
- Wider acceptance of PPP/PFI
- Monetization of existing assets

Shifts in public policy
- Increased focus of governments on core responsibilities
- Outsourcing of non-core activities
- Concession arrangements validated as effective model

Liberalization and regulatory framework
- Progressive liberalization programs
- Predictable tariff regulations

Diversification of and environmental trends in energy supply
- Energy supply diversification
- Promotion of renewable energy (e.g., wind) through financial incentives
- Significant investments in conventional energy infrastructure

[1] European Commission, *White Paper: European Transport Policy for 2010—Time to Decide,* 2001, and subsequent reports issued by the Commission.
[2] European Commission, *The Share of Renewable Energy in the EU,* 2004.

Asia

Asia is a diverse mix of developed and developing economies. In the developing countries, there are significant investments underway, but the supply of assets has not kept pace with the demand and sources of capital. High rates of economic growth, urbanization and rising levels of affluence have created bottlenecks and shortages in transportation, power and municipal utility resources. In China and India alone—two of the largest contributors to developing country economic growth—infrastructure investment is likely to be immense.

In 2005, China spent 9% of GDP ($201 billion)[1] on infrastructure. A majority of this was spent on transportation infrastructure. Investment in roads is central to China's plan for transportation and will continue at past levels. Commercial air travel is now expanding rapidly and the backlog of new plane orders and rising passenger levels imply more airport infrastructure is required. In rail, the government has committed to invest $242 billion by 2020.[2] And in ports, China's huge growth in export container traffic means that the significant levels of current investment will continue into the future.

As with China, India's remarkable growth will require significant infrastructure spending in order to be sustained at current levels. It is estimated that India's annual infrastructure spending will climb from 3.6% of GDP currently ($28 billion) to 4.9% ($50 billion) by 2009.[3] With government spending constrained, policy makers are turning to the private sector to participate in the expansion of sectors historically managed by the state. Recent examples of these initiatives include ports where the government has allowed privatization since 1996, and airports where key facilities in Delhi and Mumbai have been leased to private consortia for modernization. In other sectors, such as roads and power, the private sector is investing in new projects independently of government sponsorship.

Elsewhere in Asia, the mature economies such as Australia, Hong Kong, Japan, Singapore, Korea and Taiwan also present opportunities. These are developed economies often with OECD-type risk and returns, and established infrastructure.

[1] Morgan Stanley Research, *India and China: New Tigers of Asia—Part II,* June 2006.
[2] China Knowledge, *Tapping on China's Hidden Advantage: High-Standard Infrastructure,* May 31, 2005.
[3] Morgan Stanley Research, *India and China: New Tigers of Asia—Part II,* June 2006.

Conclusion

We firmly believe that infrastructure should be classified as a distinct asset class. Its investment characteristics may make it an ideal complement to the other asset classes within a portfolio as institutional investors seek to improve their returns and diversification. Stable cash flows, long durations and relatively high expected return potential differentiate infrastructure assets from all other asset classes. Preliminary analysis suggests that infrastructure as an asset class could represent up to 15% of portfolio allocation. The global demand for infrastructure investments is substantial and may exceed trillions of dollars over the coming years.

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