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Infrastructure: a new dimension of real estate? An asset allocation analysis

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Abstract

Purpose – The purpose of this paper is to provide conclusive evidence that infrastructure constitutes a separate asset class and cannot be classified as real estate from an investment point-of-view. Furthermore, optimal allocations are determined for direct and indirect infrastructure within a multi-asset portfolio.

Design/methodology/approach – Portfolio allocations are optimized by using an algorithm, which accounts for downside risk, rather than variance. This approach is more in accordance with the actual investor behaviour and might meet their investment objectives more effectively. An Australian dataset comprising stocks, bonds, direct real estate, direct infrastructure and indirect infrastructure is applied for portfolio construction.

Findings – Although infrastructure and real estate have common characteristics, the conclusion is that that they constitute two different asset classes. Furthermore, the diversification benefits of direct and indirect infrastructure within multi-asset portfolios are highlighted and determine efficient allocations up to 78 percent for target rates of 0.0 percent, 1.5 percent and 3.0 percent quarterly.

Practical implications – The results will help investors and portfolio managers to efficiently allocate funds to various asset classes. Most institutional investors are not familiar with investments in infrastructure. The study facilitates a better understanding of the asset class infrastructure and yields some important implications for the optimal allocation of infrastructure within institutional investment portfolios.

Originality/value – This is the first study to examine the role of direct and indirect infrastructure within a multi-asset portfolio by applying a downside-risk approach.

Keywords Structures, Real estate, Assets, Risk management, Australia

Paper type Research paper

1. Introduction

The economic importance of infrastructure has been the subject of extensive research since the late 1980s and is free of controversy. The World Economic Forum (2008) lists infrastructure as one of the most crucial elements to a country's productivity and competitiveness. Aschauer (1989) provides evidence of significant links between investment in infrastructure and a country's economic development and wealth. Yeaple and Golub (2004) suggest that infrastructure is one of the key determinants of a region's comparative advantage. Though infrastructure is recognized as a crucial input for economic productivity, there is no clear and unanimous definition of the term. An early definition is given by Stohler (1964), who characterizes infrastructure as the substructure or the "skeleton" assets of an economy that are essential for the production of goods and services. Later approaches have subdivided infrastructure

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into social and economic subgroups. Economic infrastructure (including transport, energy/utilities and communication facilities) provides key services to business and industry and enhances productivity and innovation. Social infrastructure, on the other hand, is seen as a medium for supplying basic services to households (healthcare, education and judicial facilities) (ING Real Estate, 2006). In recent years, private investments in infrastructure have increased significantly and investors have begun to perceive infrastructure as an attractive asset class enhancing the efficiency of their investment portfolios. Financial strain on governments, making them unable to provide adequate infrastructure provision in times of increasing global competitiveness has contributed to the emergence of private investment opportunities in recent years (Löwik and Hobbs, 2007a). A shortage of good quality commercial real estate, along with declining yields, has intensified this development and amplified the capital flow into seemingly related sectors (Newell and Peng, 2008). Although many investors are restraining their investments due to the current financial crisis, infrastructure still seems to be very attractive, a fact which is underpinned by the INREV[1] Investment Intentions Survey 2009: According to this study, more than 60 percent of all institutional real estate investors considered allocating funds to the infrastructure sector in 2009.

Since infrastructure and real estate exhibit many common characteristics, this paper aims at contributing to the debate on whether infrastructure can be regarded as real estate or constitutes a separate asset class. Furthermore, we provide an asset allocation model that determines optimal infrastructure asset allocations for a downside risk (DR) – averse investor. This optimization technique is based on Estrada (2008) and considers target semivariance instead of variance as measure of risk. This might more effectively meet the investment objectives of rational investors and result in more realistic asset allocations for a set of Australian data. The remainder of this paper is structured as follows. Section two presents the applied data, and section three analyzes the differences between infrastructure and real estate. This is followed by a review of the downside risk concept and its application to portfolio structuring. The study is completed with some conclusions and an outlook for future research.

2. Applied data

The Australian infrastructure market is relatively mature and time series data on infrastructure returns (direct and indirect) are available. For that reason, this market is in the focus of this analysis.

During the past decade, definitions of infrastructure have broadened and sometimes encompass categories that can barely be linked to one another (Beeferman, 2008): There are opposing views on the issue of whether utilities can be regarded as infrastructure or not (Inderst, 2009). Researchers and practitioners generally do not draw any accurate distinction between them, but use the term "infrastructure" interchangeably. Estimating the correlations between quarterly (1994:4 to 2009:1) indirect infrastructure (UBS Australia Infrastructure Index) and indirect utilities (UBS Australia Utilities Index) returns, reveals a coefficient of correlation of 0.35 which is significant at a 5 percent-level. As a result, we adhere to this common definition and use the UBS Australia Infrastructure and Utilities Index to mirror the performance of indirect infrastructure[2].

Time series total return data on direct and indirect infrastructure performance are provided by Bloomberg and Colonial First State, respectively. Return data on equities, bonds and direct property are from Thomson Datastream and IPD (Investment Property Databank). All time series range from Q4 1994 to Q1 2009, which is sufficient to cover at least one entire market cycle. The UBS Australia Infrastructure & Utility Index depicts the performance of indirect infrastructure. An index constructed by Colonial First State measures direct infrastructure performance. This index is an equally weighted total return index comprising five Australian infrastructure funds, and is based on valuations and therefore subject to smoothing. This implies a downward bias in the second central moment of the return distribution, since appraisers take into account current as well as historic information to perform valuations. In order to address this issue and remove the smoothing effect, the methodology of Geltner (1993) is applied. This serves to identify the underlying volatility of the infrastructure market and yields a greater comparability between appraisal-based returns and transaction-based equity and bond returns. Furthermore, the gearing level of 60 percent[3] was removed. Since the IPD Australian Property Index is also exposed to smoothing, the desmoothing procedure has to be applied as well. The Australian Securities Exchange index (ASX 100) is used to mirror equity performance, whereas the JP Morgan Australia Government Bond index depicts the performance of Australian Government Bonds (Table I).

The indirect infrastructure index offers the greatest average return, but is also subject to the highest standard deviation. The return from the unsmoothed and unlevered direct infrastructure index is lower than that of property and bonds. The poor performance of equities is due to the substantial withdrawal of funds in the course of the financial crisis.

3. Why infrastructure is not real estate

There is a lively debate on whether infrastructure can be regarded as real estate or whether it constitutes a separate asset class with unique characteristics (Beeferman, 2008; Newell and Peng, 2006; Mansour and Nadji, 2007b). The typical characteristics which are common to all direct infrastructure investments can be subdivided into three groups of criteria:

(1) technical;

(2) institutional; and

(3) economic.

	Bond	Property	Direct Infra + Util	ASX	Indirect Infra + Util
Mean	2.02	2.36	2.00	1.93	3.69
Median	2.05	2.63	1.90	3.68	4.52
Standard deviation	2.47	2.57	1.89	7.50	8.31
Sample variance	6.11	6.60	3.58	56.18	68.98
Kurtosis	0.42	4.19	−1.10	7.85	1.93
Skewness	0.38	−1.59	0.13	−2.39	−0.39
Range	11.86	13.68	6.81	43.92	50.84
Minimum	−2.97	−5.95	−1.22	−31.87	−22.90
Maximum	8.89	7.73	5.59	12.06	27.94
Observations	57	57	57	57	57

Table I. Descriptive statistics for asset returns

Technical characteristics include indivisibility, long lifecycles and the site dependency of assets (Meeder, 2000). The main institutional criterion is a given level of decision-making competence of the public authorities in terms of allocation and regulation (Backhaus and Wertschulte, 2003). Long-term investment horizons, together with restricted liquidity due to a very limited secondary market, can be classified as two of the main economic criteria (Löwik and Hobbs, 2007a; Erlendson, 2006). Furthermore, infrastructure has inherent monopoly characteristics and provides essential economic and social services (Liem and Timotijevic, 2005; Erlendson, 2006). Stable, and therefore, predictable cash flows associated with potential capital gains allow for high levels of financial leverage (compared to other asset classes) (Beeferman, 2008; Colonial First State, 2009; Mansour and Nadji, 2007b). Furthermore, large investment lot sizes create high barriers of entry. This, in turn, yields a market environment with professional actors who have high levels of market expertise (Mansour and Patel, 2008). Moreover, compared to other markets, the infrastructure market can be described as intransparent, due to a shortage of quality data and research (Inderst, 2009). The pricing of direct infrastructure projects is based on valuations (Newell and Peng, 2008), and underlying cash flows are intended to provide a hedge against inflation (ING Real Estate, 2006). Due to its monopolistic character, there may be a lack of market prices (Backhaus and Werschulte, 2003). Erlendson (2006,) further states that infrastructure has (at least in the short-run) a low elasticity of demand, since the construction of new assets requires a considerable amount of time. A high level of individual expertise in legal and regulatory regimes is necessary to provide efficient asset management.

Although direct infrastructure and direct property have some characteristics in common (indivisibility, long lifecycles and site dependency, long-term investment horizons, restricted liquidity, valuation-based performance, supposed inflation hedge, capital gains), there are also substantial differences. Whereas property markets can be described as relatively competitive, infrastructure markets, as mentioned, often have oligopolistic or even monopolistic structures. Moreover, there is a greater degree of transparency in the real estate market than in the infrastructure market. A further issue is the limited potential to obtain ownership of direct infrastructure assets, due to regulatory constraints, which often only allow user rights (Newell and Peng, 2008). Even though an investment in direct real estate is inhibited by large investment scales, this problem becomes even more serious when an investment in direct infrastructure is considered. This, in turn, decreases the diversification benefit when infrastructure is allocated to a(n) (multi) asset portfolio. Moreover, real estate, in general, may provide alternative appropriate uses, whereas infrastructure assets are limited to very specific and restricted uses.

Institutional investors also face this classification problem when allocating infrastructure to their portfolios. Therefore, infrastructure is often placed in existing allocations, namely private equity, real estate or fixed income, although the risk-return characteristics do not match (PFG, 2007). However, especially over the last few years, infrastructure has begun to emerge as an independent asset class (Inderst, 2009; Newell and Peng, 2008) as confirmed by a number of investor surveys. According to Preqin (2008), 47 percent of active investors have a separate infrastructure allocation, whereas 43 percent include it in their private equity portfolio and 10 percent in their real estate allocation. PFG's investor survey reveals figures of 47 percent for a separate infrastructure asset allocation, 37 percent for an allocation within the private equity portfolio and 15 percent for a real estate allocation (PFG, 2007).

According to Newell and Peng (2008), Colonial First State (2006) and Mansour and Nadji (2007b), infrastructure is appropriate for portfolio diversification, since it delivers a moderate to low correlation with traditional asset classes. We find similar results for the Australian data which, in turn, yield further indications for the separation of real estate from infrastructure.

As Table II shows, there is positive but insignificant (5 percent) correlation (0.20) between direct property and direct infrastructure returns from Q4 1994 to Q1 2009, which contradicts the claim that infrastructure can be regarded as a subclass of real estate. Moreover, the correlation is even lower (0.04), when the effects of the financial crisis (Q3 2007 to Q1 2009) are extracted. This indicates that the higher correlation in the period from Q4 1994 to Q1 2009 is due to extreme market downturns from which neither asset class could withdraw. There is a strong and significant relationship between the indirect infrastructure and the NAREIT index (0.54), which might be due to the fact that both indices contain listed companies affected by movements in the equity market. However, before the crisis, this correlation was lower (0.27) and significant at only a 10 percent-level. This indicates that both investments were perceived as only weakly related before the financial crisis. According to these results, one might expect a divergence in return behavior when the world economy recovers.

These findings, as well as the different risk-return characteristics, constitute an indicator for distinguishing explicitly between infrastructure and real estate, although many physical characteristics are common to both.

4. Infrastructure asset allocation

Modern portfolio theory (MPT)

Modern portfolio theory still constitutes an important tool for ascertaining the optimal proportion of an asset within a mixed-asset portfolio and for determining "efficient" portfolios out of a set of possible and permitted ones. According to Markowitz (1952), a portfolio is efficient when it either delivers the minimum risk for a given level of

	Bond	Property	Direct Infra + Util	ASX	Indirect Infra + Util	NAREIT
1995 Q1-2009 Q1						
Bond	1.00	− 0.21	− 0.02	− 0.39	0.27	− 0.09
Property		1.00	0.20	0.64	0.38	0.70
Direct Infra + Util		1.00	0.27	0.29	0.17	
ASX				1.00	0.36	0.54
Indirect Infra + Util					1.00	0.54
NAREIT						1.00
1995 Q1-2007 Q2						
Bond	1.00	− 0.03	0.09	− 0.18	0.45	0.11
Property		1.00	0.04	0.16	− 0.03	0.07
Direct Infra + Util			1.00	0.05	0.22	− 0.08
ASX				1.00	0.12	0.21
Indirect Infra + Util					1.00	0.27
NAREIT						1.00

Table II.
Correlations

expected return or achieves the highest level of return for a given amount of risk. Efficient portfolios are considered as dominant, implying that a rational investor would prefer an efficient portfolio to one that is not efficient. The set of these efficient portfolios form the efficient frontier and can be determined by a mean-variance analysis. However, modern portfolio theory is constrained by some serious theoretical weaknesses and practical complications:

MPT is not consistent with the concept of a minimum required return or target return, which, however, is usually applied by institutional investors. This concept describes an investor's concern with failing to meet a minimum required level of return. A rational investor would only be apprehensive of returns below this aspiration level, whereas returns exceeding this target rate cannot be considered as risk, but rather as a riskless chance of obtaining unanticipated high returns (Sing and Ling, 2003). The mean-variance approach does not allow for a certain, investor-specific, target rate, but has an implicitly defined reference point, namely the mean. This number, however, might not be suitable for all investors and could contribute to portfolio allocations that are not appropriate for a particular investor. Moreover, the mean-variance model treats deviations from the mean – irrespective of whether they are above or below – in the same way, and both kinds of deviations are incorporated into the risk assessment of a certain asset (Sing and Ong, 2000). However, this theory does not adequately mirror the risk perceptions of rational investors and therefore simply ignores their investment objectives. Consequently, the application of MPT could result in flawed asset allocations. Furthermore, due to assumptions of normally and independently distributed returns, the application of the mean-variance methodology is limited when asset returns are skewed. In terms of utility theory, the underlying utility function is unable to take into account varying degrees of risk aversion. To overcome these drawbacks and to derive asset allocations that are more in accordance with the actual behaviour and preferences of investors, a portfolio optimization technique based on a downside risk measure is taken into account.

Mean semivariance optimization

According to Estrada (2006), the downside risk of an asset i can be described by its semivariance with respect to a benchmark $B(\Sigma_{iB})$ and is given by:

$$(\Sigma_{iB}^2) = E\left\{\left[Min(R_{it} - B; 0)\right]^2\right\} \tag{1}$$

where:

R_{it} = Return on asset j during period t.

B = Investor specific benchmark return.

The semivariances of the considered assets with respect to different targets are given in Table III.

Table III.
Target semivariances

Target rate (%)	Bond	IPD	Direct Infra + Util	ASX	Indirect Infra + Util
0.0	0.49	2.00	0.09	33.21	20.10
1.5	1.88	3.37	0.99	39.65	25.74
3.0	5.20	5.65	3.87	47.63	33.13

The square root of (1) describes the semideviation of asset i with regard to a benchmark B, a common measure of downside risk. The complement to the covariance in the MPT optimization is depicted by the semicovariance (Σ_{ij}) between asset i and j with respect to a benchmark B. This is defined as follows:

$$\Sigma_{ij} = E\left\{Min(R_i - B, 0)^* Min(R_j - B, 0)\right\} \quad (2)$$

The fact that this definition can be customized to any desired B and generates a symmetric semicovariance matrix:

$$\Sigma_{ij} = \Sigma_{ji}$$

constitutes an advantage towards the traditional Hogan and James (1972) measure.

In order to derive the optimal asset allocation, the risk measure of a portfolio, defined as the semivariance, is minimized.

Minimize:

$$\Sigma_{pB}^2 \approx \sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \Sigma_{ijB}$$

subject to:

$$\sum_{i=1}^{N} x_i \bar{R}_i = \bar{R}_p$$

$$\sum_{i=1}^{N} x_i = 1$$

$$x_i \geq 0, i = 1, 2, \ldots, N \quad (3)$$

where:

$\bar{R}_i$ = Expected return on asset i.

$\bar{R}_p$ = Expected portfolio return.

Research design

This study constructs mean-downside risk-efficient mixed-asset portfolios, including: stocks, government bonds, treasury bills and commercial real estate. The expected portfolio returns range from the return on a minimum-risk portfolio of up to 3.4 percent quarterly. The maximum achievable return is 3.69 percent, which, however, can only be gained when all funds are invested in indirect infrastructure. The benchmark returns within the downside risk optimization algorithms are 0 percent, 1.5 percent, and 3 percent. The first target level indicates that an investor is concerned mainly with the nominal preservation of capital. A target rate of 1.5 percent quarterly mirrors the Australian inflation rate in 2008, reflecting an investor whose main priority is the real preservation of capital. It is not a contradiction to consider an expected return, which is above the target return. The implication is that, although the investor aims at achieving the expected return, only outcomes below the benchmark constitute a risk to him. The third target rate is set arbitrarily and is appropriate for investors who require higher benchmark returns. Although this number does not necessarily constitute a reasonable value – it is not practical to set a benchmark of 3 percent per quarter and to assess assets with a maximum expected return below that number – this benchmark is examined, so as to determine how allocations tend towards a relatively high target level. The parameter of risk aversion is set to "2", which implies that the risk measured at the asset level is the target semivariance.

Asset allocations

When the target rate of return is set to 0.0 percent, the allocation to indirect infrastructure increases, the higher the expected portfolio return is set, and the theoretical weights range between 0 percent and 78 percent. This is due to the fact that indirect infrastructure has proved to deliver the highest return of all considered assets, but is also inherent subject to downside risk. Therefore, indirect infrastructure is only allocated to the portfolio when relatively high returns must be achieved. For a return of 3.4 percent, the proportion of infrastructure in the portfolio amounts theoretically to 78 percent. Although this number is derived by the optimization algorithm, it must be interpreted with care, since it does not seem to be rational to have an exposure of 78 percent attributable to diversification issues. This high allocation is also due to the fact that no equities are incorporated into the mixed asset portfolio, which, in turn, is caused by significant losses during the financial crisis.

Owing to diverse risk-return characteristics, the case with direct infrastructure is different. The minimum semivariance portfolio has an exposure to direct infrastructure of 85 percent. The low level of downside risk, especially for a target of 0 percent, leads to this high proportion. Up to a quarterly portfolio return of 3.00 percent, the allocation to direct infrastructure diminishes to zero percent, since direct property, bonds and indirect infrastructure are incorporated. Therefore, the allocation to direct infrastructure is suggested to be situated within a range of 0 percent to 85 percent. However, in contrast to indirect infrastructure, direct infrastructure allocations are highest when a relatively safe portfolio has to be composed. But, as stated above, due to diversification issues, the overwhelming allocation to direct infrastructure has to be considered from a theoretical point-of-view.

These results demonstrate the role of infrastructure – direct as well as indirect – for investment portfolios when investors are downside risk averse: An allocation to infrastructure within a range of 0 percent up to 85 percent is suggested by the above optimization algorithm when stocks, bonds, property and direct as well as indirect infrastructure are considered. Taking into account lower expected returns, an exposure to direct infrastructure is preferable, whereby, for higher expected portfolio returns, the portfolio should be heavily weighted towards indirect infrastructure. This model obviously reveals the role and importance of infrastructure for asset allocation and demonstrates that infrastructure could play an important role in institutional investment portfolios (Table IV).

These results do not change fundamentally when the target rate of return is increased to 1.5 percent and 3.0 percent. When increasing the quarterly target from 0.0 percent to 1.5 percent, the allocation to indirect infrastructure remains constant for high expected returns, but decreases for low to medium returns.

Target 0%								
Bond	0.15	0.18	0.21	0.25	0.28	0.17	0.05	0.00
Property	0.00	0.11	0.17	0.23	0.29	0.31	0.31	0.22
Direct Infra + Util	0.85	0.62	0.42	0.22	0.03	0.00	0.00	0.00
ASX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indirect Infra + Util	0.00	0.09	0.20	0.30	0.41	0.52	0.64	0.78
SUM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Portfolio return	2.00	2.20	2.40	2.60	2.80	3.00	3.20	3.40
Portfolio risk	0.08	0.40	1.26	2.66	4.58	7.05	10.09	13.71
Target 1.5%								
Bond	0.28	0.29	0.30	0.31	0.23	0.12	0.02	0.00
Property	0.11	0.29	0.34	0.39	0.38	0.36	0.35	0.22
Direct Infra + Util	0.61	0.37	0.20	0.04	0.00	0.00	0.00	0.00
ASX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indirect Infra + Util	0.00	0.05	0.16	0.27	0.39	0.51	0.64	0.78
SUM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Portfolio return	2.05	2.20	2.40	2.60	2.80	3.00	3.20	3.40
Portfolio risk	0.78	1.19	2.34	4.09	6.47	9.54	13.29	17.78
Target 3.0%								
Bond	0.30	0.27	0.25	0.22	0.15	0.06	0.00	0.00
Property	0.28	0.47	0.49	0.50	0.48	0.45	0.37	0.22
Direct Infra + Util	0.42	0.25	0.14	0.03	0.00	0.00	0.00	0.00
ASX	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indirect Infra + Util	0.00	0.01	0.13	0.24	0.37	0.49	0.63	0.78
SUM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Portfolio return	2.11	2.20	2.40	2.60	2.80	3.00	3.20	3.40
Portfolio risk	2.89	3.21	4.73	6.95	9.90	13.63	18.15	23.58

Table IV.
Portfolio allocations

The proportion of direct infrastructure decreases significantly when the benchmark return increases. For a target return of 1.5 percent, direct infrastructure is replaced by bonds and direct property. For a target return of 3.0 percent, however, the weighting for direct infrastructure decreases even more what is due to the increase in real estate. This might be caused by the significant increase of direct infrastructure's semicovariance, relative to the risk of the other assets, when the target return exceeds the 1 percent level.

The proportion of property in the portfolio rises for almost all levels of expected returns, when the target rate increases. Altering the target rate of return from 0 percent to 1.5 percent, leads to an increase in the allocation to bonds for low-to-medium expected levels of returns, but to a decrease for higher expected return levels. Altering the target rate to 3.0 percent diminishes the proportion of bonds in the portfolio for each level of expected return.

5. Concluding remarks

This paper, on the one hand, contributes to the debate on whether or not infrastructure can be classified as real estate. The discussion, as well as the empirical investigation, yields at the conclusion that two distinct asset classes are present, even though infrastructure and real estate have some common characteristics. Especially the evaluation of correlation figures provides conclusive evidence of the different performance characteristics of infrastructure and real estate.

The portfolio allocation model as well, reveals some interesting results and suggests the benefit of substantial allocations to direct and indirect infrastructure ranging from 0 percent to 85 percent. However, the results obtained from this study must be interpreted with caution. The optimization algorithm does not include equities, due to their very poor performance during the financial crisis. However, due to diversification benefits, a rational investor will always include stocks in his portfolio. Since stocks are usually perceived as high risk – high return assets their inclusion is likely to reduce the allocation to indirect infrastructure at the upper end of the expected returns. Moreover, the portfolio model is not able to take into account some major characteristics of investing in direct infrastructure. Acquiring or selling a direct infrastructure project requires a considerable amount of transaction time, which, in turn, reduces the potential to react immediately to prevailing market trends. In addition, when investing in infrastructure, long-term contracts are imposed on investors by public agencies, considerably restricting flexibility. The very large lot size and indivisibility, especially impedes smaller investment funds in allocating a small proportion of infrastructure to their portfolios, which in turn constrains diversification. Furthermore, infrastructure is a relatively young, immature and illiquid asset class, which lacks a secondary market, thus constituting a risk for an investor who intends to allocate funds to this market. According to these facts, it would be rational for investors to impose a risk premium when investing in direct infrastructure, something that should also be considered in an asset allocation framework. Furthermore, depending on the holding period of infrastructure assets, the incorporation of transaction costs might diminish the return on investment and therefore influence portfolio weights.

If the number of investors in the infrastructure market increases and the secondary market grows, these elements of uncertainty may decline, which, in turn, may induce a reduction in the required risk premium. Accordingly, it is possible that infrastructure returns will change fundamentally when the market becomes more sophisticated. This, of course, does not exclude the possibility that infrastructure and real estate return characteristics converge in the future. Nevertheless, a current view of real estate and infrastructure yields a picture of two different asset classes with the associated need to draw an explicit distinction between the two.

We conclude that infrastructure represents an attractive asset class, which can enhance the benefits of diversification and, therefore, the performance of institutional investment portfolios. Further research could usefully consider the pricing of infrastructure firms' securities. Thus, the question arises as to what constitutes the main factors driving infrastructure returns and whether infrastructure returns can be explained by conventional asset pricing models. Moreover, transaction costs as well as liquidity risk premia should be on the agenda, when an infrastructure asset allocation model is considered.

Notes

1. European Association for Investors in Non-listed Real Estate Vehicles.
2. Although this index covers infrastructure and utility performance, we refer to the expression "infrastructure" in the course of this paper.
3. According to information provided by Mercer.

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