



RESEARCH INSIGHTS

EDHEC*infra*



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Building benchmarks for infrastructure investors

Investors hit a roadblock when investing in infrastructure. Until now none of the metrics needed by investors were documented in a robust manner, if at all, for privately held infrastructure equity or debt. This has left investors frustrated and wary. In a 2016 EDHEC*infra*/Global Infrastructure Hub Survey of major asset owners, more than half declared that they did not trust the valuations reported by infrastructure asset managers.

How, under such conditions, can the vast increases in long-term investment in infrastructure by institutional players take place? We need transparency and accurate performance measures.

This is the year of the Argentinian presidency of the G20 and it has been marked by a focus on infrastructure investment. With the support of the G20, the Singapore government, The Long-Term Infrastructure Investors Association, the Long-Term Investment Club and numerous private sector supporters, including Natixis, EDHEC*infra* has now built the largest database of infrastructure investment data in the world. With this we can now bring transparency and accurate performance measures to the infrastructure sector.

Using this data EDHEC*infra* has created performance benchmarks that are needed for asset allocation, prudential regulation and the design of infrastructure investment solutions. These first of a kind benchmarks provide investment metrics that are needed by investors; return, volatility, Sharpe ratio, duration, and maximum drawdown.

In 2019, this database will reach global coverage and a global index for private infrastructure debt and equity tracking 1,000 firms can be published.

We started our journey to build benchmarks for infrastructure investors in Europe, the oldest and largest investible market for infrastructure in the world. We analysed the European market and selected the 14 major markets for infrastructure. We studied the size, age and evolution of the infrastructure industry in each of those countries, and painstakingly identified all investible infrastructure assets.

We then selected a list of 400 firms to represent the European infrastructure market by sector, business model or country, all the while covering 50% of the market by size in each year, ensuring a representative sample through time. This became the constituent list for the benchmarks. For each firm we collected data for realised and forecast cash flow to debt and equity holders. Firms were categorised by type (either as infrastructure project or infrastructure corporate) and by business model (contracted, merchant and regulated).

This project was undertaken in coordination and collaboration with the industry. Data was submitted by banks, asset owners and managers. This collaboration is a sign that the private infrastructure industry is growing towards a more mature and transparent stage in its development. The support of private investors and lenders to this initiative is impressive and deserves to be praised.

In this context, EDHEC*infra* has also developed data collection and reporting standards that can be used to make data collection more efficient and reporting more transparent. This methodology provides a framework for data collection for the long-term financing of infrastructure.

Today, the first generation of benchmarks give us estimates of financial performance and risks of reference portfolios of privately held infrastructure investments. This will help answer asset allocation, prudential and performance monitoring questions and improve transparency and efficiency of investment in infrastructure around the world.

Sarah Tame and Frédéric Blanc-Brude

Establishing an industry standard for the infrastructure asset class

Sarah Tame

Based on the preferences of major institutions EDHECinfra has created a taxonomy of global indices and sub-indices to structure the infrastructure asset class

Today infrastructure investors use ad hoc benchmarks for unlisted infrastructure investment. We wish to establish an industry standard for the infrastructure asset class.

EDHECinfra has made significant progress, establishing a framework for data collection and developing asset pricing techniques to measure the risk adjusted performance of private infrastructure.

From this foundation we can now build market indices for infrastructure.

But what are the most relevant broad market indices for investors? Do they wish to invest in infrastructure along the same geographic or sector categories as that of the bond or equity markets? Are infrastructure investors focusing on a different segmentation of the universe? In other words, what would be the industry standard for unlisted infrastructure market indices and sub-indices?

In early 2018 we conducted one of the largest surveys of infrastructure investors globally, with more than 200 respondents, in order to establish their preferences for the segmentation of infrastructure. The majority of respondents to the survey were asset owners, and over half were focused solely on infrastructure equity investment, while a third seek both infrastructure equity and debt.

When questioned about geographic segmentation of infrastructure the geographies of standard capital market benchmarks were the least preferred, with less than 10% of responses. Instead respondents said economic development and infrastructure investability was considered the most relevant. As a result the reference market indices for infrastructure should follow broad economic development lines.

In regards to sector segmentation we found that infrastructure investors preferred both broad and sector specific segmentation. This is an indication of the infancy of the asset class. The results suggest that access to a well-defined asset class remains limited amongst investors who prefer to focus on sub-segments. However large managers and asset owners who wish to be exposed to infrastructure investments across multiple sectors say that only widely defined sector indices make sense.

The lack of adequate performance data until now has made it difficult for investors to take a strategic asset allocation view of infrastructure. Ultimately until performance of infrastructure is better understood it cannot exist as an asset class in a multi-asset class context.

Infrastructure investment is still typically segmented by industrial sector but it can be argued that business models (contracted, merchant and regulated) can be a more relevant way to group infrastructure investments, especially when considering business risk. For example Gatwick Airport, a regulated asset, has more in common with Anglian Water in terms of risk profile than Munich Airport, which operates under a merchant business model. When asked whether making a distinction between business models was relevant 90% of respondents said it was relevant or highly relevant to segment infrastructure investments in this way.

The difference between infrastructure projects and infrastructure corporates is another distinction worth making and is as relevant as that between business models. EDHECinfra's research shows it is infrastructure projects, rather than corporates, that offer investors the benefits of the "infrastructure investment narrative" of equity like returns, with reduced volatility and predictable cash flows.

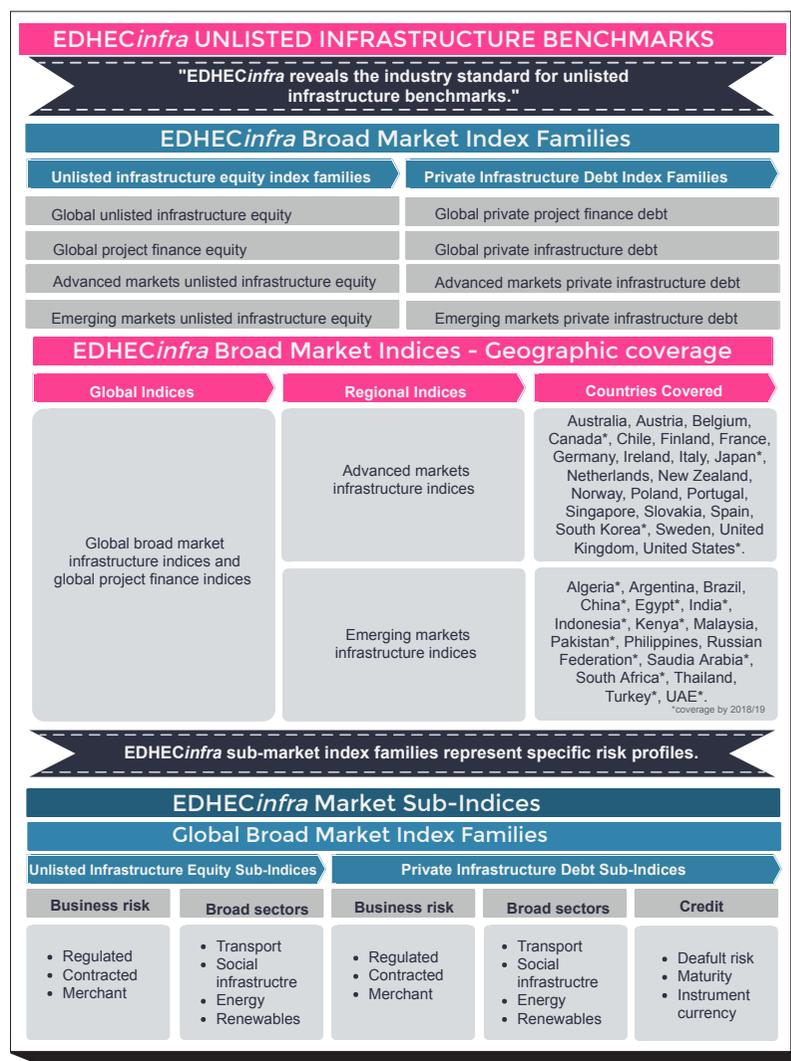
Investors' views were split between the two however; 37% favour project finance specific benchmarks, 42% would rather use benchmarks with projects and corporates and 20% would prefer an infrastructure corporates only index. These differences echo the different interpretations of what it means to invest in infrastructure.

Finally we asked infrastructure debt investors whether it is useful to create

infrastructure debt indices by maturity and level of credit risk, standard components of fixed income benchmarks, portfolios and products. Respondents were almost unanimous in the need to bucket infrastructure debt by credit risk and maturity.

Using the results of this survey, EDHECinfra is putting forward a taxonomy of unlisted infrastructure investment indices and benchmarks to represent the global infrastructure asset class.

Eight broad market indices capture the systematic dimensions of infrastructure investment. Two universes (debt and equity) are split either between broad areas of economic development or by types of corporate structure. A number of thematic sub-indices (business risk, sector groups, credit risk) represent specific risk profiles. With these sub-indices investors can track the risk adjusted performance of almost any specialised manager or dedicated account that is focused on a sub-segment of the infrastructure market. Finally infrastructure investors will have the tools to adequately measure the risk adjusted performance of infrastructure and we can begin to see the development of a distinct infrastructure asset class.





EDHECinfra indices

A survey of investor preferences for the segmentation of private infrastructure

In its effort to create global benchmarks for infrastructure investors EDHECinfra reveals the industry standard for unlisted infrastructure benchmarks.

SURVEY RESPONDENTS

200

One of the largest surveys of infrastructure investors globally with more than 200 respondents.

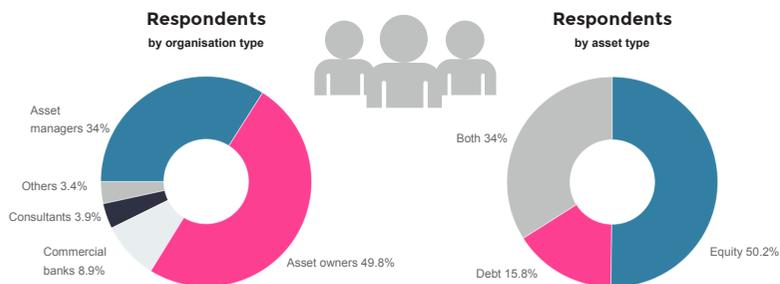
Respondents include all major asset owners and managers involved in infrastructure investment worldwide.

Infra 500

10%

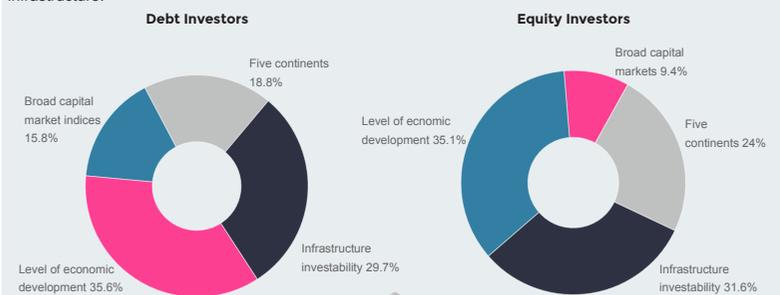
The majority of respondents to the survey were asset owners. Asset owners who responded represent more than 10% of global infrastructure AUM in 2017.

"There is an ongoing demand for investors to better understand the risk-adjusted performance of infrastructure assets."



INFRASTRUCTURE MARKET INDEX SEGMENTATIONS

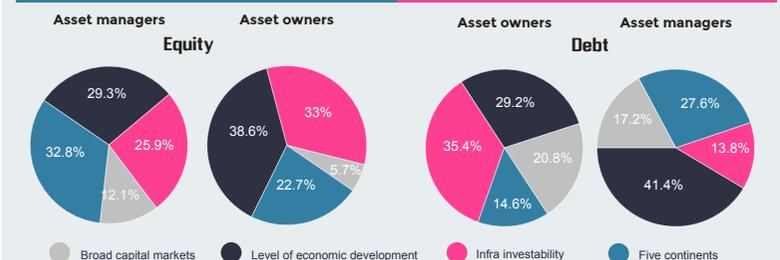
ECONOMIC DEVELOPMENT and INFRASTRUCTURE INVESTABILITY considered most relevant geographic segmentation for unlisted infrastructure.



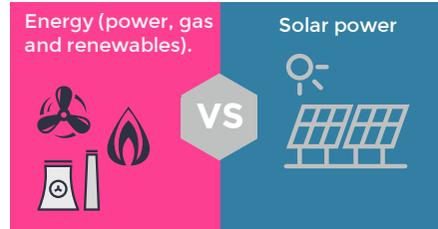
Asset owners VS Asset managers

"33% of asset managers would prefer to use five continents to segment infra equity vs 23% of asset owners."

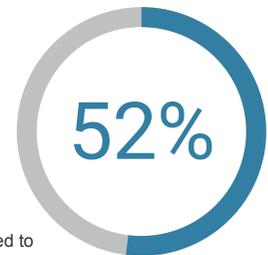
"41% of asset managers would prefer to use the level of economic development to segment infra debt vs 29% of asset owners."



SECTOR GRANULARITY



52% of respondents would prefer a broad sector index for infrastructure.

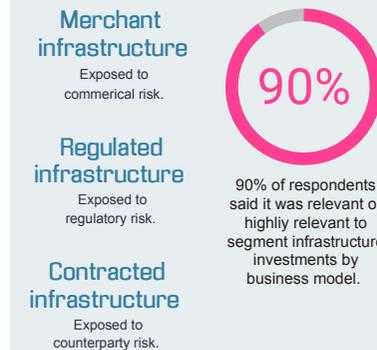


Large managers and asset owners who wish to be exposed to infrastructure investments across multiple sectors say, **"Only widely defined sector indices make sense"**.

Managers with sector specific mandates are likely to prefer narrowly defined benchmarks.

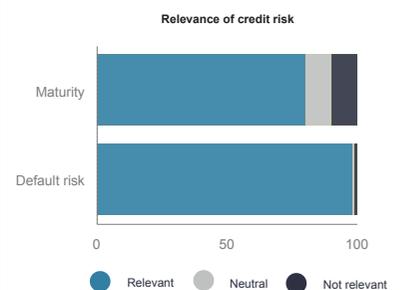
THE ROLE OF BUSINESS MODELS

"Business models can be a more relevant way to group infrastructure investments together."



INFRASTRUCTURE DEBT

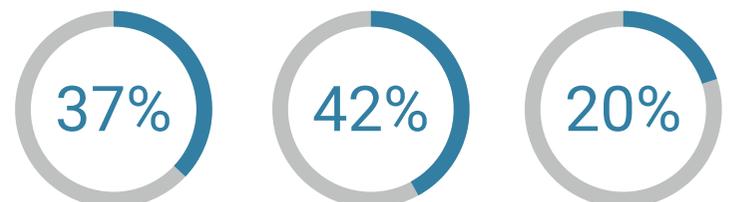
Respondents said bucketing infra debt in the same way as **fixed income** was highly relevant.



Maturity and credit risk are standard components of fixed income benchmarks.

THE ROLE OF CORPORATE STRUCTURES

Infrastructure projects VS Infrastructure corporates



37% of respondents favour **project finance** specific benchmarks.

42% of respondents would rather use benchmarks with **infrastructure projects and infrastructure corporates**.

20% of respondents would prefer an **infrastructure corporates only** index.

Infrastructure investment in emerging markets: Narrowing the ‘data gap’

Sharyn Chang, Silvia Garcia, Sarah Tame, Christy Tran, Jing-Li Yim

Better information will drive higher investment in emerging market infrastructure

The existence of a ‘data gap’ in global infrastructure markets and especially in emerging markets has been a focal point in the work on long-term investment by the G20 and OECD. EDHECinfra is committed to reducing this data gap. A global infrastructure data collection exercise by EDHECinfra is currently underway and has already led to the creation of the largest database of investment and financial data on private infrastructure in the world. The EDHECinfra database tracks hundreds of projects over the past 20 years in dozens of countries, and totalling millions of data points.

In this project, emerging markets present the greatest challenges. In what follows, we review the hurdles we encountered whilst collecting financial data on investible infrastructure in ASEAN and Latin America, and make simple policy recommendations.

The gap is elsewhere

When trying to understand the size of the investible infrastructure market, numerous reports find a gigantic ‘infrastructure investment gap’ typically measured in trillions of dollars to be invested in infrastructure by 2020 or, in more recent reports, 2030.

These figures can be relevant for the purpose of public policy and the action of multilateral development organisations. But investors should not take them too seriously.¹ Crucially, the notion of an ‘infrastructure investment gap’ should not be seen by investors as the proof that vast amounts of private capital could easily and rapidly be deployed in new infrastructure projects.

Quite the opposite. Private infrastructure investment is not solely demand driven and countries with a larger reported gap do not necessarily achieve

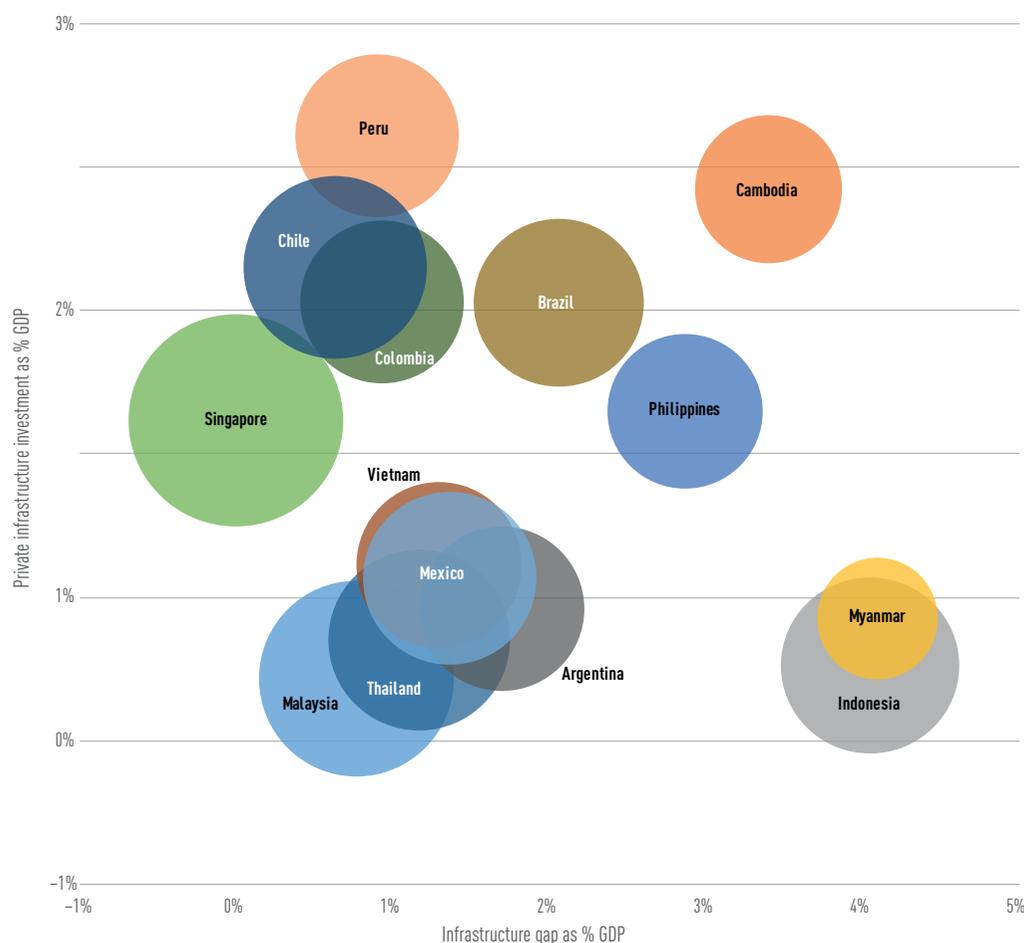
higher levels of private infrastructure investment (see figure 1). For example, infrastructure investment gap measures do not take into account the ability and willingness of various governments to roll out infrastructure procurement programs. As a result, numerous countries with a large investment gap have seldom seen private infrastructure investment. In these countries, irrespective of investors’ risk appetite (which is increasing), investible infrastructure just has not materialised.

Still, private asset owners increasingly want to invest in emerging market infrastructure, as two recent EDHECinfra/G20 surveys confirm. In the most recent survey, 82% of asset owners declare wanting to create or increase their exposure to emerging market infrastructure.

If significant supply and demand for new capital investment in emerging market infrastructure both exist, why do they fail to meet? With numerous infrastructure investment managers and strategies representing a range of risk appetites, emerging market infrastructure, despite being

¹ From the 2006 OECD Report on infrastructure investment needs to the 2017 McKinsey discussion paper (*Bridging Infrastructure Gaps: Has the world made progress?*), these studies are static in nature and do not address the optimality of infrastructure investment needs in different countries.

1. Infrastructure gap vs private investment as % of GDP



Size of bubble denotes quality of infrastructure and is measured on a scale of 1-7, based on World Economic Forum’s Global Competitiveness Index.

Sources: EDHECinfra analysis, GI Hub, IMF, McKinsey Global Institute, PPI Database, World Bank, World Economic Forum

perceived as riskier, should be attracting and receiving private capital.

Supply and demand of long-term capital fail to meet in part because of the dearth of available information. Markets are institutions designed to process information effectively and efficiently. The market for private infrastructure investment cannot function if sufficient data for investors to identify opportunities and form investment beliefs is not available.

The so-called investment gap is in part an information gap. Investors choose to allocate funds to certain asset classes and parts of the world based on information available on the risk-adjusted returns of such investments. Today, there is not enough financial data available for investment in emerging market infrastructure for it to make sense for the majority of investors.

Narrowing this 'data gap' will improve the transparency and accessibility of the infrastructure sector to private investors in emerging markets and help mobilise private finance for the development of new infrastructure.

Assessing the availability of investor-friendly information in emerging markets

The EDHEC*infra* team collects publicly available data about individual infrastructure investments globally. Each country is the object of a dedicated campaign during which all available data sources are identified and analysed.

In this context, we conducted several yet-to-be released studies of the public availability of financial data for investible infrastructure in the world, from Europe to Australia, East and South-East Asia, and the Americas.

In this article, we focus on two important regions for infrastructure investors in emerging or 'less-travelled' markets: ASEAN members and six Latin American countries (Argentina, Brazil, Chile, Colombia, Mexico and Peru) between 2006 and 2015. Indeed, Singapore or Chile cannot be considered developing or emerging markets, but they are part of the same regional block as the remaining 14 countries.

At the end of each data collection campaign, we compute a score based on the quality of publicly-available financial data on investible infrastructure. We call it the EDHEC*infra* Data Availability Score (EiDAS).

EiDAS are based on both quantity and quality of available data. An EiDAS of 1 denotes scarce or non-existent information, while an EiDAS of 5 indicates that sufficient efforts have been made to disclose information related to infrastructure companies and projects and that good quality data is easily available for investors.

In each market, we review the availability of ex ante (pre-investment) data for infrastructure projects and companies in general and specifically public-private partnership (PPP) projects. We also focus on the availability of ex post (after investments have been made) firm-level data, from primary official and third-party sources and evaluate the ability for an investor to access information that can be used to assess the risk and returns of private infrastructure investment in the relevant national markets.

Scores are computed using a three-point ordinal scale – basic, general and detailed, based on the availability and quality of information. More weight is given to the availability of information at the individual firm level (company performance, financials, business registries).

In each country, the availability of ex ante and ex post information on investible infrastructure is assessed using publicly available sources in English and local languages (including Spanish, Portuguese, Bahasa Indonesia, Vietnamese, Bahasa Malayu and Chinese). This corresponds to the information that an investor could access while conducting research and due diligence about a specific market without aiming to acquire 'private knowledge' through interviews or enquiries conducted in the field. Of course, more investigative methods could typically yield more and better information.

Ex ante information availability: procurement agencies and databases

A dedicated PPP unit can be important to centralise expertise, ensure that all participants in the PPP process follow the same regulatory guidelines, and provide a centralised

point of information on PPP programmes and projects undertaken or planned.

An official projects database is also important for investors to understand a country's infrastructure needs and the current and future investment opportunities. A database can be considered to be detailed when it provides key information about the projects that have been implemented in the past, projects that are currently being procured and projects that will be tendered in the future. It is also essential for these databases to be updated regularly.

Ex ante investment information in Latin America

The six countries studied in Latin America all have portals providing information about investing in the country, which include infrastructure investment data, laws applicable and infrastructure development plans. However, the quality and focus of information differs from country to country.

Chile, which has the highest EiDAS in Latin America at 5, has a dedicated infrastructure investment portal providing very detailed information. The portal provides investors with rich information about past, present and future PPP projects, informative PPP processes, legal and regulatory frameworks. It also details information about the incentives and public support for infrastructure projects (minimum revenue guarantee, exchange coverage insurance, etc) and outlines a pipeline of future projects. Chile is also one of the only countries in the region to disclose project evaluation criteria and process for PPPs, and provide contracts and official documentation in its databases. Chile also provides monthly reports about the operations of each project.

We note that Chile does not have a dedicated PPP unit but made clear choices at the central government level to implement its infrastructure development plan and disclose information.

Mexico, despite a shorter experience with PPPs than Chile's, is also a good example of a comprehensive and rich infrastructure investment portal. It also does not have a dedicated PPP unit, but its investment portal includes PPPs at the federal level as well as other concession contracts, service contracts and public projects contracts. The portal is clearly targeted at investors. However, its score is 3, due to poor financial data availability, which we discuss in the next section.

Colombia has a dedicated portal for transport infrastructure investment and a dedicated PPP agency, but its score is low (2) due to the limited availability of financial data. Private investment in Colombia's infrastructure market has been buoyed by its 4G roads programme and the PPP agency to date has focused on development of PPPs in transport infrastructure. It is now studying the possibility of extending private investment through PPP contracts in other sectors like education and health and it provides reports about these initiatives for investors. Despite disclosing less detailed information on PPP projects than other countries, it is the only other country in Latin America to disclose project evaluation criteria and process for PPPs.

In Argentina, Brazil and Peru infrastructure investment data, applicable laws and investment plans can be found on the main government website in a dedicated section to infrastructure and public works investments.

Brazil and Peru have dedicated PPP agencies whose main objective is to attract investors, supervise and prioritise tenders of projects. Brazil's agency

2. EDHEC*infra* data availability score: Latin America

	Procurement data	PPP programme	Official PPP database	Business registry	FOI requests	EiDAS	2018 inclusion in global index
Argentina	■ ■	■	∅	■	■ ■ ■	3	✓
Brazil	■ ■ ■	■ ■	■ ■	■ ■	■ ■ ■	4	✓
Chile	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	5	✓
Colombia	■ ■	■ ■	■	∅	■ ■ ■	2	✗
Mexico	■ ■ ■	■ ■ ■	■ ■ ■	∅	■ ■ ■	3	✗
Peru	■ ■	■	■ ■	∅	■ ■ ■	2	✗

■ Basic information available
 ■ General information available
 ■ Detailed information available
 ∅ No information available

is focused on the development of PPPs in transport infrastructure while Peru's PPP unit covers all relevant sectors.

Both countries have comprehensive databases of PPPs and disclose past, present and future projects. Brazil provides details of the incentives for foreign investors (tax, tariffs, etc) including sometimes at the regional level.

While Peru has a database of PPPs, information is limited to national projects and is not regularly updated. Peru's portal, despite the increase in private infrastructure investment in the period studied includes less information.

Finally, in Argentina, where most infrastructure development is financed by the state, information about PPPs is provided by the Ministry of Finance but there is no PPP database and future projects are only mentioned in infrastructure development plans. Argentina is now considering whether it should create a dedicated agency to help finance its next infrastructure plan.

Ex ante investment information in the ASEAN region

The Philippines has the highest EiDAS in the ASEAN region at 5. It has a well-established PPP unit, functioning as an intermediary and a resource centre not only to the Philippines but also to other ASEAN member countries such as Thailand. It provides information on past, present and future PPP projects, as well as the PPP procurement process, legal and regulatory frameworks, and other information about doing business in the Philippines.

The Philippines PPP unit also has the most comprehensive official project database in the region and provides a monthly update on the progress of all PPPs, from past to future projects, including some of the project documentation.

However, other PPP projects that are negotiated at the local government level are not included in the official PPP database. In addition, power projects in the Philippines do not fall under the PPP programme, and hence a separate list is maintained under a different government body.

Another element missing in all ASEAN project databases is information on projects that did not materialise or were cancelled.

No other country in the region provides investors with a database of infrastructure projects, be they publicly or privately funded.

Laos, Philippines, Thailand and Vietnam have official listings for past, present and future projects. However data is inconsistent and not updated regularly. These lists provide at least basic facts about projects (status, description, timeline, government parties and private parties involved) but details on potential or existing financing is currently lacking. Cambodia and Myanmar are now looking to include future projects to their listings.

In Vietnam, which receives a score of 2, both the investment portal and ministry in charge of economic development do not provide readily available information on infrastructure projects or relevant information.

At the other end of the scale Brunei (along with Cambodia, Laos and Myanmar) has an EiDAS of 1. Its PPP market is very small and there is no

information available to investors about past, present, or future projects. Official portals are either still in development phase, outdated or have ceased to function.

Nevertheless, Laos and Myanmar are in the process of developing their PPP guidelines, policies and portals. Both countries have set up dedicated websites with information on the status of PPP developments (albeit with low frequency of updates), as well as projects that fall under the PPP programme.

PPP guidelines and laws formalising a country's PPP framework are also an important source of ex ante information about infrastructure investment. Still, while most of the countries studied have PPP guidelines or laws in place, this information is not always easy to find. Indonesia publishes an annual PPP book detailing its PPP framework and available infrastructure investment opportunities, but it is often difficult to access. Only four ASEAN countries (Brunei, Indonesia, Malaysia, and the Philippines) disclose the detailed criteria and process of evaluating a project for PPP suitability on their PPP website.

Singapore and Malaysia, despite being less reliant on private sector financing for their infrastructure and therefore publishing less information on PPP procurement, achieve high EiDAS due to the quality and availability of financial data (see below).

Ex post information availability: getting hold of financial performance data

To understand the historical performance of an infrastructure project, the best source of information is often the firm's annual financial statements. While such information can be obtained for publicly listed firms, audited financial statements are not always readily available for unlisted companies in emerging markets.

As part of this study, we queried the official business registries in each of the six major economies in Latin America and the 10 member states in the ASEAN region in order to 1) identify infrastructure firms and 2) obtain historical financial reports for these companies.

Ex post investment information in Latin America

In Latin America, financial statements could only be accessed in Chile, Brazil and Argentina but the quality of information varies between each country. Chile and Brazil scored highest for the region with an EiDAS of 5 and 4, respectively.

Brazil does not have a central business registry but instead regional business registries. The availability of companies' financial statements in Brazil is generally good. Financial accounts are often disclosed in the official gazette of each state and many states make the annual financial accounts of unlisted companies available. Brazil also discloses the financial statements of toll road companies in the Agência Nacional de Transportes Terrestres (ANTT) website.

Chile also provides good financial history data for infrastructure projects. Under Chilean Company Law, corporations may be 'open' or 'closed'. Open corporations (500 or more shareholders) are regulated by the Superintendence of Securities and Insurance (SVS). Closed corporations may voluntarily register with the SVS. We found that all the PPP companies developing projects in the transport, water and public building sectors disclose their historical financial statements, which are available for investors to download in the SVS website. However, infrastructure projects in sectors such as power and renewable energy do not disclose financial statements.

In Argentina, companies are required to file financial statements to the regional business registries. However, financial statements of unlisted companies are not available to third parties. Some companies that are not listed on the stock exchange but have issued bonds are required to disclose their financials, hence the financial accounts of some power projects can be obtained. Historical financial information is only available for a limited number of companies in

3. EDHECinfra data availability score: ASEAN

	Procurement data	PPP programme	Official PPP database	Business registry	FOI requests	EiDAS	2018 inclusion in global index
Brunei	■ ■	■	∅	∅	∅	1	✗
Cambodia	■ ■ ■	■	∅	∅	∅	1	✗
Indonesia	■	■ ■	∅	∅	■ ■ ■	3	✗
Laos	■ ■	∅	■	∅	∅	1	✗
Malaysia	■ ■ ■	■ ■	■	■ ■ ■	■ ■	4	✓
Myanmar	■ ■ ■	■	■	∅	∅	1	✗
Philippines	■ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■	5	✓
Singapore	■ ■	■	■ ■	■ ■ ■	∅	4	✓
Thailand	■ ■ ■	■ ■	■ ■	■	■ ■ ■	3	✓
Vietnam	■ ■	■ ■	■ ■	∅	∅	2	✗

■ Basic information available
 ■ General information available
 ■ Detailed information available
 ∅ No information available

Argentina. As a result, it scores a lower EiDAS (3) than Brazil and Chile.

For Colombia, Mexico and Peru, there is no systematic disclosure of financials of unlisted companies. Each country was ranked as having low or no quality financial information, pushing down their EiDAS. Mexico for example scored highly in other areas of data availability but the lack of financial data available, resulted in an EiDAS of just 3.

In Mexico, private businesses are not required to publicly disclose the results of their financial operations. Mexico has local business registries and one centralised system (SIGER) to collect all companies' information. However, this information is not available to third parties.

Similarly Colombian companies are obliged to file accounts and the country has a central business registry however it is not possible for third parties to access financial statements. In some cases, companies file project financials on their websites but historical reports and access were limited.

Peru has a central business registry; however, filing financial accounts is not required for unlisted companies.

Freedom of information requests can be another route to source information about PPP projects. Official freedom of information (FOI) portals have been established by governments in Latin America through which the public can request any kind of public information in the country, including PPP project documents. Information can be requested online or in person. Requests can be made by citizens and foreigners. All six countries include information about the transparency and public information law in each of the portals.

Ex post investment information in ASEAN

In the ASEAN region, the various setup of business registries and legal filing requirements across the region posed one of the greatest challenges when obtaining historical financial reports for infrastructure companies. Out of the 10 ASEAN member states, seven have a central business registry but the availability of financial reports varies greatly. As of the beginning of 2018, there are only four ASEAN countries (Indonesia, Malaysia, the Philippines, and Thailand) which have passed policies or acts enabling the right to make FOI requests.

Malaysia, the Philippines, and Singapore all have high EiDAS because of the quality of financial data publically available on infrastructure projects. All three countries allow for the purchase of full financial reports on their business registry websites, giving investors access to companies' records of historical performance as well as debt and equity investments.

The Philippines has established an official government portal for making FOI applications. However, applications can only be made by Filipino citizens. In Malaysia, requests must be made in person and forms must be submitted at the counter. On the other hand, only Malaysia gives every individual the access to information regardless of their nationalities.

In Thailand, which has an EiDAS of 3, only summarised financial statements with key figures of the last five years are available for public access, making it difficult to study the operational history of companies. The country has also established an FOI portal; however, requests can only be made by Thai citizens.

Brunei, Cambodia, and Myanmar have business registry offices, but it is not possible to request companies' financial reports. Cambodia is in the process of developing an FOI act, which will allow Cambodian citizens to request public documents such as concession contracts from the respective state agencies.

At the other end of the scale in Laos, Indonesia and Vietnam, unlisted companies are obliged to file their financial reports with Local Registry Offices, however, many companies still do not do the necessary filing and no public disclosure is required. As in the Philippines and Thailand, only citizens can make FOI requests. Vietnam is looking to develop an FOI portal too.

Recommendations: narrowing the data gap

In a 2015 report to G20 finance ministers and Central Bank governors, the OECD outlined the importance of information availability and how the lack of it can potentially impede long-term investment in infrastructure.

Emerging markets are, for the most part, keen to attract private, including foreign investment into their infrastructure sector. For these countries, there

is a risk that distortions in the availability of data between different countries create equivalent distortions of investment flow to infrastructure between different countries.

Improving the availability and quality of financial information about infrastructure projects in emerging markets will have a direct effect on the attractiveness of investing in infrastructure in those countries.

Crucially, in the absence of sufficient ex ante and ex post information about infrastructure firms, entire countries are currently excluded from the EDHEC*infra* Global Unlisted Infrastructure Index, which covers both debt and equity investments, as shown in figures 2 and 3.

Such broad market benchmarks tend to drive asset allocation decisions and investment strategies adopted by large institutional investors. Those countries that remain too opaque and cannot be included in broad market indices are therefore unlikely to make it onto the 'shopping list' of international investors in infrastructure.

In order to narrow this data gap, a process of coordination and standardisation of infrastructure investment financial reporting, perhaps developed at the multilateral level, is required.

Investors need comprehensive, up-to-date information about current and future investments in infrastructure in order to make an informed decision about where to invest. We conclude this article with a series of simple recommendations to those governments that did not achieve an EiDAS of at least 4.

About ex ante data availability:

- Governments should maintain up-to-date unified portals at the national or regional level, listing all previous, current and future infrastructure projects and their basic information. Such databases should be comprehensive and searchable.
- Investors need to know about the regulation that may apply to infrastructure firms. While it would be ideal to list this information in the same place, countries should at least make sure that this information is easily obtainable from public sources.
- A standard information template should be set to ensure that key project information is presented. This should include basic project details, the financing obtained, and other relevant documents such as PPP contract, IFI documents on the project, and project brief. PPP contracts should be made available to the public.

On this last point, we note here the existing effort made by multilateral development agencies through their support of the SOURCE project by the Sustainable Infrastructure Foundation (SIF), which aims to create a standardised project preparation portal for all new infrastructure projects in developing countries. By 2019, SOURCE project identifiers will be linked to EDHEC*infra* project identifiers.

About ex post data availability:

- Countries should require mandatory submission of annual reports by all key infrastructure companies to the country's official company registry so that the full history of original annual reports for each company can be accessed. Without this data it is impossible to fully understand the performance of infrastructure investments.
- Information about changes in contractual terms including tariffs, regulated rates of return, project implementation and development costs should be made public as well as all project documentation.

While these recommendations may seem extravagant in some countries, it should be noted that in other countries, which receive a score of 5, this level of disclosure is perfectly normal. Moreover, it tends to be associated with a higher degree of private investment in infrastructure, whether it is Chile or the Philippines.

Better data availability, transparency and disclosure will allow the integration of emerging market countries into global and regional investment indices that will in turn drive the flow of investment towards private infrastructure.

Narrowing the data gap is thus an important endeavour when it comes to narrowing the infrastructure investment gap in developing countries.

The rise of 'fake infra'

Noël Amenc, Frédéric Blanc-Brude, Aurelie Chreng, Christy Tran

EDHECinfra examines the constituents of 144 listed infrastructure funds and documents the dangerous rise of the so-called listed infrastructure asset class

For the past 15 years, infrastructure investment has been the domain of large sophisticated investors, but it is now rapidly becoming more mainstream, and asset owners of all sizes including retail investors have heard of the promise of the 'infrastructure investment narrative'.

The investment beliefs associated with infrastructure are rooted in strong economic hypotheses about the provision of essential services to the real economy. The recent flurry of national infrastructure plans suggests that the infrastructure sector is poised for strong growth and supportive public policies.

However, this intuitive story is increasingly used to refer to a whole array of financial products. Originally confined to private equity or debt strategies, the label 'infrastructure' can now be found attached to exchange-traded funds (ETFs), mutual funds, including open-ended funds, closed-end funds, unit trusts, OEICs etc, and a range of stock market indices.

This fast growing listed infrastructure sector is almost always presented as having the ability to deliver features such as stable risk-adjusted long-term returns, inflation hedging, portfolio diversification, and downside protection while being more liquid, transparent, and associated with lower transaction costs than its unlisted (private) counterpart.

In a recent position paper – *The Rise of 'Fake Infra'* – EDHECinfra documents the dangerous rise of the so-called listed infrastructure asset class, an ill-defined series of financial products that initially targeted retail investors and now increasingly reaches institutional investors, which now represent close to a third of the sector (see figure 1).

Listed infrastructure has been growing by 15% annually for a decade, reaching \$57bn of assets under management (AUM) today. Serious research shows that listed infrastructure is failing to deliver on its many promises, and in our view, the number of false claims made about listed infrastructure products is high enough to consider a case of mis-selling.

We strongly recommend stricter regulatory oversight of these products, including the obligation to include the word 'listed' in their names to avoid misleading investors as well as the obligation to include information in marketing documents and information kits warning investors that listed infrastructure may not deliver the same performance as unlisted infrastructure investments.

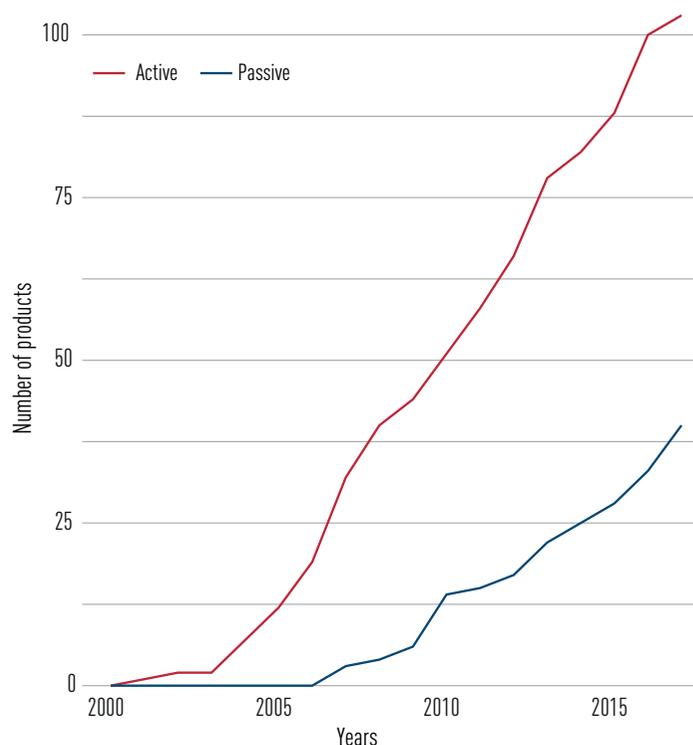
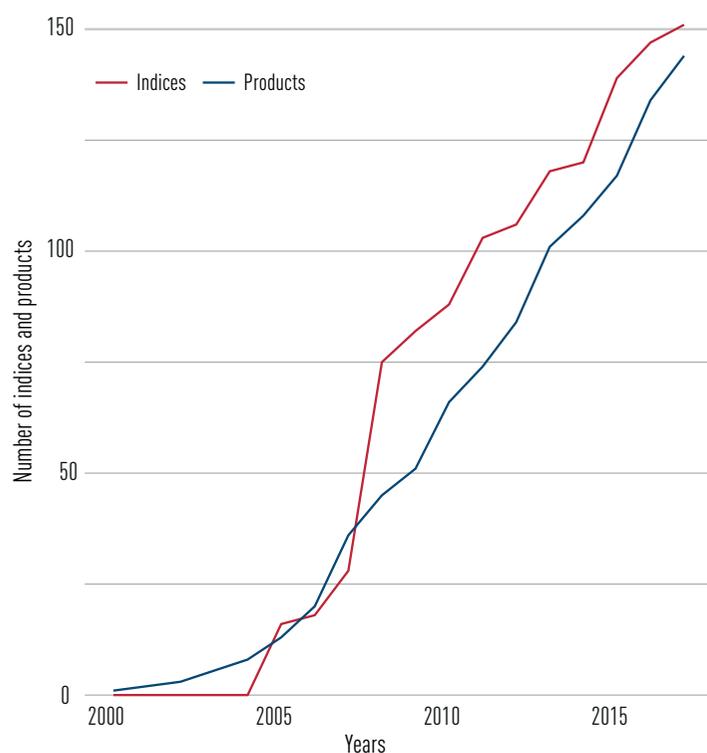
Listed infrastructure is 'fake infra'

Our review of the marketing documentation for 144 listed infrastructure products representing 85% of the sector by AUM concludes that such products typically make near-identical claims compared to private infrastructure products.

However, our and others' research shows repeatedly that listed infrastructure, as it is proposed to investors today, exhibits high drawdown and volatility, does not have better risk-adjusted performance than broad market stock indices, and can typically have its behaviour explained away by a series of well-known factor tilts available to investors throughout the stock market.

We performed new tests that extend existing research and use the actual constituents of both passive and active listed infrastructure products,

1-2. Number of listed infrastructure products and indices since 2000



The number of indices and products with infrastructure in the name has increased over time.

Sources: Bloomberg, Morningstar, ETF Database

3. Top 10 listed infrastructure products, July 2017

Product name	Nature	AUM (\$bn)	Weight	Cumulative
Alerian MLP ETF	Passive	9.52	0.17	0.17
Lazard Global Listed Infrastructure Portfolio	Active	5.13	0.09	0.26
Deutsche Global Infrastructure Fund	Active	3.52	0.06	0.32
ICVC First State Global Listed Infrastructure Fund	Active	3.31	0.06	0.38
GS MLP Energy Infrastructure Fund	Active	2.43	0.04	0.42
ETRACS Alerian MLP Infrastructure Index ETN	Passive	2.24	0.04	0.46
First Trust North American Energy Infrastructure Fund	Active	1.71	0.03	0.49
iShares Global Infrastructure ETF	Passive	1.70	0.03	0.52
Renaissance Global Infrastructure Fund	Active	1.41	0.02	0.54
Northern Multi-Manager Global Listed Infrastructure Fund	Active	1.24	0.02	0.57

The listed infrastructure sector is dominated by a few larger products, with the first five largest funds accounting for 20% of AUM allocated to these strategies. A myriad of smaller products has followed steadily over the past decade (see figures 1 and 2).

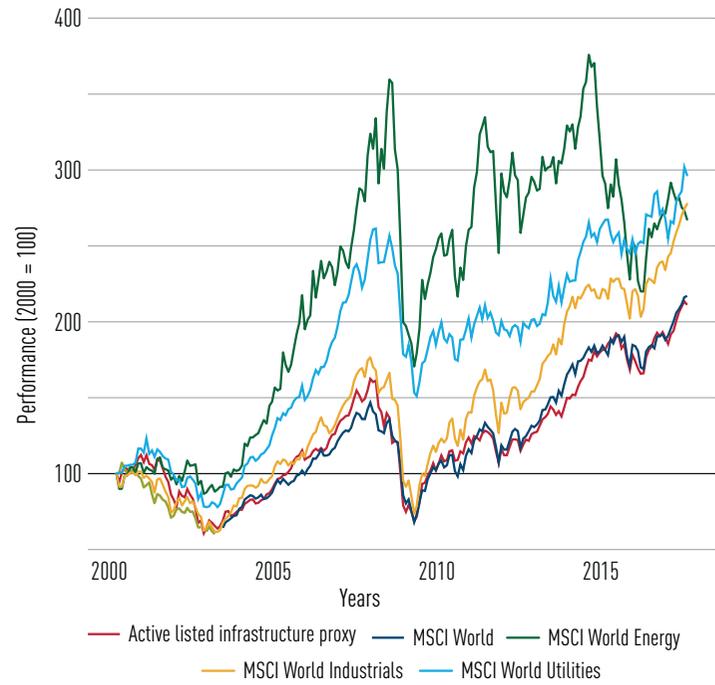
Sources: Bloomberg, Morningstar.

4. Example of 10 non-infrastructure names

Amazon.com Inc	Wal-Mart Stores Inc
Carrefour SA	Samsung Electronics Co Ltd
Nintendo Co Ltd	Qantas Airways Ltd
Pepsico Inc	Hyundai Motor Co
Tesco plc	Microsoft Corp

A look at the list of constituents shows numerous non-infrastructure names, including highly unlikely stocks such as Amazon.com, Microsoft and Nintendo.

5. Performance of active listed infrastructure proxy



capturing most available listed investment products using the word ‘infrastructure’ in their name. We find even less convincing results than previous studies, which rely on back-filled indices using data from a period when no listed infrastructure product even existed. We also find that active listed infrastructure managers have invested in close to 1,900 different stocks over the past decade, many of which cannot possibly be considered ‘infrastructure’ under any definition (see figure 4).

Fake infra poses a threat to the infrastructure investment sector

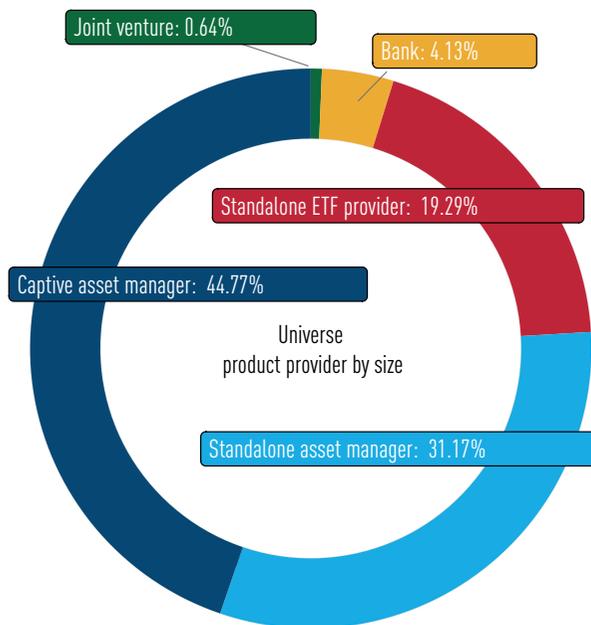
The growth of listed infrastructure products is problematic because of the

damage that their proliferation will eventually do to proper infrastructure investing. We believe in the potential of infrastructure debt and equity investment for asset owners. We also see no reason why – in principle – some of the products used to access the characteristics of underlying infrastructure assets could not be listed on public markets.

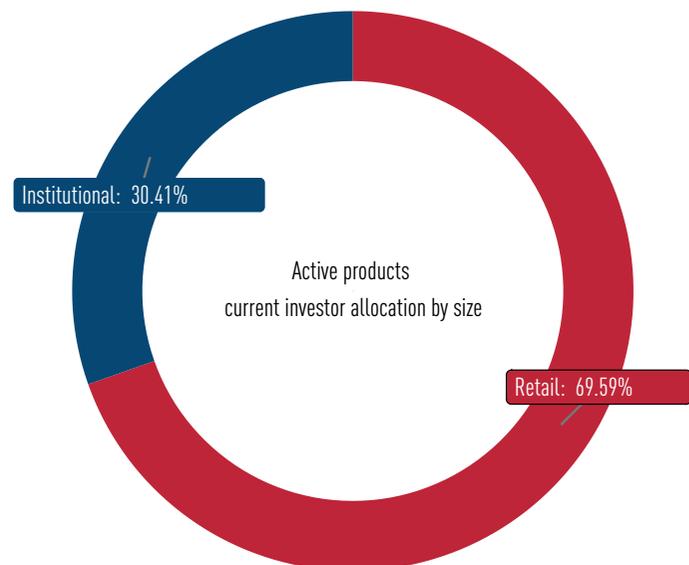
But today’s ‘fake infra’ will disappoint. It is comparatively expensive and will leave investors without the promised low-risk, stable inflation linked returns. As a result, it could give a bad name to infrastructure investing in general. Fake infra could reverse years of educating investors about the potential of infrastructure assets as sources of portfolio-diversification and

6. Listed infrastructure product providers and clients, by volume

a. Providers



b. Clients



Active listed infrastructure products came on the market first, followed by passive products delivered through exchange traded funds (ETFs) and exchange-traded notes (ETNs) – together known as exchange-traded products (ETPs).

liability-hedging instruments. It could undo recent progress in the prudential area to recognise the existence of a specific risk-return profile and capital-charge treatment for infrastructure debt and equity.

It may even jeopardise the involvement of institutional investors in the next generation of public private partnerships that underpins so much of the national infrastructure plans being put forward by most OECD governments.

Transparency and clarity are possible

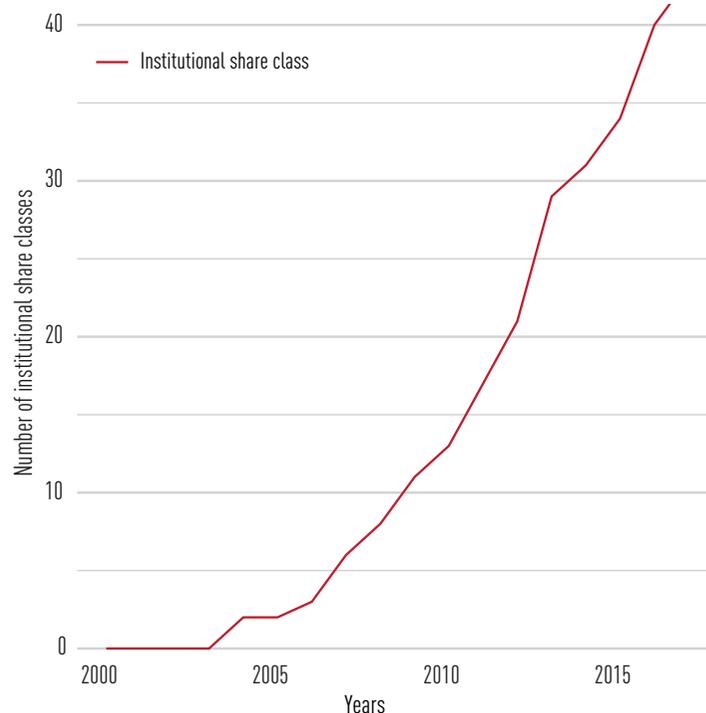
Stock market regulators should aim to achieve a clear definition of the listed infrastructure space. Better, more transparent listed infrastructure products could be created with the aim of delivering at least some of the promises of infrastructure investment to asset owners.

This definition already exists and has been developed in the context of the prudential regulation of insurers, pension plans, and banks. It can be used by stock market regulators to define underlying assets that could qualify to be included in listed equity products, as is the case for other categories or groupings of stocks.

Furthermore, asset owners should require transparency and that listed infrastructure asset managers publish their constituents; they should require concrete evidence of the delivery of infrastructure-investment narrative using listed products; and they should benchmark listed infrastructure products against unlisted ones.

Listed infrastructure managers are not all equally responsible for the state of the sector. Some have been involved in trying to create access to infrastructure businesses through listed products honestly and for a long time. Genuine providers of infrastructure investment products should work together to remove the risks created by the growth of fake infra.

7. Number of institutional share classes since 2000



Institutional share classes of active listed infrastructure funds are growing rapidly, from two in 2004 to more than 40 share classes in 2017, with half of existing share classes launched over the last five years.

Credit risk in private infrastructure debt

Frédéric Blanc-Brude, Majid Hasan and Timothy Whittaker

EDHECinfra proposes an empirical evaluation of credit risk in private infrastructure project finance debt and puts forward an approach to model the mechanism by which defaults occur as opposed to the occurrence of default events

Despite its importance in the practice of banking, project finance has received little attention in finance literature. Growing interest among asset owners in search of yield and diversification in private debt in general and infrastructure debt in particular suggests that documenting the risk profile of private debt instruments has become an increasingly relevant empirical question.

Existing empirical research on private infrastructure project credit risk relies on the possibility of observing actual events of default among a population in order to measure default frequencies – ie, so-called reduced form models that represent credit risk as an exogenous random variable or hazard rate, which have been produced by credit rating agencies (see *Moody's Investor Service Default and Recovery Rates for Project Finance Bank Loans, 1983–2015*).

These studies are built using data pooled from banks and can include hundreds of thousands of loans originated by project finance lenders over the past two decades or more. As such, they usually claim to be representative of the underlying population of originated loans. While this may be the case (assuming no reporting biases among lenders), the related claim that such datasets can provide an unbiased view of the credit risk of private infrastructure loans is not self-evident.

In making these claims, rating agencies assume that a representative

dataset of credit instruments allows the observation of enough credit events to derive unbiased default frequencies. However, this need not be the case if the population of instruments being sampled offers only limited evidence of credit events and what might cause them. Hence there exists a fallacy of composition: Inferring that the observation of a representative sample of credit instruments necessarily allows the observation of an equally representative set of credit events. If credit events are sufficiently frequent within a population of loans, this assumption can be reasonable. If, however, credit events are sufficiently rare, or are clustered in time and space, then historical events of default may not provide unbiased estimates of future credit risk to creditors. This point is well illustrated by the near-zero, 10-year marginal probability of default for project finance loans reported in the most recent Moody's study.

In the very large sample available to Moody's there is close to zero reported (first) default event in the 10th year after financial close. By this measure, conditional on no default during the first 10 years, reported default risk in private project finance debt is equivalent to that of a AAA-rated bond. Yet it typically carries a credit spread in the range of 80–250bps, and when they are rated, infrastructure project loans tend to remain in the BBB/BBB- range even after 10 years, directly contradicting rating agencies' own reported default probabilities. Insurance statisticians are familiar with these issues.

It can be difficult to derive meaningful statistics about the likelihood of events that are seldom observable, let alone in sufficient numbers to control for the multiple variables that might have determined them. The likelihood of an earthquake in a given location or that of the mid-air collision of two commercial airplanes are typical examples. Likewise, modelling a hazard rate for investors in private infrastructure project debt is made more difficult by the difficulty in observing large samples of the phenomenon of interest. Moreover, infrastructure investment is characterized by the large size of each investment and a highly illiquid private market, meaning that individual investors are usually exposed to a handful of assets and not the mean asset available at that time. Hence, even if credit events were frequent enough to model default frequencies accurately for a representative investor holding a large sample of available loans, the immense majority of creditors would not be better informed about their own risk exposure.

A new approach

We, at EDHEC*infra* propose a simple but powerful approach to deal with the dearth of information available about credit risk in private infrastructure debt. We extend the structural model of credit risk in private illiquid debt we put forward in a 2016 research paper – *A Structural Credit Risk Model for Illiquid Debt* – using Bayesian inference to extract robust credit risk estimates from observable data on cash flow ratio collected at the individual borrower level. We also provide a calibration of the model using a unique dataset of project finance cash flow covering 14 European countries and going back two decades. Our objective is to calibrate a model of distance to default (a concept first mentioned in *Quantifying Credit Risk I: Default Prediction* by S. Kealhofer in 2003) in infrastructure project finance.

Hence, the absence of observable default events does not limit our ability to model and predict default, since we can measure default risk before default events occur and even if they never occur.

As a result our approach also allows introducing control variables that are unavailable to reduced form models relying on observing actual default events. This approach can be applied to a representative sample of loans, as is the case in existing studies, or to an individual portfolio or even a single loan, thus removing the requirement to hold a representative portfolio to derive meaningful information for an investor in private infrastructure debt.

DSCR dynamics

The only empirical research available on the credit risk of infrastructure projects is provided by credit rating agencies that have pooled information about realized default events. This data is privately held and has not been available for independent academic research. Existing academic research on credit risk in project finance has focused on the pricing of credit risk – ie, the determinants of credit spreads in bank loans and bonds used to finance infrastructure.

This literature typically finds that project finance credit spreads do not have the same determinants as plain vanilla corporate debt but offers little insights into how risky such instruments actually are. We put forward a technical framework to measure credit risk in private illiquid debt using a structural approach – ie, modelling the mechanism by which defaults occur as opposed to the occurrence of default events. Implementing this approach to modelling credit risk requires collecting cash flow data, computing DSCRs, and modelling their dynamics.

Infrastructure project companies are contractually prevented from raising additional funds, the DSCR provides an unambiguous definition of default thresholds. The hard default threshold is easily defined as $DSCR_t$. Likewise, the DSCR can also be used to unambiguously define ‘technical’ default thresholds – ie, covenant breaches defined in terms of the DSCR level ($DSCR_t(1.x)$) that qualify as credit events and provide additional control or step-in rights to lenders.

Our dataset of DSCR is built using manually collected and verified data from the audited statements of accounts of individual project companies. For the purpose of describing DSCR dynamics, the dataset also includes individual project size, leverage, industrial sectors, countries, business model (whether the projects are contracted or merchant), and date schedules, including financial close and construction completion dates. The data obtained includes information reported in companies’ balance sheets, and in income and cash flow statements, and allows DSCRs, leverage, and other financial variables to be computed in each period.

In previous studies DSCRs are typically computed using an operating income but this can under/overestimate the cash flow available for debt service in practice. For instance, if a project is drawing down additional debt to make its debt payment, then the cash available for debt service will exceed operating income. Similarly, if the project is investing capital in physical assets then the cash flow available for debt service will be less than its operating income. In an effort to create a meaningful proxy for credit risk, we compute what we call an ‘economic’ DSCR.

Thus, we compute realised DSCR observations across a range of infra-

structure projects spanning more than 17 years, representing the largest such sample available for research to date, and conduct a series of statistical tests and analyses to establish the most adequate approach to modelling and predicting future DSCR levels and volatility. Our dataset includes 267 projects spanning two revenue risk families (‘Contracted’ and ‘Merchant’), in seven sectors (transport, telecoms, oil and gas, industrial, government services, environmental services and energy), from 2000 to 2016, from all major European markets.

Credit risk implications

In modelling the volatility of the DSCR we monitor the transition of the DSCR from a safe state, the DSCR being so high that the probability of default is extremely limited, to a risky state, where the project may default if the DSCR falls below 1. The probability of the DSCR being in the risky state, times the probability of the hard default threshold of the DSCR falling below a certain threshold in the risky state is the equivalent of the marginal default frequencies (PD) reported by rating agencies.

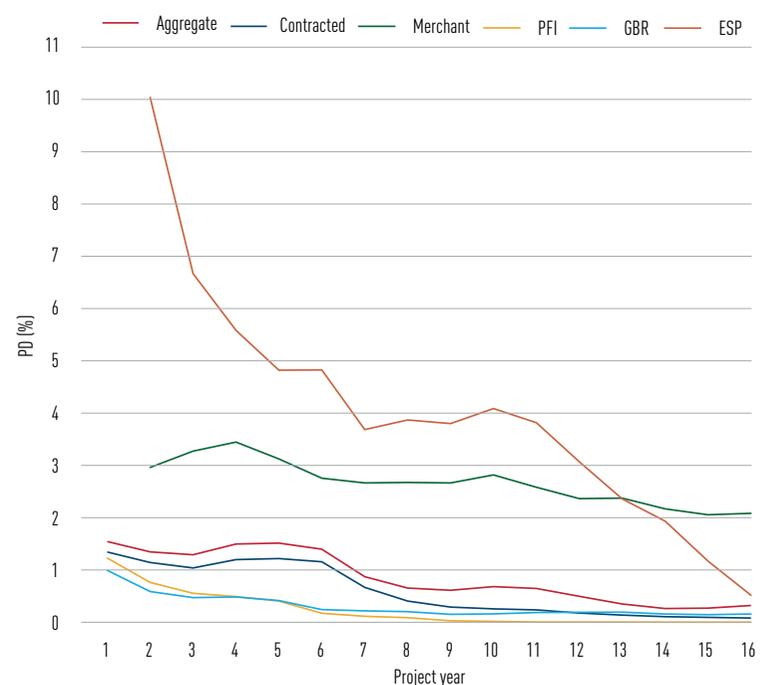
Cumulative default rates, default risk over calendar (as opposed to project) time and distance to default can also be reported.

Figure 1 shows the unconditional probability that $DSCR_t$ falls below the hard default threshold at each point in project time for the full sample period. Only the first default of payment is counted, which is consistent with Moody’s definition of default (missing one payment) and computation of marginal PDs in Moody’s (2017).

Consistent with rating agencies results, we find that project finance borrowers tend to de-risk over time. However, we find a range of default risk profiles depending on the control variables used. At the aggregate level (see figure 1, dark red line), we find higher levels of marginal PD than in Moody’s (2017). This is not surprising since we measure all potential defaults, as opposed to a biased sample of actual credit events.

We note that after 10 years, conditional on no default until that time, PD in project finance senior debt is typically not equal to zero, in contrast with reported PDs in Moody’s (2017), but more in line with typical credit ratings. The ability to introduce control variables in our model allows differentiating between different project business models, sectors or countries and suggests very different risk profiles. For instance, projects financed in Spain exhibit at the beginning of their lives, very high credit risk but also the most dynamic change in their risk profile over time. Merchant projects are markedly riskier than contracted ones and projects in the UK, especially those created under the Private Finance Initiative (PFI), are found to be considerably less risky, primarily because they exhibit high levels of expected DSCR when cash at

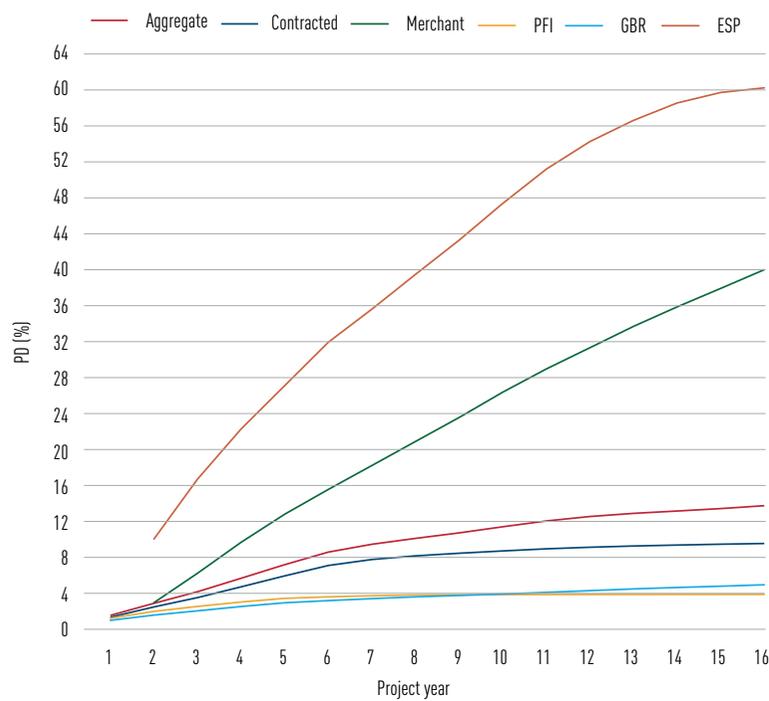
1. Probabilities of hard default for various project families with defaulted borrowers (computed as the DSCR, falling below 1:0)



After 10 years, conditional on no default until that time, PD in project finance senior debt is typically not equal to zero, in contrast with reported PDs in Moody’s (2017), but more in line with typical credit ratings.

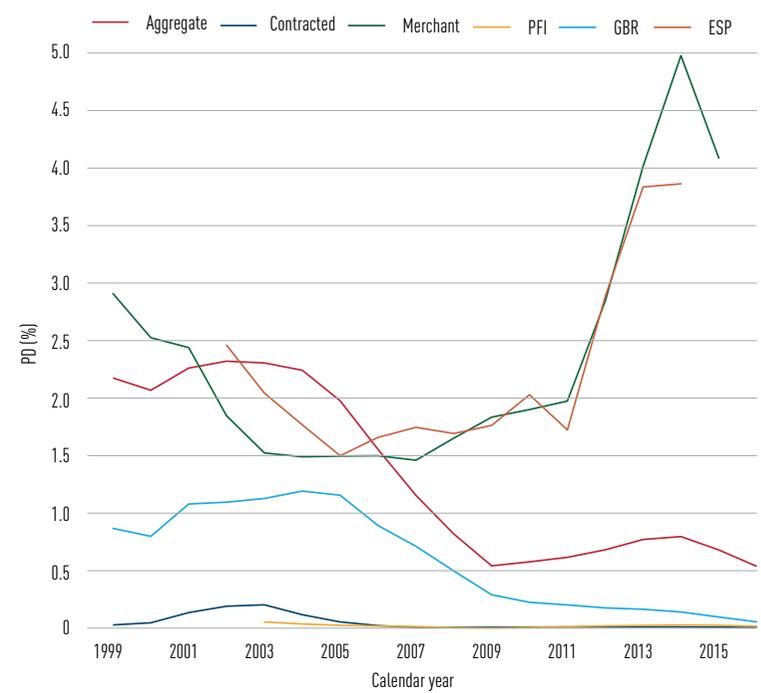
2. Cumulative probabilities of hard default and probabilities of hard default by year

Panel A



When observing cumulative default risk in project time we report higher cumulative PDs than rating agencies. Across all sectors and countries 10-year cumulative PD is close to 12%, almost double the figure reported in Moody's (2017).

Panel B



In calendar time the aggregate PD follows the business cycle, decreasing from the early 2000s until the 2008 financial crisis and increasing again from 2009 onwards but not quite as much.

bank is included in the computation of cash flow available for debt service.

When observing cumulative default risk in project time we report higher cumulative PDs than rating agencies (see panel A, figure 2). Across all sectors and countries 10-year cumulative PD is close to 12%, almost double the figure reported in Moody's (2017). We note that the 10-year cumulative probability of default in Spain is close to 50%. In calendar time (panel B, figure 2), the aggregate PD follows the business cycle, decreasing from the early 2000s until the 2008 financial crisis and increasing again from 2009 onwards but not quite as much.

This is consistent with previously reported evidence and is driven by the much larger number of contracted projects relative to merchant ones in the underlying population of infrastructure projects in Europe since 2008. In effect, merchant project PD taken in isolation tends to peak much more markedly at bad times in the economic cycle, especially Spanish projects, but also any merchant project as illustrated by the green line on figure 2.

Distance to default

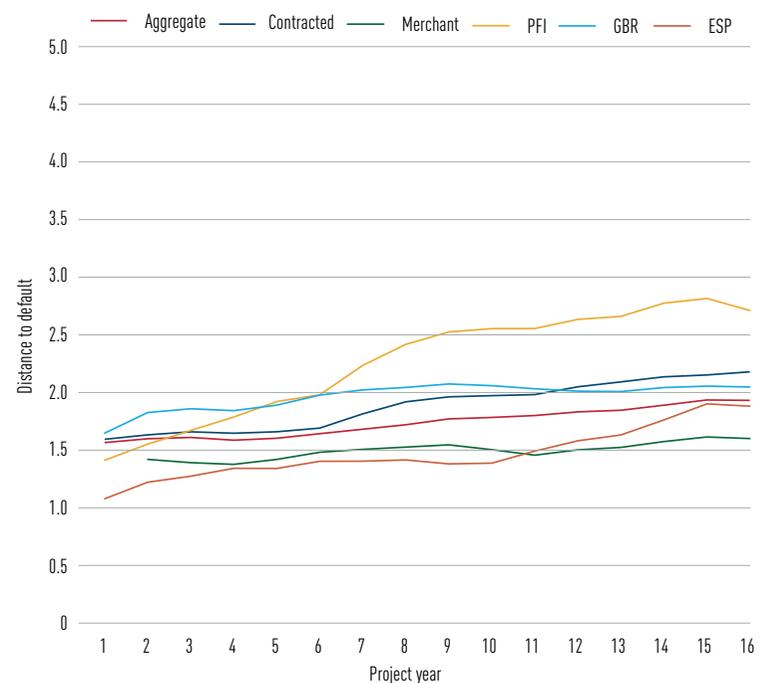
Projects tend to de-risk over time as their hard default threshold increases and volatility decreases. Figure 3 reports distance to default. PFI projects in particular are found to be further away from a hard default after less than a decade of operation, which confers them a very low credit risk. Conversely, merchant projects exhibit a stable distance to hard default over time.

Distance to default in Spain is the lowest in early project years but shifts upward closer to the sample mean as numerous projects fail to survive the first 10 years and leave the reporting sample, having experienced hard defaults.

Relying on reduced form models that require observing numerous event of defaults is ill-suited in a sector characterised by a limited number of observable credit events. Instead, the structural approach proposed by EDHECinfra can be calibrated using observable DSCR data and Bayesian inference. Our results suggest that credit risk in project finance is heterogeneous and driven by project business models but also regional and sector specific dimensions resulting from the procurement choices and types of creditors active in various markets.

This research is drawn from the Natixis/EDHECinfra research chair on the characteristics of private infrastructure debt.

3. Distances to hard and soft default at threshold of 1:0



PFI projects in particular are found to be further away from a hard default after less than a decade of operation, which confers them a very low credit risk. Conversely, merchant projects exhibit a stable distance to hard default over time.

Revealing investors' return preferences

Frédéric Blanc-Brude, Timothy Whittaker and Jing-Li Yim

EDHECinfra conducts first ever study examining the impact of returns on investors' willingness to invest in private infrastructure

At the end of 2017 EDHECinfra, on behalf of the G20, conducted the largest survey of infrastructure investors globally. As part of this survey we tried to understand what impact returns have on an investor's willingness to invest in private infrastructure.

When investors buy and sell assets at a given price, their decision to invest can be said to reveal their preferences about the risk/return trade off of a given investment. We derived a 'willingness-to-invest' survey methodology, whereby we asked our respondents to agree or disagree with a series of bid prices (returns) corresponding to hypothetical but also quite familiar investment scenarios.

The rationale behind this methodology is that if you have ever bought a \$500m combined-cycle gas turbine power generator in an OECD country with a 15-year power purchase agreement using 75% senior leverage, you probably have some idea of what equity returns are reasonable, too low, or too good to be true in similar transactions.

While survey respondents may not know the exact return they would require based on reading a short synopsis of an investment, they should have a good sense of where good deal bounds on value should lie.

More formally, private markets like the one for infrastructure equity stakes are typically incomplete markets where large bid-ask spreads can survive for a long time (infrastructure projects cannot be shorted!). In incomplete markets, investor preferences have a direct influence on transaction prices (ie, the law of one price does not apply). Hence, not all respondents have the same view on what the reasonable bounds on investment returns should be. The methodology we implement in this survey allows estimating an average bid-ask spread and comparing it across project types and investor types. This is the first time that this kind of experimental research has been implemented in the private infrastructure investment space.

The survey was designed so that investors could give reasonable upper and lower return limits. Below the lower limit investors deem the price too high and are not willing to invest.

Willingness to invest is expressed in terms of IRR.

The results focus on the willingness to invest of the different groups of the survey respondents in OECD and emerging market project equity, across business models and the project lifecycle, as well as different kinds of debt and equity investment products.

Willingness to invest in private infrastructure equity

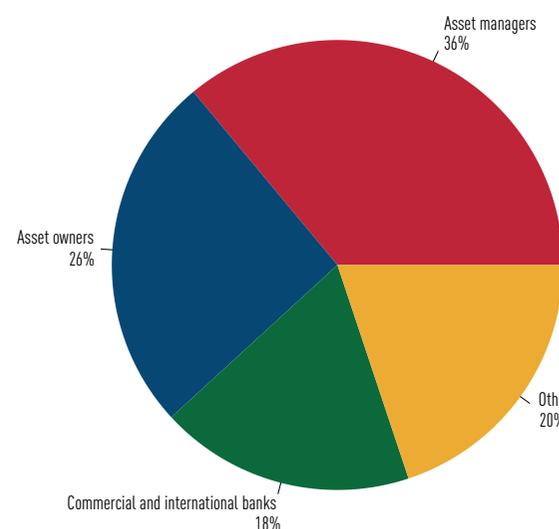
On average, in OECD markets investors require an IRR between 10.6% and 12.4% to invest in private infrastructure equity. The similar range of required returns in emerging markets is an IRR between 16.9% and 19.6% before investors are willing to invest in private infrastructure equity.

This range can be interpreted as the bid-ask spread (the amount by which the ask price exceeds the bid price) that applies to these assets in a highly illiquid and incomplete market where investor preferences determine required returns as much as market forces. In the OECD, the private infrastructure equity bid-ask spread is less than 200 basis points, whereas in emerging markets it is closer to 270 basis points.

Investors thus report a broad-market emerging-market equity premium (over OECD infrastructure equity) in the 6-7% range, which is significant. Finally, we note that required returns for OECD private equity are very much in line with the realised returns of the EDHECinfra private broad market European infrastructure index for 2016.

While each set of results was obtained using completely different and independent methodologies, the mean broad market equity return estimated from stated preferences (the survey) matches the one derived from revealed preferences (the EDHECinfra index).

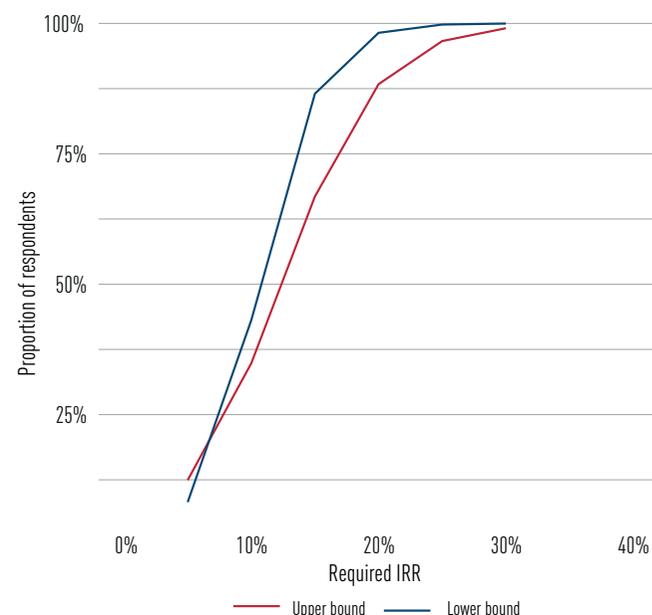
1. Proportion of survey respondents by organisation type



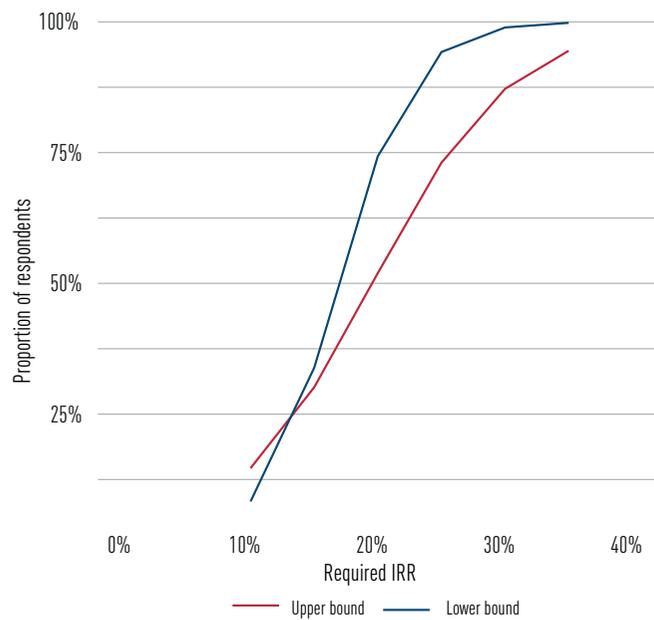
Figures 2 and 3 show upper and lower limits of the probability that a survey respondent is willing to invest at a given IRR in OECD or emerging market infrastructure equity, respectively. The bounds we find are typical of the persistent bid-ask spread phenomenon discussed earlier.

At very low levels of return, most market participants agree that they

2. Proportion of respondents willing to invest at the required IRR – OECD infrastructure



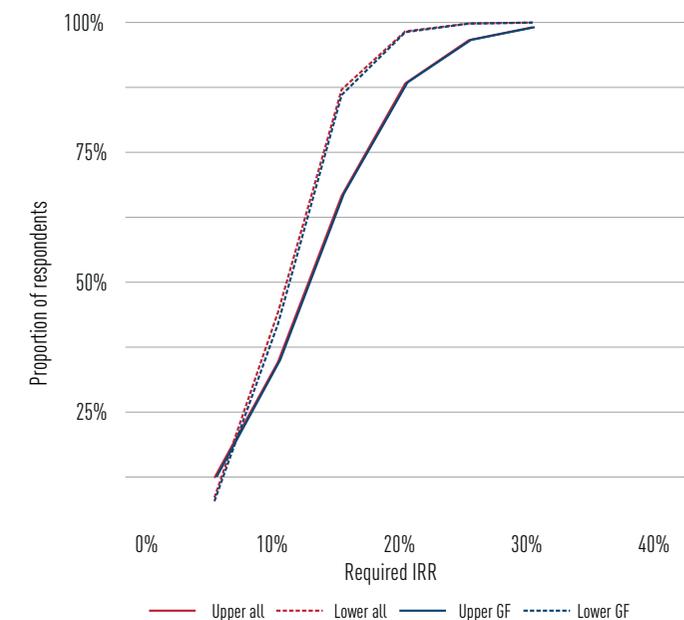
3. Proportion of respondents willing to invest at the required IRR – emerging market infrastructure



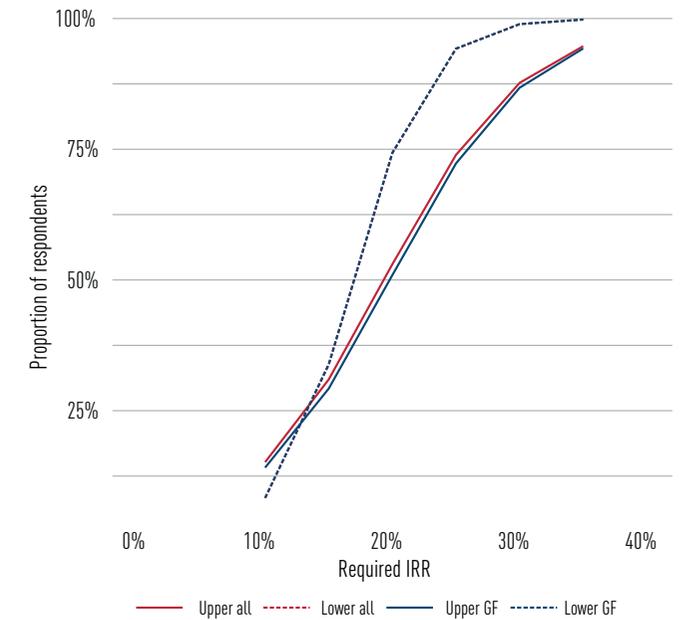
4. Average IRR demanded by investors for an investment in greenfield (GF) or brownfield (BF) infrastructure equity

	Lower all	Upper all	GF lower	GF upper	BF lower	BF upper
OECD						
Mean willingness to invest	10.6%	12.3%	10.8%	12.3%	10.5%	12.4%
Emerging market						
Mean willingness to invest	16.9%	19.6%	16.9%	19.8%	16.9%	19.4%

5. Proportion of respondents willing to invest at the required IRR – OECD, greenfield or other infrastructure



6. Proportion of respondents willing to invest at the required IRR – emerging market, greenfield or other infrastructure



would not invest, irrespective of their nature or preferences or of the details of the transactions. At the other end of the return spectrum, the immense majority of respondents agree that they would invest in infrastructure equity beyond a certain return threshold (eg, in the OECD, beyond 30% return, 100% of respondents are willing to invest equity in any of the different categories of infrastructure firms that were included in the survey). In between, differences in investor preferences create a bid-ask spread which varies in size.

Sometimes this bid-ask spread can be very narrow. We examined whether the individual characteristics of infrastructure assets affect the IRR demanded by investors. We consider the impact of the project lifecycle, business model, and investor type.

No greenfield risk premia

To test for a project-lifecycle effect, respondents were asked about identical scenarios in terms of business model and geography, with the only variation being whether the investment proposed was greenfield or brownfield. We defined greenfield assets as entirely new assets and brownfield assets as existing assets. It is usually believed that the greenfield stage of infrastructure projects carries higher risks and therefore higher risk premia.

A number of surveys ask a question reflecting a preconceived notion that greenfield projects should have a higher risk premia. For example, “What is the range of expected returns in a) greenfield infrastructure and b) brownfield infrastructure?” Respondents typically answer that they expect greenfield risk premia. However, this prior assumption should be qualified for several reasons. First, while construction risks are non-trivial in infrastructure projects, they do not necessarily impact investors requiring risk premia. For instance, equity investors in project-finance transactions are mostly protected from construction risk by a fixed price, date-certain construction contract, and cost overruns at the project company level that have been shown to be close to zero on average (see 2014 paper from EDHEC*infra* – *How much construction risk do sponsors take in project finance?* – for an empirical analysis using ex ante and ex post construction costs).

Second, the size of construction risks and any related premium, may not be larger than risk premia associated with risks in the post-construction phase of infrastructure projects, such as traffic risk or regulatory changes. Existing research shows that construction risk is not the main cause of failure for infrastructure projects nor the driver of the cost of debt in projects.

Finally, and perhaps most fundamentally, construction risks are almost entirely idiosyncratic. As such, they are unlikely to be driving the risk pricing of the average investor, since they can, in principle, be diversified away. Thus, from a portfolio perspective, it can be argued that the construction risks associated with the greenfield phase of infrastructure investments are only one source of idiosyncratic volatility among others, which does not tend to affect equity investors (at least in project finance).

Neither is it the largest source of investment risk for investors. Looking at the survey results, the average willingness to invest in greenfield (GF) or brownfield (BF) infrastructure equity is shown in figure 4. Survey respondents report continuing to be willing to invest between 10.5% and 12.4% with no noticeable greenfield premium. In emerging markets, this average return

is still between 16.9% and 19.8% with, again, no discernible premium for greenfield investments. Figures 5 and 6 demonstrate the lack of difference between greenfield and other infrastructure investments. The lines either overlay each other or the difference is very small.

This result will surprise many readers, since it contradicts the assumption that greenfield infrastructure investment should always carry an additional risk premium. However, for the reasons highlighted above, we believe that this is a correct representation of investors’ actual risk preferences. Construction risk is project specific, and it is not necessarily large compared to other factors impacting the overall business risk of the firm, such as demand risk.

Business models

The idea that infrastructure investments should be categorised by business models and not by industrial sectors was first put forward in *Benchmarking Long-Term Investment in Infrastructure* (EDHEC-Risk Institute Position Paper, 2014). The argument draws from simple finance theory: business models can be expected to correspond to systematic sources of risk in infrastructure investments whereas industrial sectors cannot. This view has since become widely adopted by investors and prudential regulators, such as

EIOPA. Simply put, infrastructure firms can derive a contracted, merchant, or regulated income stream, and their size, financial structure, debt covenants, and in fine their business risk profile can be expected to reflect this.

The range of IRRs demanded by investors to make them willing to invest in merchant infrastructure is significantly higher than for contracted or regulated infrastructure. Figure 7 shows the range of IRRs for the three business models for OECD and emerging market infrastructure. Investors demand a premium of about 150 basis points to invest in merchant infrastructure in both emerging markets and the OECD.

This is consistent with our 2016 survey results in which respondents reported a very small, possibly insignificant difference in expected returns between OECD and emerging-market merchant infrastructure. Figures 8 and 9 illustrate these results and show that at each required IRR level there is a lower probability that any respondents would be willing to invest in merchant infrastructure rather than all other infrastructure types.

7. Average IRR demanded by investors for an investment in infrastructure equity by business model

	Lower all	Upper all	Contracted lower	Contracted upper	Merchant lower	Merchant upper	Regulated lower	Regulated upper
OECD								
Mean willingness to invest	10.7%	12.4%	10.3%	12.3%	12.2%	13.8%	11.4%	12.6%
Emerging market								
Mean willingness to invest	16.9%	19.7%	16.0%	17.5%	18.2%	21.3%	18.7%	23.9%

Asset owners vs asset managers

Next, we examine the expected returns required by different types of investors for private infrastructure equity in OECD and emerging markets.

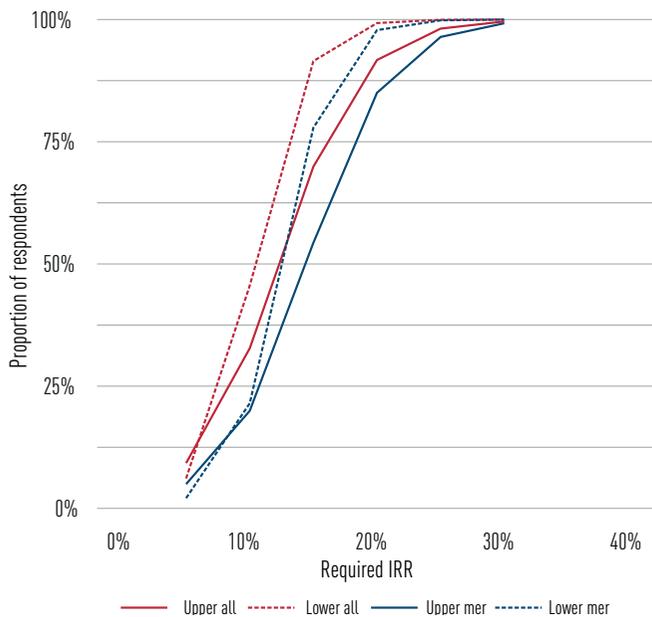
In both geographies, we find a statistically significant difference between the IRR required by asset owners and that required by asset managers. Asset owners' return requirements for OECD infrastructure are rather tight, between 10.75% and 11.5%, whereas return requirements reported by asset managers, between 9.65% and 14%, are much broader and completely include asset owners' return preferences.

Figure 10 illustrates this point even better at different levels of required return: the bid-ask spread of the asset-owner category is in fact rather narrow and only significant at the lower end of the return spectrum, where asset owners are equally likely to invest at differing levels of expected returns. For instance, there is one chance in three (33% probability) that asset owners would be willing to invest between 8% and 10% IRR. The bid-ask spread reported by asset managers is however much wider, and explains most of the observed range of prices shown in figure 2. As the likelihood of investment increases, so does the bid-ask spread: at a 75% chance that an asset manager would agree to invest in OECD infrastructure equity, the required return can vary between roughly 12.5% and 17.5%, a 500bps difference.

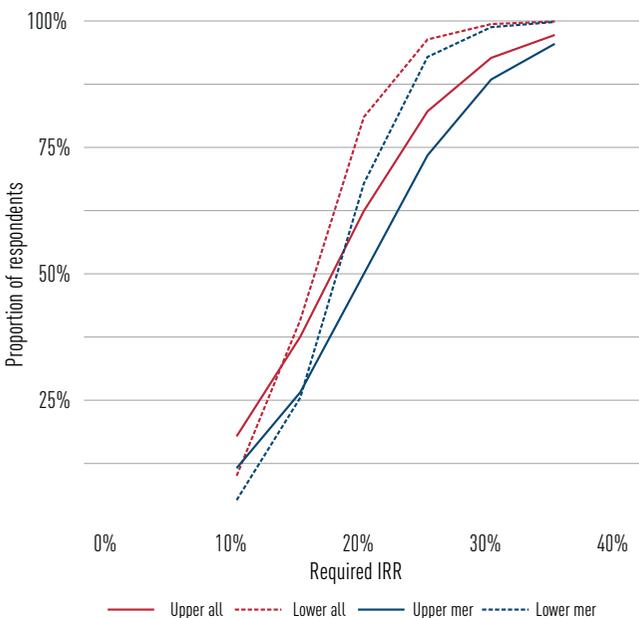
At the same probability of agreeing to invest, asset owners almost unanimously require a 14% return. This difference could be the result of several non-exclusive effects, including:

- Asset managers are infrastructure specialists and have better information about the riskiness of the different investments proposed, hence they are more granular in their answers;
- Individual asset managers correspond to a heterogeneous group of strategies, from investing in low-risk contracted solar power, to high-risk merchant toll roads, whereas asset owners would be exposed to all these strategies simultaneously and require broad market returns.

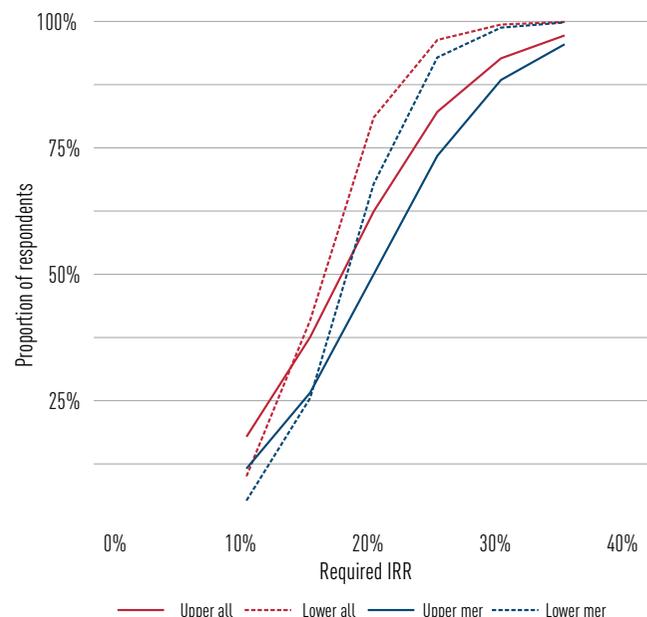
8. Proportion of respondents willing to invest at the required IRR – OECD, merchant or other infrastructure



9. Proportion of respondents willing to invest at the required IRR – emerging market, merchant or other infrastructure



10. Proportion of respondents willing to invest at the required IRR – OECD infrastructure



Emerging markets

For emerging markets, the picture of asset owners and managers is very different. The mean IRR demanded by asset owners is between 17.5% and 22.9%, while asset managers require returns between 16% and 18.7%.

As shown in figure 11, the degree of consensus and the likelihood of an investment decision are very different than for OECD infrastructure. Asset owners have a wide range of views on required returns in emerging-market infrastructure, and even at the 75% positive investment-decision probability, the bid-ask spread again exceeds 500bps. Asset managers exhibit a narrower, perhaps more accurate view of required equity returns in emerging-market infrastructure. They are happy to invest at a lower average level of returns.

Asset owners' required emerging market premium (over OECD infrastructure equity) ranges between 7% and 11.5%, whereas asset managers are content with a premium of 5-6%. Such differences in stated preferences of required returns in emerging-market infrastructure suggest that asset managers are able to intermediate such investment for only a fraction of asset owners: those requiring equity returns in line with what asset managers deem achievable. Alternatively, asset managers will have to take higher risks to meet the return requirements of asset owners. This finding also illuminates the fact that while many asset owners declare wanting to invest in emerging-market infrastructure, much fewer actually already do. The discrepancy between what asset managers report to be achievable and what asset owners require may partly explain the slow pace with which institutional investors have entered emerging-market infrastructure.

Infrastructure investment products

Finally we asked survey respondents about infrastructure investment products, as opposed to single investment projects. A product can simply be a private equity fund or a co-investment facility, structured product, etc.

We report answers for product types that already exist: a classic infrastructure private equity fund, a long-term infrastructure equity fund, and a private debt co-investment platform; we also describe the responses to a product that does not yet exist: a hybrid index-tracking infrastructure fund.

Traditional infrastructure equity fund

The question proposed becoming a limited investment partner (LP) in a closed-ended private equity fund that would target "brownfield 'core' and 'core+' infrastructure in the OECD". The fund would have a 10-year life and three transactions were expected to require 50% of the invested capital. The general partner would charge a 1.5% management fee, with 20% cost of carry over a 7% hurdle rate. The general partner was also able to leverage the fund for the investments. This kind of fund is the most common and widely available type of infrastructure investment vehicle available to asset owners who do not wish to invest directly. It is also a type of product that 80% of respondents to the 2016 EDHEC*infra*/GIH survey declared to be "obsolete and not adding value".

This kind of fund is in fact so well known to investors that there is a great degree of consensus among respondents about required returns: we find that all investors, on average, would be willing to invest if the promised IRR was between 12.2% and 13%. There is no significant bid-ask spread: all respondents agree about their willingness to invest for a given level of required return. Hence, the mean required IRR is 12.2%, with asset owners (here the LPs) requiring 13% on average, whereas asset managers (the GPs) are happy to invest an average return of slightly less than 12%. This is also evident from figure 12.

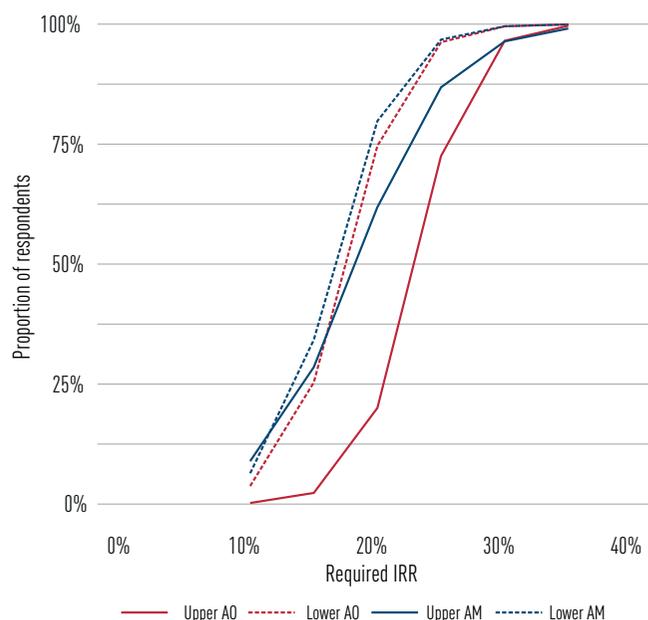
Long-term infrastructure equity fund

Long-term infrastructure equity funds contrast significantly with the traditional private equity style infrastructure funds described above. The question posed to respondents asked what IRR they would require to be willing to invest in an infrastructure fund that had a 25-year life and an investment mandate for both greenfield and brownfield infrastructure.

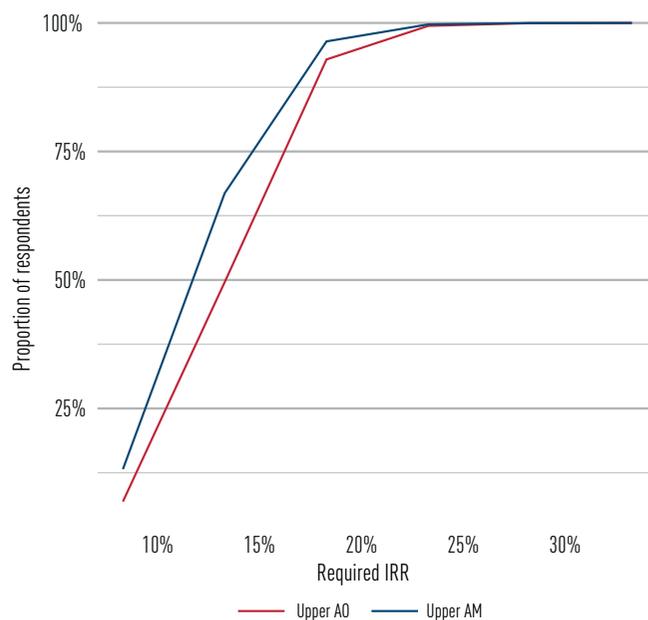
The underlying infrastructure projects would all be 'contracted' with only 30% of the invested capital being allocated to greenfield infrastructure and no fund-level leverage. Investors would be locked in for the life of the fund, but the fund manager would focus on providing regular pay-outs to the investors. For this type of product investment, respondents do have a range of views and demand a lower IRR than for an infrastructure private equity fund, between 12.3% and 12.6%. There is also a statistically significant difference between respondents from both banks and asset managers on the one hand and asset owners on the other.

The return preferences expressed by asset owners are themselves bounded by those expressed by asset managers. Asset managers consider that investors in long-term infrastructure equity funds should be happy to receive returns between 9.6% and 12.9%, whereas asset owners express narrower expectations with a midpoint at 12%. As expressed above, the wider price bounds of asset

11. Proportion of respondents willing to invest at the required IRR – emerging market infrastructure



12. Proportion of respondents willing to invest at the required IRR into a traditional infrastructure equity fund



managers could be the result differences in risk preferences but also in expected fee levels (see figure 13).

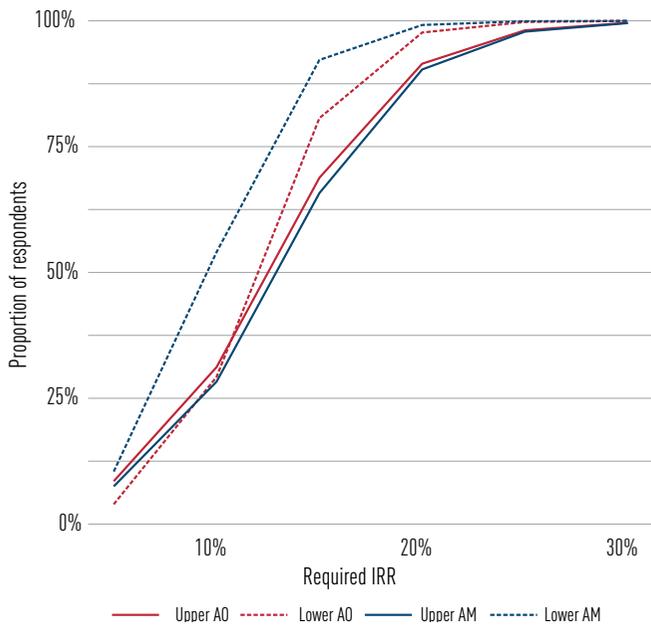
Co-investment infrastructure debt platform

Infrastructure debt co-investment, alongside originating banks or debt funds, is becoming more mainstream as an infrastructure investment alternative. With this question, respondents were asked what yield to maturity (YTM) they would demand if they were to co-invest in a portfolio of project-finance loans alongside a commercial bank. The bank would originate and structure the loans and would act as a servicing agent. The investor would receive a fixed-rate tranche of the debt with a tenor between 12 and 18 years. The debt would be unrated, and the underlying projects would be 50% contracted and 50% merchant globally.

Respondents reported a required YTM between 4.4% and 5.2%. We observe no significant difference between asset owners and managers or banks.

Figure 14 shows the mean required return for all groups examined. Figure 14 indicates that investors are willing to co-invest at a YTM between 4% and 6%. At 6%, 100% of the respondents would co-invest. This is a clear indication that in this low-interest-rate environment, investors are looking at alternatives to obtain yield.

13. Proportion of respondents willing to invest at the required IRR into a long-term infrastructure equity fund



14. Average required yield to maturity for an investment in a debt co-investment platform, by investor type

	Lower all	Upper all	AO lower	AO upper	AM lower	AM upper	Other lower	Other upper
Mean willingness to invest	4.51%	5.08%	4.20%	5.50%	4.66%	5.00%	4.50%	5.00%

Index-tracking hybrid infrastructure fund

The final infrastructure investment product we consider is a novel type of infrastructure fund. Respondents were asked what IRR they would require to invest in a unit trust that invests in both listed and unlisted infrastructure assets.

The fund's objective would be to optimise investor liquidity while minimising the tracking error with an EDHEC*infra* emerging market private infrastructure equity index. The listed infrastructure portion of the portfolio would aim to replicate some of the investment factors estimated in the unlisted infrastructure portfolio. Investors would be able to redeem their investment, but there were gates and liquidity fees.

Survey respondents would demand a mean IRR between 12.4% and 13.0% to invest in this fund. Given the innovation inherent in this fund, as it provides both liquidity and exposure to infrastructure, it is interesting to observe no statistically significant difference between asset managers, asset owners and banks in the mean willingness to invest.

Only 'other' respondents have a different expectation of an appropriate IRR for this investment requiring an IRR between 12.76% and 14.9%.

*This research is drawn from the 2017 EDHEC*infra*/GIH survey on investor perceptions of infrastructure.*

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1 - The average live outperformance and improvement in Sharpe Ratio across all Scientific Beta developed regions of Scientific Beta Multi-Beta Multi-Strategy (Equal Weight and Equal Risk Contribution) indices is 2.18% and 2.18% for the outperformance and 55.21% and 53.72% for the improvement in Sharpe Ratio. This live analysis is based on daily total returns in the period from December 20, 2013 (live date) to March 31, 2018 for all diversified multi-strategy indices that have more than 3 years of track record for all available developed world regions - USA, Eurozone, UK, Developed Europe, Developed Europe ex UK, Japan, Developed Asia Pacific ex Japan, Developed ex UK, Developed ex USA and Developed. The benchmark used is a cap-weighted portfolio of all stocks in the respective Scientific Beta universes.

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*Average of the differences in Sharpe ratio and differences in annualised excess returns observed between December 31, 1976 and December 31, 2016 (40 years) for all US long-term track record Scientific Beta Narrow High-Factor-Exposure Diversified Multi-Strategy indices: SciBeta Narrow High-Factor-Exposure Value Diversified Multi-Strategy, SciBeta Narrow High-Factor-Exposure Low-Volatility Diversified Multi-Strategy, SciBeta Narrow High-Factor-Exposure Mid-Cap Diversified Multi-Strategy, SciBeta Narrow High-Factor-Exposure High-Momentum Diversified Multi-Strategy, SciBeta Narrow High-Factor-Exposure High-Profitability Diversified Multi-Strategy and SciBeta Narrow High-Factor-Exposure Low-Investment Diversified Multi-Strategy) and their Scientific Beta cap-weighted factor equivalents calculated on a universe of the 500 largest-capitalisation US stocks.

Information based on historical simulation. Information containing any historical information, data or analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction. Past performance does not guarantee future results.

Take the next exit: A case study of road investments gone wrong, Spain 1998–2018

Frédéric Blanc-Brude, Silvia Garcia, Sarah Tame, Timothy Whittaker

In a series of short models based on simple game theory EDHECinfra explores the lessons learnt from the disastrous Spanish toll road projects procured between 1998 and 2004

In the late 1990s, against the backdrop of a strong economy, the Spanish government procured 10 new toll roads around Madrid and the south east Mediterranean coast of Spain. Despite these projects being procured with the discipline of non-recourse project financing and the presence of a blanket government guarantee, within a few years of their becoming operational, nine out of 10 roads were bankrupt, their equity investors wiped out and their lenders booking losses of 90 cents on the dollar.

What happened?

Based on detailed financial data on each of the concession companies as well as in-depth interviews with individuals representing the public and private sector directly involved in the collapsed projects, EDHECinfra studies the collapse of the Spanish toll road projects.

Bad procurement increases systematic risk

The simultaneous procurement of numerous large projects in a single national market not only tends to inflate construction prices and limit competition, which is bad for individual project economics, but can also create sufficiently large contingent public sector liabilities.

Each of the toll road projects was backed by a termination guarantee, the Responsabilidad Patrimonial de la Administración (RPA), designed to protect the private sector in the event of expropriation by the state.

By the time all road projects were procured, the total amount owed under the public guarantee represented 6% of the Spanish budget deficit or more than half of all public infrastructure expenditure.

While Spain could always afford to pay such sums, the liabilities created by each concession were significant because by design they were very likely to be triggered together: for a real toll road to fail entirely, the country must be in the middle of a very deep recession, which means that all toll roads fail at the same time.

The procurement choices made by Spain led to the extremely aggressive financial structuring of most public-private toll road companies on the back of the RPA. Combined with the primera hipoteca (the equivalent of a share pledge) provided by developers, the RPA gave lenders the apparent certainty of recovering their investment in the case of failure.

These projects were at the high end of the levels of senior leverage typically found in 'merchant' project financing, often approaching and in one case exceeding 90%. Moreover, several projects featured loans with so-called bullet repayment structures, creating significant refinancing risk.

Amongst the warning signs, the fact that the projects were originally tendered in the middle of a debt-fuelled real estate bubble and were themselves highly leveraged suggested higher risk than individual project specifications might have revealed.

Synchronised shocks

Having been procured over a relatively short period of time, the nine concessions were still going through the early years of their life-cycle when they were all hit by two, mostly unrelated, but simultaneous shocks: a dramatic fall in traffic revenues and the rapid escalation of their development costs due to legal issues around land use rights.

Eventually all but one of the concession companies filed for bankruptcy, hoping to claim the public sector guarantee. This happened after a recently re-elected conservative government (which had put the roads to tender a decade before) scrapped plans to subsidise the projects in a previous attempt

1. Concessionaires and toll road names

Concession company	Corresponding toll roads
Henarsa	Radial 2
Autopista Madrid – Sur C.E.S.A.	Radial 4
Autopista Madrid Toledo C.E.S.A.	AP-41
Autopista Madrid Levante	AP-36
Ciralsa S.A.C.E.	Circunvalación Alicante
Aucosta	AP-7 Cartagena–Vera
Acesos de Madrid Concesionaria Española S.A.	Radial 3, Radial 5
Autopista Eje Aeropuerto Concesionaria Española	M-12 Eje Aeropuerto
Ausur	AP-7 Alicante–Cartagena

to keep them from failing. By then, the government's job included bailing out the entire banking sector and saving road concessions had become a second-order problem.

Commonly in the event of default exit costs for lenders are high and it will likely lead to a restructuring or 'work out' between sponsors and creditors in order to maximise the expected value of both senior debt and equity.

In this case however, the workout value of almost every project was not high enough to justify restructuring the firms and their debt. Instead, lenders acknowledged that the projects they had financed could no longer be considered viable and instead chose to claim the public guarantee provided by the government.

It could be argued that the RPA created moral hazard: the presence of a government guarantee led creditors to make very risky bets with the financial structuring of merchant toll roads, when they would otherwise not have supported such projects or at least have required a much deeper equity commitment from sponsors.

In a series of short models based on simple game theory, we show that as the cost of supporting the projects becomes higher, it becomes rational for the public sector to let them fail, knowing that lenders will also fail (or not prefer) to achieve a private sector debt workout, as long as the public sector is also willing to engage in a 'war of attrition' with the same lenders.

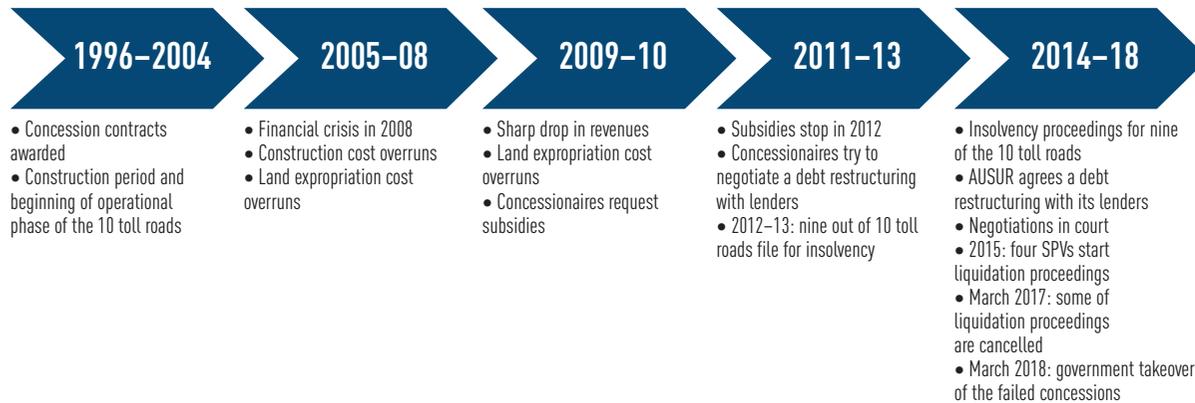
There were no bad guys, just rational actors

The war of attrition model provides an insightful framework to understand this phenomenon: in some cases, it is in the best interests of both parties (their best rational move) to engage in a seemingly absurd (zero net benefit) conflict that can last for a long time. A number of military doctrines have been developed in response to this phenomenon, many of which are variants of the 'overwhelming force' approach, by which an opponent chooses to exit the fight immediately when faced with a credible commitment to engage vast resources into a confrontation.

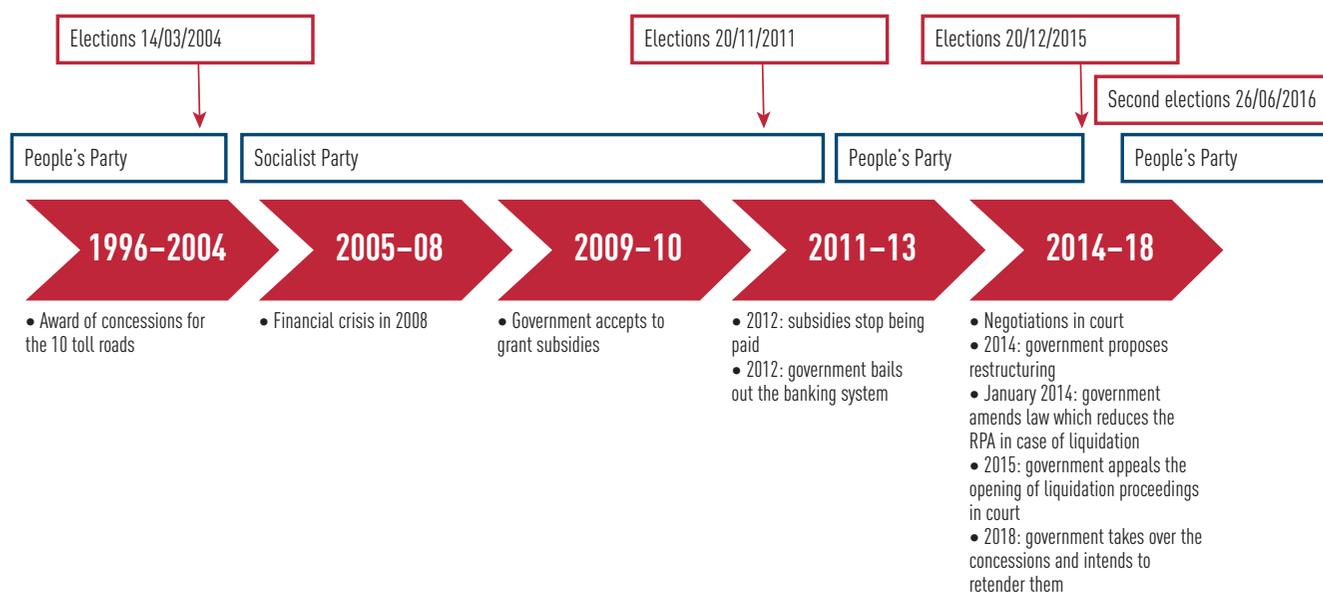
In this war of attrition, there are no bad guys: the government is not unfairly reneging on its commitments, and the private sector is not shamelessly exploiting the moral hazard created by procurement design. It is simply rational for all involved to wait for as long as it takes, because giving up

2. Timelines: summary of major events

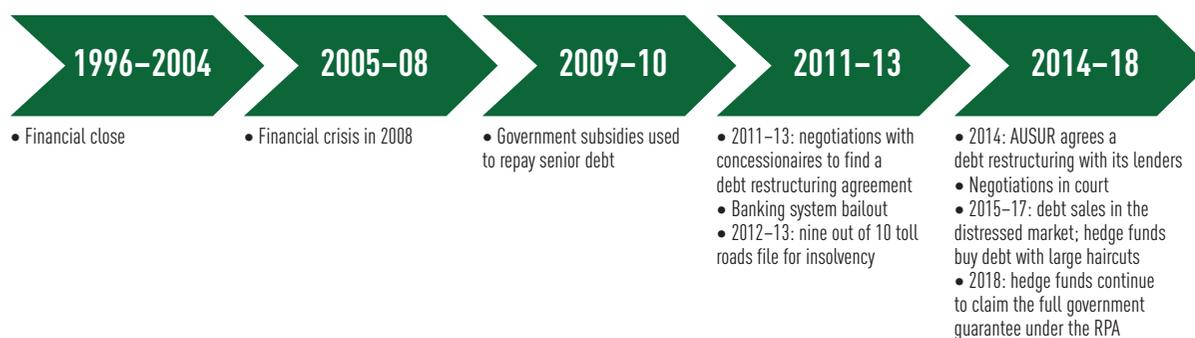
Concessionaires' timeline



Government timeline



Lenders' timeline



means a large cost now and waiting (which is also costly but only by increment) means that the other side might give up first.

Following the game theory literature, most wars of attrition never start because one side can credibly commit to wait for 'as long as it takes' and the other thus immediately gives up. Hence, most public sector guarantees, whether they create moral hazard or not, are honoured immediately. However, in certain circumstances, which investors would do well to understand and perhaps try to anticipate, war is the best option for all. In the end, losses for both can be enormous.

The inability of creditors to organise and make a credible commitment to wait for 'as long as it takes' to claim the RPA made it possible for the Spanish government to successfully push creditors to exit the game and sell their claims to a second group of investors, while substantially reducing the size of the liability in the process. In wars of attrition, it can be difficult to declare a

winner. In Spain, lenders eventually gave up and sold their debt in the secondary market with 60–90% haircuts, a world away from the usual 80–100% recovery rates typically expected in project finance.

The government still owes the guarantee to the new debtors (even though the amount has been significantly reduced in the process) and also faces the added financial and political cost of having to retender the projects.

Rational choice and game theory can provide investors with a powerful set of tools to model and predict what is often labelled as 'political risk' – ie, determine what the best moves of public and private actors would be conditional on certain states of the world, such as a recession requiring the government to bail out the entire banking system, and what this implies for creditors who hold claims on the same government at the same point in time. Game theory analyses also hold lessons for the design of guarantees and the dynamics they create at the procurement stage.

Three routes to maximising infrastructure finance for development

Frédéric Blanc-Brude

By promoting better standards, methods and benchmarking, development finance institutions can move the mountain that is preventing institutional capital from flowing into infrastructure

The World Bank's initiative to maximise finance for development (MFD) aims to "find solutions to crowd in all possible sources of finance, innovation, and expertise" in order to achieve the Sustainable Development Goals (SDGs). In the case of infrastructure investment, a significant contribution to long-term sources of private finance is expected from institutional investors such as pension plans, life insurers or sovereign wealth funds.

These investors have become increasingly interested in infrastructure investment in recent years, in search of new sources of returns, diversification, duration and inflation hedging. However, they cannot be expected to make a substantial and durable contribution to the long-term financing of infrastructure if three important changes do not take place:

1. Valuation methodologies need to improve to represent financial performance more accurately

Current valuation methodologies used in private infrastructure are wrong. Fifty percent of the respondents of the largest survey of asset owners ever undertaken (by EDHEC*infra* on behalf of the G20) agree with this statement¹. Discounting 25 years of 'base case' cash flows using a single discount rate built from ad hoc risk premia assumptions, with little regard for the term structure of risk that characterises infrastructure firms, contradicts basic corporate finance textbooks. It is easy to do a lot better. Advanced private asset pricing techniques using stochastic discounted cash flow modelling that takes into account market transactions and systematic sources of risk can make significant improvements to current valuation methodologies. Today's approach, based on 'forward-looking views' often amounts to unrealistic guess work about the future of energy prices or the world economy over the next 25 years.

2. Credit risk methodologies need to evolve to better capture default risk

Infrastructure debt seldom defaults. Even if a large number of credit instruments is observable, a representative set of default events may not be at hand, especially if no attempt is made to control for financial structure or business model. If almost no defaults have been reported in project finance 10 years after origination, is 10-year old project debt risk-free? Is it AAA-rated? Of course not. The so-called 'reduced form' models used by credit rating agencies work well when large samples of defaults can be observed. When this is not possible, structural models that look at the risk of crossing certain observable default thresholds (like the debt service cover ratio) perform a lot better. Recent EDHEC*infra* results show that such an approach accurately predicted default rates as high as 5% in European

merchant infrastructure in 2013, or a cumulative 10-year default rate close to 50% in Spanish infrastructure projects. A far cry from the usual 'stylised facts' from credit risk studies but also much more realistic in hindsight. Importantly however, this approach would also have predicted this level of credit risk at the time².

3. Proper benchmarks capturing risk should be used to evaluate infrastructure investment

Infrastructure is often described as an absolute return strategy. It is expected to deliver a certain level of performance defined ex ante, typically a few hundred basis points above the risk free rate or inflation. While such return targets can be useful for investors, especially if they have liabilities defined in similar terms, the performance of infrastructure products, strategies and teams should not be compared with 'absolute' returns. Benchmarking a strategy against 'risk-free-plus-five' implies that it is risk free and has an alpha of 5%! Instead, infrastructure investors are exposed to credit risk, interest rate

“Only by insisting on adequate risk-adjusted benchmarks can investors’ disillusionment with performance measurement in private infrastructure investment be counteracted.”

risk, macro risks and certain systematic risks only found in infrastructure (eg, the systematic differences between merchant, contracted and regulated investments). They are also likely to be exposed to risk factors found in stocks such as the size (small outperforms large) and momentum (winners tend to keep winning) effects.

Only by insisting on adequate risk-adjusted benchmarks can investors' disillusionment with performance measurement in private infrastructure investment be counteracted. This, in turn, requires better methods, data and reporting to better understand and measure risk and performance.

The World Bank's MFD calls for best practice using all sources of finance but also for innovation. Innovation in the area of performance measurement and reporting, credit risk modelling and scoring, and above all benchmarking the risks private investors are expected to take when investing in infrastructure, will play a significant role in maximising private finance for development.

Furthermore, new projects – such as the ones championed by the Global Infrastructure Facility – and new products, like the new co-lending structures adopted by IFC, supported by multilateral organisations are an important channel to support and implement such innovations. This can only serve to have a positive effect in improving transparency and efficiency in the more private and opaque parts of the infrastructure financing sector.

These changes will take time and will not be easy to achieve. They require an unprecedented paradigm shift in the world of private infrastructure finance and investment. These changes are however necessary and asset owners will increasingly demand them if they are to invest in infrastructure on a large scale. Maximising this potential today will require leadership and vision.

¹ More than half of respondents representing \$10trn of assets under management declared that they did not trust or were not sure if they could trust the valuations reported by infrastructure asset managers – F. Blanc-Brude, G. Chen and T. Whittaker (2016). Towards Better Infrastructure Investment Products? EDHEC Infrastructure Institute Publication, with the support of the Global Infrastructure Hub (a G20 initiative).

² For a detailed discussion based on 20 years of debt service cover ratio data, see F. Blanc-Brude, N. Hasan and T. Whittaker (2018). Calibrating Credit Risk Dynamics in Private Infrastructure Debt. *Journal of Fixed Income* 27(4): 54–71.



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