
Original Article

Pension fund investment in infrastructure: What have we learnt?

Received (in revised form): 2nd February 2010

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ABSTRACT Pension funds have started investments in infrastructure as a separate asset class in recent years. This article investigates the first experience against the promises made. Early studies show good risk-adjusted returns of private equity-style infrastructure funds and relatively low correlations to other asset classes. However, the picture became less rosy through the financial crisis. Research available does not give much support to the supposed long-term characteristics such as the stability of income or inflation hedging, while indicating a high degree of heterogeneity. Strong caveats apply: history is short, good data are rare and empirical research is in its infancy. Surprisingly little theoretical work has been done, which contributes to the considerable confusion in the field. Meanwhile, changes are underway in the industry to better match investors' needs with suitable vehicles, and perhaps rediscovering infrastructure bonds.

Pensions (2010) 15, 89–99. doi:10.1057/pm.2010.4

Keywords: infrastructure investment; infrastructure fund; infrastructure bond; pension fund; asset allocation; alternative asset

INTRODUCTION: THE ASSET ALLOCATION BACKGROUND

Investing in infrastructure has become increasingly popular with pension funds in recent years. Infrastructure is presented as one of the new alternative asset classes ('alternative' to mainstream equities and government bonds), expected to provide new sources of return and better diversification of risk.

The key driver in this process is a new approach to asset allocation after the *previous* financial crisis of the early 2000s (when the tech bubble burst), which led to substantial pension funding deficits.

The idea of investing in infrastructure strikes a chord with many pension plan trustees and members. Infrastructure feels more 'solid and real' than many other complex products and strategies presented, in which they find it difficult to detect the underlying value. It also seems to provide a natural fit with long-lasting, often inflation-linked pension liabilities.

The connotation to sustainable and socially responsible investing is also being made an increasingly important theme, especially for public pension plans (but not only). The political pendulum, too, has swung back in favor of infrastructure – in difficult economic times, infrastructure investment is made a 'saviour of the world economy' from America to China.¹

Can infrastructure investments keep up to the promise? This article investigates the early

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experience with infrastructure as an asset class. Unfortunately, we still know very little, both *in theory and in practice*.

Pension funds' experience with infrastructure funds is rarely longer than 3–4 years, and is shaped by the boom-bust-environment of the mid/late noughties. Nonetheless, some hard and useful lessons have already been learnt in practice.

Academic research on the subject is still in its infancy. Data are very limited in quantity and quality, making empirical work difficult. More surprisingly, there is hardly any theoretical work performed in this field. There are a number of issues that confuse investors and researchers alike.

THE VALUE PROPOSITION

Already the definition of 'infrastructure' is controversial. Widely defined, it covers 'services essential to society'. In the investment context, it typically includes economic infrastructure such as transport (for example, ports, airports, roads and tunnels), utilities (for example, energy distributions networks, water, waste), communication (for example, cable networks, towers) as well as social infrastructure (for example, schools and hospitals).

What do these sectors have in common? The basic value proposition put forward by the investment industry is to capture excess returns resulting from *limited competition* as a result of natural monopolies, government regulation or concessions. Infrastructure is said to share attractive *financial characteristics*, in particular:

- long term, stable cash flows;
- good inflation hedge;
- low sensitivity to swings in the economy and markets;
- low correlation of returns with other asset classes;
- relatively low default rates;
- sustainability (for example, renewable energy).

The latest financial crisis has led to disappointments with alternative funds including losses in 'absolute return' funds, rising correlations among asset classes and the emergence of unknown risks. As a consequence, they have come under increased

scrutiny. The list of potential issues is long: performance, volatility, diversification, liquidity, leverage, valuations, transparency, governance, fees, administration and others.

Infrastructure, too, will be facing more critical investigation. Investors go back and ask very basic questions such as: What is the appropriate risk–return profile? Is there a performance record? What is the exact cash flow pattern? Do we understand the specific risks? Do we have the right investment vehicles? How to benchmark infrastructure funds? What are fair terms for investment mandates?²

VEHICLES

More confusion is generated by the variety of investment vehicles available for infrastructure assets. It is particularly important to distinguish between *listed* and *unlisted*, *companies* and *funds*.

- As a start, it is often overlooked that pension funds have been investing in *publicly traded shares and bonds* of utility, transport or energy companies for a long time. This is the traditional sector approach.
- New-age infrastructure investment works through private equity-type of investments, predominantly via *unlisted funds*. In addition, some bigger pension plans have started *direct or co-investments* in (unlisted) infrastructure companies.
- There are also a number of *listed infrastructure funds* on the market, closed or open-ended, which invest in listed and unlisted infrastructure companies.

Dedicated (listed and unlisted) infrastructure funds were first set up in Australia in the mid-1990, and the local pension plans were early investors in them. Some bigger Canadian plans also pioneered in the field. Specialist infrastructure funds have been mushrooming in Europe since the mid-2000s, followed by Asia and United States, where the trend took off surprisingly late.

Within the various categories of investment vehicles, there is considerable differentiation in terms of geography (including emerging markets), sectors and development stages (for example

brownfield and greenfield). Further product developments include infrastructure fund-of-funds as well as derivatives and exchange-traded funds built around various listed infrastructure indices.

VOLUMES

The total volume of money raised in *unlisted* infrastructure funds is already substantial. Preqin,³ a research firm, reports a figure of US\$ 119 billion for institutional fundraising in the years 2004–2009. Of the 979 deals recorded, the majority (423) were made in Europe.⁴ Deals in energy (299), transport (229) and utilities (193) clearly dominate other sectors. At the end of 2009, 116 infrastructure funds were reported to be ‘on the road’, looking to raise a further US\$117 billion.

Over 20 *listed* infrastructure funds are reported with a market capitalization of over US\$30 billion, the majority listed in Australia.⁵

Fundraising rose strongly over the years up to 2007, but has sharply slowed since, as has the number of new funds launched. The financial crisis also seems to have cooled down investors’ intentions towards infrastructure.⁶

How much have *pension funds* invested? There are no exact data. Obviously, not all the money going to infrastructure funds comes from pension funds. At the same time, pension funds also use other routes into infrastructure, often classified as, for example, private equity or real estate. Unfortunately, infrastructure is only slowly appearing on the radar screen of asset allocation surveys and independent performance analysis.⁷

About 150 public and private pension funds, globally, are reported to already have commitments to infrastructure funds, and the press frequently reports new allocations of individual pension plans to infrastructure, of 2 per cent, 3 per cent, 5 per cent or more of their funds. However, they are still in a minority, and capital committed does not automatically mean capital invested.⁸

The allocation of Australian Superannuation Funds and large Canadian public pension funds is estimated at 3.6 per cent (listed and unlisted funds) and 1.3 per cent (unlisted only), respectively.⁹ However, the global average allocation to specialist infrastructure vehicles is still well below

1 per cent. Watson Wyatt,^{10,11} a consultancy firm, reports a volume of US\$75 billion managed by 19 infrastructure managers *for pension funds* at the end of 2008. This implies an allocation of only 0.4 per cent globally, despite the initial strong growth.¹²

Finally, it is forgotten that the pension funds’ total exposure to infrastructure is several times higher than these figures because of their investments in *listed companies* (estimated allocation of 2.5 per cent, or roughly half a trillion US\$).¹³ However, such investments are often dominated by traditional utility stocks as opposed to ‘core infrastructure’, another important point easily overlooked.¹⁴

PERFORMANCE AND VOLATILITY

The next question is about the performance record of infrastructure *funds*. There are many figures flowing around in the financial industry but it is often less clear what their substance is. The ‘evidence’ presented is frequently taken from *listed infrastructure stocks*, which is a rather different cattle of fish.

Listed infrastructure indices tend to show outperformance against global stock market indices for most of the last decade but underperformance in the late 2000s. Volatility of listed infrastructure indices is comparable to that of the general stock market indices, in some cases even higher. As expected, dividend yields tend to be somewhat higher, mainly because of the inclusion of utility stocks.

For *unlisted* infrastructure investments, there are hardly any reliable data available. There are a number of reasons for that:

- The history of most unlisted infrastructure vehicles is quite short.
- Data are often proprietary and not made public. Independent performance measurement services have hardly collected or provided data yet.
- There is much variety and diversity in unlisted infrastructure funds.
- Infrastructure funds and pension plans use different benchmarks.
- There are no agreed performance and risk reporting standards.

However, some work has been done to produce historic time series and performance figures for unlisted infrastructure, in particular for Australia, where the record is longest.

Peng and Newell¹⁵ analyzed 19 unlisted Australian infrastructure funds with a total volume of A\$4.5 billion invested in 144 assets. Over a 10-year period to Q2 2006, both risk and returns compare very favorably to other asset classes. The average annual return of unlisted infrastructure funds of 14.1 per cent beats the returns of bonds (7.2 per cent), stocks (12.9 per cent) and direct property (10.9 per cent). Volatility of unlisted infrastructure (5.8 per cent) is lower than for stocks (11.0 per cent) but higher than for bonds (4.3 per cent) and direct property (1.5 per cent).

Finkenzeller and Dechant¹⁶ report similarly good return figures for direct infrastructure and utilities, both absolute and in comparison with other asset classes in Australia, over a period of 10 years between Q1 1998 and Q4 2007. The annualized return of direct infrastructure of 12.1 per cent is higher than for bonds (5.5 per cent) and direct property (11.2 per cent) but lower than equities (13.9 per cent). However, the annualized standard deviation of the (de-smoothed) returns for direct infrastructure of 10.4 per cent is higher than for bonds (4.1 per cent), and property (7.9) and equities (9.5 per cent).¹⁷

Caveats are necessary, some also mentioned by the authors:

- the small and incomplete sample of funds (funds of different sizes and inception years);
- data gathering (from different sources);
- the period analyzed (before the credit crunch 2007);
- the appraisal-based valuation of unlisted infrastructure and direct property tends to underestimate volatility and correlations with listed instruments, and overestimate their diversification potential.

Not surprisingly, such good figures were not sustainable forever. Performance of unlisted infrastructure funds suffered in recent times. The Colonial First State¹⁸ Index of Australian unlisted infrastructure slipped into the red, for

the first time, with a rolling 12 months return of -2 per cent to end Q3 2009.

Center of Private Equity Research (CEPRES)¹⁹ takes a different approach in their empirical analysis of the risk-return characteristics of the *direct* investments with unlisted funds. They develop two *global* data sets: a narrow one (in which the word 'infrastructure' appears in the fund's name) and a wider one (including other funds with an infrastructure or mixed focus) over a time period between 1986/1988 and 2007.

Data set I shows an average gross internal rate of return (IRR) of 48.0 per cent for 196 *realized* transactions and of 14.3 per cent for 187 *unrealized* investments. The median values are 14.3 per cent and 0.0 per cent. In data set II, the average figures are 34.2 per cent (for 478 realised transactions) and 45.4 per cent (for 355 unrealized investments), and the medians are 18.4 per cent and 10.1 per cent.

The authors emphasize an extraordinary high degree of variation across projects, and also a high spread of returns across sectors, regions and years.²⁰ The frequency chart of IRR distributions of fully realized transactions shows substantial deviation from a normal distribution. It is skewed to the right with a high frequency of extreme outliers in both tails (see Figure 1).

Early indications of performance reports from individual pension funds also demonstrate a very high degree of dispersion of results.²¹ Obviously, it is still very early days for performance measurement and analysis and much is left to do in this field in every sense.

There are a number of difficult questions including the construction of appropriate (unbiased) indices for unlisted assets, the frequency of data, the diversity of vehicles, the impact of fees, the effect of gearing (sometimes 80 per cent and higher) and the performance measurement methodology in general.²²

DIVERSIFICATION

Studies of Australian data also seem to confirm the diversification opportunity of unlisted infrastructure (see Table 1).

Correlations with equities and bonds are measured rather low. However, there are substantial

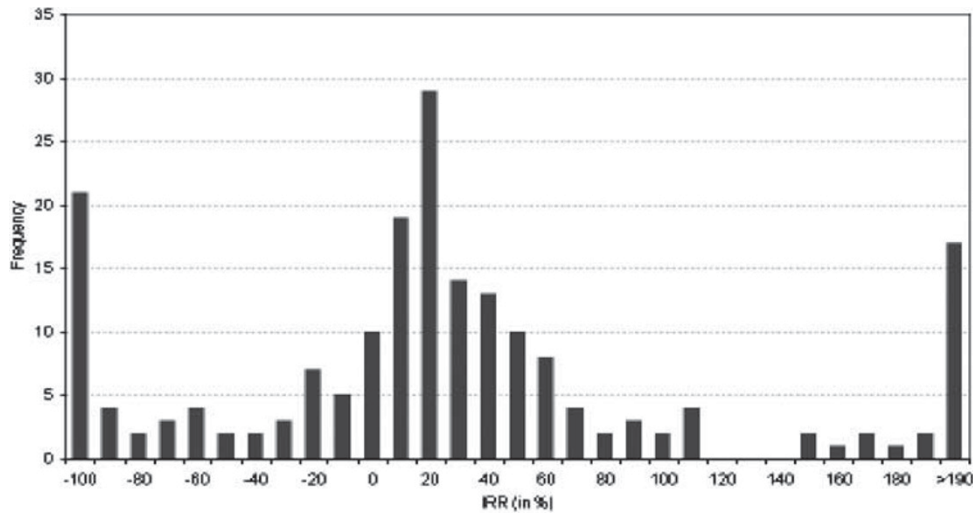


Figure 1: Distribution of the gross IRRs for the realized transactions of sample 1 (direct infrastructure investments: sample 1; realized deals $N=196$).

Table 1: Correlation of unlisted infrastructure in Australia

Research	Period	Data frequency	Equities	Bonds	Direct property	Listed infrastructure
Peng and Newell ¹⁵	Q3 1995–Q2 2006	Quarterly	0.06	0.17	0.26	0.31
Colonial First State ¹⁸	October 1999–September 2009	Monthly	0.10	0.06	0.50	0.26
Finkenzeller and Dechant ¹⁶	Q1 1998–Q4 2007	Quarterly	0.15	-0.02	-0.65	0.07

swings in correlations. For example, in Peng and Newell¹⁵, the historic rolling 5-year correlation with equities moves within an approximate range of -0.15 and $+0.30$. The range appears even bigger for the rolling 3-year correlation, shown in Colonial First State,²³ that is, between -0.25 and $+0.50$. The correlation figures of unlisted infrastructure with direct property vary widely across studies, presumably because of the use of different methodologies (in particular de-smoothing of the returns of unlisted vehicles).

It might also be interesting to know, how listed and unlisted infrastructure compare in terms of the diversification effect. It should not surprise that listed infrastructure indices have a high and significant correlation with stock market indices, typically in the region of 50–80 per cent. The general stock market volatility is clearly a major factor affecting *listed* infrastructure prices.

Unfortunately, no historic correlation data are known for unlisted infrastructure in other regions or globally.²⁴ None of the known empirical

studies measure the correlation with private equity or other asset classes.

In summary, it would be unwise to make too strong conclusions about the diversification effect of infrastructure investments in a (broad, alternative or real estate) portfolio. Apart from the reservations on the quality of data, it is yet unclear what the economic diversification potential of the underlying assets is. How significant is the purely ‘statistical’ diversification effect stemming, for example, from different data frequency or different valuation methods (mark-by-market versus appraisal)?

WHAT RISK-RETURN PROFILE?

History can offer little guidance. In the longer term, it is still unclear what the appropriate risk-return profile of infrastructure assets is, even in theory.

Given the much longer history, a lot more is known about *listed* infrastructure than *unlisted*. The substantial differences in terms of their

financial characteristics are also indicated by the very low correlation statistics between the two series (see Table 1).

For unlisted investments, pension funds were being presented all sorts of stylized risk–return charts, at the start of the infrastructure boom, sometimes promising ‘equity-type returns with bond-type risk’. Return expectations for infrastructure funds were well in the double digits, whereas expected volatility was put somewhere in between bonds and equities.

Some providers split expectations for brownfield (mature) infrastructure assets (10–14 per cent) and greenfield (early-stage) assets (18 per cent).²⁵ The analysts’ projections also vary across infrastructure sectors.²⁶ Similarly for expected volatility.

CEPRES¹⁹ calculates an average *target* IRR of 17.9 per cent, with values ranging from 10 per cent to 30 per cent (sample of 49 funds). As expected, the average expected IRR is higher for greenfield funds (23.3 per cent) than for brownfield funds (13.5 per cent). The average leverage ratio (at individual transaction level) is 74 per cent, with values ranging from 0 per cent to 95 per cent, across 19 funds giving the information.

Pension funds are somewhat more cautious in the context of asset–liability–modeling: typical figures used are 9–10 per cent for expected returns and 7–8 per cent for expected volatility.

More recently, adjustments to the original risk–return picture for infrastructure investments had to be made in three ways:

- First, the prime mover advantage has evaporated. Many industry observers believe that infrastructure had been undervalued in the 1990s, but enjoyed a revaluation process in the 2000s. Assets appeared to overheat in 2006/2007. Money was cheap and easily available, and this led to excessive leverage and bidding wars among all sorts of players and syndicates. Therefore, as asset price rose, return expectations had to be moderated.
- Second, the recent crisis dramatically reshaped the financial environment at all levels in 2008/2009: for infrastructure companies (more difficult lending conditions, changing demand),

fund providers (need to de-leverage, investors withdrawing commitments and funds) and investors (for example, falling asset valuations and rising liabilities).

- Third, through the recent up and downturns in the economy, investors realized the enormous heterogeneity of infrastructure. Some assets revealed their very cyclical nature in (for example, transport), whereas others proved to be more resilient.

BENCHMARKS

Another practical question for investors is how they should benchmark infrastructure funds. What could be considered success or failure? This is already difficult (and often controversial) for asset classes such as real estate and private equity with a much longer history. In theory, there are a number of possibilities, including²⁷

- absolute return figure (for example, 9 per cent);
- inflation, plus margin (for example, consumer price index (CPI) + 4 per cent);
- LIBOR or bond yield or nominal GDP, plus margin;
- (inflation-linked) bond index return, plus margin;
- blend of equity, real estate, bond and private equity benchmark;
- listed infrastructure index or global equity index or blend of the two;
- peer group of unlisted infrastructure funds;
- proper index of unlisted infrastructure (yet to be produced).

In practice, there is currently a trend towards ‘absolute return’ benchmarks, with the first two types being the most popular.

The choice of an appropriate benchmark depends on a number of factors such as the liability profile of the pension fund, the asset allocation approach and the type of infrastructure investment.

NEW ASSET CLASS OR NEW VEHICLE?

Should infrastructure be regarded as a new and separate asset class in the first place? Investing in

infrastructure companies is certainly not new but many vehicles on offer these days are.

The proposition of infrastructure, as a separate asset class, applies primarily to unlisted instruments, although a similar case is frequently made for listed infrastructure.^{28,29} The question, however, remains why the listed infrastructure and/or utilities sectors should be considered a separate asset rather than just traditional stock market sectors.

It appears that infrastructure assets, not all to the same degree, have *certain* characteristics of bonds, equities, private equity and real estate. But in what combination? Proponents of (unlisted) infrastructure as a distinct asset class stress the difference not only to listed stocks and corporate bonds but also to private equity (for example longer time horizon, higher yields) and real estate (for example, investment in companies rather than physical property, monopolistic position).

The relationship between *real estate* and infrastructure assets is evaluated by a number of studies discussed. In a qualitative analysis, the differences look pretty obvious, but in the quantitative analysis of financial characteristics it is less clear what the decisive factors are: the nature of the underlying assets or the vehicles in which they come.

Most of the unlisted infrastructure funds that have been analyzed have traditional *private equity* type fund structures. Not surprisingly, fee levels and other structures are also quite similar. For example, the average management fee in the CEPRES¹⁹ fund sample analyzed is 1.8 per cent (range from 0.9 – 2.5 per cent).³⁰ The average fund term is 11.4 years, with values ranging from 5 to 25 years.

There is a high degree of variation in cash flow patterns, indicating that infrastructure cash flows are far from being stable and predictable. The report concludes: 'Infrastructure investments have more in common with traditional private equity and do not show the features traditionally regarded to be constituent for infrastructure'. 'Furthermore, the investment risks also seem to be quite similar to that of traditional buyout deals – both in terms of the standard deviation of the

IRRs and also in terms of the default rates of the deals'.

In conclusion, it remains to be seen how the supposed commonalities of infrastructure assets will stand rigorous scientific scrutiny as they may turn out to be sheer idealizations of a very diverse reality. For example, can it be shown that (the very heterogeneous) infrastructure assets correlate more with each other than with other asset classes?

Nonetheless, some scholars and firms try to calculate 'optimal allocation levels' for infrastructure in a portfolio context.³¹ Such exercises need to be interpreted with a high degree of caution, given the issues with infrastructure concepts and data.

What do investors do *in practice*? *Listed* infrastructure securities are mostly still kept in the traditional equity and corporate bond portfolios. As for the *new-style infrastructure funds*, investors seem to take different routes. According to Probitas, a consultancy investors put infrastructure into the following categories: 27 per cent private equity, 13 per cent real estate, 39 per cent separate, 12 per cent general alternatives portfolio, 7 per cent inflation-hedged and 15 per cent others. New trends in allocation create new categories such as 'real assets'.³²

RISKS

Infrastructure assets are very heterogeneous, ranging from a pioneering Greenfield energy project to a boring old toll bridge. It remains unclear what level of aggregation would be appropriate for a meaningful risk-return-correlation analysis, and what reasonable assumptions to make more generally in asset-liability-modeling. In practice, investors need to look deep into infrastructure projects.³³

Risk analysis must go much further than backward-looking statistics. Pension trustees will be interested in the specific risks of infrastructure investments, not the least in regulatory, political and social uncertainties. All people in pension funds have their own views about private finance of public infrastructure, and are aware of some fundamental opposition against it.

The recent market turmoil has increased the awareness for the ‘other’ risks and issues such as leverage, concentration, counterparties, valuations, liquidity, opacity, fees and conflicts of interests. For example, most unlisted infrastructure funds have quite concentrated investments and face high event and cluster risk. Decision-makers bitterly need help but research is again still in its infancy in this field.³⁴

NEW DEVELOPMENTS

Investors have expressed concerns over the ‘mismatch’ between the lifetime of the underlying assets and the lifetime of the vehicle into which they are packaged. Some trustees feel ‘mis-sold’ when they were looking for stable, long-term income comparable to bonds, utility stocks or real estate but ended up with a highly leveraged, high risk fund. Others bemoan ‘bond-like returns at private equity-like fees’.

Many pension funds are not (yet?) at ease with the workings of private equity-type funds (for example, relatively short life time, phased investment stages, J-curve effect and so on). Adjustments in the industry are underway. Recent developments include the creation of funds with a longer lifetime (or ‘ever-green’) and flexible exit strategies. Not surprisingly, fee levels, incentive structures and other terms in the general partner/limited partners (GP/LP) relationship have come under pressure.³⁵ As with other alternative assets, transparency and governance standards need to be raised.^{36,37}

New thinking on *asset allocation* is also taking shape. Given the perceived failures of asset class diversification during recent volatile markets, some experts suggest a policy focusing on diversification across underlying economic and risk factors (such as growth, interest rates, inflation, credit, liquidity and so on) rather than traditional asset classifications.

Pandora’s box is open: what is an ‘asset class’ in the first place? New thinking about asset class definition and diversification might well have useful applications to an investment universe as diverse as infrastructure.

INFRASTRUCTURE BONDS

There is also an increased interest in infrastructure *bonds* both from the side of issuers and investors. Pension funds are reconsidering the spectrum of debt instruments as they may get ‘boring’ infrastructure yields perhaps in a simpler and cheaper form. Sawant³⁸ also argues for infrastructure debt as a superior governance mechanism instead of private equity.

Only about 10 per cent of infrastructure debt funding comprises capital market *bonds*, whereas a majority is in the form of (syndicated) *loans*. Loans to infrastructure companies may increasingly come into the alternative investment picture of pension funds.^{39,40} The credit agencies report comparatively low default rates for infrastructure projects. However, much more analysis is needed in this field.

In practice, infrastructure bonds are represented in pension funds portfolios, for example, in the form of corporate bonds of utility companies or Private Finance Initiative (PFI) bonds in the United Kingdom. However, volumes still seem small but, again, little is known. Compared to the noise around new-age infrastructure funds, there has been surprisingly little exploration of the low-cost, long-duration, inflation-linked infrastructure bonds, at least in the developed world.

In contrast, there is a lively discussion in the developing world about the benefits of infrastructure bonds, the financing of infrastructure needs and the investment in them by pension funds (for example in Chile, India, Kenya).^{41,42}

Sawant⁴⁰ undertakes a return analysis of 60 emerging market infrastructure bonds from 15 countries and five sectors. The sample average for the tenor is 12.7 years, for the coupon 8.4 per cent and for the average rating BBB-.

Over the specific period from December 2002 to March 2009, the returns were flat and the risk-return profile not attractive. More interestingly, correlation with the Standard & Poor’s (S&P) 500 was low (0.35) but higher with listed infrastructure equity indices (0.47–0.58) and emerging bonds (0.80). He also found a slightly negative correlation with inflation as coupons

were fixed, 'which implies that infrastructure bonds are not a good hedge against inflation'.

Overall, research of infrastructure bonds in the context of institutional portfolio management is only at the beginning.

OPEN QUESTIONS

There are very important questions that will have to be researched more thoroughly. To list some:

1. Risk premia: What types of long-term return generators are exactly at work with infrastructure investments?
2. Exposure: We are still lacking a factor and style analysis that would help us understand the risk premia for equity, credit, term, inflation, liquidity, size and other risks.
3. Business cycle: How defensive are infrastructure assets, and how do they differ in terms of the sensitivity to the economic cycle?
4. Inflation-hedge: How good is the protection against inflation? (Some investors find inflation actually hedged out in infrastructure companies).
5. Diversification: What do we really know about changing correlations of (alternative) asset classes in general, and infrastructure assets in particular?
6. Cash flows: What is the pattern of cash flows of different infrastructure sectors and assets? It would be important for pension funds to know when to expect stable and predictable incomes and when private equity-style J-curves.
7. Heterogeneity: Analysis will need to go well beyond the common distinction of early-stage assets (being closer to private equity) and high-yielding mature assets (similar to utility bonds, real estate or low-beta stocks).
8. Liability management: What infrastructure assets and investment vehicles are suitable for liability-hedging strategies of pension funds?
9. Risks: More thorough qualitative and quantitative analysis of the risks involved in the underlying assets and investment vehicles.

Such questions are not purely academic. The recent years have already revealed (sometimes painful) real-life examples of the exposure to

interest rate, credit, economic and political risks to those invested already.

CONCLUSION

Pension funds have shown increasing interest in long-term infrastructure investments in recent years. However, the early experiences with infrastructure funds have been very mixed in the recent boom-bust environment.

There is considerable confusion in the field, in particular over the definition of infrastructure (for example, to include or exclude utilities), the (listed and unlisted) investment vehicles available, the volumes allocated and invested, the long-term risk-return profile and the diversification potential of infrastructure assets.

This article scrutinizes the evidence against the promises made. Early studies show good risk-adjusted returns of unlisted infrastructure and relatively low correlations to other asset classes. However, history is short, good data are rare and empirical research had a slow start. The picture became less rosy, during the financial crisis, when investors were surprised by the risks of specific projects and sectors (for example, cyclicality) and of investment vehicles involved (for example, high leverage).

Research available does not give much support to the supposed long-term characteristics such as the stability of income and inflation-hedging. Instead, the similarities of unlisted infrastructure funds to private equity funds prevail. The question remains to what extent infrastructure is a new asset class in the first place, or just a range of new investment vehicles.

There is still surprisingly little theoretical work that has been performed in this field. A better framework for the analysis of the factor exposures and risk premia of infrastructure assets is needed. The broad heterogeneity of the sector needs to be better captured and so do the risks specific to infrastructure.

In the meantime, adjustments in the investment industry are noticeable to better match investors' needs with suitable (old and new-style) investment instruments, in both the equity and bond space.

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- 17 The main difference to Peng and Newell¹⁵ in the risk statistics is presumably the result of ‘de-smoothing’ the time series of the unlisted infrastructure and direct property series.
- 18 Colonial First State (2009b) Evaluating Infrastructure from a Property Perspective: The Case for a Diversified Real Asset Allocation. Infrastructure Research Note, 30 November.
- 19 CEPRES (2009) *Infrastructure Private Equity*. Munich, Germany: CEPRES. They analyze 70 funds (of which 28 based in the United States, 22 in the United Kingdom) out of a database of 186 unlisted funds.
- 20 Furthermore, the years 2005–2007 appear to generate extremely high transaction IRRs.
- 21 Preqin reports IRRs of 10 unlisted funds with ‘mature information available’, out of a database of 175, ranging from –6 per cent to +32 per cent. Net multiples achieved are in the region of 1 in recent years. See Preqin (2009b) Infrastructure fund performance: Low risk, low returns? *Infrastructure Spotlight*, March 2(3): 3–5.
- 22 For example, pension funds are used to time-weighted annual returns whereas project finance and private equity funds work with IRRs, multiples and vintage years.
- 23 Colonial First State.¹⁸ They use their index of monthly data of five equally weighted unlisted infrastructure funds, for the 10 years to September 2009. They mention the relative immaturity of the infrastructure sector, ‘with only two funds represented in the Mercer unlisted infrastructure index until June 2000, and three funds until October 2003’.
- 24 Colonial First State try to construct a time series for unlisted infrastructure in the United Kingdom using available time series of UK and Australian listed and unlisted property and infrastructure series, and different estimation techniques (Ratio and Fourier analysis). In the 10 years to Q2 2008, their preferred index shows an annual return of 7.9 per cent and a standard deviation of 5.4 per cent. The correlation with equities is 0.22. The return appears lower compared to Australia, a result mainly driven by the strong performance of the Australian listed infrastructure series relative to the United Kingdom. See Colonial First State. (2009c) Constructing an Investment Return Series for the UK Unlisted Infrastructure Market: Estimation and Application. Infrastructure Research Paper, 15 January.
- 25 See, for example, RREEF (2007) Performance characteristics of infrastructure investments. RREEF Research, August.
- 26 For example, JP Morgan expects the lowest IRR for PFI projects (6–12 per cent) and toll roads (8–12 per cent). Airports (14–18 per cent) and communication network (15–20 per cent) are among the higher expectation sectors. See J.P. Morgan Asset Management. (2009) Infrastructure investing: Key benefits and risks. Insights, March.
- 27 For a discussion, see Colonial First State (2007) A Look at Wholesale Infrastructure Fund Benchmarks. Infrastructure Research Note, Colonial First State Global Asset Management, 12 March.
- 28 See, for example, Timotijeciv, D. (2007) *The Case for Global Listed Infrastructure*, 14 March. Mercer.
- 29 Lazard. (2007) *Listed Infrastructure Investments: In a Class of their Own*, Lazard Asset Management.

- 30 Furthermore, the performance fee has an average carry of 20.2 per cent (range from 2–50 per cent) and an average hurdle rate of 7.9 per cent (range from 6–10 per cent).
- 31 See, for example, Finkenzeller and Dechant¹⁶, Idzorek and Armstrong¹⁴ and research from Colonial First State 18, 24.
- 32 Probitas (2009) Infrastructure market review and institutional survey. Probitas Research, November.
- 33 For an analysis of the steps in the process including organization models (for example, PPP) and project financing instruments, see, for example, Weber, B. and Alfen, H.W. (2010) *Infrastructure as an Asset Class*. Chichester, UK: Wiley.
- 34 For a discussion of risks and issues for pension funds and regulators, see Inderst, G. (2009) Pension Fund Investment in Infrastructure. Paris, France. OECD Working Paper no. 32, January.
- 35 See, for example, Watson Wyatt (2009b) *Improving Fees in Infrastructure*, October.
- 36 See, for example, RiskMetrics (2008) Infrastructure funds: Managing, financing and accounting. Whose Interests? Melbourne, Australia: RiskMetrics Group.
- 37 Torrance, M.I. (2007) The power of governance in financial relationships: Governing tensions in exotic infrastructure territory. *Growth and Change* 41(8): 671–695. Probitas³³ registers an increasing demand for independent vehicles as opposed to those sponsored by larger financial institutions.
- 38 Sawant, R. (2010) *Infrastructure Investing: Managing the Risks and Rewards for Pensions, Insurance Companies and Endowments*. New York: Wiley & Sons.
- 39 Sawant argues that syndicated loans are better in terms of mitigation of political risk in emerging markets (Sawant, 2010).
- 40 See Sawant, R. (2010) Emerging market infrastructure project bonds: Their risks and returns. *The Journal of Structured Finance* 16(1): 1–9.
- 41 See, for example, Vives, A. (1999) Pension funds in infrastructure project finance: Regulations and instrument design. *The Journal of Structured Finance* 5(2): 37–52.
- 42 See also the discussions held at the OECD/IOPS Global Forum on Private Pensions, Mombasa, October 2008.