The Investment Characteristics of OECD Infrastructure: A Cash-Flow Analysis

Serkan Bahçeci and Mark Weisdorf

Serkan Bahçeci, PhD, is Executive Director and Head of Infrastructure Research, and Mark Weisdorf, CPA, CA, CFA, CBV, is Managing Director and Portfolio Manager, for the Infrastructure Investments Group of J.P. Morgan Asset Management, based in New York (USA).

Sufficient reliable data on private market total returns do not exist for infrastructure investments, which makes it difficult to assess the performance of infrastructure through macroeconomic cycles. In this article, using 27 years of historical EBITDA data (1986–2012) for 229 mature infrastructure assets across six sub-sectors in the United States and Western Europe, the authors explore cash-flow growth rates generated by infrastructure, real estate, and corporations to provide important insights into the investment performance of infrastructure. The results demonstrate that the volatility of infrastructure cash flows is materially lower than, and not highly correlated with, those of real estate and equities. Further, infrastructure cash flows outpaced CPI inflation and GDP growth during the past three recessions. Finally, diversification opportunities exist across infrastructure sub-sectors and geographies.

Keywords: Cash-Flow Analysis, Diversification, EBITDA, Infrastructure, Pension Fund, Volatility

The Infrastructure Data Challenge[1]

Continued volatility in equity and fixed-income markets, concerns about economic growth and inflation, and low returns on fixed-income investments are causing investors to step up their search for alternative investments.[2] Ideally, these investments will generate predictable, growing, low-volatility returns that exhibit low correlation to equity and fixed income and provide some protection against inflation. This search has led to renewed interest in infrastructure investments.[3]

Infrastructure investments have monopolistic demand characteristics for the essential services they provide. However, insufficient private market data are available to give investors the quantitative tools necessary to analyze, assess, and compare investment performance, particularly during the severe recession and global financial crisis of 2008 and 2009. Historical return data simply do not exist, particularly in the United States, where toll roads, bridges, airports, and seaports are largely owned and operated by the government or by quasi-governmental agencies and have, until recently, rarely been bought and sold on the open market. Some historical public data relating to this asset class do exist in Australia and, to a more limited extent, in Western Europe, but we do not consider these data sufficient to present an accurate assessment of future returns and risks for the overall asset class.

When faced with an asset class for which rate-of-return data from any particular geographic region are limited, researchers have two options. First, given the characteristics of infrastructure assets with regulated returns, concession agreements, or long-term contracts, we can generate hypothetical future return performance. Second, we can use existing (but limited) historical return data from outside the region and look at the relationship of infrastructure investments to other asset classes in such regions.

However, both methods have important weaknesses. The hypothetical option, without supporting data, might easily lead to inefficient allocation decisions, as it is easy to overlook essential factors in the absence of unbiased quantitative measures. On the other hand, use of historical data from other regions is suspect, given that the performance of infrastructure depends heavily on the characteristics of a specific geographic region, including population growth and other demographic trends, tastes and preferences of people, income levels, regulation, and other institutional factors.

A Cash-Flow Approach

The goal of the analysis described here is to provide empirical evidence and additional insight into the investment performance of infrastructure assets. Although this asset class as an investment opportunity is relatively new, the assets themselves have existed, and have provided essential services, for decades and even centuries. Instead of the regular rate-of-return analysis, therefore,

we can create a bottom-up approach, building the rate of growth of cash flows (or cash-flow proxies) by looking at operating incomes and costs of individual assets. This allows us to analyze historical cash-flow performance and compare it to that of other asset classes. It is a simpler way of looking at performance, since asset appreciation, initial yield, and capital expenditures are not factored in. Nevertheless, combined with other approaches, including those mentioned above, it provides valuable insights.

We have constructed historical cash-flow indices for 27 years for infrastructure assets in six sub-sectors in the United States and Western Europe, which allows us to develop a viable bottom-up approach to looking at infrastructure performance over time. An analysis based on this approach uncovered the following four key insights:

- The volatility of infrastructure cash flows is materially lower than those of both equities and real estate.[4]
- Infrastructure cash flows are not highly correlated with those of equities and real estate.
- Cash flows of infrastructure assets grow faster than the consumer price index (CPI) growth rate over time, and they performed better than nominal gross domestic product (GDP) growth during the past three recessions.
- Diversification opportunities exist within the infrastructure asset class itself.

Constructing a Cash-Flow Index

Constructing an index of cash flows generated by infrastructure assets requires combining data for different types of entities: privately owned companies, publicly traded companies, and government-owned entities. For example, as well as having different forms of financial statements, a government-owned toll road can also have quite different economic and political goals from a privately operated toll road. Looking at a common denominator such as cash flows helps to avoid mixing apples and oranges. The assumption is that in the long run, the growth rate of cash flows is a function of increases in tariffs and in volume, which do not directly depend on what entity operates the asset. Some management experts argue that the private sector can often produce greater operating efficiencies and will charge for services in a more economically rational manner than the public sector. Because we have not adjusted for the additional efficiencies that might be available if government-owned assets were operated by the private sector, the performance results presented in this article likely err on the conservative side.

We used annual EBITDA (earnings before interest, taxes, depreciation, and amortization) as the main cash-flow measure in our data set. An advantage of using EBITDA is that it is not affected by an entity's capital structure and taxes; a disadvantage is that it looks only at earnings before various expenses, including the cost of maintaining the assets. A good understanding of maintenance costs is important to assessing the performance of an asset. For almost all infrastructure assets, however, maintenance is a continuous effort; as long as the maintenance work is not an improvement (i.e., it does not eventually increase either capacity or demand), it should not affect the growth rate of cash flows. Also, we are averaging cash-flow growth rates of many assets for sub-sectors to create indices, which should smooth the effects of maintenance schedules.

We should also add that the true maintenance capital in infrastructure tends to be relatively small as a percentage of asset value. After all, the main characteristic of this asset class is that it has long-lived capital assets with low depreciation rates.[5] Since we are looking only at the growth rates of cash flows, subtracting a smooth line item for maintenance cost from the series does lower the free cash flow, but it does not materially change the growth rates. Consequently, for conceptual reasons (invariance to capital structure, taxes, and capital expenditures) as well as practical reasons (availability of a wide variety of entities, from publicly traded companies to government-controlled assets), we believe that EBITDA remains a valid measure.

The Data Set

We measured cash flows across all infrastructure sub-sectors from 1986 to 2012 – the longest period we could track using available data. For entities for which reported EBITDAs do not exist (e.g., state and local government-owned toll roads, bridges, and airports), we estimated EBITDA by using operating revenues and subtracting expenditures provided in annual financial statements. Any entity that undertook significant capital expenditures is excluded. The focus on mature entities with stabilized cash-flow streams creates a selection bias in our sampling method, consistent with "core" and "core-plus" strategies that focus on relatively lower-risk and lower-return parts of the risk / return spectrum.[6] We chose to focus on mature assets and not to attempt to predict the future value of an asset or major improvements to an asset. For that reason, we excluded companies and entities established after 1986, entities that ceased operations during the timeframe examined, and entities with significant mergers and acquisitions activity.

The infrastructure assets in our data set span six sub-sectors (see Table 1):

1. ***Electricity companies***, including regulated utilities, transmission companies, and companies with contracted generation assets
2. ***Natural gas companies***, including regulated utilities as well as storage and pipeline companies
3. ***Water and sewerage companies***, including investor-owned regulated utilities

Table 1: Number of Infrastructure Entities in the Cash-Flows Database by Geography and Sub-sector

Location	Utilities			Transportation Assets			Total
	Electric	Natural Gas	Water and Wastewater	Toll Roads	Airports	Seaports	
United States	38	14	6	33	38	7	**136**
EU-15	18	8	10	12	25	20	**93**
Total	**56**	**22**	**16**	**45**	**63**	**27**	**229**

Table 2: Compounded Annual Growth Rates (CAGR), Standard Deviations, and Correlation Coefficients of Infrastructure, Corporate, and Real-Estate Cash Flows in the United States, 1986–2012

	Infrastructure EBITDA	US Real-Estate NOI	S&P500 Operating Earnings	US Inflation
CAGR	4.07%	1.99%	8.43%	2.88%
SD	2.25%	4.17%	17.60%*	1.15%
Correlation coefficients				
Infrastructure EBITDA	1.00	0.45	0.34	0.32
Real Estate NOI		1.00	–0.10	0.17
S&P Operating Earnings			1.00	–0.23
US inflation				1.00

** In earlier versions of this work[7] we reported lower SD figures for S&P Operating Earnings. This figure increased significantly with the inclusion of 2010–2012 data.*
Source: J.P. Morgan Asset Management

4. ***Toll roads***, including assets operated by state and local governments as well as by privately owned entities
5. ***Airports***, including large to mid-sized airports with continuous commercial air traffic
6. ***Seaports***, including the largest seaports by cargo tonnage handled

We constructed an illustrative infrastructure cash-flows index in two steps. First, for each sub-sector considered, a weighted average of cash flows is calculated. Second, the infrastructure cash-flows index is created by giving each sub-sector an equal weight. Though the equal-weights infrastructure portfolio may not be optimal, it strongly demonstrates that infrastructure as an asset class provides diversification opportunities.

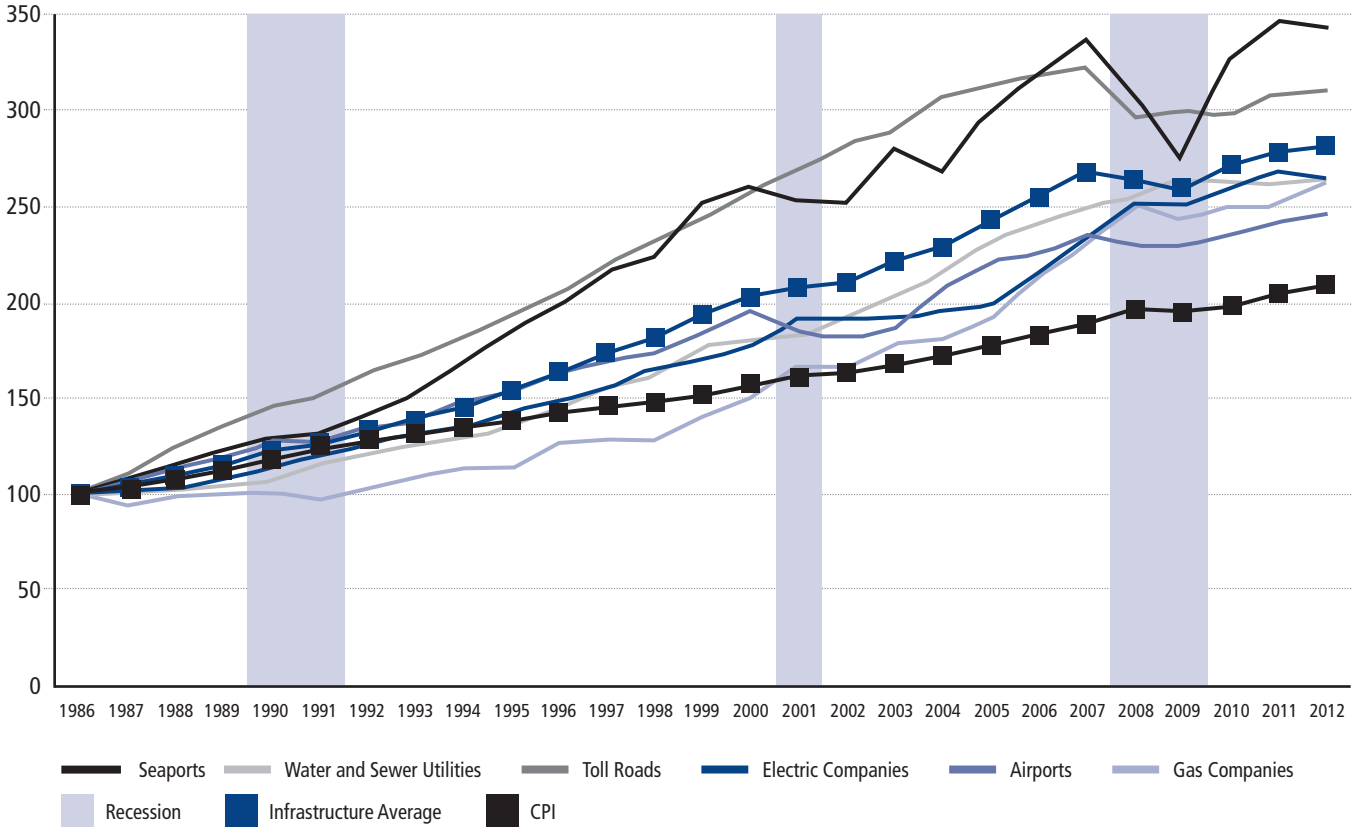
Infrastructure vs. Equities and Real-Estate Cash Flows: Key Findings

To compare infrastructure with other asset classes in the United States, we considered the EBITDA index of infrastructure assets in the United States, net operating income (NOI) of American real-estate assets, and annual aggregate EBITDAs for publicly listed American corporations. EBITDA and NOI are proxies for cash flow, and the comparison, though not perfect, is reasonably meaningful.

As Table 2 demonstrates, infrastructure assets perform quite well:

- First, infrastructure has the lowest cash-flow volatility (measured by standard deviation (SD) of growth rates), and its compounded annual growth rate (CAGR) ranks between those of real estate and corporations.
- Second, correlation coefficients among the three sectors are low.
- Third, the correlation coefficient between infrastructure cash flows and CPI is not exceptionally high, likely because of timing differences between the monthly publication of inflation statistics and the annual (or less frequent) rate increases allowed by regulators and under concession agreements. It is nevertheless the highest of the three sectors, and we can therefore conclude that infrastructure assets protect against inflation better than either equity or real estate.

Figure 1: Indices of Annual Cash Flows for American Infrastructure Sub-sectors against American CPI, 1986–2012 (1986 = 100)



Sources: J.P. Morgan, FactSet, FAA, Federal Highway Administration, Maritime Administration, and company websites

Table 3: Infrastructure EBITDA vs. Inflation and GDP Growth Rates during Recessions*

Recessionary Periods	Infrastructure EBITDA Growth	CPI Inflation	Nominal GDP Growth	Real GDP Growth
1990–1991	5.8%	4.7%	5.4%	0.5%
2001	4.2%	2.8%	3.9%	1.0%
2008–2009	–1.4%	0.7%	–2.2%	–1.6%
Full sample (1986–2012)	4.1%	2.7%	4.3%	2.1%

** Inflation and GDP growth rates are US and EU-15 weighted averages.*
Source: J.P. Morgan Asset Management

Figure 1 shows the American cash-flow indices for six sub-sectors and maps a portfolio of infrastructure assets based on equal weights against American CPI. The average cash flow grew faster than CPI in 19 of 27 years and, as Table 3 shows, was stable enough to outperform nominal GDP during the recessions in our sampled time frame.

Table 4 illustrates that the cash-flow growth rates of infrastructure sub-sectors are not highly correlated. An infrastructure portfolio with assets from all six sub-sectors is well diversified, with a low-volatility cash-flow stream.

Table 4: Correlation Coefficients of Annual Cash-Flow Growth Rates of American Infrastructure Sub-sectors, 1986–2012

	Toll Roads	Airports	Seaports	Electric Companies	Gas Companies	Water and Sewer Utilities
Toll Roads	1.00	0.49	0.28	–0.27	–0.32	0.00
Airports		1.00	0.38	–0.29	–0.15	0.19
Seaports			1.00	–0.05	0.09	–0.08
Electric Companies				1.00	0.33	–0.08
Gas Companies					1.00	0.06
Water and Sewer Utilities						1.00

Source: J.P. Morgan Asset Management

Table 5: Standard Deviations, CAGR, and Correlation with CPI of Annual Cash-Flow Growth Rates of American Infrastructure Sub-sectors, 1986–2012

	Infrastructure Portfolio	Toll Roads	Airports	Seaports	Electric Companies	Gas Companies	Water and Sewer Utilities
SD	2.19%	4.03%	3.97%	6.77%	2.72%	4.75%	2.86%
CAGR	4.20%	4.61%	3.60%	5.09%	4.02%	3.74%	3.92%
Correlation with inflation	0.32	0.28	0.25	0.17	0.36	0.08	–0.12

Source: J.P. Morgan Asset Management

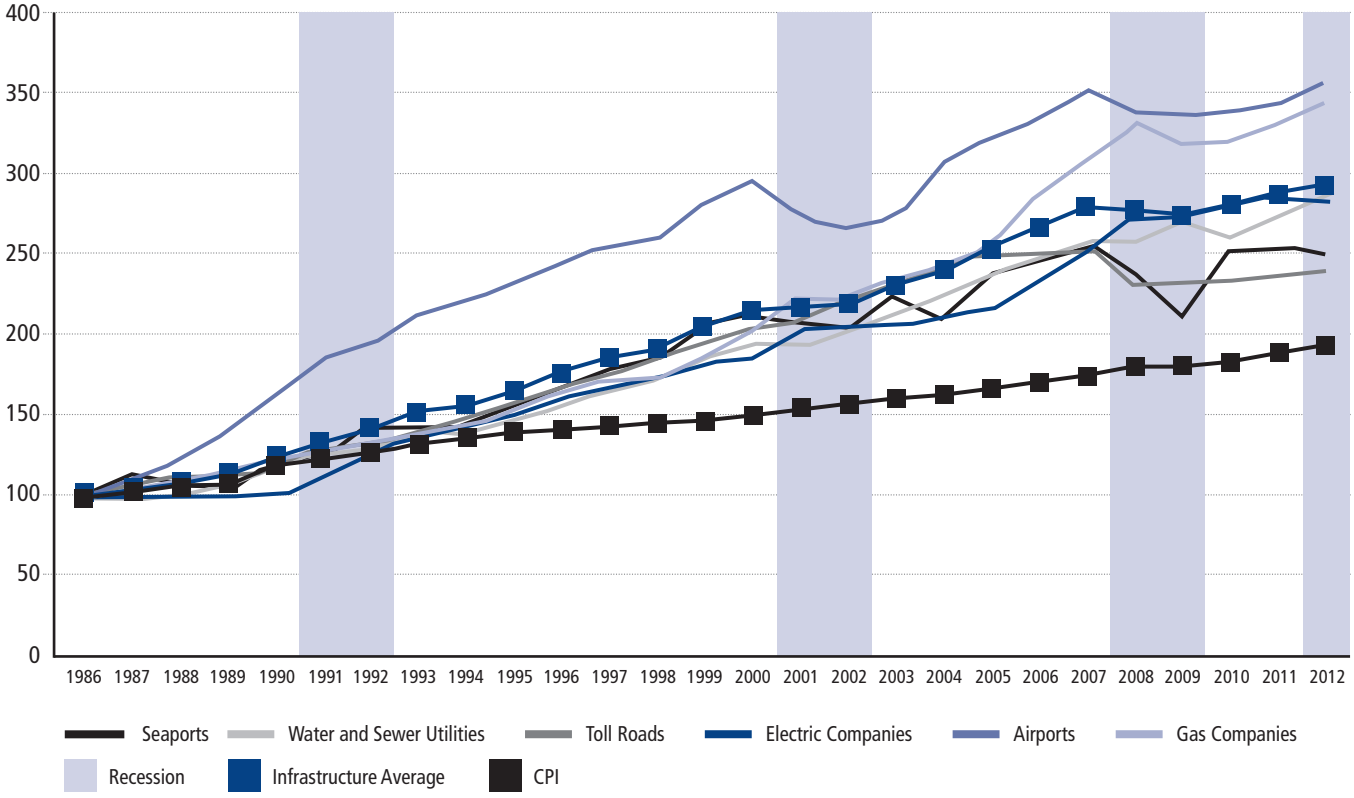
As Table 5 shows, the standard deviation of growth rates for our sample infrastructure portfolio with equal weights is 2.2%, significantly lower than the corresponding figures for individual sub-sectors. The equal weights portfolio is not the optimum portfolio from a mean-variance perspective; for instance, a portfolio consisting of 30% electricity companies, 30% toll roads, and 10% each for the remaining four sub-sectors has a comparable CAGR of 4.3% and a significantly lower standard deviation of 1.9%.

For some sub-sectors, correlations with CPI are positive but lower than expected. One reason for this is the differences in the inflation measure selected. When determining regulated returns for infrastructure assets, some regulatory bodies use CPI-U (CPI All Items urban consumers) while others opt for specific measures such as a construction cost index, the employment cost index, or regional inflation measures rather than the nationwide CPI-U. A more important issue is regulatory lag – the time difference between cost increases and a regulator's approval of rate increases for cost recovery. While inflation is measured continuously, regulatory rate increases are usually discrete events, occurring in intervals of two years or more. Similarly, concession-based toll roads managed by private-sector operators generally allow toll rate increases no more than once a year, while many government-operated toll roads in the United States experience toll rate increases only every 10 or 20 years.

Adding European Infrastructure Assets to the Mix

The history of private-sector involvement in infrastructure assets is longer in Europe, especially in the United Kingdom, than in the United States. In order to look at a portfolio consisting of both American and European assets, we gathered similar cash-flow data for European infrastructure companies. For consistency with an investment strategy that focuses on Western Europe, we used only EU-15 countries, those included in the European Union before its 2004 enlargement. One important issue to consider when determining the combined cash-flow data for the sub-sectors is the volatility of exchange

Figure 2: Indices of Annual Cash Flows for EU-15 Infrastructure Sub-sectors against Average European CPI, 1986–2012 (1986 = 100)



Sources: J.P. Morgan, FactSet, Eurostat, OECD, IMF, and company websites

Table 6: Standard Deviations and CAGR of Annual Cash-Flow Growth Rates of European Infrastructure Sub-sectors, 1986–2012

	Infrastructure Portfolio	Toll Roads	Airports	Seaports	Electric Companies	Gas Companies	Water and Sewer Utilities
SD	2.52%	3.51%	5.83%	7.80%	3.84%	3.92%	4.25%
CAGR	4.32%	3.52%	5.07%	3.81%	4.29%	4.91%	4.10%

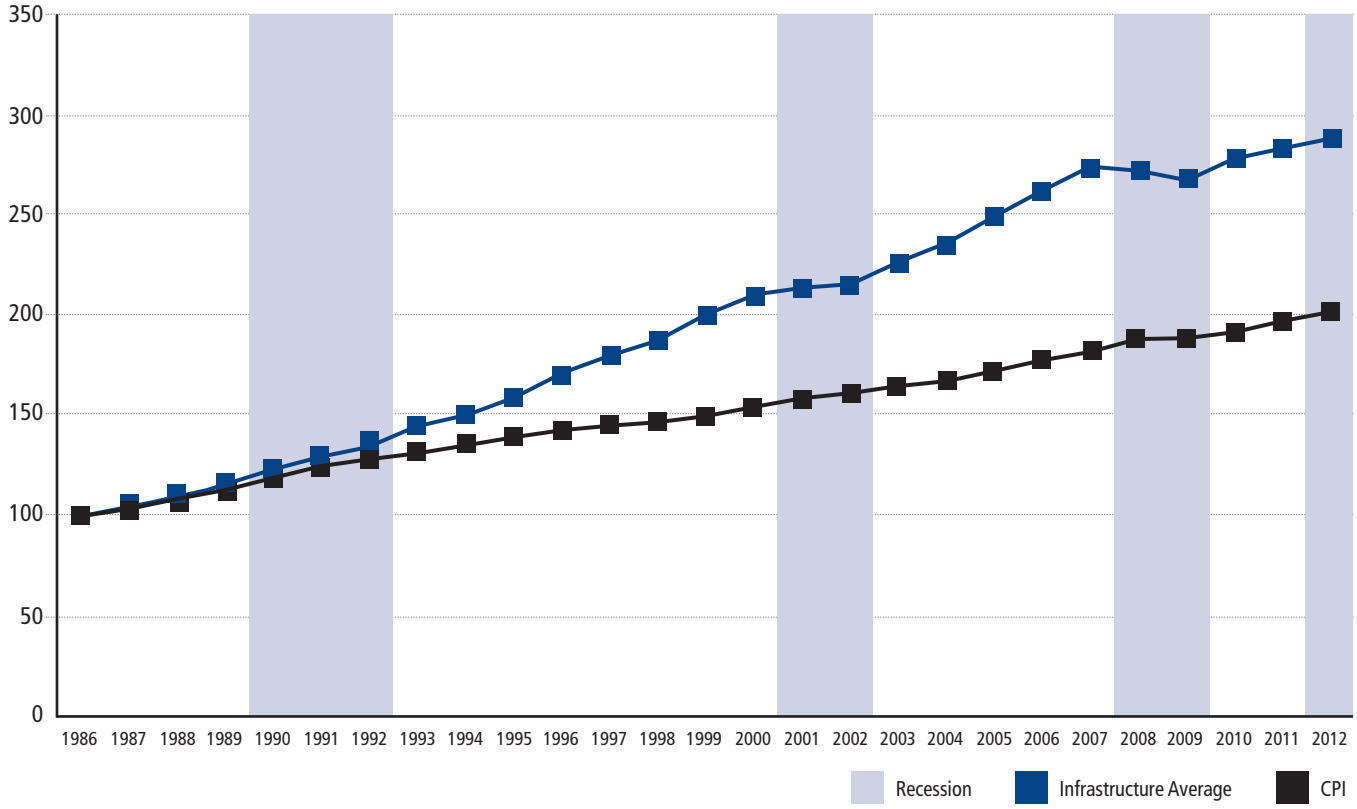
Source: J.P. Morgan Asset Management

rates across European currencies; the volatility of European currencies against the US dollar is also an issue going forward. One simple solution to this problem is to keep the figures in local currencies and calculate averages in that manner.

Figure 2 presents cash-flow indices for European infrastructure sub-sectors measured against a weighted CPI average for the countries considered. Because of regional differences, not all European economies went through recessions simultaneously; therefore, instead of the strict definition of recession, we considered the years when the EU-15's aggregate GDP growth slowed. Figure 2 shows that the behaviors of American and European infrastructure sub-sectors – in terms of generated cash flows – are very similar, generating EBITDAs that grow faster than the European CPI average and are resilient to recessions.

The standard deviations and CAGRs across all infrastructure sub-sectors in Europe, shown in Table 6, illustrate that, as in the American case, an equally weighted average infrastructure portfolio has significantly lower volatility, providing diversification benefits thanks to low correlations between sub-sector growth rates.

Figure 3: Index of Annual US and EU-15 Infrastructure Cash Flows against Average High-Income OECD CPI, 1986–2012 (1986 = 100)



Source: J.P. Morgan Asset Management

In addition, the correlation coefficient between EBITDA growth rates for American and European infrastructure sectors is 0.57,[8] producing a diversification benefit illustrated by the low standard deviation shown in Table 7 and the smooth cash-flow progression shown in Figure 3 for a combined American and European infrastructure portfolio.

Attractive Characteristics

What does all this analysis mean for investors? While the past is no guarantee of the future, the patterns we observed indicate that for mature core infrastructure assets,

- cash flows are not highly correlated with those of equities, fixed income, or real estate;
- over time, cash flows grow faster than CPI, and hence may offer long-term protection against inflation;
- diversification opportunities exist across infrastructure sub-sectors; and
- historical cash-flow growth and volatility are similar in American and European infrastructure assets, yet investments in both geographic regions diversify each other.

Our research also indicates that infrastructure investment produces stable, growing cash flows and that the cash flows generated by these assets may be less influenced by economic cycles than corporate operating earnings and the net operating income of private real estate. Investors seeking investments with different risk and return characteristics from more traditional investments such as public equity, fixed income, and private real estate may do well to consider adding infrastructure to their portfolio.

Table 7: Standard Deviations and CAGR of Annual Cash-Flow Growth Rates of Infrastructure Indices in the US and Europe, 1986–2012

	US	EU-15	Combined
SD	2.19%	2.52%	2.25%
CAGR	4.20%	4.32%	4.26%

Source: J.P. Morgan Asset Management

Endnotes

1. This document is intended solely to report on various investment views held by J.P. Morgan Asset Management. Opinions, estimates, forecasts and statements of financial market trends that are based on current market conditions constitute our judgment and are subject to change without notice. We believe the information provided here is reliable, but it should not be assumed to be accurate or complete. The views and strategies described may not be suitable for all investors.

2. Allocations and commitments to the infrastructure sector grew rapidly in 2006–2008, slowed considerably in 2009 and 2010, and resumed in 2011–2013.

3. For an earlier discussion of the subject and an introduction to the asset class, see Weisdorf (2007).

4. Fixed income, as the name suggests, has the most stable cash flows, thanks to fixed coupon payments. It goes without saying that infrastructure cash flows are not correlated with fixed-income returns.

5. Various studies by the Federal Highway Administration (FHWA) in the United States, for example, put the depreciation rate for US highways at 8 basis points per year. See, e.g., Nadiri and Mamuneas (1998); FHWA (1996).

6. Following common usage in real-estate investing, we use "core," "core-plus," "value-add," and "opportunistic" strategies to describe relative risk and potential return on a spectrum from lower-risk (core) to higher-risk (opportunistic).

7. Earlier versions, with less current data, were distributed as J.P. Morgan Asset Management Insights pieces titled "Infrastructure Investing: A Portfolio Diversifier with Stable Cash Flows."

8. The correlation coefficient between American and European infrastructure EBITDA growth rates is higher than in earlier versions of this article that did not include data updates through 2010–2012. One major reason for the higher figure is the impact of American and European currencies' moving in opposite directions during much of that time frame.

References

Federal Highway Administration. 1996. "Productivity and the Highway Network: A Look at the Economic Benefits to Industry from Investment in the Highway Network." Publication No. FHWA-PL-96-016. http://www.fhwa.dot.gov/policy/otps/060320b/

Nadiri, M. Ishaq, and Theofanis P. Mamuneas. 1998. "Contribution of Highway Capital to Output and Productivity Growth in the US Economy and Industries." Federal Highway Administration, US Department of Transportation. http://www.fhwa.dot.gov/policy/gro98cvr.htm

Weisdorf, Mark. 2007. "Infrastructure: A Growing Real Return Asset Class." *CFA Institute Conference Proceedings Quarterly* 24 (3): 17–25.

About Rotman International Centre for Pension Management

The mission of the Rotman International Centre for Pension Management (Rotman ICPM) is to be an internationally-recognized, high-impact catalyst for fostering effective pension design and management. Its four primary tools to achieve this goal are the funding of objective and transformative research, the organization of interactive, action-oriented discussion forums, the publication of a readable journal relevant to professionals in the pensions and related fields, and the delivery of the globe's leading governance education program for Board members of pension and other long-horizon investment institutions.

Publisher and Editor
Keith Ambachtsheer

Associate Publisher and Editor
Ann Henhoeffer

Copy Editor
Sylvia Hunter

Design
watermarkdesign.ca

Rotman ICPM
International Centre for Pension Management

105 St. George Street
Toronto, Ontario Canada M5S 3E6
Tel: 416.925.4153
icpm@rotman.utoronto.ca
www.rotman.utoronto.ca/icpm

Rotman School of Management
UNIVERSITY OF TORONTO
a new way to think | pension management

Editorial Advisory Board

Unsolicited articles can be submitted via PRESTO! for consideration by the Editorial Advisory Board. Please visit **http://rotmanijpm.presto.utpjournals.com/jmanager/users/login**.

2014 / 2015 Research Partners

International
Global Risk Institute in Financial Services
World Bank

Australia
Australia Future Fund
Australian Super
QSuper
Queensland Investment Corporation
SunSuper

Canada
Alberta Investment Management Corporation
Alberta Local Authorities Pension Plan
British Columbia Investment Management Corporation (bcIMC)
Caisse de dépôt et placement du Québec
Canada Pension Plan Investment Board
Healthcare of Ontario Pension Plan
Ontario Municipal Employees Retirement System
Ontario Teachers' Pension Plan
Public Sector Pension Investment Board

Denmark
Danish Labour Market Supplementary Pension (ATP)
Pensionskassernes Administration (PKA)

Finland
Finland State Pension Fund
Ilmarinen

France
Etablissement de Retraite Additionelle de la Fonction Publique (ERAFP)

Japan
Nomura Research Institute

Korea
Korea Institute for Health and Social Affairs (KIHASA)

Netherlands
Algemene Pensioen Groep
MN
De Nederlandsche Bank
PGGM
Stichting Philips Pensioenfonds
Syntrus Achmea Asset Management

New Zealand
New Zealand Superannuation Fund

Sweden
Första AP-Fonden (AP1)

United Kingdom
National Employment Savings Trust
Railways Pension Trustee Company Ltd.
Universities Superannuation Scheme

United States
California Public Employees' Retirement System
California State Teachers' Retirement System
State Board of Administration of Florida (SBAFLA)
TIAA-CREF
Washington State Investment Board

ISSN 1916-9833 (Print) – C$50.00
ISSN 1916-9841 (Online) – no charge