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NBIM DISCUSSION NOTE

Infrastructure investments

In this note we look closer at infrastructure investments. Our objective is to provide an overview of the opportunity set, key risks and return drivers.

Main findings

- The OECD defines infrastructure as the system of public works in a country, state or region, including roads, utility lines and public buildings. Infrastructure investments are direct or indirect stakes in businesses that own or operate these assets.
- Infrastructure assets are often grouped according to physical characteristics, cash-flow properties, contractual approach, maturity of asset and stages of market development. Infrastructure as a group covers a set of heterogeneous investment opportunities.
- Demand for capital to fund infrastructure arises from needs to renew ageing infrastructure assets in mature economies and needs to expand capacity in emerging economies. At the same time Government capability to supply the capital needed is restrained. The result has been a widespread recognition of a significant infrastructure funding gap.
- Investors considering investing in infrastructure assets can choose from a wide spectrum of investment vehicles. The choice of vehicle may shape the risk-return profile of the investment.
- The performance history for infrastructure investments is limited and performance data are to a large extent private. The high degree of heterogeneity makes comparisons across projects, structures and jurisdictions challenging. Scholarly studies on infrastructure investments are few and the approaches taken to deal with the shortcomings in available datasets vary widely. It is therefore challenging to draw general and firm conclusions based on these studies.
- Infrastructure investments can exhibit bond, real estate or equity characteristics. The risk-return profile of an infrastructure investment generally arises from the nature of the underlying asset itself, the environment in which it operates and the choice of investment vehicle. Different investors have different goals for their infrastructure investments, which leaves no "right" way to benchmark such investments.

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1. Definition

In a standard dictionary infrastructure is defined as:

> *" The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communication systems, water and power lines, and public institutions including schools, post offices and prisons" (American Heritage Dictionary)*

The OECD uses a simple and general definition of infrastructure as the system of public works in a country, state or region, including roads, utility lines and public buildings. Infrastructure investments are described as direct or indirect stakes in the businesses that own or operate these assets. We interpret the term public in the OECD definition in an economic context (public goods) rather than as a reference to the legal ownership of the asset.

Infrastructure assets are often grouped according to their physical characteristics. Most infrastructure assets fall into one of two groups – economic or social. These two groups are again made up of different sectors. Economic infrastructure is commonly used to describe assets which permit circulation of goods and commodities that directly supports and promotes economic activity. Economic infrastructure includes transportation (e.g. toll roads, airports, seaports, tunnels, bridges, metro and rail systems), utilities (e.g. water supply, sewage system, energy distribution networks, power plants, pipelines and gas storage), communication (e.g. TV/telephone transmitters, towers, satellites, cable networks), and renewables. Social infrastructure will typically include assets that accommodate social services such as educational facilities, health (hospitals and health care centres), security (e.g. prisons, police and military stations) and others (e.g. parks) (Inderst (2009)).

Another approach is to define infrastructure by certain common economic and financial characteristics (Inderst, 2009). Infrastructure assets often exhibit economic characteristics such as economies of scale, inelastic demand and limited competition. The lack of competition is often the result of high barriers to entry which again are often linked to restrictions on ownership and/or restrictions on the uses to which infrastructure can be put. The perceived common financial characteristics are predictable, steady, often inflation-linked cash flows with long duration, relatively low defaults rates and associated low risk of capital loss.1 Infrastructure assets' ability to provide these types of characteristics varies both across sectors and within the same sector. For example, within the transport sector, cash flows from operating toll roads should in general be fairly stable in real terms since tolls are often directly adjusted for inflation. In contrast the cash-flows from an investment in an airport will offer less inflation protection as they are made up of a combination of fairly stable landing slot revenues and highly cyclical revenues from retail operations.

Blanc-Brude (2013) argues that from the point of financial economics, infrastructure investments are best defined as high sunk cost, long-term investments in immobile, relationship-specific assets.[2] In this context, it is the contractual design rather than physical characteristics that matters. Blanc-Brude identifies three types of commonly used contracts: availability payment schemes, commercial schemes and capped commercial schemes. Under an availability payment scheme the public sector makes fixed payment to a private contractor over a pre-agreed period in exchange for the design, construction, long-term maintenance and financing of the project. The terminal value of the project is most often set to zero and the control of the asset is returned to the public sector when the contract expires. This model is typically used for social infrastructure projects. Commercial schemes are more common for transport projects where the public sector grants the private contractor a variable cash flow through the right to collect tariffs/tolls for an agreed period. The terminal value of such projects under this type of arrangement is also set to zero. Capped commercial schemes involve some degree of revenue sharing between the public sector and the private contractor, e.g. capped/floored equity returns in utilities. The terminal value may not always be set to zero. In some instances, the private contractor owns the facility outright for infinity.

1 A Moody's study of project finance bank loans showed only 19 defaults out of 867 infrastructure projects, or a default rate of 2.2 per cent compared to an average default rate of 8 per cent in a total sample of 5,846 loans (Moody's 2010).

2 Blanc-Brude (2013) defines relationship-specifics as assets that have little or no value outside of the contractual relationship in question.

Physical characteristics, cash flow properties and contractual approach are three dimensions along which infrastructure assets may vary, but they are not the only ones. Another dimension is the maturity of asset development. Greenfield investments is the term used for growth stage investments in new projects that have yet to be designed and constructed and that will generate little or no income for a long period. Brownfield or core investments are the terms used to describe investments in well-established cash flow-generating assets, such as fully operating and stabilised toll roads. Brownfield investments are therefore generally perceived to be less risky than greenfield investments as they are more mature. De Ponte (2009) lists two additional stages of asset development: rehabilitated brownfield and opportunistic infrastructure. Rehabilitated brownfield investments[3] are investments in an operating, cash flow-generating asset with a need or potential for further development. Opportunistic infrastructure investments are investments in projects with significant operational and regulatory issues that need to be addressed before a project can be turned around or optimised. Such turn-around plays are usually of a shorter duration than projects in one of the other three categories, with the project sold or transferred once the turnaround is completed.

The stage of market development is another aspect of infrastructure investments. An investment in a developing market exhibits different risks than an investment in more developed markets, along both the geographical and technical dimension. Another distinction can be drawn between privately and publicly owned assets. Within the first category we find both private investments in highly regulated sectors subject to public supervision such as energy distribution, and investments in less regulated sectors such as, for example, investments in an LNG terminal or a parking facility.

From an investors' perspective it may be useful to classify infrastructure projects according to the different investor roles. For some projects, such as an investment in a highly regulated grid or a pipeline, the investor's key role is often to serve as a financier, by providing either equity or debt. Other type of infrastructure investments, for example an investment in an airport, will often require that the investor engage more actively in operational issues. An investor's preferred route of investment may vary depending on which of these different roles the project will entail.

The challenge to come up with one encompassing definition mirrors the high degree of heterogeneity in infrastructure investments. Infrastructure is not a general panacea in a risk-averse world, but a set of investment opportunities. There are fundamental differences between regulated infrastructure, public private partnerships (PPPs) that rely on long-term government contracts and corporate or private infrastructure. Beeferman (2008) concludes that the diversity of definitions suggests caution when considering investments offered under the rubric of "infrastructure".

2. The infrastructure funding gap

Infrastructure assets provide essential services, structures and social capital enabling economic and social growth. Investments in infrastructure assets are often labelled as socially responsible investments[4] as the underlying assets provide public goods and services essential to society. Since they stretch over an extended time period such investments are often categorised as long-term investments. The European Commission (2013) argues that such long-term productive investments are important drivers to boost productivity, improve competitiveness and ensure sustainable growth. The Group of Thirty (2013) concludes that long-term investments, all things being equal, can expand the productive capacity of an economy. Torrisi (2009) summarises studies that examine the relationship between economic growth and infrastructure and concludes that the general consensus considers basic infrastructure facilities to be important to economic performance. Apart from this main idea, he finds that opinions differ greatly, and that both magnitude and causality remain subjects of debate.

Infrastructure investments require periodical renewal and upgrading. After a long period of fairly low investments, there is a strong need to renew ageing infrastructure assets in the mature economies. In developing economies, strong economic growth has put the capacity of existing infrastructure under

3 Rehabilitated brownfield investments are also often described as value-added investments.

4 See, e.g. Underhill (2007). Furthermore, he argues that sustainable infrastructure investment programmes offer substantial, tangible benefits to the labour movement. However, Torrance (2006) does not find SRI to be a major factor in pension funds' interest in infrastructure.

pressure and bottlenecks are emerging in some areas, such as power supply. The OECD forecasts that annual infrastructure requirements for electricity transmission and distribution, road and rail transport, telecommunication and water is likely to average 3.5 per cent of world GDP, approximately USD 2 trillion per year through to 2030. This amounts to a sum of over USD 50 trillion over the period (OECD (2007)). The figures rise even higher if other infrastructure sectors are added. Airoldi et al. (2010) looked closer into the needs in developing countries and estimated that in these countries USD 18.1 trillion will be needed over the next 20 years, close to half of the OECD's estimate of global investment needs. Another commonly cited survey is that of the International Energy Agency, which estimates that adapting to and mitigating the effects of climate change will require around USD 45 trillion or around 1 trillion a year in new investments over the next 40 years. This estimate is based upon the assumption that around half of the investments will involve replacing conventional technologies with low-carbon alternatives, with the remainder being additional investments (IEA 2008). To view these numbers in a context, RREEF Research calculates the value of global infrastructure stock as a percentage of GDP and adjusts for variations in quality, estimating the value to USD 20.5 trillion as of 2006 (RREEF 2010).

In the post-war era, infrastructure investments have traditionally been a public venture in most countries. The trend over the past decades, however, has been one of declining public capital investments measured in terms of GDP. According to the OECD (2013), the average ratio of capital spent in fixed investments to GDP (mainly infrastructure) in OECD countries fell from above 4 per cent in 1980 to 3 per cent in 2005. The OECD argues that this development has been driven by a combination of constraints on public finances and a growing understanding that public provision of infrastructure has sometimes failed to deliver efficient investments. The impact of the 2007–2009 financial crisis is perceived to have exacerbated the situation. Most governments are currently facing pressures to consolidate public finances further and deleverage their balance sheets. The OECD (2013) argues that the result has been a widespread recognition of a significant infrastructure funding gap.

The share of private sector investments in infrastructure has increased over the past years in OCED countries alone – some USD 1 trillion of state owned assets have been sold in recent decades. About 63 per cent of total privatisations since 1990 have been accounted for by infrastructure. In addition to privatisations where governments sell the assets outright, variants of public-private partnerships (PPPs), often using project finance techniques[5], have emerged. Different countries remain at vastly different stages of PPP implementation. Deloitte (2007) distinguishes between three stages of PPP market maturity: low, sophisticated and high. UK, Australia and to some extent Ireland are the only countries where the PPP market is classified as high maturity.

Engel et al. (2010) examine the economics of PPPs and conclude that PPPs affect the intertemporal government budget in much the same way as public provisions. The case for PPPs must therefore rest on something else, they argue, and highlight efficiency gains associated with bundling construction, maintenance and operations as potential candidates.

The infrastructure funding gap may provide attractive investment opportunities for private investors in the future. The concept of private ownership of infrastructure assets is, however, not a new one. Private capital has financed massive infrastructure investments previously.[6] However, the need for private capital to fund infrastructure investments should not be confused with automatic, attractive risk-adjusted returns to the providers of equity and or debt. Cambridge Associates (2011) refers to the experience from previous surges in infrastructure investments, such the US railways of the nineteenth century and the global airline industry of the twentieth century, which often left investors disappointed.

Even if a transfer from public to private ownership may yield greater efficiency and move infrastructure financing off public balance sheets and out of the hands of politicians, someone still must pay to build and run new public facilities or modernise existing ones. How private infrastructure investments alter the taxes or fees citizens (or users) must pay is an issue not extensively addressed in the debate on infrastructure. Beeferman (2008) points to the fact that a change in how the projects are financed,

5 Project finance is a financial technique based on lending against the cash flow of a project that is legally and economically self-contained. Project finance arrangements are generally highly leveraged and lenders normally receive no guarantee beyond the right to be paid from the cash flows of the project. Yescombe (2007) points out that the growth and spread of PPPs around the world is closely linked to the development of project finance.

6 For example, when trading started at the Oslo Stock Exchange in 1881, 13 of 21 stocks traded were railroad companies.

for example from general taxes to user fees, can raise questions of equal access for lower-income tax payers. We discuss possible implications of this in section 3 under political risk.

An infrastructure funding gap has been identified. A number of global initiatives are currently being undertaken under the auspices of international organisations such as the World Economic Forum, the OECD, the G20 and the European Commission with the objective of identifying bottlenecks and coming up with solutions as to how this gap may be closed. The need for supporting regulations, appropriate investment vehicles, global project standards, high quality data, appropriate risk measures and risk transfer mechanisms are some of the suggestions being put forward. These initiatives need to tackle challenges arising from the potential mismatch between institutional investors' perceived preference for brownfield assets in developed markets and the need to channel significant capital to greenfield projects in the developing world.

3. Risk – a multi-faceted concept

The risks associated with a specific infrastructure project generally arise from the nature of the underlying asset itself and the environment in which it operates. Investors' exposure to these risks depends on the design of the contract, which part of the capital structure the investor has invested in and how this exposure is structured. The high degree of heterogeneity implies that any generalisation about risk and reward can be misleading. Our discussion on different sources of risk below could serve as a reference point for investors assessing the opportunity set. Our focus in this section will mainly be on risks facing an investor who is considering committing capital in the form of equity to infrastructure. Some of the risk dimensions discussed will also be of high relevance for a debt investor.

In the run-up to a construction phase, investors are exposed to bid or deal risk – the risk of not being awarded a contract in an auction or beauty contest. The capital put at risk at this early stage of a project's life cycle is normally equity only. After a contract is awarded, investors are exposed to construction risks. Construction risks relate to the risk of a project being delayed or exposed to cost overruns. A number of factors may push the costs of a project higher, factors both within and outside the control of the responsible contractor. In the latter category you find uncertainty about issues such as ground and weather conditions. Blanc-Brude (2013) also emphasises a second source of construction risks, namely who takes on uncertain cost elements and how potential agency problems are dealt with.

Operational and management risks relate to the day-to-day running of the facility once the installation is up and running. Infrastructure investments are sometimes portrayed as investments with limited operational risks. This will not always be the case. The installations are often highly complex. It is of key importance that the management team have the appropriate skill-set to run technical installations in a cost-efficient way. Investors may need to rely on external experts to assess the capabilities of potential management teams.

During the life-time of the project, a project is exposed to risks originating from changes in demography, changes in economic conditions and/or the emergence of new competing infrastructure. These risks are often broadly determined as patronage or demand risk. Demand risks are of particular relevance for projects whose returns are driven by user fees. For these projects the demand for the services provided during the lifetime of the contract drives the overall project return. Assets with user fees are therefore deemed more risky than assets which derive government-guaranteed payments based on the availability of the asset. According to Standard & Poor's (2004), demand risks are the primary reason why infrastructure projects[7] experience significant problems.

When assessing the risks related to investments in more mature infrastructure assets, investors also need to take into consideration that the usage of services provided by infrastructure assets tends to grow over time. JP Morgan (2013) argues with reference to the OECD that mature infrastructure cash flows on average have mostly continued to grow, even during recessionary periods, and that such investments over the past 25 years have offered high and increasing free cash flow-to-equity as the cash flows generated have risen in real terms.

7 The analysis covers infrastructure investments structured as project finance.

Hence the so-called Free Cash Flow hypothesis advanced by Jensen (1986) managers endowed with free cash flow will invest it in negative net present value projects rather than pay it out to shareholders. Consequently, a high debt level has a disciplinary effect on managers. Infrastructure projects are normally highly leveraged. A high leverage ratio implies that a significant share of the cash flow generated from an infrastructure project will be channelled to service debt. Sawant (2010) argues the disciplinary effect posed by high leverage is of particular relevance for infrastructure assets since most of them provide stable cash flows and most operate in an environment with few growth options.

Highly leveraged projects have, all else being equal, less financial and operational flexibility. In cases where project returns are generated through user fees, an unanticipated economic downturn can significantly increase risks and eliminate returns in highly leveraged projects. Investors in leveraged projects will also be exposed to refinancing risks. To what extent depends on whether the debt is provided on a floating rate or fixed rate basis, the maturity of the contract and whether the loan or debt is pre-payable or not. The bulk of the debt in infrastructure projects has traditionally been provided by banks as floating rate project finance loans, in particular in Europe. As projects reach a more mature phase, these loans are sometimes replaced by fixed rate bonds. During periods of financial turbulence, refinancing risk may accelerate as the traditional providers of financing withdraw. As an illustration, the Infrastructure Journal notes that global project finance loans declined from around USD 260 billion to roughly USD 130 billion over the two year period from 2007 to 2009 as banks facing pressures to deleverage then withdrew from the sector.

Infrastructure projects are often irreversible and investors' options to abandon a project, once the project is awarded, are limited. Investors are therefore exposed to liquidity risks. In periods with financial stress it may be challenging to sell the assets in the interim. The number of potential buyers and the time it will take to settle a transaction in the secondary market generally decrease with the complexity of the asset. Investors should not design their strategy in way that may force them to sell at a discount, but invest with an ability to hold the investments for the economic life of the underlying asset or at least for the duration of the contract.

Many infrastructure assets are essential for the functioning of a society; hence governments continuously monitor and regulate them either through a specific regulatory regime or through long-term concession agreements. Investments in these traditionally public ventures are subject to regulatory risks. In most cases, different sub-sectors are regulated by different government bodies. In jurisdictions with a relatively shorter regulatory history, regulatory decisions may be inconsistent and difficult to predict, increasing uncertainty for investors.

Related to regulatory risk is the political risk investors are exposed to. Political risk encompasses risks covering issues such as rejection of contracts, risk of expropriation, changing tax laws, political instability or potential civil strife. Some of these risks may not be observable at the time of investment and can therefore be labelled as hidden risks. Political risk is of highest relevance for investments in sectors characterized by large sunk costs, sizeable economies of scale and highly politicised pricing, such as telecommunications and electricity generation. Heinzs and Zelner (1999) argue that in addition to analysing political stability using macroeconomic indicators or measures of risk based on managerial perceptions, investors should also make an effort to analyse the credibility of the government's own promises by examining the feasibility of policy change. Investors contemplating entry into an infrastructure industry need to consider not only the current policy regime in the host country but also the likelihood that the policy regime will be stable in the future. Infrastructure projects are popular targets for the expression of public discontent with government. The services provided are normally widely consumed. It is fair to assume that the risk of social unrest increases if the terms in the contract between the public and private sector are perceived as too generous. This implicitly puts a cap of the acceptable level of return for some of these projects.

The risks discussed above may to some extent be mitigated through efficient contract design at the origination of the project. Experience does however show that contracts are often re-negotiated. Orr (2006) finds that more than 40 per cent of the contracts for non-telecommunication-related private infrastructure had been or were being re-negotiated, although this appears to have occurred primarily in the developing world. The need for re-negotiation partly arises from the inability to deal with uncertainty over the life of infrastructure projects and the inadequacy of the frequently used principle

of allocating risks to the party most able to bear them. Blanc-Brude (2013) concludes, with reference to the economic literature, that long-term contracts will almost inevitably lead to re-negotiations either because the contract is silent about a particular state of the world or because the opportunity to continue the delegation process initially agreed is questioned by one party. The outcome of the re-negotiation, however, is not necessarily to increase the risk an investor committing equity to the project is exposed to.

A number of the risks discussed above are highly idiosyncratic and it should in principle be possible to reduce them through holding a diversified portfolio of infrastructure investments. A well-diversified portfolio of infrastructure investments is, however, not easily achieved. First, each investment requires significant amounts of capital. Second, the number of jurisdictions with a proven and sufficiently long track record for private financing of infrastructure assets is fairly limited.

Further, not all risks can be diversified away. Anecdotal evidence suggests that there are some systematic risk factors at work. These factors may be related to issues such as global market cycles, regional and political crises and regulatory trends. The magnitude of such risks has, however, yet to be properly researched and should be an area for future research. Finally, it is fair to assume that investors' choice of investment vehicle may influence the risk-return profile of an infrastructure investment. In the next section we discuss the different options currently available.

4. Investment vehicles available for institutional investors

Infrastructure investing has matured significantly since Australian and Canadian pension funds made their initial investments in the early 1990s. Today investors can chose from a wide spectrum of investment vehicles. Figure 1 illustrates how different vehicles are exposed to political, regulatory and liquidity risk, and the required investment horizon and capital needed.

Figure 1: The most common form of infrastructure investments

Capital requirement, political and regulatory risk

Time horizon, liquidity risk

	Direct	Indirect
Unlisted	Direct investments (PPP; project finance)	Unlisted infrastructure funds
Listed	Stocks; bonds	Listed infrastructure funds; indexes

Source*: Bitsch et al. (2010)*

4.1 Unlisted investment vehicles

Investors can gain exposure to infrastructure by investing in listed shares or bonds of infrastructure companies or more indirectly through investments in various types of listed infrastructure funds. RREEF (2011) divides the opportunity set for listed infrastructure stocks into three segments: broad, core and pure-play. The broad segment includes industries such as engineering and construction, timber, power generation, shipping and diversified operations. Infrastructure services, integrated utilities, rail, diversified utilities and diversified infrastructure are included within the core segment. In the pure-play segment you find industries characterised by high barriers to entry and relatively inelastic demand such as power transmission and distribution, oil/gas storage and transportation, toll roads, seaports, airports, communication towers and satellites and water. As of June 2011, RREEF estimated the global market cap of listed infrastructure stocks at approximately USD 3 trillion, whereof 0.9 billion in pure-play industries.

For some investors, the listed instruments may have some advantages over the unlisted alternatives. Their prices are determined by frequent transactions rather than appraisals, the instruments are more liquid and subject to the financial reporting requirements imposed by the various stock exchanges. By limiting investments to the listed universe it may become a less challenging task for a capital constrained investor to construct a diversified portfolio and manage portfolio exposure to single-country

political and regulatory risks. A potential challenge with listed infrastructure investments is that for companies classified as infrastructure, infrastructure assets often constitute only part of their business.

Investors focusing on listed investment vehicles may also invest in different types of listed infrastructure funds or indices. Underlying assets in listed infrastructure funds vary considerably, from collections of publicly traded stocks whose business is directly related to infrastructure investments, to shares in unlisted vehicles which again invest directly in some underlying infrastructure assets or operational companies. In addition to listed funds, there is a number of exchange traded infrastructure funds (ETFs) including one tracking the FTSE/Macquarie Global Infrastructure Index, a commonly used benchmark for listed infrastructure investments. Listed infrastructure funds and indices allow quick and easy access to infrastructure investments at relatively low cost. Investors should, however, also take into account implicit fees and management costs associated with assets going into the fund. We examine the historical risk-return relationship of some of these listed indices in more detail in section 6.

4.2 Unlisted investment vehicles

Direct investments should per definition offer direct exposure to the cash-flow of the underlying assets. Direct investments are therefore commonly perceived to offer the purest form of infrastructure exposure, although studies examining the risk-return profile direct investments are rare. Direct investments enable investors to match investments with their specific needs, stay in control of the asset and avoid the relatively high-fees traditionally charged by infrastructure funds. Direct investments also enable the investor to hold the investment for the economic life of the investment and do not force investors to exit when the fund expires.

However, direct investments in unlisted assets are illiquid, big-ticket investments requiring a long investment horizon. An infrastructure asset has on average a life of 60 years (Rickards, 2008) and some concessions can even last as long as 99 years (Beeferman, 2008). Big-ticket investments make it more challenging to build a portfolio with diversified exposure to political and regulatory risk. Furthermore, as the decision time-frame to invest in a deal is usually tight, direct investing requires a significant degree of delegation in the decision making structure. Significant resources are needed to fully assess and understand the opportunity set, making it an unviable option for the average investor. Investors actively pursuing such investments are generally large and long-term investors. An emerging trend in the field of direct investing is that these institutional investors join forces in club deals.

The more direct route to infrastructure investing can also be pursued in the debt market by either providing loans or investing in different types of project bonds. Project bonds are fixed income debt securities with their coupon being serviced by the revenue stream generated by the project. While the project bond market has a long history in countries such as Canada, the US and some developing countries, project bonds have traditionally played a minor role in the financing of European infrastructure where debt has traditionally been provided by banks in the form of loans. This may change in the future in light of initiatives such as *The Europe 2020 Project Bond Initiative*.[8]

Investors can also gain exposure to infrastructure through different types of unlisted funds structures. The number of unlisted infrastructure funds has grown markedly over the past years. According to Preqin (2013) there were 142 unlisted infrastructure funds on the road in Q2 2013 seeking an aggregate of USD 92 billion in commitments. The corresponding numbers for Q1 2007 were 47 funds and USD 30 billion respectively. According to the same report, private sector pension funds are the most prominent type of investor active in the infrastructure asset class, representing 18 per cent of the total universe.

In most regions the unlisted infrastructure funds have been designed as close-end limited partnerships along the same lines as used for private equity funds. Through limited partnerships investments are normally made in a variety of infrastructure assets or operating companies. These funds have primarily focused on opportunities in the equity space. However, over the past few years a number of debt/mezzanine funds have been launched. Investments in unlisted infrastructure funds may provide the diversification lacking from direct investments, but pose their own set of challenges including lock-up

8 The initiative is designed to enable promoters of infrastructure projects to attract additional private finance from institutional investors such as insurance companies and pension funds. View http://www.eib.org/products/project-bonds/ for more details.

periods, high fees and risks associated with the use of high leverage. It has also been questioned whether a close-end fund is the appropriate vehicle for investing in assets with 20-50 years maturity.

Open-ended or so called evergreen unlisted funds are offered in some countries, in particular in Australia. By definition, open-ended funds have an indefinite term enabling these funds to hold on to the assets for the life-time of the associated revenue stream. The assets of these evergreen funds are typically core assets that are held to maturity. Open-ended funds have been offered at lower fees and may offer better liquidity provisions than the close-end funds. Some of these funds offer liquidity on a best-effort basis at pre-determined dates. Recurring dividends are the main source of returns in these evergreen funds compared to proceeds from exits in close-end "PE-style" funds. A potential disadvantage of these open-ended funds is that they may have to maintain a cash balance to handle potential requests for withdrawals, which can have a negative impact on returns.

Perhaps the biggest challenge is that investors surrender control over which type of assets goes into the fund when they commit money to a pooled capital arrangement. Clark et al. (2011) argue that principal-agent challenges and the time inconsistency embedded in the third-party fund management have put investments in unlisted funds out of favour and guided a handful of institutional investors down the direct route. They argue that although going direct might not be the appropriate strategy for the more opportunistic infrastructure investments – such as greenfield development – it is the superior model for "core" infrastructure. Investing in capital-demanding, long-life, low volatility assets such as infrastructure means that avoiding fatal pitfalls is critical. Even distant future risks will eventually become near-term problems. In such a complex environment, Clark et al. argue that they still believe third-party managers will have a role to play. However, this will warrant a re-conceptualisation of the intermediation role where these managers partner with and guide direct investors into infrastructure deals rather than investing on their behalf through a general/limited partner structure.

A number of different investment vehicles are available today for an institutional investor who is considering investing in infrastructure assets. The choice of investment vehicle may shape the risk return profile of the investments. Experience from the financial crisis was that not all fund structures offered the promised stable cash flows. The OECD (2013) lists lack of appropriate financing vehicles as one of the barriers to investments in infrastructure since only the largest investors have the ability to invest directly in infrastructure investments. The OECD argues that the combination of high fees and extensive leverage means that collective investment vehicles such as funds have become less popular since the financial crisis, and points to developments in some Latin American where special vehicles have been set to facilitate pension fund investments in infrastructure. In a comparative study, the OECD (2013a) compares and contrasts the experience from infrastructure investments by Canadian and Australian pension funds, widely perceived to be the leading investors in this field. The OECD's ambition is to come up with a set of lessons learnt for both investors and policy makers. The open-ended fund model, an experienced investment industry, the absence of restrictive investments and solvency regulations and well-functioning markets for both PPPs and project bonds are among the success factors listed in the report. Of lessons learnt the hard way, the OECD highlights overly optimistic demand projects and overvaluation of assets, challenges related to management of liquidity risk and governance and fee issues of infrastructure funds.

5. Findings in the academic literature

> *"Longer term it is still uncertain what the appropriate risk-return profile of infrastructure assets is. History can offer little guidance, and financial theories have not yet been designed" (Inderst, 2010).*

The performance history for infrastructure investments is limited and performance data are to a large extent private. Furthermore, the high degree of heterogeneity makes comparisons across projects, structures and jurisdictions challenging. Scholarly studies on infrastructure investments are few and the approaches these studies have adopted to deal with the shortcomings in available datasets vary widely. Below, we summarise the findings in some of the more recent studies. We have grouped the studies into four groups: studies conducted using mainly data from listed infrastructure firms,

studies focusing on the experience from Australia, studies examining the characteristics of PE-style infrastructure funds, and other studies.

5.1 The performance of listed infrastructure firms

Martin (2010) argues that time series of listed infrastructure stocks might serve as a useful reference point but that they are primarily driven by stock market volatility and therefore are not likely to be a good proxy for unlisted infrastructure. Nevertheless, most of the academic studies on infrastructure use data from the listed markets. The reason for this is fairly simple – these data are easily available.

Oyedele et al. (2012) study the performance of global listed infrastructure investments in a mixed asset portfolio. They find robust comparative performance over the 10-year time frame examined (2001-2010), and argue that the inclusion of infrastructure in a mixed asset portfolio enhances investment performance. The role of global infrastructure in a multi asset portfolio is shown to contribute more to risk reduction than to enhancement of returns.

Rothballer and Kaserer (2012) examine the risk profile of infrastructure investments using a global sample of more than 1,400 publicly listed infrastructure firms across all infrastructure sectors in 45 countries over a period of more than 30 years. They find that infrastructure stocks on average exhibit significantly lower market risk than other equities, confirming the portfolio diversification benefits of infrastructure. The total risk, however, is not significantly lower for infrastructure stocks mirroring a high level of idiosyncratic risk, which the authors attribute to construction risk, operating leverage, exposure to regulatory changes and the lack of product diversification.

The potential relationship between infrastructure returns and inflation is of key relevance for some investors who may have liabilities implicitly or explicitly linked to inflation indices. Infrastructure concessions agreements often include some form of inflation protection, and most contractual earnings in the infrastructure sector are directly linked to inflation. In the case of GDP or patronage assets, tolls and usage charges are often indexed for inflation, although in some cases this many not always occur annually. Roedel and Rothballer (2012) examine the inflation-hedging properties of listed infrastructure. Drawing from the same sample of listed infrastructure firms as Rothballer and Kaserer (2012) they find no superior inflation protection. Investments in listed infrastructure firms are just as good (bad) a hedge against inflation as other listed equities. Only portfolios of infrastructure firms with high pricing power can slightly improve inflation hedging compared to equities in general and average infrastructure.

Bird et al. (2012) set out to test claims that infrastructure investments offer benefits via a combination of monopolistic and defensive assets using a factor model of infrastructure returns. They define infrastructure as encompassing the utility sector (power generation and distribution) as well as "pure" infrastructure sectors (toll roads, communication and airports), and use data from both Australia and the US. For the Australian market, they consider both listed and unlisted infrastructure assets, either directly or through managed funds. For the US, they use data for listed infrastructure firms. They find that excess returns exist in both US and Australian infrastructure investments, suggesting that additional factors have a role to play in explaining the variation in infrastructure returns, and point to a regulatory risk premium as a likely candidate. Furthermore, their analysis confirms earlier findings by Martin (2010) and Armann and Weisdorf (2008) that infrastructure investments offer some inflation protection, although limited to the utility sector. When testing the defensive ability of infrastructure investments during stressed equity markets, they find no evidence of defensive characteristics.

Ammar and Eling (2013) aim to derive an asset class factor model for infrastructure investments that explains the specific characteristics of infrastructure investments. They create a seven-factor model based on infrastructure-specific risk exposure: market risk, cash flow volatility, leverage, investment growth, term risk, default risk and regulatory risk. The study is conducted using data on listed US infrastructure stocks over the period 1980 to 2011. Their definition of infrastructure stocks follows that of Rothballer and Kaserer (2011) and compromises the utility, communication and transportation industries. The most notable result is that they find a strong, economically significant positive relationship between an infrastructure firm's use of leverage and the performance of its shares. Further, they find a significant negative relationship between cash flow volatility and stock performance, and that the regulatory premium is positive but not significant. In line with Bird et al. (2012) they find no evidence of defensive characteristics.

A general challenge is the lack of indices that can be deployed to evaluate infrastructure investments over the long-term. Howard et al. (2011) take one step towards filling this gap. By mapping the returns of five listed US indices onto the Fama and French (1993) and Carhart (1997) risk factors, they construct time series of infrastructure returns over the long-term (1927 to 2010). They find that all the five US listed indices offer low market beta and a value tilt even though each index differs when it comes to methodology and industry sector composition. Despite common risk factors, the indices exhibit sufficient differences in mean returns, tail-risk and return volatility. The MSCI US Broad Utilities Index exhibited the strongest risk/return profile of all the five indices investigated.

5.2 Insights from Australian data

Peng and Newell (2007) investigate the risk adjusted performance and portfolio diversification benefits of Australian listed infrastructure funds, listed infrastructure companies and unlisted infrastructure funds over the eleven-year period from 1995 to 2006. They show that such infrastructure investments contribute positively to investment portfolios by generating the highest return, but also exhibit high volatility.

Bird et al. (2012) suggest that this finding is largely attributable to the relatively high leverage employed by the listed infrastructure managers in Australia. The data do not include the global financial crisis when leading, highly leveraged Australian listed infrastructure firms such as Babcock and Brown[9] and Macquarie were forced to liquidate or restructure. In an update of the 2007 study, Newell et al. (2011) use the same sample to investigate the effects of the global financial crisis and extend the period to Q2 2009. Compared to the earlier study, the average annual returns are lower for all asset classes with the exception of unlisted infrastructure. Finkenzeller et al. (2010) examine the same dataset but adjust for leverage and the typical smoothness, or high autocorrelation, which often characterizes appraisal-based numbers. This makes the data more comparable to the data on listed assets. They find that returns on unlisted infrastructure and utility have been similar to that of equities and bonds, but less so than direct real estate and listed infrastructure. Unlisted infrastructure, however, does exhibit lower volatility than all other assets examined.

These results should be interpreted with some caution; the data sample is small and the valuations are appraisal-based rather than transaction-based. Blanc-Brude (2013) argues that the use of Australian infrastructure funds is problematic and refers to Bird et al. (2012) who report that Australian infrastructure data is biased because it covers a period where assets were acquired at significant discounts from distressed local governments (e.g. the Victorian government in the early 90s) and there was a benign regulatory environment that allowed tariff increases consistently above real GDP-growth.

Table 1: Academic studies on Australian data

Study	Period	Freq.	Unlisted infrastr.	Equities	Bonds	Listed RE	Direct RE	Listed infrastr.
Annualised returns								
Peng and Newell (2007)	95-06	Q	14.1	12.9	7.2	13.8	10.9	22.4
Newell et al. (2010)	95-09	Q	14.1	9.1	7.0	4.9	10.6	16.7
Finkenzeller et al. (2010)	94-09	Q	8.2	7.9	8.2		9.8	15.6
Annualised vol.								
Peng and Newell (2007)	95-06	Q	5.8	11.0	4.3	7.9	1.5	16.0
Newell et al. (2011)	95-09	Q	6.3	13.9	4.6	17.5	3.0	24.6
Finkenzeller et al. (2010)	94-09	Q	6.7	15.0	5.0		5.1	16.6

9 Babcock and Brown was a global investment and advisory firm based in Sydney, Australia, that went into liquidation in 2009.

5.3 The performance and return drivers of PE-style infrastructure funds

Inderst (2010) examines global infrastructure funds using data from Preqin and finds that these funds exhibit a similar performance pattern to PE funds in general, but appear to offer somewhat more downside resilience. Bitsch et al. (2010) analyse the risk, return and cash flow characteristics of infrastructure investments using a dataset of deals done by private-equity like investment funds. They find that these deals offer attractive returns, downside protection and low correlation to GDP. They do not, however, find any proof of stable, inflation-linked cash flows as they find no significant difference between infrastructure and non-infrastructure investments in terms of their cash flow profiles. Bitsch (2012) highlights that this finding may be due to the peculiar return characteristics of the private equity investment style, and is not necessarily representative of the overall infrastructure market.

Bitsch (2012) examines a global sample of 120 listed infrastructure investment companies and funds and compares the performance of these firms to an international sample of listed private equity. He finds no significant differences between the volatility of net income. When decomposing net income into the cash flow and accrual components, he does, however, find that infrastructure investments offer lower volatilities of operating cash flows than non-infrastructure investments.

5.4 Other studies and observations

Direct infrastructure investments have become increasingly important for investors over the recent years. Dechant and Finkenzeller (2013) use a transaction-based[10] infrastructure index covering a sample 930 individual operating infrastructure, or so-called brownfield, projects in the US as an approximation for direct infrastructure investments. When examining the role of infrastructure investments in a multi-asset portfolio they deploy two different algorithms for portfolio construction, finding that infrastructure investments play an important role both in the standard mean-variance optimised portfolio and in the mean-downside efficient portfolio.[11] Infrastructure is allocated predominantly to portfolios that exhibit low-to-medium levels of risk as it exhibits both low expected returns and low variance. With increasing investment horizons, infrastructure is also attractive to investors who aim at higher returns, and especially to those who wish to protect low-expected-return portfolios from downside risk. Measured over longer investment horizons they do, however, find that infrastructure is highly correlated to large-cap stocks, which they argue make an investment less attractive when a certain proportion of total wealth has already been allocated to large cap stocks. Despite similar underlying characteristics, they fail to find strong evidence that the inclusion of infrastructure in the asset mix significantly affects the allocation to real estate. They draw the conclusion that infrastructure appears not to be a substitute for real estate.

Hartigan et al. (2010) create a synthetic return series for UK unlisted infrastructure, drawing on information from different asset classes and geographical markets. They examine the role of unlisted infrastructure in a balanced portfolio and find that unlisted infrastructure investments have a significant role to play in investors' balanced portfolios.

Finkenzeller and Fleischmann (2012) investigate the long-run relationships and short-term dynamics between direct and indirect infrastructure returns using samples from the US. Listed infrastructure is represented by the UBS US Infrastructure and utilities index. The direct infrastructure performance index covers 930 operating infrastructure projects in the US where the data are sourced from a reporting sample of 135 global infrastructure equity investors. Based on a co-integration analysis they detect a long-run relationship between direct and indirect infrastructure driven by a common underlying business factor. In this respect, infrastructure projects exhibit behaviour in terms of long-term relationships between their listed performance and their direct counterpart similar to real estate investments.[12] Both pairs (real estate and infrastructure) reveal a significant link over time. When examining the relationship between infrastructure and real estate they are not able to confirm an interrelationship between the two in the long term. They conclude that it is rational to include both types of assets in a portfolio aiming at long-term investment horizons.

Infrastructure investments are often labelled as real assets in the context of strategic asset allocation. One definition of real assets is that such assets provide some type of inflation protection. Grelck et

10 No appraisal values and thus no smoothing effect.

11 The mean-down side risk portfolio also takes into account the non-normal distribution of various asset returns.

12 View Hoesli and Oikarinen (2012) for a discussion on the relationship between indirect and direct real estate investments,

al. (2011) consider adding additional liquid real assets such as commodities, real estate, infrastructure and shipping to a portfolio of stocks and bonds in order to earn higher risk-adjusted returns. The article takes the position of an investor whose considerations are mainly driven by inflation fears, a desire for liquidity and the wish for diversification. Consequently, their analysis is limited to the listed universe and they use the NMX30 Infrastructure Global index as a proxy for liquid infrastructure investments.[13] They find that the addition of real assets improved portfolio performance, and infrastructure and shipping clearly outperformed commodities and real estate for an investor with these preferences.

Cremers (2013) examines the diversification and inflation hedging properties of a narrower set of infrastructure investments. In his analysis he considers the performance of direct investments energy infrastructure[14], timberland, farmland, and commercial real estate. He finds that investing in these real asset classes would have provided significant diversification benefits relative to a traditional portfolio consisting of only public equities and government bonds, without evidence of deteriorating overall performance. However, with the exception of timberland investments, the real asset classes did not provide any inflation hedging benefits over the time period examined (1996 to 2012 for energy infrastructure).

Blanc-Brude (2013) concludes after going through relevant academic literature on infrastructure investments that it is difficult to find a confirmation of the infrastructure investment narrative[15] in the existing literature. He suggests that these papers suffer from a fundamental problem of study design since they aggregate financial instruments that are labelled as infrastructure based on industrial categories, without attempting to isolate methodically the contractual and regulatory characteristics that explain risks and returns, or taking into account how different investment vehicles may distort the investment characteristics of the underlying investments. An area for future research should be to increase the understanding on how these mechanisms work.

6. Historical return data

Building on some of the papers discussed in the previous section, we do further data work on listed infrastructure indices and the Australian unlisted fund indices. We also look at the historical returns on infrastructure investments made by Canadian pension funds relative to respective benchmarks, and comment on a recent survey undertaken by UK's National Audit Office on UK Private Finance Initiatives (PFIs).

6.1 Unlisted infrastructure

Australia

In section 5 we presented the findings from a number of academic studies, all based on data from Australia. Most of these studies use a time series initially constructed by Mercer Investment Consulting.

In its original version, the Mercer index was a monthly net-of-fees total return index of a group of unlisted infrastructure managers, starting with five funds in 1994 and extending membership as new funds were launched. Most infrastructure funds hold both utilities and "pure" infrastructure assets such as toll roads, airports and railroads. The managers in the index invest in Australian and international infrastructure where the latter have grown to make up around half of the portfolios over time. After Mercer discontinued the calculation of the index, the infrastructure manager Colonial First State (CFS) maintains a monthly infrastructure return series that is essentially based on the Mercer methodology, i.e. uses equal weighting of monthly net-of-fees fund returns.

13 The NMX30 Infrastructure Global consists of the 30 largest and most-liquid basic infrastructure companies. The NMX30 Infrastructure Global is diversified across countries, currencies and infrastructure industries. Eligible companies for inclusion in the NMX base universe show a minimum basic infrastructure (network) revenue contribution of at least 50 per cent The index is provided by the LPX Group (www.lpx-group.com).

14 The data on direct infrastructure is based on the Alerian MLP (Master Limited Partnership) Infrastructure Index, which is not directly investable but reflects the performance of constituents (25 energy infrastructure MLPs) that are publicly traded.

15 Kahneman (2002) defines narrative as the passive acceptance of the formulation given. In the case of infrastructure the formulation is one of stable, long-term inflation-adjusted cash flows with low covariance with other assets allowing attractive risk adjusted returns.

When Mercer discontinued the calculation of the time series, a number of infrastructure managers began sponsoring the creation of the IPD Unlisted Infrastructure Index. The IPD index deviates in some aspects from the original Mercer index. First, it reports return data at quarterly frequency and breaks out income and capital return as shown in Table 2. The other key differences between the IPD and the CFS indices are coverage and weighting. While both include the largest Australian infrastructure managers, the IPD index covers a broader universe and contains more and smaller funds. Furthermore, the IPD index is asset-weighted, while the CFS index is equal-weighted.

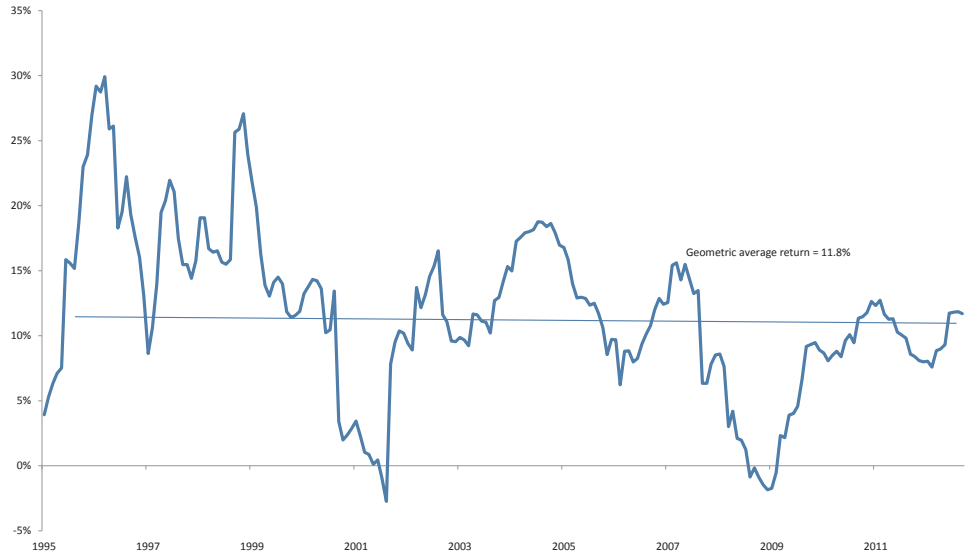
Table 2: Characteristics IPD index as at June 2013

	Number of funds	Projects	Net asset value AUD million	Distribution yield	Gearing
All Funds	20	158	27 703	3.8	0.8
Domestic Funds	7	78	8 454	3.7	2.4
Other Funds	13	80	19 249	3.9	0.1

Source: *IPD*

Finally, the Mercer/CFS index has a longer history going back to 1994 whereas the IPD index starts in 2005. Since both return series have similar properties for the time in which they overlap, we report the statistics on the Mercer/CFS index due to its longer history. The year-on-year return of the index is plotted, starting in 1995. The geometric annualised return of this proxy for unlisted infrastructure is 11.8 per cent. The annualised standard deviation based on monthly data is 5.9 per cent.

Figure 2: Mercer/CFS Unlisted Infrastructure total return index % y/y



Source: *Colonia First State*

In general, the Australian performance data find relatively high risk-adjusted returns and relatively strong resilience in the market downturns. Inderst (2010) argues that strong caveats are necessary when interpreting these findings. First, like most private asset class return data both the Mercer/CFS index and the IPD index are appraisal based rather than transaction based. Such appraisal-based valuations can be subject to biases and time lags. The volatilities and correlations of unlisted asset returns computed at monthly or quarterly frequencies should therefore be treated with caution, in

particular when compared to listed securities.[16] Second, the sample of funds is small, incomplete and includes funds of different sizes with different inception years. For the period prior to 2000 there are only two funds in the dataset. Thirdly and as discussed in section 5, some of the assets were bought from distressed local governments at a significant discount, creating a potential bias in the data.

Canada

Canadian pension funds are among the pioneers in institutional infrastructure investment with a solid share of their balance sheets invested in infrastructure.

Table 3: Selected Canadian pension funds infrastructure allocations

			Total	Infrastructure	
Fund	Fiscal year	Currency	Assets	Assets	in %
OTPP	31.12.12	C$	129.5	9.6	7.4
PSP	31.03.12	C$	64.5	3.6	5.6
OMERS	31.12.12	C$	61.5	9.8	14.8
CPP	31.03.13	C$	183.3	11.2	6.1
Alberta	31.03.12	C$	69.7	3.1	4.4
Total		C$	508.5	37.3	7.3

Source: *OECD (2013b)*

In Table 4 we report the performance of five Canadian pension funds' infrastructure investments against the respective benchmarks using publicly available information. We are aware that during the period examined the respective investors' strategies may have been subject to changes, both in strategic priorities and principles for benchmarking. Their portfolios of infrastructure investments have also grown significantly over the period examined.

The annualised geometric average returns have been very variable, ranging from 5.2 per cent to 11.5 per cent, and the returns on the respective benchmarks also diverge to a comparable degree.[17] It must be noted that some of the infrastructure programmes were not immune from the effects of the financial crisis, recording negative returns in one or more years around 2008.

16 Due to the lack of adequate data, some researchers have attempted to synthetically construct return series from listed and unlisted proxies. Hartigan et al. (2010) estimate five different UK unlisted infrastructure series by drawing on information from the UK property market, Australian listed and unlisted infrastructure, and UK listed infrastructure. The varying methods yield return series with vastly different return and volatility characteristics. While the authors present intuitively plausible criteria to select the most suitable among these series, in our view the robustness of this method has not been proven yet. We therefore do not include synthetically constructed return series in our analysis.

17 View section 7 for a discussion on different investors' choice of benchmarks.

Table 4: Annual return of infrastructure programmes of selected Canadian pension funds

Pension fund	OTTP		PSP		OMERS		CPPIB		Alberta	
Year	Portf. %	BM %	Portf. %	BM %	Portf. %	BM %	Portf. %	BM %	Portf. %	BM %
2006	17	5.6	–	–	14	10.8	18.4	–	20.5	7.4
2007	0.8	-4.3	14.8	7	12.4	9.9	23.6	–	13.4	8.4
2008	6.3	13.5	6	5.8	11.5	9.8	-5	–	12.8	8
2009	-5.5	-1	7.2	3.7	10.9	9	-6.5	–	3.1	7.1
2010	3	4	-1.6	6.8	10.1	8.5	13.3	–	5.9	10.7
2011	7.7	6.1	2.7	9.6	8.8	8	12.8	–	8	6.7
2012	8.4	8	10.1	7	12.7	8.6	8.8	–	8.1	9.5
Geometric Average	5.2	4.4	6.4	6.6	11.5	9.2	8.8	–	10.1	8.2

Source: *Pension funds' annual reports*

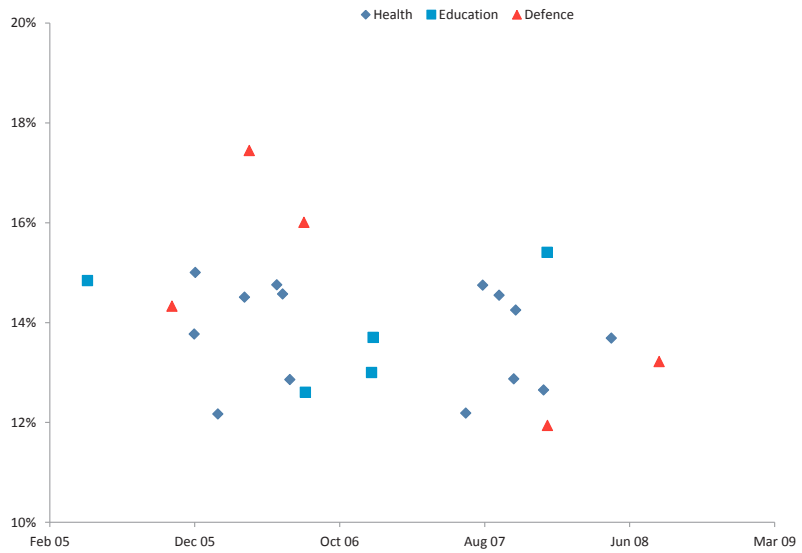
UK Private Finance Initiatives

PFIs were introduced in the UK in the early 1990's in order to contract with the private sector in the design, build, finance and operation of public infrastructure such as roads, hospitals and schools (UK Treasury (2013)). As of the end of 2012, over 700 PFI projects had reached financial close and the volume of private sector investment was around £55 billion.

Projects under the UK PFI programme have typically been funded using 90 per cent debt and 10 per cent equity. Private companies that are in the business of developing and maintaining infrastructure assets (so-called industry sponsors or primary investors) have been the major source of primary equity. In addition to equity, these industry sponsors also provide their expertise in the construction and delivery of projects.

In Figure 3, we show the after-tax expected returns at the point of contract award for a selection of UK PFI projects, as analysed by the UK National Audit Office (NAO). Over the period from 2005 to 2009, expected returns generally were concentrated between 12 per cent and 15 per cent, with a couple of defence projects exceeding that range.

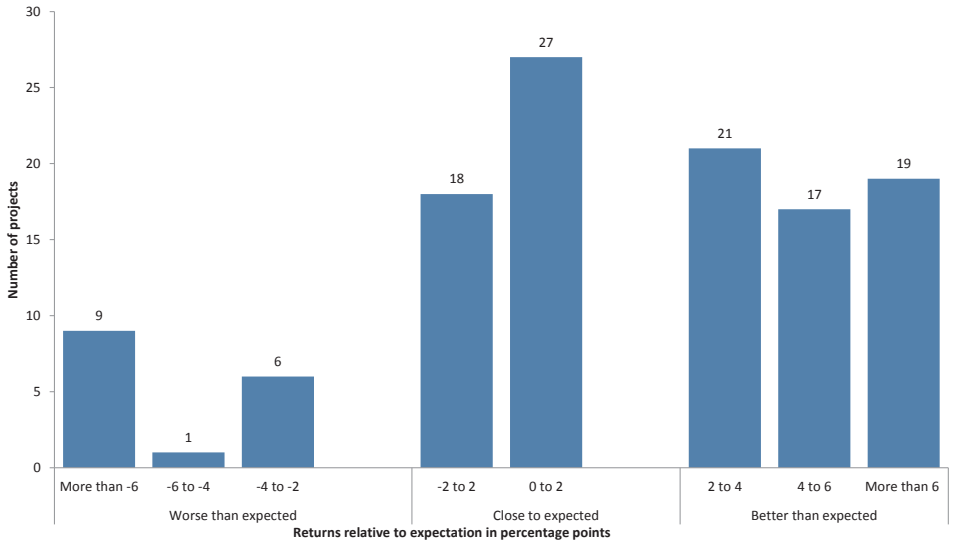
Figure 3: Ex-ante equity returns at bid stage



Source: *National Audit Office (2012)*

The expectations of primary investors at the bid stage can turn out to be overly optimistic or pessimistic, depending on the economic and financial conditions that subsequently materialise. From survey evidence gathered by the NAO, it appears that a greater number of PFI projects actually exceeded their return expectations, see Figure 4. Nearly half of the projects analysed exceeded the returns' expectations formed at the time of contract award by at least 2 percentage points, and almost 40 per cent were within 2 percentage points of the ex-ante return. Less than 15 per cent of projects were disappointing relative to expectations. All in all, the experience of primary equity investors in UK PFIs seems to have been positive although the return numbers might be elevated by survivorship or selection biases.

Figure 4: Realised returns relative to expectations

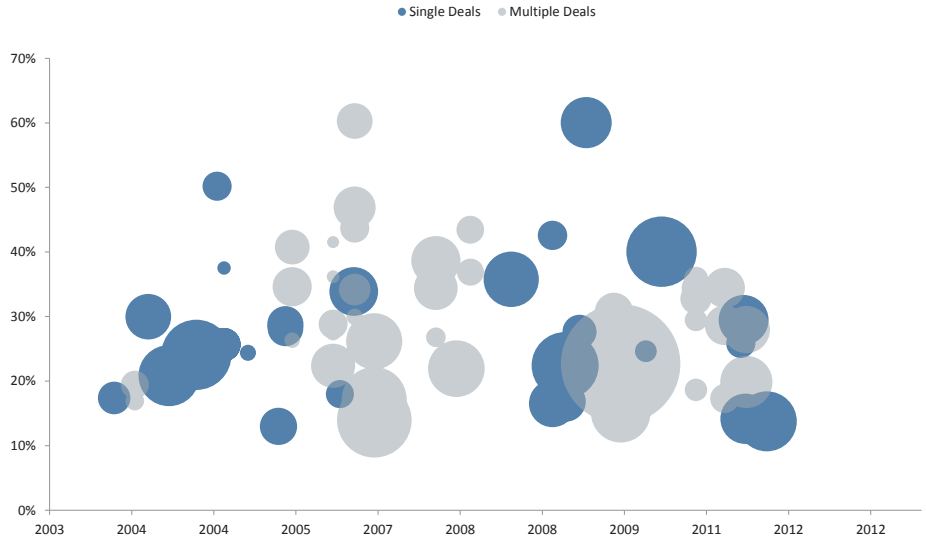


Source: *National Audit Office (2012)*

Primary investors will sometimes seek to release their capital after a project has been constructed and delivered early to fund new projects. They can do so by either selling their equity in the secondary market or refinancing bank debt. In the early years of the UK PFI programme, the National Audit Office (NAO, 2012) reports that some primary investors were able to increase their returns from between 12 and 15 per cent to 50 to 70 per cent through bank debt refinancing. Since the UK Treasury introduced new terms for sharing gains from refinancing with the public sector, the benefits accruing to the private sector have been significantly reduced.

The other way of releasing capital is through sale of equity, whereby primary investors sell their equity stake in the PFI project. The NAO's analysis examines the so-called exit rate of return and finds that investors selling equity early have typically earned annualised returns between 15 and 30 per cent, see Figure 5. In exceptional cases, returns have been as high as 60 per cent or as low as 5 per cent. These high returns may signal that secondary investors are prepared to pay up to invest in an established process, and/or the result of potential inefficiencies in the initial pricing of equity.

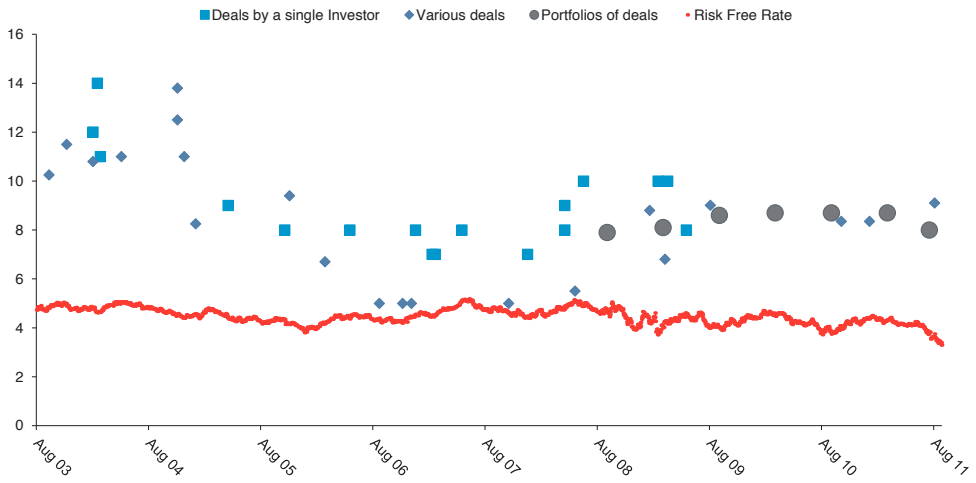
Figure 5: Exit rates of returns in UK PFI



Source: *National Audit Office (2012)*

A third approach to examining the returns on UK PFI projects is by using the prices investors paid for infrastructure projects in the secondary market. These ex-ante returns can be expected to be lower than those demanded by primary investors due to the reduced development risk at the time of purchase. In Figure 6, the secondary market after-tax returns collated by the NAO are plotted against the nominal yield on the longest-term UK government bonds, which may serve as a risk-free comparator. Implied secondary market returns declined from between 10 to 14 per cent in 2003/2004 to 5 to 8 per cent in the period preceding the global financial crisis, converging towards the risk-free yield. Since the end of the crisis, the ex-ante returns have risen to settle in a range of 8 to 10 per cent, markedly higher than government bond yields which have oscillated closely around 4 per cent in that period.

Figure 6: Reported secondary market rates of return



Source: *National Audit Office (2012)*

In conclusion, the evidence presented suggests that primary and secondary investors have targeted and appear to have achieved attractive equity returns in UK PFI projects. However, it is likely that equity rates of return for primary investors will decline from their elevated levels in the 1990's and 2000's. One reason is the increased demand by pension funds for less leveraged capital structures that will reduce equity return, but also risk. The other factor is the UK government's desire to reduce the equity returns to industry sponsors, which the NAO (2012) had judged to be high as a result of inefficient equity pricing and favourable financial conditions prior to the crisis. In its policy document outlining a "new version" of the PFI programme (PFI2), the Treasury makes clear its intention to act as a minority equity co-investor in future projects, thereby sharing the upside and downside potential of infrastructure projects. In addition, the government wants to encourage more investors with longer-term investment horizons, such as pension funds, to invest in projects at an earlier stage by organising equity funding competitions for a proportion of equity, even after a preferred industry bidder has been determined.

6.2 Listed infrastructure indices

Listed infrastructure indices are groups of publicly traded stocks whose businesses are closely related to infrastructure assets. The most commonly used listed infrastructure indices are the following.

Dow Jones Brookfield Global Infrastructure Index

This is a free float-adjusted, market capitalization-weighted index designed to track the performance of global listed infrastructure. The Index was started in 2008 and has a back-filled history to 2003. To be included, a company has to have at least 70 per cent of its operating cash flows come from the ownership and operation of infrastructure assets.

Macquarie Global Infrastructure Index

This is a free float-adjusted, market capitalization-weighted index designed to track the performance of globally listed infrastructure. The Index was started in 2006 and has a back-filled history to 2000. Stocks are included in the index if at least 50 per cent of the revenues come from infrastructure-related activities.

S&P Global Infrastructure Index

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

UBS Global 50/50 Infrastructure & Utilities Index

This is a free float-adjusted, market capitalization-weighted index designed to track the performance of 100 global infrastructure-related securities, split evenly between utilities and infrastructure. The Index was started in 2006 and has back-filled history to 1995. Companies are included in the index if at least 50 per cent of the EBITDA comes from infrastructure or utilities.

In Table 5 , we report the summary statistics of the listed infrastructure proxies discussed above and compare them to the Australian unlisted infrastructure series collected by Mercer/CFS. We also include indices representing the global government bond market (Merrill Lynch Global Government Bond), broad world equity market (MSCI World) and world listed utility stocks (MSCI World utilities). The statistics are based on monthly USD returns, with the exception of the Mercer/CFS series, which is in AUD.

Table 5: Summary statistics of infrastructure proxies versus bonds and stocks, as at 30 June 2013

	Mercer/ CFS Unlisted Infra Index AUD	Dow Jones Brookfield Global Infra Index USD	Macquarie Global In-fra Index USD	S&P Global Infra Index USD	UBS Global Infra & Utilities Index USD	ML Global Gov. Bond USD	MSCI World Return Index USD	MSCI World Utilities Return Index USD
Start	Jan-95	Jan-03	Jul-00	Dec-01	Jan-95	Jan-95	Jan-95	Jul-00
Mean return	11.8 %	15.3 %	9.6 %	12.4 %	8.5 %	6.0 %	5.6 %	5.6 %
Max	9.4 %	8.8 %	8.5 %	12.4 %	10.1 %	7.1 %	10.0 %	8.5 %
Min	-2.2 %	-14.5 %	-14.7 %	-18.6 %	-17.5 %	-5.0 %	-16.5 %	-13.4 %
Skew	2.1	-1.0	-0.9	-1.1	-0.9	0.1	-0.8	-0.8
Max draw-down	-3.1 %	-45.2 %	-43.2 %	-52.7 %	-48.4 %	-8.6 %	-52.2 %	-42.0 %
St. dev.	5.91%	13.64%	14.10%	15.90%	13.72%	6.75%	14.62%	14.24%
Return/ < St. dev.	2.00	1.12	0.68	0.78	0.62	0.89	0.39	0.39

Source: *Colonial First State, Bloomberg*

The risk statistics of the listed infrastructure proxies are quite similar to each other and to those of the MSCI World and MSCI World Utilities indices. Annual standard deviations are around 14 per cent – 16 per cent and the maximum drawdowns range from -42 per cent to -53 per cent, occurring during the 2008-2009 equity downturn. There is also negative skew in the four listed infrastructure series, just as in the MSCI World index. In that sense, listed infrastructure appears to share most of the risk characteristics of the broader equity market.

Due to the different inception dates of the infrastructure series, mean returns and Sharpe ratios cannot be easily compared. However, visual inspection of the year-by-year returns in Table 6 confirms the impression that the risk properties of the four listed infrastructure proxies are very similar to each other. Despite differences in industry and geographical exposure, the monthly returns of the listed infrastructure benchmarks have pairwise correlations of over 90 per cent. Additionally, their returns very much resemble general equity risk in that the return correlations between the infrastructure proxies and the MSCI World are between 65 per cent and 80 per cent.

Table 6: Annual returns of infrastructure proxies versus other asset classes

	CFSGAM	Dow Jones Brookfield Global Infrastruct. Index	Macquarie Global Infrastruct. Index	S&P Global Infrastruct. Index	UBS Global Infrastruct. & Utilities Index	ML Global Governm. Bond	MSCI World Return Index	MSCI World Utilities Return Index
1995	6%				6%	18%	17%	
1996	30%				12%	15%	15%	
1997	14%				4%	11%	21%	
1998	17%				19%	6%	19%	
1999	16%				-12%	3%	26%	
2000	14%				17%	0%	-11%	
2001	1%		-11%		-16%	0%	-15%	-22%
2002	14%		-8%	-2%	-12%	2%	-25%	-16%
2003	9%	29%	32%	40%	39%	6%	23%	28%
2004	18%	33%	30%	31%	33%	4%	9%	28%
2005	14%	11%	15%	15%	14%	5%	14%	13%
2006	9%	37%	37%	40%	36%	6%	14%	36%
2007	16%	16%	23%	23%	21%	4%	3%	21%
2008	3%	-36%	-32%	-39%	-36%	2%	-40%	-29%
2009	2%	34%	15%	25%	19%	2%	23%	6%
2010	8%	12%	3%	6%	6%	2%	8%	-1%
2011	12%	14%	0%	0%	0%	1%	-8%	-3%
2012	9%	16%	6%	12%	13%	4%	13%	2%

Source: *Colonial First State, Bloomberg*

The resemblance of listed infrastructure with the broader equity market is in stark contrast to unlisted infrastructure, which appears to deliver equity-like returns at bond-like volatility. As mentioned before, short-term fluctuations of unlisted infrastructure returns should be interpreted with some caution due to the fact that they are based on appraisals rather than transactions.

7. The role of infrastructure investments in strategic asset allocation

Pension fund investments in the more direct form of infrastructure remains fairly low and represent around 1 per cent of total assets on average across the OECD (OECD, 2013). Wehinger (2011) argues with reference to calculations from the OECD that this is far below their balance sheet potential for long-term assets estimated at USD 7 trillion of their USD 65 trillion in total assets under management. Different countries are at different stages in the evolution of pension fund investments in infrastructure, with Australia and Canada at the forefront with allocations as high as 10 to 15 per cent for some funds. Australian and Canadian pension funds' healthy appetite for infrastructure investments may also reflect governments' long tradition of tapping into private sources for the financing of infrastructure projects.

Infrastructure investments are not easy to fit into a single asset class category. Depending on the nature of the investment, they can exhibit bond, real estate and equity traits. An illustration of how investments within the same sector compare to other type of investments is given in Table 7 (Cambridge 2011).

Table 7: The role of infrastructure in asset allocation

	Economic				Social
	Toll Roads	Air/Seaports	Energy/Utilities	Telecoms	
Bonds	Mature toll roads		Regulated utilities		PPPs
Real Estate	Expansion of toll roads	Typically all assets	Expansion of regulated assets		
(Private) Equity	New toll road		Merchant power plant	Depending on asset type	

Source: *Cambridge Associates*

Investors have taken different approaches to how they treat infrastructure investment in an asset allocation context. The OECD (2012) identifies two groups of investors in its survey of larger pension funds. The first group is made up of investors that have a separate allocation to infrastructure and a target allocation as part of the total portfolio. Infrastructure assets are normally accessed through unlisted equity investments. The majority of the funds within this group are investing directly, mostly co-investing along infrastructure funds but also taking on leading roles in consortia. The OECD finds that the pension funds in this group generally have a significant share of their total assets allocated to so-called alternatives with a target allocation of 30 per cent on average. These investors often treat infrastructure investments as a subcategory of a real asset category or as part of a broader allocation to inflation-sensitive assets. Loans to infrastructure projects are generally classified as infrastructure, while infrastructure bonds generally are treated as fixed income. Within this group we find fourteen pension funds from Canada, Australia, New Zealand, Denmark, UK, Netherlands and South Africa with a total of USD 1.1 trillion in assets under management.

The other group in the OECD's survey is made up of pension funds that do not have a separate allocation to infrastructure. Their investments in infrastructure, mainly bonds and listed infrastructure equity, are treated as a part of their overall allocation to fixed income and equity respectively. This group is made up of 14 smaller pension funds, mainly from Europe and Latin America, with roughly USD 300m in assets under management. The OECD argue that the investors' approach to infrastructure investments relates to factors such as maturity of the infrastructure market, pension funds system, regulations and experience in the sector.

Probitas Partners (2009) found that only 40 per cent of their sample of global institutional funds had a dedicated infrastructure allocation. Some investors view infrastructure as part of a broader asset

category of real assets, others see it as a sub-category of their fixed income investments while yet others have added infrastructure to their general private equity, alternative or real estate allocations.

All in all, these surveys of different investors' allocation to infrastructure should be interpreted with some caution as the survey data have clear limitations. Infrastructure assets often get mixed up with other types of assets and grouped into different asset categories and investors have different approaches to how they deal with this when reporting. Confusion also exists between terms such as strategic allocations, target allocations, commitments and actual investments. As institutional infrastructure investing is still in its infancy, the difference between actual investments and target allocation can be substantial.

Investors also differ in how they benchmark their infrastructure investments. Bachher et al. (2012a) examine the benchmark practice of nine experienced institutional investors in infrastructure. The listing below is from their paper:

- British Columbia Investment Management Corporation
  8 per cent absolute return with adjustments for asset, country, and currency risks

- Borealis Infrastructure (OMERS)
  Absolute return set at the beginning of the year based on operating plan

- California Public Employees' Retirement System
  CPI + 5 per cent

- Caisse du Depot
  50 per cent S&P 500/TSX + 25 per cent S&P 500 + 25 per cent MSCI EAFE Index

- CPP Investment Board (CPPIB)
  Calculated benchmarks on an investment-by-investment basis
  *(w1) *(CDN equity return) + (w2) * (CDN bond return) + (w3) * (Equity return of asset currency/country) + (w4) * (Bond return of asset currency/country) + inflation sensitivity + leverage sensitivity*

- Municipal Employees' Retirement System
  Barclays Aggregate Bond Index

- OPSEU Pension Trust
  CPI + 5 per cent

- Ontario Teachers' Pension Plan
  CPI + 4 per cent + Sovereign spread (where CPI is based on country and currency of investment)

- PSP Investments
  CPI + Bond return + Equity premium

Bachher et al. (2012b) argue that different investors have different goals for their infrastructure portfolios, which leaves no singular "right" way to benchmark such investments. In the report they discuss strengths and weaknesses of different type of benchmarks.[18] Further, they point to general challenges when trying to apply benchmarking approaches developed in the listed sphere to the unlisted sphere such as challenges related to pricing, coverage and what they describe as the analytic tool kit problems. The latter is related to the fact that most of the tools such as tracking error, active positions and style exposure available and in use today for measuring performance were developed in the context of listed portfolios and require continuous transaction-based pricing.

18 The types of benchmarks assessed falls into the following eight groups of benchmark families: absolute return, inflation + margin, fixed income + margin, equity return + margin, hybrid returns, custom portfolio benchmark, peer group and liability based.

Beeferman (2008) argues that different and complex definitions might suggest that infrastructure is at best a heterogeneous class, if it can be considered an asset class at all. Any claims about diversification benefits require careful scrutiny, particular in light of the wide array of investment vehicles available and the extensive regulatory and political differences across regions and countries. This requires a deep understanding of the specific value drivers and risk factors related to the asset, the environment the asset will be operative within, as well as the structure.

Investors considering investing in infrastructure should reflect on which role(s) such investments are expected to play in their total portfolio, and design their strategy to best support these objectives. The opportunity set is heterogeneous and the risk-return profile is shaped by the underlying investments, the investment vehicle chosen and the environment is which the asset operates. The diversification properties of specific investments should be assessed in a total portfolio context, rather than in the context of a sub-portfolio of infrastructure investments. The high degree of heterogeneity also raises the question of what level of aggregation would be appropriate for a meaningful risk-return-correlation analysis and what assumptions are reasonable to make in asset-liability managing. The combination of early-stage assets and mature-assets spanning a wide range of sectors into one broad category might not be appropriate.

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