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Contents

Do absolute return benchmarks still makes sense for infrastructure investors? 2

Noël Amenc, Frédéric Blanc-Brude, Abhishek Gupta

Do top infrastructure asset owners and managers beat the market? ... 9

Abhishek Gupta, Frédéric Blanc-Brude

Identifying the fundamental characteristics of infrastructure companies 18

Tim Whittaker, Rebecca Tan

Towards a scientific approach to measuring ESG in infrastructure . 22

Nitisha Manocha, Silvia Garcia, Frédéric Blanc-Brude

The evolution of TICCS 26

Frédéric Blanc-Brude, Tim Whittaker, Jack Lee

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Know your TICCS, understand your risks

What the COVID-19 lockdowns have revealed more clearly than any stress test or downside simulation ever could are some of the risks that have always been present in infrastructure investments. In the event of a large shock, even infrastructure assets become more correlated with other asset classes. These implications are important for long-term investors who report liabilities on a fair-value basis and need to understand the impact of infrastructure investments on their funding ratio. Ignoring these risks is not an option any more for either asset owners or managers.

In this issue of EDHEC*infra* Research Insights, we first discuss the surprising persistence of absolute return benchmarks in unlisted infrastructure investment. They remain the norm in the sector to this day, yet they are completely inadequate when it comes to encapsulating the risk, performance and contribution of infrastructure assets within the total portfolio. The vast majority of investors agree with this assessment. We review what they have to say about the problem, in particular the reasons why these benchmarks are inadequate but also why they have tended to persist.

We also explain that while long-only infrastructure investment cannot be considered an absolute return strategy (since it is not market-neutral), the usual alternatives of using appraisals or listed proxies have in the past been even worse options because they misrepresent the asset class. With this as the only option, absolute return benchmarks have persisted as the lesser evil.

However, recent innovations have increased the range of choices available when it comes to benchmarking unlisted infrastructure. We show that that the Q1 2020 release of the EDHEC*infra* indices captured the impact of COVID-19 on infrastructure investment with a high degree of granularity, with each sub-index capturing a different risk profile for different segments of the universe.

This granularity facilitates a complete analysis of the sources of risk and performance of any infrastructure portfolio. In our second article, we use this data to explore the performance of two peer groups of infrastructure investors: large asset managers and large asset owners.

We show that large infrastructure asset managers outperform both the market and large asset owners thanks to their better asset selection skills. However, we also find that they are unable to use asset allocation to different sectors or business risk segments to improve their performance. Instead, they often underperform the benchmark because of their implicit or de facto asset allocation choices.

Next, we summarise some of the findings of a new paper exploring whether infrastructure companies exhibit statistically significant differences from other investable assets. Controlling for variables such as size, profitability, leverage, investment opportunities and industry, we show that they do indeed demonstrate unique fundamental characteristics. These include higher asset tangibility, asset illiquidity and inflexibility and lower operating leverage than a control sample of non-infrastructure firms.

A fourth article presents the first steps of our research programme into the ESG characteristics of infrastructure companies: it highlights some of the key findings of a comprehensive review of ESG standards used in the sector. We argue that, as the standardisation of ESG follows its path towards consolidation, a scientific, theory-based approach to designing and implementing ESG assessments has yet to be created.

Finally, we review the evolution of TICCS® in the wake of the updated version of The Infrastructure Company Classification Standard that was published in March 2020. TICCS is designed to be an objective and consensus tool enabling infrastructure investors to clearly identify the segments to which their infrastructure portfolios are exposed. Thanks to TICCS, we can create well-defined sub-indices that capture the characteristics of different segments of the infrastructure universe – as well as customised benchmarks that are representative of any individual portfolios that use the same taxonomy.

Frédéric Blanc-Brude, Director, EDHEC*infra*

Do absolute return benchmarks still make sense for infrastructure investors?

Noël Amenc, Professor of Finance, EDHEC Business School; **Frédéric Blanc-Brude**, Director, EDHEC*infra*; **Abhishek Gupta**, Senior Product Specialist, EDHEC*infra*

What we learned from the COVID-19 stress test

Today, absolute return benchmarks, which correspond to a 'cash-plus' approach that integrates an ad-hoc risk premium (including a liquidity risk premium) in addition to the risk-free asset, are the norm in the unlisted infrastructure investment sector. Yet they are completely inadequate to understand the risk, performance and the contribution of infrastructure assets to the total portfolio. The vast majority of investors agree with this assessment.

In this paper, we discuss the surprising persistence of absolute return benchmarks in unlisted infrastructure investment. We review what investors have to say about it, the reasons why these benchmarks are inadequate but also why they have tended to persist.

Finally, using the EDHEC*infra* indices, we show that the COVID-19 lockdowns revealed the risks embedded in infrastructure investments. After a negative shock that could not be ignored, the risk profile of infrastructure assets is more apparent. This shock also reveals key differences within the asset class as well as common risk factors with others.

Absolute return benchmarks served a purpose as long as too little useable risk and performance data was available, but thanks to better data and improved asset pricing technology, they can now be abandoned, and infrastructure treated as a genuine asset class – ie, one that has a market benchmark.

A quandary: why the widespread use of absolute return benchmarks in infrastructure investing?

In April 2019, EDHEC*infra* published a global market survey[1] of the use of various types of benchmarks by investors in infrastructure assets (Amenc et al [2019]). More than 300 respondents took part, including 130 large asset owners representing more than $10trn of assets under management and the bulk of all major institutions investing in infrastructure.

This survey was the largest ever undertaken on the subject of benchmarking infrastructure investments and revealed very clear stylised facts about industry practices and perceptions (see figure 1).

The key findings were:

- Most investors (70%) use absolute benchmarks for their unlisted infrastructure equity or private debt investments:
  - ◆ Most investors use a risk-free rate plus a spread to determine this benchmark;
  - ◆ A smaller proportion of investors uses the rate of inflation (CPI) plus a similar spread of 400–500 basis points.
- The overwhelming majority of investors (90%) declares that absolute return benchmarks are not adequate because they:
  - ◆ Are not representative;
  - ◆ Do not measure risk; and
  - ◆ Are not usable for strategic purposes such as asset allocation or asset-liability management.

These widely held positions recorded in our 2019 survey have not changed today. In April 2020, a poll of 130 participants in an EDHEC*infra* webinar on the impact of the COVID-19 crisis on unlisted infrastructure performance asked the following question: 'Does the COVID-19 crisis confirm that absolute return benchmarks are not adequate for infrastructure investments?'

The majority of participants (70%) answered 'yes', confirming that absolute return benchmarks are mostly considered inadequate to assess risk in private infrastructure investments.

1 With the support of the G20's Global Infrastructure Hub.

1. Key results of the EDHEC*infra* survey of benchmarking practices among infrastructure investors

Use of absolute and relative benchmarks			
Use an absolute return benchmark	70%	Risk-free + spread	50%
		CPI + spread	40%
Use a relative benchmark	30%	Listed equities infrastructure	75%
		Peer group appraisals	25%
Issues with current benchmarks			
No challenge: the benchmark is adequate	10%	They do not measure risk adequately	50%
They are not representative	75%	Does not capture correlations with other asset classes	55%

Results based on 300 respondents, including 130 asset owners representing $10trn of AUM, see Amenc et al (2019).

Which begs the question: Why do investors use absolute return benchmarks when the overwhelming majority also considers them to be ill-suited for asset allocation, risk management or performance monitoring?

One may argue that such benchmarks have simply been inherited from other private asset classes, such as private equity or real estate. In addition, the choice of a more complex metric can have adverse consequences for the investment teams. This is notably the case when the relative benchmarks are, for example, indices that are representative of another asset class (listed infra or bond benchmarks, for example) because they can provide an erroneous view of the real added value of these teams. Hence, there can be resistance to change, at least on the part of managers and investment teams.

But while such issues are relevant, they are also secondary in comparison with the two fundamental justifications for using absolute return benchmarks in infrastructure investment: first, the claim of market neutrality and second, the lack of an alternative. We review each in turn.

Is infrastructure market-neutral?

By definition, a market-neutral investment strategy is not impacted by market movements. In effect, only a truly market-neutral portfolio would warrant an absolute return benchmark.

Indeed, the promise of absolute return strategies is that their return depends on stock characteristics and not on systematic features and notably, as far as equities are concerned, for example, on the market return.

Likewise, infrastructure assets are often presented as decorrelated from the rest of the economy and notably its main financial proxy, which is the equity market. This belief in the decorrelation of infrastructure leads investors to expect higher returns and limited downside risk from these investments (see Blanc-Brude [2013], for a review of the 'infrastructure investment narrative').

Still, like any other asset class, unlisted infrastructure is exposed to systematic risks. These may be different from the risks of public equities, but nonetheless drive variations in returns. Thus, there is no reason to believe ex ante that unlisted infrastructure is a pure absolute strategy, the performance of which would only be due to the inherent characteristics of the assets and, by extension, of the managers or investors who select them.

There is no infrastructure investing strategy today that could be considered market-neutral in the sense that it would not be related to any systematic source of volatility. What is more, today there is no market to short unlisted infrastructure equity or debt. Nor are derivative contracts written against unlisted infrastructure assets widely available. Thus, unlike hedge

fund strategies, any claim of the market-neutrality of infrastructure investments would have to rely entirely on the intrinsic characteristics of the business of infrastructure companies.

While it is reasonable to assume a degree of independence from the business cycle for most types of infrastructure assets in good times, this may not apply in all states of the world, as the Covid-19 lockdowns perfectly illustrated. Moreover, some types of infrastructure companies can be expected to be correlated with the business cycle even in good times, such as large airports or toll roads.

A cursory analysis of the potential outcomes of infrastructure investments also suggests that they can be impacted by the state of the economy. For instance, in the 630-plus companies tracked in the EDHEC*infra* broad market universe, over the past 20 years we observe more than 150 events of default or dividend lockup, several dozen events of bankruptcy and more than a dozen events of termination by the public sector.

These defaults and bankruptcies are typically found in companies that are exposed to the economy because they have a 'merchant' business model (eg, after a recession) or because of structural shifts affecting an entire industrial sector (eg, electricity market prices permanently lower than the marginal production cost of older power plants).

Nor should the financial performance of unlisted infrastructure investments be expected to have no relation with asset prices in capital markets.

Indeed, the key point of modern finance theory since Markowitz (1952) and Sharpe (1963) is that the excess return of any given portfolio of financial assets can always be decomposed into at least two parts: a systematic one that is related to the market for financial assets (usually referred to as beta) and a portfolio-specific one that is not (and is usually called alpha). In its simplest form, this is the well-known capital asset pricing model (CAPM).

The systematic part represents the average future exposure to market returns and is necessarily expressed relative to a benchmark (the portfolio beta captures the correlation of portfolio returns with market returns).

Treating infrastructure as an absolute return investment implies that the systematic part of the infrastructure portfolio does not exist, that is, the beta in the portfolio return equation always equals zero.

Instead, in line with modern financial theory, we can show that a series of risk factors systematically explain expected returns observed in secondary markets for unlisted infrastructure equity or debt (we return to this below). The nature of infrastructure assets and of the risks that determine their future returns are such that the systematic part of portfolio returns is always there.

In theory, the beta part of the portfolio can be expected to explain most of its expected returns. In Sharpe's CAPM, alpha always equals zero and, on average, betas explain all asset returns. While it can be reasonable to assume non-zero alpha because of the presence of market inefficiencies and of investment skills to exploit these, the notion that any portfolio includes a large systematic part is impossible to escape, even for unlisted infrastructure assets.

This last point boils down to the fundamental nature of a market for any asset. Investors are not alone. Even infrastructure investors buy and sell assets (from each other) in a market, where they tend to behave in certain, correlated ways.

What is more, the same infrastructure investors are active in the markets for other asset classes, where they express the same preferences for risk and have the same investment objectives as the ones they bring with them to the market for infrastructure assets.

Finally, the reasons (call them factors) for which investors value financial assets are found in many markets at once. For instance, if an investor values highly profitable listed tech companies, she also values highly profitable unlisted infrastructure companies. The same goes for liquidity or leverage.

When investors speak of a liquidity premium in private assets like infrastructure, they implicitly recognise that all assets are priced in part as a function of their liquidity and thus that asset prices are formed together in a market for all assets.

Thus, not only do many infrastructure investments often exhibit prima facie a degree of correlation with the business cycle, but the fact that infrastructure investors are increasingly large asset owners and managers expressing the same risk preferences across multiple asset classes at the same time necessarily implies that a long-only unlisted infrastructure portfolio cannot possibly be market-neutral.

Thus, the hypothesis of the market-neutrality of infrastructure investment cannot be retained as a good reason to use absolute return benchmarks in infrastructure investment. But a second reason for their continued use could be the perceived absence of other useable benchmarks.

The lesser evil?

The use of absolute return benchmarks can be a fall-back option in a context where there is very little data available to benchmark investor portfolios. Investors might say that while they acknowledge that absolute return benchmarks are not adequate, they have no alternative but to treat unlisted infrastructure as if it was an absolute return investment.

Until recently, alternatives to absolute benchmarks in infrastructure portfolios have been so limited that using absolute benchmarks could be considered the lesser evil.

The two other common choices to benchmark unlisted and illiquid investments like infrastructure are appraisal-based indices or listed proxies. In the case of infrastructure, both are fraught with such serious problems that ultimately a simple 'cash-plus' benchmark adjusted for an ad-hoc premium for the specific, and especially illiquidity, risks of private assets could appear more relevant than these flawed relative benchmarks.

Appraisals are collected from a limited number of asset managers, causing the indices built with such data to have two fundamental flaws:

- Lack of representativity: the constituents included in appraisal-based indices (which are typically not revealed) are not chosen according to any rule or logic other than being the data reported by certain investors at one point in time. The composition of such indices thus keeps changing randomly. Moreover, appraisal-based indices suffer from survivorship biases: only the investments of reporting funds are still present in the portfolio of the reporting investors, hence the index fails to include past bankruptcies and terminations that nevertheless exist in the universe. Figure 2 shows the sector composition of the MSCI Global Unlisted Infrastructure index compared to the investible universe across the 25 largest markets in the world and highlights the lack of coverage of certain sectors and the excessive weights placed on others due to the selection bias introduced by contributions.
- No measure of risk: the net asset values used to compute appraisal-based indices exhibit very low return volatility and no return correlation with other asset classes (see figure 1). This is because valuation methods rely on smooth time series of interest rates and the 'equity risk premium' to arrive at a discount rate that changes very little over time. If expected cash flows are indeed stable, then valuations barely change from one period to the next, even though market participants may be willing to pay very different multiples from one valuation date to the next. This smoothing of the volatility of private assets is reflected in the significant serial correlation of returns reported in appraisal-based datasets (see figure 3).

It can be noted that if infrastructure investment really was as appraisal-based indices suggest it is, then an absolute return benchmark could be justified, given the complete lack of correlation with other asset classes (making the appraisal-based index irrelevant by the same token).

2. MSCI unlisted infrastructure index: sector weights vs the unlisted universe

	MSCI Global Unlisted Infrastructure	Over/underweight	Unlisted infrastructure universe*
Transport	54.6%	160.0%	21%
Network utilities	6.4%	–69.5%	21%
Renewables	0.0%	–100.0%	18%
Power	32.8%	118.6%	15%
Energy resources	0.0%	–100.0%	11%
Data	2.3%	–67.1%	7%
Social infrastructure	0.0%	–100.0%	4%
Environmental services	0.0%	–100.0%	2%
Other	3.4%	na	

Sources: MSCI, * EDHEC*infra* Universe Standard 2020. No sector exposure data is available for the Preqin Infrastructure index.

3. Statistical characteristics of the Preqin, MSCI and infra300 unlisted infrastructure indices

Index	10-year total return	10-year total return volatility	10-year Sharpe ratio (Rf = 1%)	Maximum drawdown	Return correlation with: MSCI World	30-year Treasuries	Listed real estate	Serial correlation of returns
Preqin Unlisted Infrastructure (Appraisals)	10.41%	3.11%	2.99	1.37%	–5.0%	16.0%	–7.0%	Statistically significant
MSCI Unlisted Global Infrastructure	13.42%	3.26%	3.78	0.0%	4.6%	3.4%	–5.7%	Statistically significant
Infra300 (EDHEC*infra*)	12.03%	13.90%	0.78	14.67%	40.2%	20.4%	24.3%	No serial correlation

Source: Preqin, MSCI, EDHEC*infra*. Correlation data from 2009 to Q3 2019 (latest data available for the Preqin infrastructure index), All computations use quarterly US dollar returns.

4. Statistical characteristics of listed infrastructure

Index	Total return volatility	Sharpe ratio	Return correlation with equities
MSCI World	15.20%	0.33	na
S&P Global Listed infrastructure	15.45%	0.19	90%
EDHEC*infra* listed infrastructure managers proxy	14.90%	0.40	84%

Source: Datastream, edhec.infrastructure.institute/research/listed-infrastructure/; data for Q1 2000–Q1 2020.

However, this absence of correlation is only the result of the low quality and lack of market representativity of the inputs used to produce such indices. The 10-year annualised Sharpe ratio on the appraisal-based index is obviously too high to be real.

Next, listed infrastructure indices and proxies have been studied extensively and have always been found to pose a different kind of challenge for investors in need of an unlisted infrastructure benchmark:

- While some listed firms are indeed infrastructure companies and qualify as such under the TICCS® taxonomy, only a handful exist (we estimate about 100 globally) and these firms are concentrated in the energy, utilities and airport sectors in a small number of jurisdictions. Crucially, existing listed infrastructure indices and products usually include many other types of firms that are not infrastructure (Amenc et al [2017]). Hence, listed infrastructure data is either too narrow for most investors in infrastructure or too noisy.
- As a result, listed infrastructure indices and products have been shown time and again to be highly correlated with listed equities and to have a similar risk and drawdown profile (see figure 4).

Again, it can be noted that if infrastructure investment really was as listed infrastructure indices suggest it is, then there would not be much point in investors seeking an exposure to infrastructure since they are already exposed to the same risk-return profile through their listed equity positions. A portfolio optimiser given both listed equities and listed infrastructure as inputs would exclude one of the two from the portfolio since they are equivalent.

Thus, since both appraisals and listed proxies fail to produce convincing benchmarks, it can be argued that until now investors have been left with the sole option of using absolute return benchmarks, despite significant evidence that infrastructure investment cannot be considered market neutral.

Next, we discuss how a bottom-up, mark-to-market approach to creating market indices of unlisted infrastructure is now a genuine alternative to create benchmarks of unlisted infrastructure portfolios.

Building better market indices of the unlisted infrastructure

Building a genuine alternative to absolute return benchmarks requires addressing the two major issues found in appraisal-based indices: representativity and convincing measures of risk and value.

The EDHEC*infra* indices have been designed to address both problems: a representative universe and measuring fair value.

Addressing representativity

To build a representative view of the investible universe we follow a scientific approach to identify the relevant markets and pick the relevant constituents of a broad market index:

- Data is collected and structured using TICCS, an objective and consensus-based taxonomy that is the industry standard;
- A universe is defined that corresponds to the 25 most active (principal) markets globally;
- The complete investible universe is identified in each country through market research, leading to a list of several thousands of private infrastructure companies and projects vehicles categorised by TICCS and sized by book value (see figures 5, 6 and 7);
- We obtain an investible universe of $2.1trn of total asset book value at the end of 2019;
- A representative sample of the universe is built that matches its characteristics over time in terms of each TICCS segment (business risk, industrial activity, corporate governance).
- This sample becomes the list of constituents of the EDHEC*infra* broad-market index and includes more than 600 companies over the past 20 years.
- Each of the firms included in the sample must also meet a number of firm-level inclusion criteria including the availability of its detailed financials.[2]

The firms included in the broad market index are studied in detail by a team of financial analysts who collect, aggregate and validate their financials, understand their history and prospects and produce quarterly updated revenue forecasts on the basis of sector and company specific information.

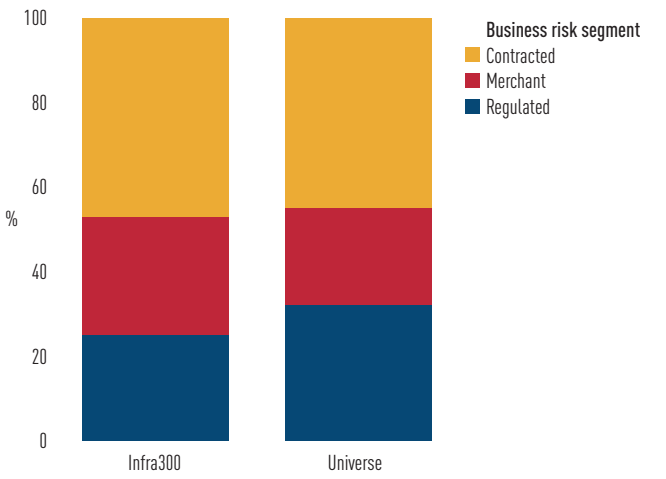
Each year, the investible universe is updated and the sampling recalibrated. Each quarter, the broad-market index constituents are updated for new financial data, new business information and new revenue forecasts.

With this approach, we avoid two major pitfalls of contributed indices like those based on appraisals:

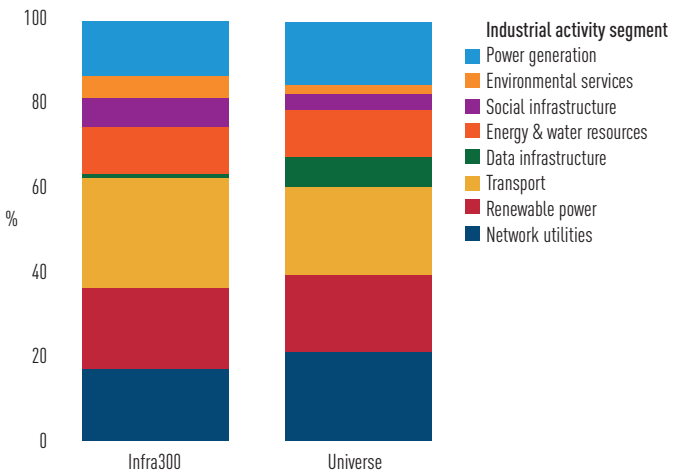
- We avoid selection bias since the constituents of the broad-market index are sampled from a well-defined and most relevant population of investments and based on the structure of the market at each point in time.

2 See the EDHEC*infra* Universe Standard at docs.edhecinfra.com/display/UN

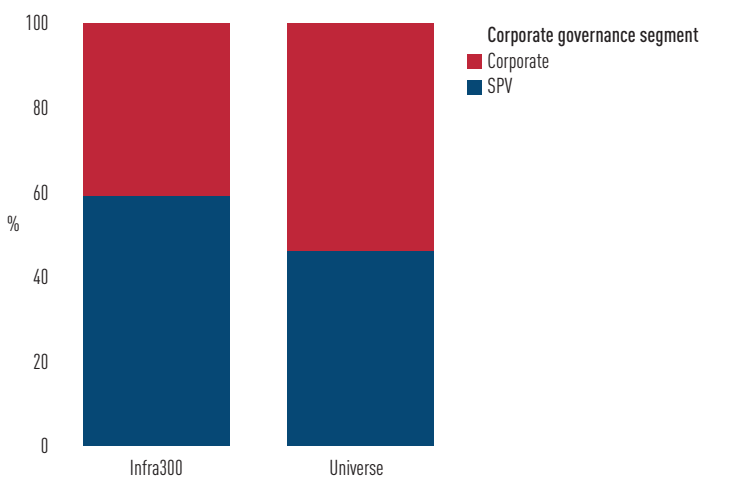
5. Investible universe and infra300 equity index breakdown by TICCS business risk segment (Q1 2020)



6. Investible universe and infra300 equity index breakdown by TICCS industrial activity segment (Q1 2020)



7. Investible universe and infra300 equity index breakdown by TICCS corporate structure segment (Q1 2020)



- We also avoid any survivorship bias since there is no backfilling of the broad market constituents, instead we 'fill forward' as new infrastructure companies become investible or have to leave the index. This is well illustrated by the number of bankruptcies in the history of the index reported above.

Thus, we build a representative set of investible unlisted infrastructure companies in the major markets where investors are active.

Measuring fair value

An important question that some investors might raise is why they should aim to mark illiquid assets like unlisted infrastructure at their 'fair market value' since there is no liquid market to observe frequent transaction prices in the first place. This point is often argued alongside the notion that since investments in infrastructure are often intended to be held to maturity. Indeed, one of the main reasons for investing in infrastructure is to generate income rather than capital gains, often with a long-term liability matching objective. This is typical of long-term investors such as pension funds or insurance companies.

The answer to these questions can be found in the way they are formulated.

If the reason for holding the investment is to collect revenue, then it seems fairly obvious to observe the preference for the present, as for any form of investment that generates flows that are spread out over a long period. This preference for the present is the source of the discounting of future cash flows, and the more these future cash flows are spread out over time, the more important the discounting of the future cash flows.

In the same way, since these future cash flows are not fixed but are subject to uncertainty, it is normal to take account of these uncertainties, and the whole point of a risk premium that is additional to the risk-free rate is to take account of this uncertainty. De facto, any financial instrument that is purchased in order to receive cash flows in the future can only be valued by taking the present value of these future cash flows into account using a discount rate that includes the value of the time and of the risk.

In addition, if these future cash flows correspond to liabilities that are themselves discounted to take account of their present value, not taking the discounting of the cash flows of appropriate infrastructure projects into account would not only be inconsistent from an economic and accounting perspective, but above all would also lead to inadequate risk analyses.

Suppose, for instance, that the risk-free rate that is used in the discounting of the liability cash flows were to decrease. This would lead to an upward revaluation of the liabilities. Under these circumstance, failing to discount the cash flows of infrastructure asset while using contemporaneous market data would lead to the asset/liability mismatch. Essentially, the change in value of infrastructure assets would not be taken into account, despite the fact that it was positively impacted by a fall in interest rates.

Whether it involves dividends or coupons, equity or debt infrastructure needs to be valued at fair value, whatever its liquidity. The idea that an asset conserves its historical value because it is difficult to sell does not make sense from a financial point of view.

We can draw a very valid comparison with fairly illiquid assets such as corporate bonds. When valuing such instruments, investors refer to a credit spread and the rate of interest as components of the discounting of the cash flows associated with corporates bonds. It would not occur to long-term investors not to value such important components of their portfolio at their fair market value. The same logic applies to unlisted infrastructure.

Still, pricing hundreds of unlisted companies at the end of each quarter in a very illiquid market where few transactions occur in each quarter cannot be done using comparators. The data that would be needed to find comparable airports or power plants trading in the same year, let alone the same quarter, are not available.

However, using insights from modern financial theory, we can reduce the problem to pricing a limited number of risk factors at the end of each quarter, each of which is relevant to all the firms that have to be priced, only in different amounts:

- Several years of research into the determinants of expected returns in unlisted infrastructure companies have led to the selection of several key factors that are found to explain observed transaction prices and their implied IRR (see, for example, Blanc-Brude and Tran [2019]).
- These factors are observable for any firm for which financials and other basic information are available and include its size (total assets), profits (return on assets), leverage (senior liabilities divided by total assets) and investment (capex divided by total assets), as well as the country of the investment and its TICCS classification.
- Each time we observe a transaction and its implied risk premium, we can decompose this premium into the market price of each of its risk factors – eg, larger investments (size factor) command a relatively higher risk premium, etc.
- Since we know the size, leverage, profits etc, of all the constituent companies of the broad market index, we can price all of them at the end of each quarter using the updated market price of these risk factors at the time of valuation.[3]
- This approach is parsimonious and statistically robust. Out-of-sample (before the fact), the average pricing error of actual secondary market prices is in the ±5% range.

The firm-specific market risk premia estimated at the end of each quarter is also combined with a term structure of risk-free rates that matches the horizon of the investment and therefore its duration.

It is important to note that such an approach rigorously follows the IFRS 13 guidance on measuring fair value in unlisted investments, from focusing on principal markets to using contemporaneous market inputs and, crucially, calibrating valuations to market inputs at the time of valuation.

As shown in figure 2, we avoid the other major issues of contributed indices that rely on appraisals:

- There is no more smoothing of valuations and a proper measurement of the variance of prices and thus of return volatility is possible. This is clear from the absence of serial correlation in the EDHEC*infra* returns;
- We estimate risk much better and can understand correlations with other asset classes and consider integrating unlisted infrastructure in a multi-asset portfolio. Figure 1 shows that infrastructure exhibits some correlation with bonds (both are exposed to interest rate risk) and with listed equities (which have risk factors in common with unlisted infrastructure including 'profit' or 'leverage').

Thus, a valuation based on discounted cash flows of hundreds of unlisted infrastructure companies can be implemented at the end of each quarter so that a broad market total return index can be computed.

For instance, the infra300 index tracks the performance of 300 infrastructure companies and $200bn of market capitalisation worldwide (Bloomberg ticker: infra300). Each quarter, EDHEC*infra* computes several hundred indices of performance and risks of its broad market universe that correspond to the different TICCS segments of the market.[4]

Next, we discuss how the validity and relevance of measuring risk properly in the unlisted infrastructure asset class was highlighted by the COVID-19 lockdowns.

The COVID-19 revelation

Infrastructure businesses are usually impacted by the tail end of recessions as demand for essential services flags or public counterparty risks increase. But from the onset of the COVID-19 crisis, it was clear that infrastructure was going to be impacted before every other business. The initial phase of this crisis was not an economic shock but a state of emergency requiring nationwide lockdowns, effectively shutting down most key transport links. The impact of the oncoming economic recession on infrastructure investments will only come later.

Appraisal-based indices like Preqin's have yet to be published (the latest reported value date as of June 2020 is Q3 2019). But it can be expected that the impact of the COVID-19 crisis on such indices will be completely random: it will depend on how many managers report data for what kind of infrastructure, none of which is based on transparent index construction rules. Meanwhile, listed infrastructure indices show a drop of 18–22%[5] for Q1 2020, in line with the wider equity market.

Still, who could doubt that equity returns for unlisted infrastructure companies were lower and often negative in the first quarter of 2020? Major airports, ports and roads saw their traffic collapse, often by more than half. Along with lower expected revenues and dividends, investors' required risk premia had also increased, not only for so-called merchant assets, but also for holding any illiquid assets, including infrastructure.

The Q1 2020 release of the EDHEC*infra* indices captured both impacts (on revenues and risk premia). The infra300 equity index was down –6.37% for the quarter, and the most impacted sectors exhibited returns more than twice as negative.

These results are the combination of the sector-level and firm-level analyses conducted by the EDHEC*infra* team of analysts and the ongoing estimation of the unlisted infrastructure risk premia using the relevant market inputs, in line with IFRS 13.

The impact of COVID-19 on asset prices

Merchant companies are exposed to the business cycles and were hit the hardest both by lower expected cash flows and higher risk premia. Among these firms, the transport sector, especially airports, roads and ports, was even more impacted.

3 See the EDHEC*infra* Asset Pricing Methodology for more technical details: docs.edhecinfra.com/display/AP

4 Accessible at indices.edhecinfra.com

5 Global Listed Infrastructure Organisation (–17.7%), EDHEC*infra* listed infrastructure managers proxy (–22.5%).

Conversely, contracted business models, especially very low risk profiles such as wind farms, were much less impacted during this period of lockdown. Still, as we argued above, the price of risk is relevant to all assets in the same market, even though each investment may be more or less exposed to each risk factor. As a result, the risk premia for contracted infrastructure including wind farms increased in Q1 2020 and these sectors also experienced negative returns albeit much smaller than transport projects.

Figure 8 details the impact of the COVID-19 lockdowns on the valuations of the constituents of the of the EDHEC*infra* broad market universe as of Q1 2020.

First, it shows the impact on asset prices between Q4 2019 and Q1 2020 of the lower dividends due to the COVID-19 lockdowns, keeping risk-free rates and risk-premia constant at their Q4 2019 level.

Next, figure 8 shows the average impact on valuations of the evolution of risk-free rates between Q4 2019 and Q1 2020, keeping future dividends and risk premia constant at their Q4 2019 level.

Likewise, the figure shows the average impact of the change in equity risk premia between Q4 2019 and Q1 2020, keeping future dividends and risk-free rates constant at their Q4 2019 level.

Finally, it shows the aggregate impact of all three effects on unlisted infrastructure asset prices.

Figure 8 confirms that, by the end of March 2020, while only transport infrastructure revenues were impacted by COVID-19 lockdown, all infrastructure sectors were exposed to changes in risk premia and risk-free rates.

Indeed, these changes were in part also the results of the COVID-19 lockdowns. Interest rates changed partly as a result of new monetary policy decisions and risk premia increased across all asset classes. This is consistent with the point made earlier that certain risk factors are common to multiple types of asset and reflected simultaneously across all of them.

The merchant road sector was faced with an estimated –11.8% drop in revenues over the next three years, which translates into a –6.5% average drop in the sum of all future dividends. In turn, if risk-free rates and risk premia did not change between Q4 2019 and Q1 2020, this effect alone creates an average decrease of –6.6% in the equity price of these firms.

Figure 8 shows that this impact is even stronger for airports and ports, with average fall in value due to the COVID-19 impact on revenues and future dividends of –7.3% and –14.9% respectively. Conversely, fully contracted business models like social infrastructure and wind farm projects were not impacted at all in term of future cash flows by the COVID-19 lockdowns. The impact on all infrastructure sectors combined of the COVID-19 impact on dividends is thus less dramatic at –1.2%.

Next, figure 8 shows that the impact of duration and changes in interest rates is very variable across asset types. On average, merchant roads are not materially impacted because some of these companies are situated in countries where long-term interest rates increased during Q1 2020 (eg, Southern Europe), while they decreased in most other countries; others are located in countries where rates decreased. The average effect of interest rate movements in the merchant road sector is very close to zero between Q4 2019 and Q1 2020.

In other sectors, on average interest rates decreased (across the term structure) – for example, for the assets in the airport index, risk-free rates decreased on average by 38bps. With an average duration of 16 years, this led to a significant increase in valuations of +8% (excluding other effects), completely offsetting the impact of lower dividends (–7.3%). For all infrastructure sectors, the impact of lower rates on valuations (+2.1%) also more than offsets the impact of lower future dividends (–1.2%) on valuations.

Finally, changes in risk premia also vary across sectors and the impact of higher risk premia is compounded by the duration of each asset. Thus, while the average increase in risk premia of the merchant road sector (+88bps) is lower than that of the port sector (+114bps), the impact on valuations is greater in the road sector. In the merchant infrastructure sector, higher risk premia alone explain a drop of more than 10% in asset values. At the asset class level, the impact of higher premia on asset prices is –8%.

The systematic differences between infrastructure risk and return profiles

While the COVID-19 lockdowns impacted performance negatively, it should be noted that the infra300 has had worse quarters, including –11.5% in Q1 2009. In effect, as shown above, some segments of the unlisted infrastructure universe are much less impacted due to the contracted nature of their business model, but also their exposure to interest rates and the evolution of the relevant risk premia.

As figure 9 illustrates, depending on the nature of infrastructure assets, which is captured by their TICCS classifications, the impact of the COVID-19 lockdowns on total returns was very different whether investors were exposed to certain sectors and certain business models or not. Moreover, this distinction is also valid over much longer periods of time.

These differences are also visible at a much longer investment horizon: looking at the 10-year total return and volatility of the same segments, it is clear that the riskier segments – eg, merchant roads – experience higher volatility and returns than less risky business risk profiles such as contracted wind farms.

Looking at extreme risk measures in figure 9, based on the past 10 years of data, we see that the 99.5% value at risk and the maximum drawdown of unlisted infrastructure companies that can be derived from these results is in line with the impact of a shock like the COVID-19 lockdowns. Again, the risk of a sharp drop in value did not appear with COVID-19 and is part of the long-term investment profile of infrastructure companies.

It is also important to note the role of duration (interest rate sensitivity) in each segment of the infrastructure space, especially in periods of low and volatile interest rates. Along with the volatility of cash flows and risk premia, the movement of interest rates contributes to the variance of unlisted infrastructure equity prices significantly because they have very long repayment periods.

Figure 10 provides a comparison of the total return volatility of different long-duration asset classes, including unlisted infrastructure equity and shows that long-term treasury bonds, while they have highly stable cash flows and no credit spread, exhibit a high total return volatility because of their significant duration. Likewise, long-term investment grade corporate debt exhibits a 10-year annualised total return volatility above 10% despite limited spread risk (standard deviation of credit spreads) around 20bps.

The infra300 index of unlisted infrastructure equity investments has higher total return volatility than corporate bonds, in part due to its more volatile risk premia, but lower volatility than long-duration public bonds that have no credit risk premia. We note that the volatility of the unlisted infrastructure risk premia is significantly lower in the more recent period (five-year volatility). Indeed, after a transition to higher valuations in the years immediately following the 2008 financial crisis, which is one of the

8. Impact of COVID-19 lockdowns (Q4 2019–Q1 2020) on valuation inputs of unlisted infrastructure equity investments (selected segments)

	Merchant roads	Airports	Ports	Merchant infra	Contracted infra	All infra
Average COVID-19 impact on annual revenues 2020–22*	–11.8%	–17.8%	–19.3%	–6.6%	0%	–2.3%
Average change in sum of all future dividends due to COVID-19	–6.5%	–6.5%	–15.7%	–3.8%	0%	–1.2%
Average impact of change of future dividends on valuations**	–6.6%	–7.3%	-14.9%	–3.89	0%	–1.2%
Average duration (Q1 2020, years)	13.1	16.7	12.0	10.1	7.7	8.3
Average change of risk-free rates (across the term structure, bps)	~0	–38	–33	–28	–19	–22
Average impact of change in rates on valuations**	~0%	+8%	+2.9%	+3%	+1.4%	2.1%
Average change in equity risk premia (Q1 2020, bps)	+88	+74	+114	+124	+109	+113
Average impact of change in premia on valuations**	–10.5%	–10%	–9.5%	–10.1%	–7.7%	–8.6%
Aggregate average impact on valuations	**–16.6%**	**–10.6%**	**–20.9%**	**–11.4%**	**–6.49%**	**-8.0%**

* as estimated at the end of Q1 2020; ** keeping other factors constant

9. Performance and risk measures of the EDHEC*infra* indices as of Q1 2020

Indices	TICCS filters	Q1 2020 total return	10-year total return	10-year volatility	99.5% one-year VAR	Maximum drawdown	Duration (years)
Infra300	na	–6.37%	15.11%	12.87%	25.86%	13.75%	9.28
Contracted infrastructure	BR1	–5.00%	15.60%	11.46%	20.70%	10.35%	7.73
Merchant infrastructure	BR2	–9.62%	17.04%	14.83%	26.56%	21.60%	10.13
Merchant road companies	BR2, IC6050	–13.54%	15.97%	19.24%	38.48%	30.88%	13.11
Airport companies	IC6010	–10.10%	14.79%	17.50%	31.81%	23.24%	16.70
Wind power companies	IC7010	–2.64%	14.46%	11.14%	12.48%	10.18%	7.42

Source: EDHEC*infra*. The Q1 2020 return is a quarterly figure. VAR is the 10-year rolling one-year Cornish Fisher value at risk measure at the 99.5% confidence level. Maximum drawdown is since inception (2000). Duration is the modified duration (sensitivity to interest rate risk). All results for equally weighted indices computed in local currency.

reasons for the high variance of unlisted infrastructure asset prices, risk premia have been more stable since 2017 (see Blanc-Brude and Tran [2019], for a discussion of 'peak infra'). However, as interest rates decreased further during that period, the duration of unlisted infrastructure has also increased, as it did for other financial assets (figure 10).

Clearly, the level of volatility found in unlisted infrastructure is commensurate with that of other asset classes that are exposed to interest rate risk. Thus, taking duration into account in the pricing of unlisted infrastructure investments also contributes to better documenting their risk profile.

There are risks in infrastructure investments, and the COVID-19 lockdowns only highlighted some of the risks that were there all along. While infrastructure is often touted as being different from the rest of the economy, it does not follow that it is uncorrelated with economic activity. Instead, infrastructure companies are the backbone of the economy, which means that they are exposed to deep-seated risks that investors should not ignore.

For a decade, investors have increasingly focused on 'real assets' partly as a response to the financial crisis of 2008. The COVID-19 crisis however is the reverse phenomenon: a crisis in the 'real economy' contaminating the financial sphere.

The COVID-19 lockdowns did not change the risk profile of the infrastructure assets that investors hold today. They are the same infrastructure assets as the ones they held at the end of 2019. Their long-term value, business and financial risks have not changed. Neither have their potential obsolescence in a lower carbon economy or any long-term trends of the usefulness of certain types of infrastructures.

What the COVID-19 lockdowns achieved better than any stress test or downside simulation is to reveal some of the risks that were always present in businesses that are at the core of the economy. The stability of infrastructure assets is conditional on the economy itself being stable. In the event of a large shock, even infrastructure assets become more correlated with other asset classes. The implications are important for long-term investors who report liabilities on a fair-value basis and need to understand the impact of infrastructure (which has a significant duration) on their funding ratio, including for shorter reporting periods.

In effect, this does not change the potential role or attractiveness of infrastructure for investors. As the EDHEC*infra* analytics demonstrate, these companies continue to have unique characteristics, including a high cash yield and attractive risk-adjusted returns.

The current crisis is a demonstration of how valuable infrastructure assets are in normal times (when they can be used) but also that they are not risk-free. Ignoring these risks is no longer an option for asset owners or managers alike.

Conclusion: a viable alternative to absolute return benchmarks

The realisation among investors that infrastructure assets represent significant risk exposures and that these should be understood and managed will determine the coming of age of the infrastructure asset class.

For asset owners, a better understanding of the risks related to infrastructure assets will:

- Require documenting the risk exposures created by their infrastructure investments;
- Require benchmarking performance relative to the market index or customised benchmark that best represents these risks and creates better aligned incentives in terms of fees; and,
- Allow for a better integration of infrastructure assets in the total portfolio, including for asset-liability management purposes.

For asset managers, showing which systematic sources of risks (and returns) their investment strategy embodies will:

- Explain what part of their performance is driven by risk factors within or beyond their control;
- Demonstrate their ability to deliver access to a well-defined infrastructure portfolio in terms of risks and rewards; and,

10. Duration, spread volatility and total return volatility of public and corporate bonds compared to the infra300 equity index

	Average duration (years)		Spread risk premia volatility (bps)		Total return volatility	
	5-year	10-year	5-year	10-year	5-year	10-year
30-year US Treasuries	20.5	19.6	na	na	18.1%	18.5%
20-year UK Gilts	15.0	14.3	na	na	8.4%	9.0%
Long IG corporate bonds	14.1	13.9	20	21.5	10.2%	10.1%
Infra 300	9.9	9.3	53	173.5	12.1%	12.9%

Sources: Datastream (United States Benchmark 30-Year Datastream Government index, United Kingdom Benchmark 20-Year Datastream Government index, Bloomberg Barclays Long AA+ US Corporate), EDHEC*infra*. All data is quarterly.

- Help demonstrate their ability to outperform the benchmark that best represents their strategy.

What can infrastructure investors do this year with absolute returns benchmarks defined as the risk-free or inflation rate plus a spread of 400 or 500bps? Is everyone who invested in transport and probably any merchant asset going to underperform? Or is it not more relevant to ask how they are doing relative to the market given the investment choices they have made? With such bad benchmarks, it is not possible to tell who made the right choices and who did not.

Most investors understand and agree that absolute return benchmarks are ill-suited to investing in unlisted infrastructure but until recently they were probably the lesser evil given the lack of representativity of appraisal-based indices.

EDHEC*infra* indices were launched in the summer of 2019 and now have a live track record. They represent a viable alternative to absolute return benchmarks for unlisted infrastructure. The COVID-19 lockdowns not only acted to reveal the risk profile of unlisted infrastructure to investors but also to validate the EDHEC*infra* approach: unlike any of the other options available to investors to benchmark unlisted infrastructure portfolios, the results shown above are both realistic and consistent.

Our recommendations to investors in infrastructure (asset owners and asset managers) are:

- Define your infrastructure universe clearly: investors can use TICCS to determine the boundaries of what they call infrastructure and categorise their investments objectively;
- On that basis, pick one of the several hundred mark-to-market indices that EDHEC*infra* computed each quarter as your benchmark; and
- Use this data to understand the sources of risk and returns in your infrastructure portfolio, its contribution to your total portfolio and how it can be improved.

With proper benchmarks numerous applications are possible that will bring unlisted infrastructure forward as a fully-fledged asset class.

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Do top infrastructure asset owners and managers beat the market?

Abhishek Gupta, Senior Product Specialist, EDHEC*infra*;
Frédéric Blanc-Brude, Director, EDHEC*infra*

Benchmarking, performance and risk analysis of infrastructure investor peer groups

In this case study, we use the EDHEC*infra* index data to better understand the performance of two peer groups of infrastructure investors: large asset managers and large asset owners. Leveraging the granularity of the families of EDHEC*infra* indices and the TICCS® taxonomy of infrastructure investments, a complete analysis of the sources of risk and performance of any infrastructure portfolio can be conducted.

Objectives

This case study documents how two peer groups of infrastructure investors perform relative to the market and to each other, and why they perform the way they do.

In what follows, we will describe:

- The formation of peer group portfolios of large asset managers and large asset owners;
- The risk-adjusted performance of each peer group;
- A performance contribution and attribution analysis for each peer group;
- An analysis of systematic versus idiosyncratic risk; and
- The case for selecting the right benchmark by looking at a peer group portfolio of contracted projects only.

We also show how to use the EDHEC*infra* index data to perform a return contribution and attribution analysis of any unlisted infrastructure equity portfolio.

Also note that for this analysis:

- We use the TICCS classification system of infrastructure investments to categorise individual assets in peer group portfolios;
- We use the data from the EDHEC*infra* platform to determine the right benchmarks;
- We report local currency returns only (excluding the impact of foreign exchange on returns and volatility);[1]
- All return computations are the standard calculations made for any financial asset given time series of prices and cash flows;
- All results are presented gross of fees or investment costs; and
- We compute portfolios of individual equity investments in infrastructure companies (not funds) and there is no extra leverage at the portfolio level.

Peer group pooled portfolios

The two peer groups examined are:

- Large unlisted infrastructure asset managers; and
- Asset owners with the largest unlisted infrastructure portfolios.

For each peer group, a pooled portfolio is built using the following approach:

- We take the list of the largest infrastructure asset managers (top 20 AM) and largest asset owners (top 20 AO) investing in infrastructure by AUM;[2]
- We take the EDHEC*infra* broad market universe – which includes more than 630 firms in 22 countries – as the reference universe;
- We take the intersection of the list of infrastructure investments made by each peer group and the constituents of the EDHEC*infra* broad market;
- For each investment made by members of each peer group, we also obtain entry and exit dates, as well as the percentage stake invested;[3] and
- Using EDHEC*infra* data for quarterly mark-to-market valuations and dividend payouts, we use each investor's stake and investment dates to compute the value and returns of pooled portfolios of the top AO and top AM, going back 10 years from Q1 2020.

It is important to highlight that the two peer portfolios do not include all the investments made by the top AO or top AM. Instead, they are the intersection of the EDHEC*infra* broad market universe and the list of investments made by the largest infrastructure investors (the full list is available in the Appendix). Nevertheless, when pooled together these portfolios capture the kind of investment decisions that the top 20 infrastructure asset managers and top 20 asset owners tend to make.

Figure 1 shows the profile of each peer group pooled portfolio compared to the broad market index.

The top AM pooled portfolio includes investments in 118 assets over 10 years, with 54 exits and 64 assets in the latest quarter (Q1 2020) representing $52bn of market value and $22bn of actual investment (taking into account actual equity stakes).

The top AO pooled portfolio includes 31 investments made over the same period but only one exit, leaving 30 assets in the portfolio today or $47bn of market value and $8bn of actual investment, taking equity stakes into account.

Both peer groups represent about 20% of the broad market universe by market capitalisation.

There are some clear differences in style between the two peer groups:

- Top AM invest in more assets and exit more often;
- Top AO invest in fewer, larger assets and tend to hold them; and
- Both peer groups are more concentrated than the market, as the effective number of bets indicates, but top AO are much more concentrated in a few large assets than top AM.

Figure 2 lists the top 10 weights in each peer group pooled portfolio. The largest weights in peer group portfolios are very large (more than 10% for top AM, more than 20% for top AO) compared to the broad market.

We note that this is a realistic picture of what unlisted infrastructure investment has been like for the top 20 asset owners and managers in the infrastructure sector over the past two decades.

The top AM peer group pooled portfolio is typical of what a large infrastructure fund manager would hold over a period of 10 years

1. Characteristics of two peer group portfolios and the broad market index

	Top AM	Top AO	Broad market index
Number of constituents (since inception)	118	31	623
Number of constituents (latest quarter)	64	30	508
Number of constituents exited	54	1	115
Portfolio market cap ($bn, Q1 2020)	52	47	238
Amount invested ($bn, Q1 2020)	22	8	238
Overlap with benchmark (by market cap)	22.5%	19.9%	–
Effective number of bets* (portfolio concentration)	20	9	58

* Inverse of the portfolio HHI index

1 However, all these indices are available in seven different currencies on the EDHEC*infra* platform.

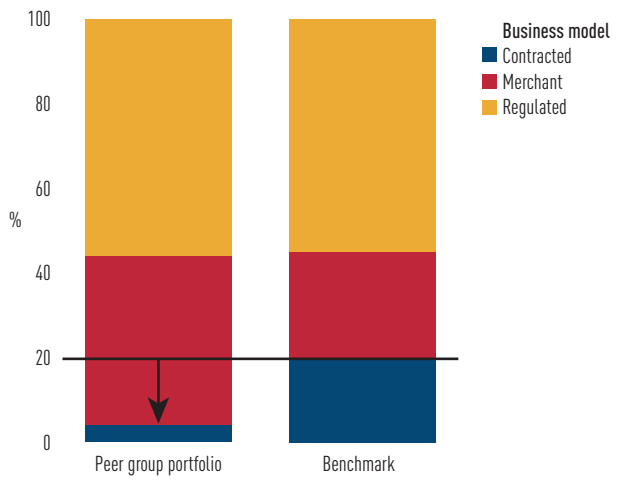
2 Source: IPE Real Assets.

3 Source: Inframation.

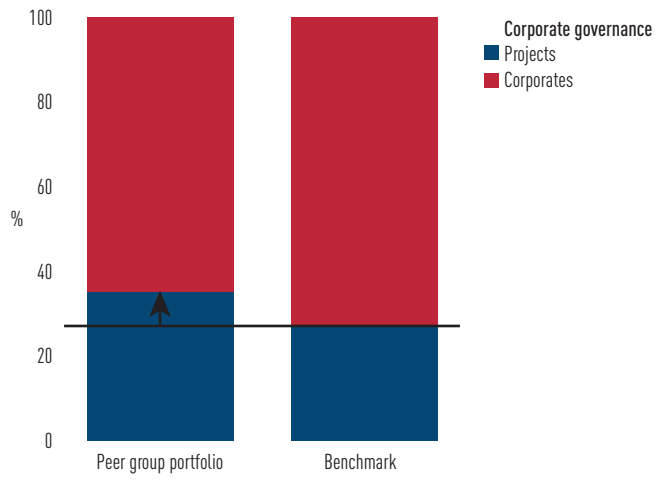
2. Top 10 weights in peer group portfolios and the broad market index

Top AM peer group		Top AO peer group		Broad market index	
Investment	**Weight**	**Investment**	**Weight**	**Investment**	**Weight**
Ausgrid Group	11.4%	Scotia Gas Networks	20.8%	Heathrow Airport TopCo	7.3%
Gatwick Airport	10.0%	Associated British Ports	15.8%	Aeroportos de Portugal	3.8%
Open Grid Europe Top Co	6.6%	Gatwick Airport	13.6%	50Hertz Transmission	3.6%
Edinburgh Airport	5.9%	Open Grid Europe Top Co	8.4%	Gatwick Airport	3.5%
Dalrymple Bay Coal Terminal	4.7%	Thames Water Utilities	7.2%	ASF Motorways	2.8%
Sydney M1 Eastern Distributor	4.6%	EastLink	5.4%	Thames Water Utilities	2.8%
Elizabeth River Crossings	4.6%	Westlink M7	3.9%	Scotia Gas Networks	2.7%
Electricity North West	4.0%	HS1 high speed rail	3.9%	Yorkshire Water Services	2.6%
M5 South West Motorway	3.8%	Anglian Water	3.8%	APRR motorways	2.4%
APRR motorways	3.4%	Autopista Central	3.0%	Associated British Ports	2.4%

3. Top asset manager peer group pooled portfolio breakdown by TICCS business risk segments vs EDHEC*infra* broad market benchmark



4. Top asset manager peer group pooled portfolio breakdown by TICCS corporate governance segments vs EDHEC*infra* broad market benchmark

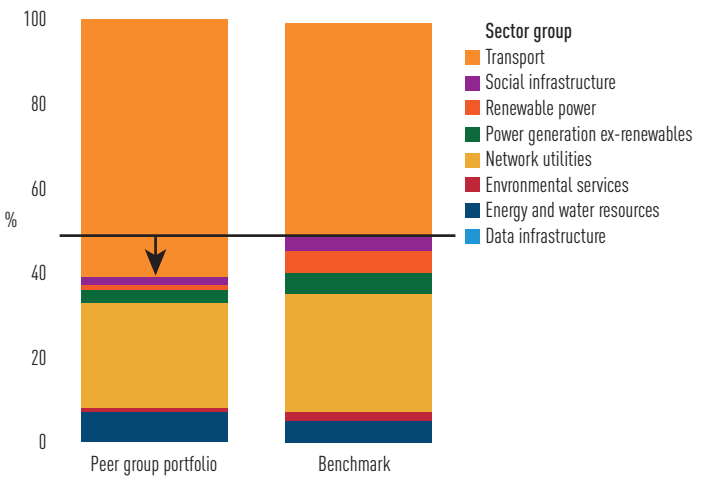


through multiple funds. Likewise, a large asset owner (and direct investor) in infrastructure would have built a buy-and-hold portfolio of a smaller size, with more larger ticket deals on average and more concentrated positions.

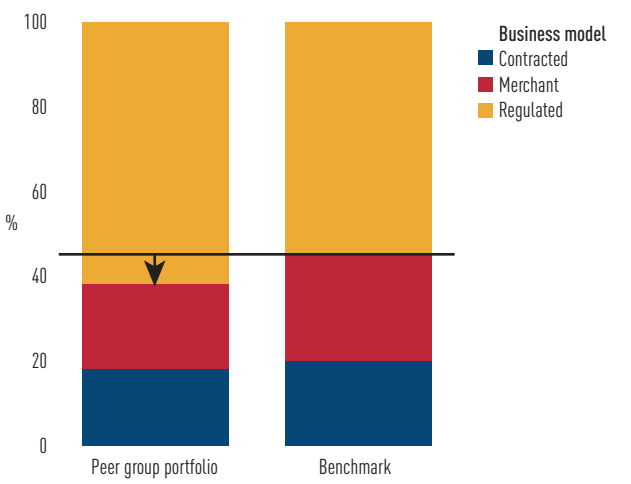
Looking at the top AM pooled portfolio in more detail, there are several structural differences with the market benchmark.

- Figure 3 shows that top AM have a greater exposure by value to merchant assets;
- Figure 4 shows a small bias towards project finance (even though the majority of the portfolio is made up of corporates, like the market benchmark); and

5. Top asset manager peer group pooled portfolio breakdown by TICCS industrial activity segments vs EDHEC*infra* broad market benchmark



6. Top asset owner peer group pooled portfolio breakdown by TICCS business risk segments vs EDHEC*infra* broad market benchmark



- Figure 5 shows a clear bias towards transport at the expense of smaller sectors like renewables and social infrastructure.

The top AO pooled portfolio also exhibits structural differences with the board market:

- Figure 6 reveals a small bias towards regulated assets but more contracted and less merchant infrastructure than in top AM portfolios;
- Figure 7 shows a small bias towards corporates, which is the opposite of the top AM portfolio; and
- Figure 8 shows the same bias towards transport as in the top AM portfolio but less pronounced.

For both peer groups, we use the EDHEC*infra* broad market index as the benchmark for two main reasons:

- It is the natural market for large investors to operate in; and
- For the sake of this exercise, it allows more direct comparisons between the two peer groups.

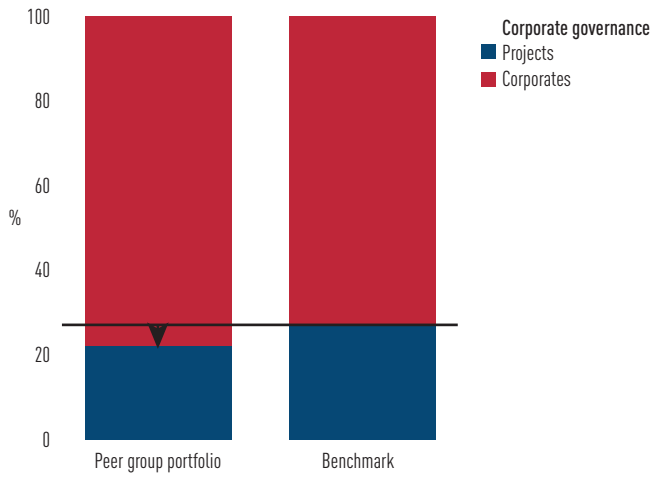
Risk-adjusted performance of top infrastructure investors

Looking at the performance of the peer groups relative to each other and the broad market index benchmark, we see that both peer groups perform better than the market as a whole.

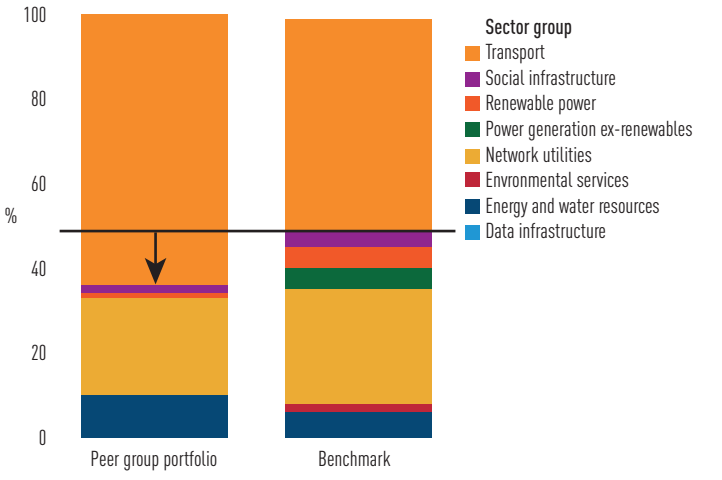
Figure 9 shows the total returns, risk and risk-adjusted returns of each portfolio. While historical performance is better for both peer groups of large infrastructure investors, they also exhibit higher volatility, in particular the top AO peer group portfolio, which we know to be more concentrated than the other peer group portfolio.

The top AM peer group has the highest risk-adjusted return (Sharpe ratio). While it has higher returns (and as we will see later it is exposed to more risk) than the market it also manages to achieve a higher degree of

7. Top asset owner peer group pooled portfolio breakdown by TICCS corporate governance segments vs EDHEC*infra* broad market benchmark



8. Top asset owner peer group pooled portfolio breakdown by TICCS industrial activity segments vs EDHEC*infra* broad market benchmark



9. Performance and risk metrics for both peer group portfolios and the broad market benchmark

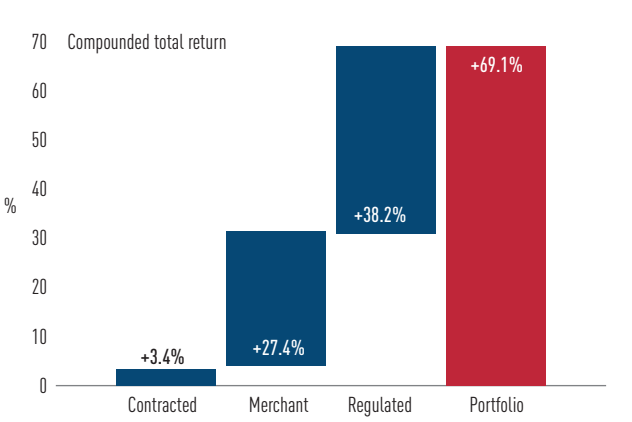
Horizon	Asset managers	Asset owners	Benchmark
Total returns			
Q1 2020*	–9.20%	–6.43%	–6.51%
3 years	11.55%	9.93%	4.05%
5 years	11.08%	9.43%	3.69%
10 years	19.16%	17.90%	13.36%
Historical volatility			
3 years	14.59%	15.13%	12.53%
5 years	17.08%	17.45%	13.99%
10 years	15.83%	17.06%	14.04%
Sharpe ratio**			
3 years	0.75	0.61	0.28
5 years	0.62	0.50	0.22
10 years	1.14	0.99	0.89
Value at risk†			
3 years	25.02%	23.30%	24.80%
5 years	35.14%	34.98%	31.29%
10 years	25.51%	29.39%	24.84%

* Quarterly return; ** Excess returns divided by standard deviation of returns; † One-year 99.5% Cornish Fisher VAR. All figures annualised except when indicated. Source: EDHEC*infra*.

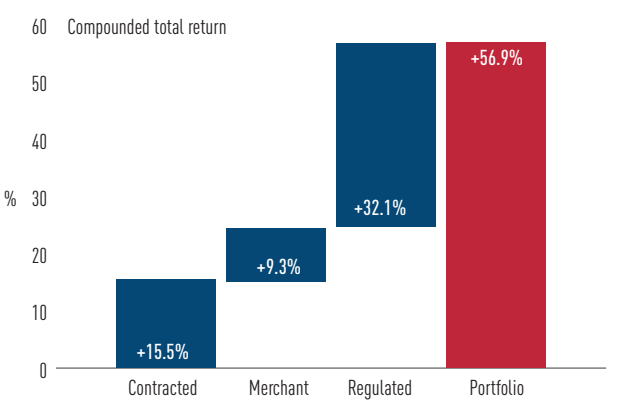
How to read the return contribution chart

- The numbers in the chart represent absolute contribution of each segment, which sums up to the total compounded return of the portfolio.
- The height of each segment's bar gives an idea of the relative contribution of that segment to the portfolio.

10. Return contribution of top AM portfolio by TICCS business risk



11. Return contribution of top AO portfolio by TICCS business risk



diversification and thus earns a higher return per unit of risk.

In terms of extreme risk, measures like value at risk suggest that the top AM and top AO peer portfolios are more alike, and that both tend to have a higher VAR than the market. However, another measure of extreme drawdown is the impact of the COVID-19 lockdowns in Q1 2020. This reveals that while top AO experience a negative performance in line with the market (–6.4%), the top AM peer group had a –9.2% quarterly return.

Indeed, the top AM peer group is highly exposed to transport and merchant assets as shown above and was impacted by the COVID-19 lockdowns much harder than the top AO peer group or the market.

Next, we perform a performance contribution and attribution analysis to better understand why the two peer groups consistently outperform the market benchmark.

Performance contribution and attribution analysis

Simply beating the benchmark is not necessarily the sign of better-informed investment decisions. It is important to understand what the return drivers are, so that any investment strategy can be adapted, and a portfolio can be expected to outperform in the future.

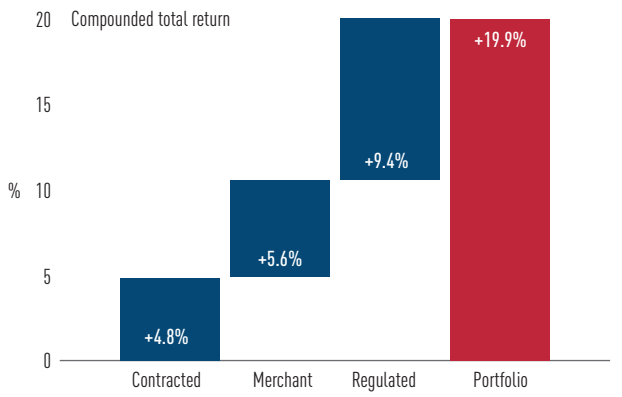
There are several ways to explain the returns depending on an investor's focus areas and the strategy. We analyse the returns by the three TICCS pillars: business risk, industrial activity and corporate governance.

Which business models drive performance?

Figures 10–12 show the decomposition of five-year compounded return using the three TICCS business risk classes. We find that:

- Regulated infrastructure explains most of the strong performance in the peer group portfolios. This segment also contributes the most in the benchmark, but the proportion is relatively smaller as compared to the peer group portfolios.

12. Return contribution of benchmark by TICCS business risk



- Top AM drive second largest return contribution from merchant assets, whereas contracted assets play that role in the top AO portfolios.
- Another key point is that while top AO have lower exposure to contracted assets as compared to the benchmark, they generate a larger proportion of return from contracted assets. This suggests that top AO have been successful in picking 'winner' contracted companies.

Attributing between allocation and selection choices

Figure 13 breaks down the difference in the mean quarterly return (over the past five years) of the portfolio and the benchmark into the impact of asset allocation differences to each segment of the benchmark and individual investment selection choices (see Brinson, Hood and Beebower [1986][4]).

- First thing to note is that both peer groups derive their outperformance through selection of companies rather than the allocation by business models and the effect is very prominent, with the total selection effect contributing 1.59% and 1.64% to the outperformance for top AM and top AO portfolios respectively.
- In the top AM portfolio, the bulk of the outperformance is driven by the selection of better merchant and regulated assets. Their portfolio also suffers from the smaller exposure to contracted investments contributing –18bps.
- Top AOs suffer by being underexposed to both contracted and merchant business models, but derive some of their outperformance from selecting superior contracted companies. Here, the interaction effect of –28bps can be understood as a punishment for underallocating to the contracted business

13. Return attribution by business risk

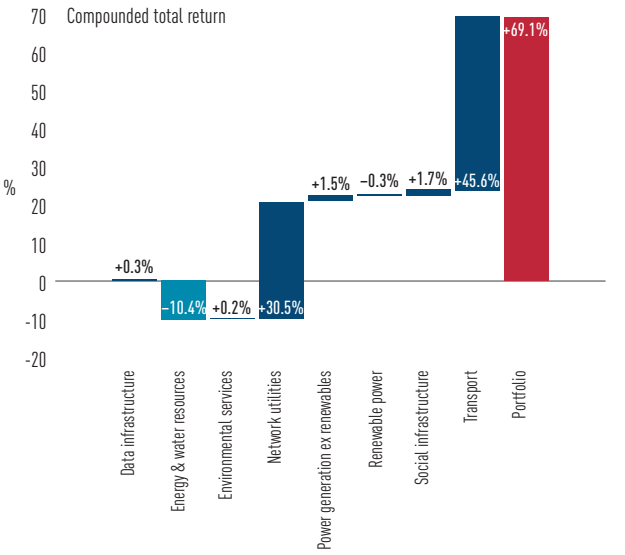
	Allocation	Selection	Interaction	Difference from benchmark
Top AM				
Contracted	–0.18%	0.16%	–0.10%	**–0.12%**
Merchant	0.07%	0.59%	0.22%	**0.87%**
Regulated	0.17%	0.84%	0.11%	**1.11%**
Total	**0.06%**	**1.59%**	**0.23%**	**1.87%**
Top AO				
Contracted	–0.12%	0.81%	–0.28%	**0.42%**
Merchant	–0.08%	0.24%	–0.03%	**0.14%**
Regulated	0.23%	0.59%	0.12%	**0.94%**
Total	**0.03%**	**1.64%**	**–0.19%**	**1.49%**

Understanding return attribution

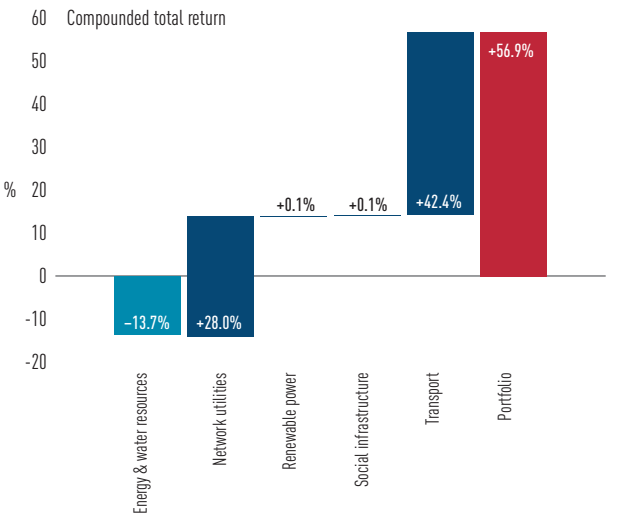
- Allocation effect implies that if a segment earns the same return in the portfolio as as the benchmark, the only difference in the contribution of the segment will be due to the difference in the allocation.
- Selection effect measures the investor's capability to select better companies. It implies that if a segment has the same allocation in both the portfolio and the benchmark, the only difference in the contribution will be due to the performance of the selected companies.
- Interaction effect is the cross product of both allocation and selection effects. Intuitively, it rewards the investors for under-allocating to the segments where their company selection was bad (or overweight segments where it was good) and punishes them for an overweight in a segment where their company selection was bad (or an underweight in a segment where it was good).

The sum of the three effects equals the difference in the contribution of a segment between portfolio and benchmark. Sum across all segments equals the total performance difference between the portfolio and the benchmark.

14. Return contribution of top AM by TICCS industrial activity



15. Return contribution of top AO by TICCS industrial activity



model even though they are better at company selection in this segment. A significant proportion of their outperformance also comes from the combination of allocating and selecting regulated investments.

Decomposing the return by industrial activity

On similar lines as business risk, we decompose the five-year compounded portfolio return by industry type (figures 14–16) and note that:

- Transport is the biggest contributor to the total cumulative return over the five years period in both the peer group portfolios. However, it contributes a much smaller fraction in the benchmark return.
- Network utilities is the second largest contributor to the portfolio return. Energy assets, both conventional and renewable, as well as social infrastructure assets, have contributed very little to the performance, owing to their smaller weights and lower relative returns.
- Energy and water resources companies, composed of some large gas pipelines, are the biggest contributor of negative returns in all the three portfolios.

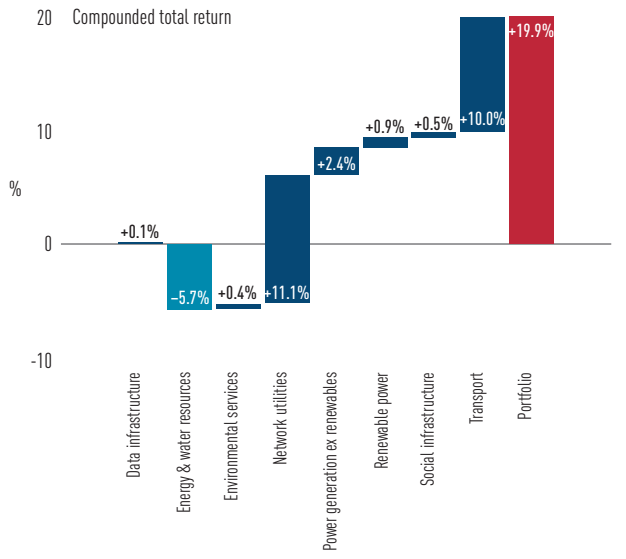
Attributing between allocation and selection choices

Attribution of outperformance by industry types in figure 17 shows that:

- Both peer groups derive their superperformance from the selection of transport and network utilities assets, rather than by trying to improve their industry allocation relative to the benchmark.
- Their asset allocation choices relative to the benchmark contribute little to the outperformance.

4 Brinson, G.P., L.R. Hood and G.L. Beebower (1986). Determinants of portfolio performance. *Financial Analysts Journal* 42(4): 39–44.

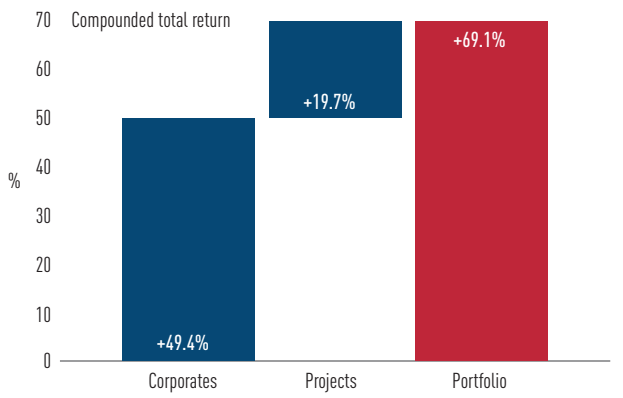
16. Return contribution of benchmark by TICCS industrial activity



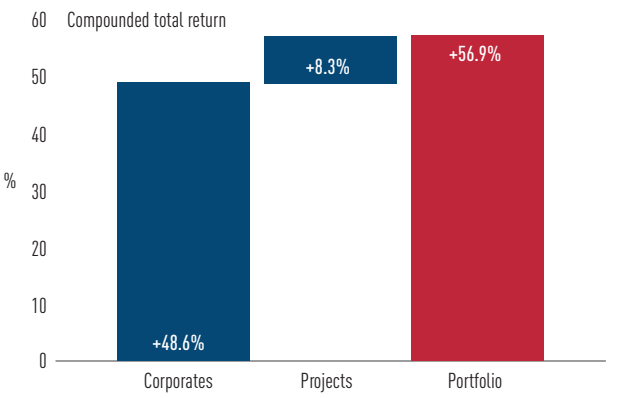
17. Return attribution by industrial activity

	Allocation	Selection	Interaction	Difference from benchmark
Top AM				
Data infrastructure	0.00%	0.01%	0.00%	**0.01%**
Energy and water resources	0.06%	–0.14%	0.00%	**–0.08%**
Environmental services	–0.02%	0.04%	–0.04%	**–0.01%**
Network utilities	0.07%	0.47%	0.11%	**0.65%**
Power generation ex-renewables	–0.07%	0.03%	–0.01%	**–0.06%**
Renewable power	–0.04%	–0.12%	0.11%	**–0.06%**
Social infrastructure	0.01%	0.01%	0.01%	**0.03%**
Transport	–0.01%	1.23%	0.17%	**1.40%**
Total	**0.00%**	**1.53%**	**0.35%**	**1.87%**
Top AO				
Data infrastructure	–0.01%	–0.01%	0.01%	**–0.01%**
Energy and water resources	0.04%	–0.23%	–0.02%	**–0.22%**
Environmental services	–0.02%	–0.02%	0.02%	**–0.02%**
Network utilities	0.11%	0.36%	0.09%	**0.56%**
Power generation ex-renewables	–0.12%	–0.12%	0.12%	**–0.12%**
Renewable power	–0.05%	0.04%	–0.03%	**–0.04%**
Social infrastructure	–0.02%	–0.03%	0.02%	**–0.03%**
Transport	0.03%	1.16%	0.17%	**1.36%**
Total	**–0.04%**	**1.15%**	**0.38%**	**1.49%**

18. Return contribution of top AM portfolio by TICCS corporate governance



19. Return contribution of top AO portfolio by TICCS corporate governance



● Interestingly, the transport sector has a small negative allocation effect (on average over five years) in the top AM portfolio. This is largely the result of the negative impact from COVID-19 in Q1 2020. Top AO, on the other hand, had relatively lower allocation to transport and, thus, on a five-year basis, still benefit a little by over-allocating to this sector.

● In both the peer group portfolios, the interaction effect rewards the better selection in the transport and network utilities sectors, where portfolios are also over-weighted as compared to the benchmark. At the same time, it rewards top AM for under-allocating to renewables, where they have poor asset selection, and it rewards top AO for their lower allocation to the power sector, in which their company selection was worse than the benchmark.

Understanding returns by corporate governance

Decomposition of returns by corporate governance in figures 18–20 highlights that:

● A large part of the outperformance is driven by corporates and this is the direct result of portfolios having higher exposure to corporates.

● Top AM derive a significant part of their returns from investing in infrastructure projects, whereas the contribution is much smaller for top AO.

Attributing between allocation and selection choices

Looking at the performance attribution in figure 21, we note that:

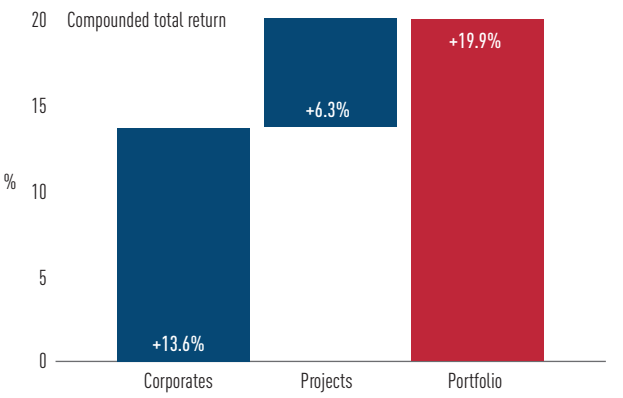
● Both the peer group portfolios derive their superior performance from the selection of better corporates.

● Top AM are also relatively better at selecting better projects.

● Top AO suffer from not investing as much in projects as the market.

However, since they are better at selecting corporate companies, it might be in their interest to continue over-allocating to corporates. In the end, it is a trade-off between selecting better assets in one segment and diversifying between segments.

20. Return contribution of benchmark by TICCS corporate governance



21. Return attribution by corporate governance

	Allocation	Selection	Interaction	Difference from benchmark
Top AM				
Corporates	0.05%	1.32%	–0.01%	**1.36%**
Projects	–0.01%	0.49%	0.04%	**0.51%**
Total	**0.04%**	**1.81%**	**0.03%**	**1.87%**
Top AO				
Corporates	0.14%	1.16%	0.13%	**1.43%**
Projects	–0.12%	0.22%	–0.04%	**0.06%**
Total	**0.02%**	**1.38%**	**0.09%**	**1.49%**

Systematic versus idiosyncratic risk-return analysis

We also decompose portfolio returns in terms of systematic (beta) and idiosyncratic risks (alpha).

We regress the quarterly total returns of the two portfolios against the market benchmark (EDHEC*infra* broad market unlisted infrastructure equity index) for a period of 10 years. The results are reasonably robust, achieving an adjusted R2 in the range of ~70–80%.

Looking at figures 22 and 23, we see that:

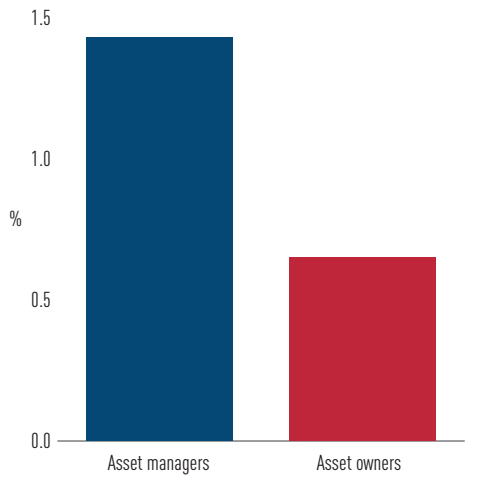
- Top AM have a beta very close to 1 and earn a much higher alpha of approximately 1.43% on a quarterly basis.
- Top AO, on the other hand, are more exposed to systematic risk, as indicated by their higher beta of 1.14, and they earn less than half the alpha as compared to top AM.

Using these results, portfolio volatility can be also decomposed into systematic and idiosyncratic components.

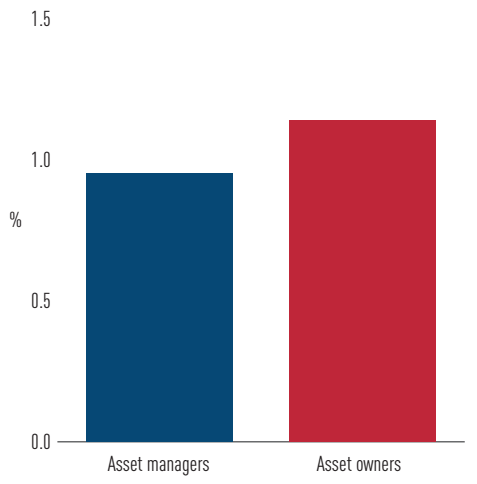
Figure 24 shows that:

- The higher portfolio volatility of top AO is driven by its systematic component, as a result of their higher beta against the benchmark.
- Top AM have higher idiosyncratic volatility, which is congruent with their higher alpha.

22. Alpha contribution of top AM and top AO portfolio returns



23. Beta contribution of top AM and top AO portfolio returns



24. Decomposition of historical volatility

	Historical volatility	Systematic	Idiosyncratic
Top AM			
3 years	14.59%	12.3%	7.91%
5 years	17.08%	13.7%	10.21%
10 years	15.83%	13.7%	7.86%
Top AO			
3 years	15.13%	14.3%	4.92%
5 years	17.45%	16.0%	7.02%
10 years	17.06%	16.0%	5.83%

Risk factor analysis

The EDHEC*infra* asset pricing methodology hinges around estimating each company's equity risk premium at the end of every quarter. This premium is used to generate marked-to-market valuations for each company. The index or portfolio level risk premia is reported as the weighted average of each constituent's risk premia.

Figure 25 shows this weighted average risk premia for the two peer group portfolios and the benchmark over the past five years. We find that:

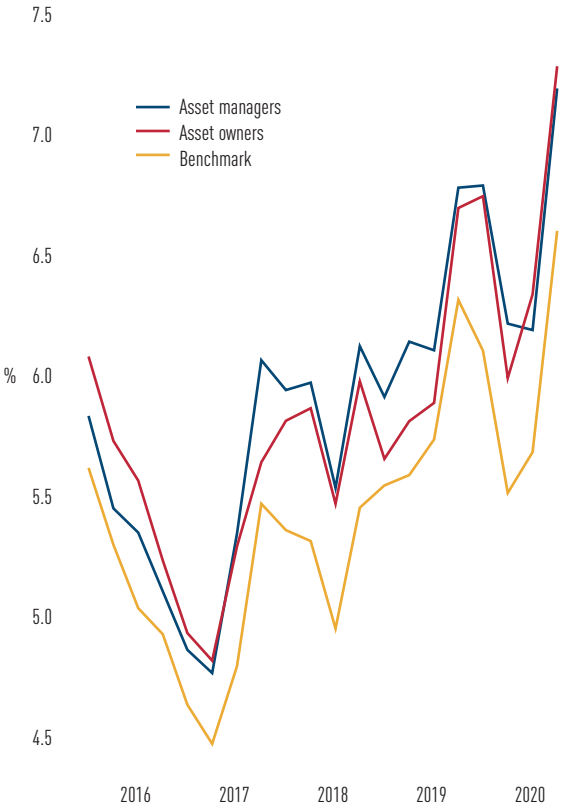
- Both peer group portfolios exhibit higher equity risk premia than the market – ie, they are both exposed to more risk than the market, which is also why their returns are higher than the market.
- On average, top AM have been harvesting a higher equity risk premium than the top AO.

What is the exposure of these portfolios to different risk factors?

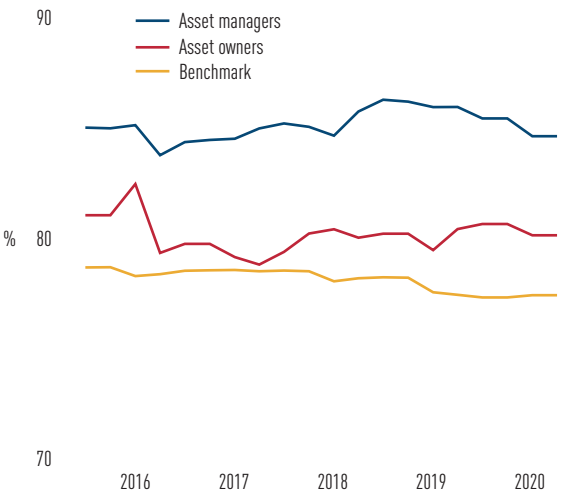
The risk premium harvested by each peer group is the combination of their exposures to several risk factors times the price of each one of these risk factors.

Figures 26–29 highlight the risk exposures to the four key risk factors used in the EDHEC*infra* methodology: leverage (senior liabilities/total assets), size

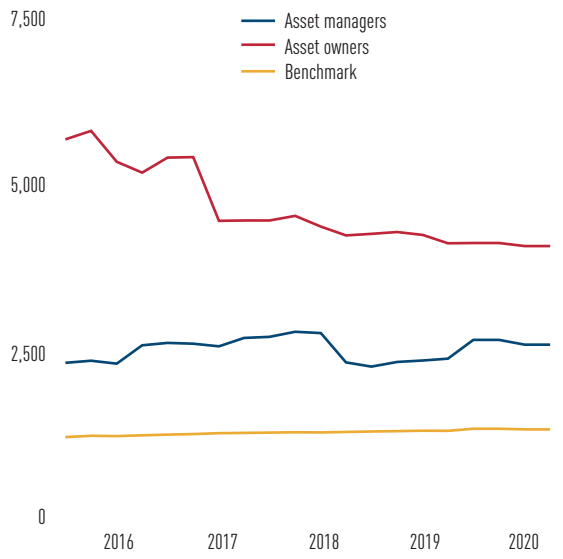
25. Weighted average risk premia of top AM and top AO portfolios and the benchmark



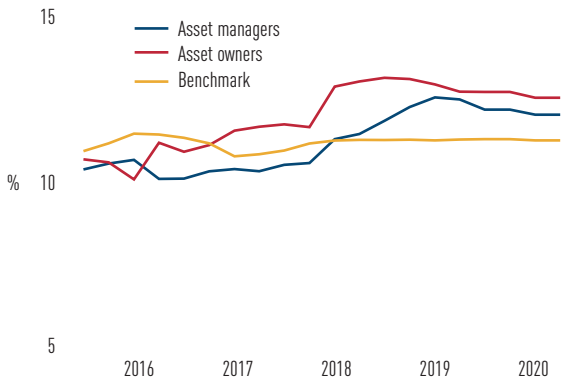
26. Average exposure to the leverage factor of top AM and top AO portfolios and the benchmark



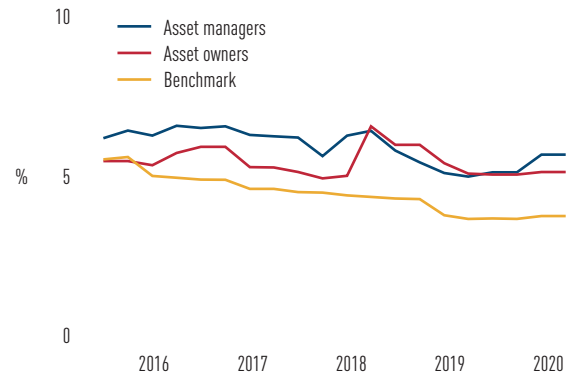
27. Average exposure to the size factor of top AM and top AO portfolios and the benchmark



28. Average exposure to the profit factor of top AM and top AO portfolios and the benchmark



29. Average exposure to the investment factor of top AM and top AO portfolios and the benchmark



(total assets), profit (return on assets) and investment (capex/total assets).[5]

The top AM peer portfolio includes the greatest exposition to the leverage factor, almost 85% on average. Top AO, on the other hand are a little less exposed (~80%) but still have higher exposure than the market.

Top AO tend to invest in larger companies with average size of $4bn–5bn; in comparison, top AM have relatively smaller assets on average, but still larger than the market average.

Exposures to the profit and investment factors, while increasingly higher than the market, are also more in line with market averages.

5 Other factors in the expected return model are term spread and control variables. These four factors explain most of the variance of expected returns between these portfolios.

Marginal contribution of risk factors to the equity premia

Next, we compute the marginal impact of each of the risk factors to the risk premium of a portfolio (figures 30–33).

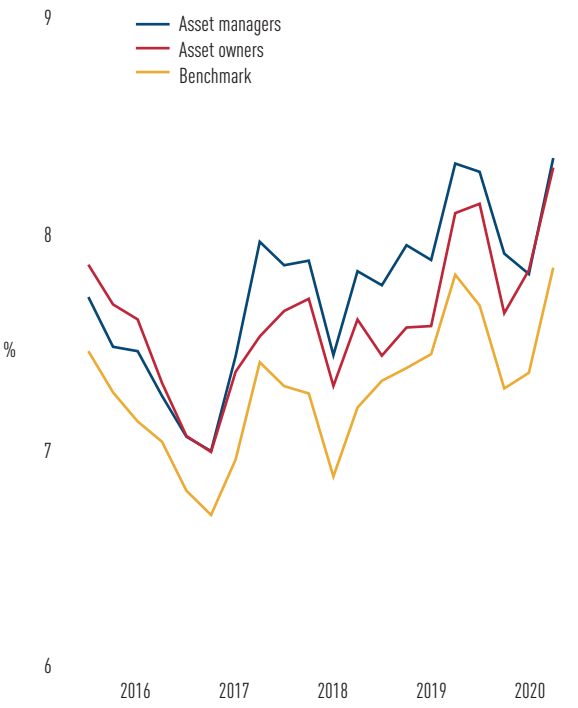
The leverage factor has the strongest impact and, recently, has been responsible for more than 750bps of the equity premia for all three portfolios. Top AM, as a result, are most impacted by their greater exposure to leverage and earn the highest equity premium. Top AO, as well, derive larger equity premium from leverage factor as compared to the market.

The size factor is the second biggest contributor to the equity premia and, in this category, top AO are able to harvest higher premium driven by their greater exposure to large assets.

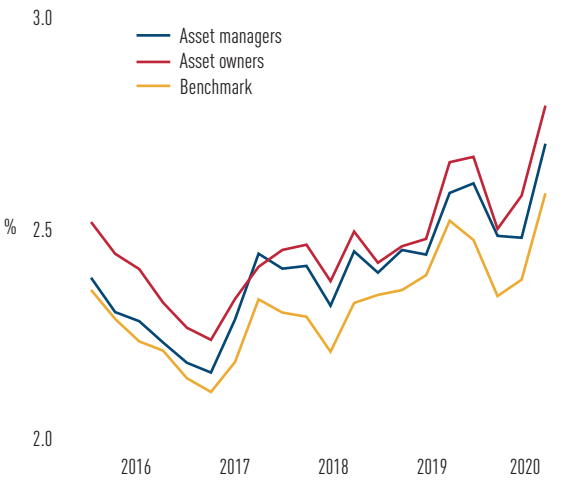
More profitable companies require a lower equity risk premium, as indicated by figure 26. However, owing to their similar exposures to profit factor, there is little difference in the marginal impact of the profit factor in the peer groups relative to the market.

Similarly, the effect of the investment factor makes a relatively small difference between the two peer group portfolios and the market benchmark.

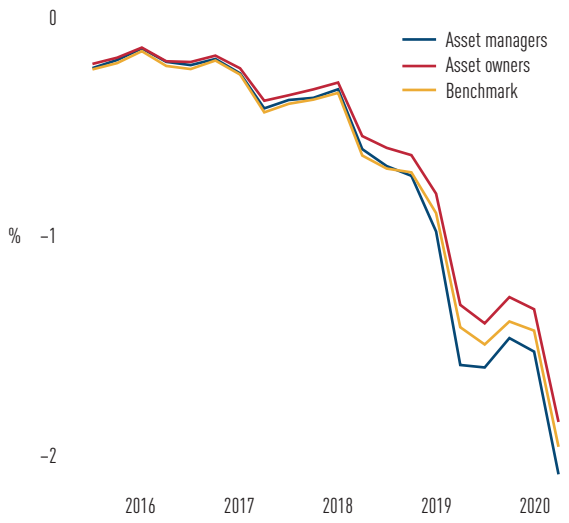
30. Marginal contribution of the leverage factor to equity risk premia of top AM and top AO portfolios and the benchmark



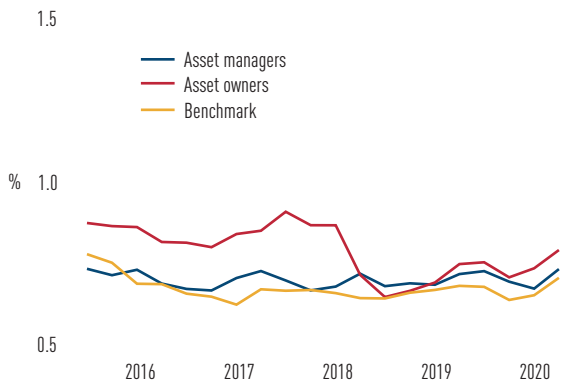
31. Marginal contribution of the size factor to equity risk premia of top AM and top AO portfolios and the benchmark



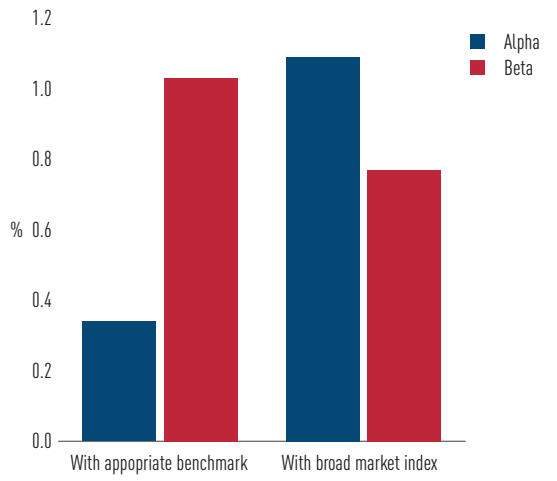
32. Marginal contribution of the profit factor to equity risk premia of top AM and top AO portfolios and the benchmark



33. Marginal contribution of the investment factor to equity risk premia of top AM and top AO portfolios and the benchmark



34. Alpha and beta decomposition of the contracted project peer portfolio using the wrong (broad market) benchmark and the adequate benchmark



Choosing the right benchmark – the case of contracted project investors

The analysis presented above used the broad market index as the benchmark for the top AO and top AM peer groups because the global market for unlisted infrastructure investment is the relevant market for these two peer groups.

However, not all infrastructure investors have this outlook. If an investor focuses only on a specific segment of the unlisted infrastructure market, the choice of benchmark to conduct this analysis will be very important. As is the case in other asset classes, by picking the wrong benchmark, investors risk underestimating beta and overestimating the alpha of their portfolio.

Next, we consider the case of an infrastructure investor that specialises in contracted projects. Using the same information collected for the top AM peer group, we build a portfolio that includes only contracted (TICCS–BR1) project finance vehicles (TICCS–CG1).

This yields a peer portfolio of 60 assets invested over 10 years with 18 still present in the portfolio today after 42 exits. As of Q1 2020, this contracted project (top AM) peer portfolio represents $2bn of market value and $700m of actual investment by top AM during that time.

As shown in figure 34, if this portfolio was benchmarked against the same broad market index used for the two peer groups presented earlier, an investor would find a beta of 0.70 and an alpha of 109bps.

However, with the more adequate contracted project benchmark, we get a beta of 1.03 and a much lower alpha of 34bps.

This illustrates how having access to a granular set of benchmarks that accurately represent the assets in the portfolio or the infrastructure segments defined in the investment strategy matter to be able to understand the sources of performance. Note that a clear and objective asset classification scheme like TICCS is also essential to be able to implement such granular benchmarking.

Conclusions

In this case study, we have examined the risk and performance of two important peer groups of investors in the unlisted infrastructure sector: large infrastructure asset managers and large asset owners (by infrastructure AUM).

Key findings about the two peer groups are:

- These two peer groups perform well relative to the market primarily because they manage to invest in the best assets;
- However, they are not able to use asset allocation to different sectors or business risk segments to improve their performance. Instead, they often underperform the benchmark because of their implicit or de facto asset allocation choices;
- They are quite concentrated in a few firms, which is in line with the first finding;
- They are exposed to more risk than the market average, in particular:

You can try this yourself

Asset managers, asset owners and consultants can do this analysis on their own portfolio using the data available in the EDHEC*infra* platform.

Classification
First, categorise your unlisted infrastructure equity investments using TICCS.

Benchmark selection
Use your asset values to determine the business risk, industrial activity and corporate governance weights of your portfolio or target portfolio. Use this profile to select the best market index or sub-index for your benchmark among 120-plus options on the EDHEC*infra* platform.

Performance contributions
Using your infrastructure portfolio's valuations (prices or NAVs) and cashflows, you can compute quarterly total returns. Use the relevant TICCS sub-indices in the EDHEC*infra* platform to get the returns of each segments of your portfolio. Use your portfolio weights to derive the contributions of each segment to your portfolio returns

Performance attribution
Use your portfolio weights and returns for each TICCS segment relative to the EDHEC*infra* sub-indices weights and returns, to attribute the performance difference by allocation, selection and interaction effects.

Market beta/alpha assessment
Regress your portfolio returns against the benchmark returns to determine alpha/beta (you need a few years of data).

This works for portfolios of infrastructure debt as well. The EDHEC*infra* platform includes several hundred indices of private infrastructure debt including project finance and corporate infrastructure debt, CPI-linked and all the different TICCS classes.

higher exposure to leverage in the case of top AM, and a higher exposure to larger assets in the case of top AO;
- Top AM are also exposed to higher idiosyncratic risk than the top AO peer group, which exhibits a higher market beta;
- Overall, top AM are the best performers on a risk-adjusted basis; and
- Because AM exit their investments regularly, they can also benefit from market timing effects which are not necessarily available to the top AO.

This analysis also gives us some insights into infrastructure investing:
- Using asset allocation at the asset class level is tough (rebalancing cannot be done once a quarter).
- If selection skills are rare and different across segments, then there can be a trade-off between diversifying across more segments and using your skills to pick the best deals in only a few segments.
- With lumpy assets and under-diversified portfolios, security selection makes all the difference, and hence, unlisted infrastructure remains a very active investment strategy.
- The beta versus alpha decomposition of a fund manager is often used to measure 'added value', assuming that the beta of the portfolio is available to investors at a low cost through an index fund or equivalent. In the case of infrastructure, building an infrastructure portfolio can take a decade and is conditioned by each investor's ability to access a very illiquid and segmented market. Thus, delivering a well-defined beta (corresponding to a well-documented benchmark) may well add more value to the final investor than beating the same benchmark by a few basis points.
- This last point suggests that infrastructure managers or teams could also be evaluated in terms of tracking error relative to a benchmark which represents the target risk exposures that a given investor wants to achieve by investing in infrastructure.

Appendix

Constituents in the top AM portfolio

2i Rete Gas SpA
50Hertz Transmission GmbH
A2 Motorway: Nowy Tomysl to Swiecko Section
A63 Salles-Saint Geours de Maremne
Adelaide Airport
Affinity Water
Airwave Radio System
Allenby/Connaught Accomodation
Amey Birmingham Highways PFI
Amliden Wind Farm
AndaSol Solar Power Project
Anglian Water
Arlanda Express
Associated British Ports
Ausgrid Group
Autopista Vespucio Norte Express
Autoroutes Paris-Rhin Rhone (APRR) motorway
Autovia del Camino (A-12)
Barnet Hospital Development
Benavente to Zamora A-66 Shadow Toll Road
Bexley Schools
Birmingham Acute and Adult Psychiatric Hospitals PFI
Bishop Auckland Hospital Uk
Blackburn Hospital UK
Bournemouth Library
Brisbane Airport
Central Middlesex Hospital
Connect A30/A35 Limited
Connect M1-A1 Limited
Connect Project PFI
Conwy Schools PFI
Dalmuir Sewage Treatment Works
Dalrymple Bay Coal Terminal
Defence Headquarters Joint Operations Command Project (complex known as General John Baker Complex)
Doncaster Mental Health
Drakelow Solar Farm
Ealing Schools
EastLink
Ecogen Energy
Edinburgh Airport
Electricity North West
Elenia Group
Elizabeth River Crossings Project
Energy Power Resources
Exeter Crown and County Courts PFI
Firenze Tram
First Hydro Company
Gateway motorway and Logan motorway
Gatwick Airport
George Best Belfast City Airport
Glasgow Schools
Goonhilly wind farm
Greater Manchester Police Stations
Hobart International Airport
Home Office & Prison Service Accomodation
HS1 high speed rail
HSL High Speed railway Link Project (Hogesnelheidslijn-Zuid)
IH 635 Managed Lanes Project
Isle of Wight Highway Maintenance PFI
L'autoroute A28
Linea 9 Metro Barcelona Tramo II PPP
Linea Nueve Tramo Cuatro
London City Airport Limited
London Luton Airport
Lynn wind farm
M40 Motorway
M45 Motorway – Section B
M5 South West Motorway
M6 Birmingham Expressway
M6/M74 DBFO
M8/M73/M74 Motorway Network PPP
Madrilena Red de Gas
Marseille L2 Motorway
Melbourne Airport
Mercurio Solar Tinajeros
Metropolitan Police Specialist Training Centre (MPSTC)
MoD Main Building (Whitehall Building)
Naples Airport
Newham Hospital
New Tyne Crossing Project
Northern Gas Networks
North Tarrant Express I-820 and SH 121/183 (Segments 1 and 2A)
North Tyneside Schools PFI
NTE Segment 3
Open Grid Europe TopCo
Peel Ports
Penwith Leisure PFI
Perth CBD Courts PPP
Perth International Airport
Powerco
Regasificadora del Noroeste
Severn Power Station
SH 288 Toll Lanes Expansion
Singapore Sports Hub
Sjisjka Wind Farm
Societa Gasdotti Italia
Sorne Wind Farm
South East Queensland (SEQ) Schools
South East Water
Southern Water
South Europe Atlantic High-Speed Line (SEA HSL) Tours-Bordeaux High Speed Rail PPP
Sussex Custodial Centre PFI project
Sutton And East Surrey Water
Sutton Bridge Power Plant

Sydney M1 Eastern Distributor
Tasmanian Gas Pipeline
Taurbeg Wind Farm
Thames Water Utilities
Thyssengas GmbH
Toscana Floating Storage Regasification Unit (FSRU Toscana)
UK Highways A55 Limited
Universal Terminal
University of Hertfordshire Student Accommodation
Victorian Desalination Plant PPP
Wales & West Gas Networks
Walsall Street Lighting
Westrail
Ytterberg Wind Farm

Constituents in the top AO portfolio

Anglian Water
Associated British Ports
Autopista Central
Autopista del Pacifico (Interconexion Vial Santiago–Valparaiso–Vina del Mar)
Birmingham Airport
Brisbane Airport
Bristol Airport
Camino Internacional Ruta 60 CH
Concesion Internacional Ruta 5 Tramo Los Vilos-La Serena
Dalrymple Bay Coal Terminal
EastLink
Edinburgh Airport
Forth Ports
Gateway motorway and Logan motorway
Gatwick Airport
HS1 High Speed Rail
London City Airport Limited
MoD Corsham PFI
Northumbrian Water
Open Grid Europe TopCo
Perth International Airport
Project Single Living Environment and Accommodation Precinct (LEAP) PPP – Phase 2
Redexis Gas
Scotia Gas Networks (SGN)
Single Living Environment and Accommodation Precint (LEAP) 1 project
Solar PV Plant of La Coste Portfolio
Sydney Airport Link
Thames Water Utilities
Universal Terminal
Ventos do Araripe 3 Wind Complex (357.9MW)
Westlink M7 (formerly Western Sydney Orbital)

Identifying the fundamental characteristics of infrastructure companies

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A deeper look at the infrastructure investment narrative

A new paper explores whether infrastructure companies exhibit statistically significant differences from companies in other industries. Controlling for variables like size, profitability, leverage, investment opportunities and industry, we find that they do indeed demonstrate special characteristics. Infrastructure firms exhibit higher asset tangibility, asset illiquidity and inflexibility and lower operating leverage than a control sample of non-infrastructure firms.

Introduction

The aim of this paper is to establish what attributes infrastructure assets possess that distinguish them from the wider investment universe. In that respect, it builds on the insights of Blanc-Brude (2013), in which the author summarises the case for diversifying investment portfolios into infrastructure assets. More specifically, the narrative of the asset class is that investing in infrastructure is expected to create the following benefits: '...tangible infrastructure assets, immobile and demanding high sunk-capital costs and long repayment periods, are expected to create monopolies thanks to barriers to entry and increasing returns to scale. Thus, assets owners are expected to benefit from the low elasticity of demand creating pricing power and an inflation hedge, as well as low return covariance with other investments, allowing attractive risk-adjusted returns' (Blanc-Brude [2013]: 36).

To date, to the authors' knowledge there has been no examination of whether infrastructure as an investment is different to other types of firms. The sole examination of these potential differences assumes that the core investment narrative described above holds and that the asset pricing model can explain returns (see Ammar and Eling [2015]). However, without testing to verify the existence of the special characteristics of infrastructure, any further investigation into its return characteristics is premature.

This paper contributes to our understanding of infrastructure as an investment by examining whether it does indeed exhibit the special characteristics described by Blanc-Brude (2013). Specifically, we test whether infrastructure firms have more tangible and inflexible assets than other firms. Furthermore, we assess whether their assets are more illiquid than other firms and examine their relative operating leverage.

By employing a matched sample of non-infrastructure firms in the UK, we are able to confirm that infrastructure firms are different, exhibiting higher asset illiquidity, tangibility and inflexibility whilst at the same time a lower operating leverage. These findings fit with the view of infrastructure firms being 'special' and go some way to supporting the infrastructure investment narrative.

Methodology

The decision to set up an infrastructure firm is an endogenous one which can result in firms exhibiting certain ratios and sizes. This endogeneity limits the ability to draw conclusions from the analysis unless it is explicitly controlled for. As a result, we employ propensity score matching to attempt to control for endogenous differences between infrastructure and non-infrastructure firms and then conduct tests on differences again.

The matching of one or several non-infrastructure firm-year observations to each infrastructure firm-year observation is achieved by computing propensity scores, as proposed by Rosenbaum and Rubin (1983, 1985).

The matching of firm-year observations is done in the same way as Michaely and Roberts (2013), employing firm characteristics that can be expected to explain underlying business models. These are firm size, profitability, leverage, investment opportunities and industry.

The match between infrastructure and non-infrastructure firm-year observations is determined by first estimating the following profit regression:

$$Infra\ Dummy_{i,t} = \beta_0 + \beta_1 Size_{i,t} + \beta_2 Leverage_{i,t} + \beta_3 \Delta Revenue_{i,t} + \beta_4 Profitability_{i,t} + \varepsilon_{i,t}$$

where:
$Infra\ Dummy_{i,t}$ is a dummy variable indicating whether the firm is an infrastructure firm or not;
$Size_{i,t}$ is log total assets;
$Leverage_{i,t}$ is defined as the sum of trade creditors, short-term loans and long-term debt, divided by total assets;
$\Delta Revenue_{i,t}$ is the percentage change in revenue from time t–1 to t; and
$Profitability_{i,t}$ is operating profit at time t divided by total assets at time t.

Once the control group is obtained by using the propensity scores, we examine the differences in mean and median for the variables of interest. The variables we intend to examine are described in the next section.

Measures for infrastructure characteristics

We examine four characteristics of infrastructure: asset tangibility, asset illiquidity, asset inflexibility and operating leverage. The measures are described in detail below.

Asset tangibility

In this paper we employ two measures for asset tangibility. The first is the measure from Berger et al (1996). This estimates the liquidation values for the assets of a firm. A firm with a higher asset tangibility measure is likely to possess more liquid assets and a lower property plant and equipment (PP&E) intensity in its total assets. The asset tangibility measure is given as:

$$Tangibility1 = \frac{Cash\ Holdings + 0.715 \times Receivables + 0.547 \times Inventory + 0.535 \times Capital}{Total\ Assets}$$

where:
Cash Holdings are cash and short-term investments;
Receivables is Receivables – Total;
Inventory is Inventories – Total;
Capital is Property Plant and Equipment – Total (Net); and,
Total Assets is Assets – Total.

The second measure employed in this paper was introduced in Campello and Giambona (2013). This, as described below, is the ratio of PP&E to total assets.

$$Tangibility2 = \frac{Property\ Plant\ \&\ Equipment}{Total\ Assets}$$

Asset illiquidity

Asset illiquidity is related to asset tangibility. Firms with large capital investments are hard to liquidate in times of distress. As infrastructure possesses large, capital-intensive assets that are relationship specific, it is reasonable to assume that these firms exhibit high asset illiquidity. To measure asset illiquidity, we adopt three measures from Gopalan et al (2012) and Ortiz-Molina and Phillips (2014). These are as follows:

$$WAL1_{i,t} = \frac{Cash\ \&\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{Other\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0$$

*WAL*1 or Weighted Average Liquidity 1 measures the proportion of highly liquid cash and cash equivalents to lagged total assets. This measure assumes all non-cash like assets are effectively illiquid.

$$WAL2_{i,t} = \frac{Cash\ \&\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{NonCashCA_{i,t}}{Total\ Assets_{i,t-1}} \times 0.5 + \frac{Other\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0$$

In the second Weighted Average Liquidity measure *WAL*2, Gopalan et al (2012) assume non-cash current assets can be liquidated at 50% of their face value, while all other assets, except for cash, possess zero asset value.

$$WAL3_{i,t} = \frac{Cash\ \&\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{NonCashCA_{i,t}}{Total\ Assets_{i,t-1}} \times 0.75 + \frac{Tangible\ Fixed\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0.5 + \frac{Other\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0$$

The third Weighted Average Liquidity measure that Gopalan et al (2012) employ assumes that cash and equivalents and non-cash current assets have the same liquidation value as in *WAL*2. However, *WAL*3 assumes that tangible fixed assets exhibit a 50% recovery rate when liquidated while all other assets possess no liquidation value. Tangible fixed assets measure the difference between the book value of assets and the sum of current assets and goodwill.

Asset flexibility

Asset flexibility measures the ability of a firm to either expand or contract production in response to market shocks. Infrastructure firms, as a result of their assets being large, durable and with substantial sunk costs, would be unable to adapt as well as firms benefiting from greater operational flexibility. Therefore, we hypothesise that infrastructure firms would have limited ability to reallocate their assets to other tasks. To measure asset flexibility, we employ the Gu et al (2018) measure of asset inflexibility, which is given as:

$$INFLEX_{i,t} = \frac{max_{i,0,t}\left(\frac{OPC}{Sales}\right) - min_{i,0,t}\left(\frac{OPC}{Sales}\right)}{std_{i,0,t}\left(\Delta \log\left(\frac{Sales}{Assets}\right)\right)}$$

where:
OPC is the sum of selling and administrative expenses and cost of goods sold;
Sales is the total revenue for the period; and
Assets is the book value of total assets.

This measure employed by Gu et al (2018) aims to identify the range bounds for which a firm does not change its production process when hit by a productivity shock. Firms with a higher measure are likely to exhibit greater inflexibility due to contracts and capital investments that limit their ability to respond to shocks in the short term. As a result, for the Gu et al (2018) measure we hypothesise that on average infrastructure firms exhibit a higher inflexibility measure.

Operating leverage

In this paper we employ two measures for operating leverage. The first measure follows the work of Chen et al (2019), which includes only selling and general administrative expenses as a measure of the fixed costs for the business. These costs are adjusted for the size of the business by dividing by the book value of assets as described in the following equation:

$$OL1_t = \frac{XSGA_t}{Assets_t}$$

where:
$XSGA_t$ is the selling and administrative expenses at time *t*; and
$Assets_t$ is the book value of total assets at time *t*.

The second measure of operating leverage employs a measure similar to Novy-Marx (2011). Employing the FAME data variables, we obtain total costs for the period. However, we have had to remove the depreciation expense as this is included by FAME in the variable. As a result, the following variable is employed as the second measure of operating leverage:

$$OL2 = \frac{XSGA_t + COGS_t - Depreciation_t}{Assets_t}$$

where:
$XSGA_t$ is the selling and administrative expenses at time *t*;
$Assets_t$ is the book value of total assets at time *t*;
$COGS_t$ is the cost of goods sold at time *t*; and
$Depreciation_t$ is the depreciation and amounts written off fixed assets at time *t*.

As with the first measure of operating leverage, this second measure of operating leverage adjusts for the size of the business by scaling the measure by total assets.

Hypothesis summary

The summary of the different hypotheses we intend to test is provided in figure 1.

1. Null hypotheses

	Infrastructure	Non-infrastructure
Asset tangibility	Greater	Lower
Asset illiquidity	Greater	Lower
Asset inflexibility	Greater	Lower
Operating leverage	Lower	Greater

This table presents the null hypotheses that will be tested in this paper.

2. Post matching: differences in mean and median of infrastructure and non-infrastructure samples

	Unlisted		Listed	
Difference in	Mean	Median	Mean	Median
Inflexibility	0.42***	0.02	–5.93	0.5
Operating leverage 1	–0.34***	–0.20***	–0.17*	–0.11*
Operating Leverage 2	–0.98***	–0.70***	–0.49*	–0.22**
Tangibility 1	–0.02***	–0.10***	0.02	0.04
Tangibility 2	0.06***	–0.14***	0.41***	0.57***
Illiquidity 1	–1.46	0.01***	–0.23*	–0.15***
Illiquidity 2	–5.11	0.05**	–0.31***	–0.29**
Illiquidity 3	–6.94	0.08***	–0.14	–0.06

This table presents the results of a difference in mean and the Brown-Mood test for difference in medians for the variable of interest between the matched infrastructure and non-infrastructure samples. $Size_{i,t}$ is log total assets; $Leverage_{i,t}$ is defined as the sum of trade creditors, short-term loans and long-term debt over assets; $\Delta Revenue_{i,t}$ is the percentage change in revenue from time t–1 to t; and $Profitability_{i,t}$ is operating profit at time t divided by total assets at time t. The operating leverage definitions are OL1 and OL2. Asset tangibility 1 and 2 are as defined in the text. Asset illiquidity measures are the WAL1, WAL2 and WAL3, respectfully. The definition of asset inflexibility is as described in the text. *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Data

For this study we look at the UK as it has the largest and longest history of infrastructure investment. The data we use all comes from the FAME database provided by Bureau van Dijk. The FAME database is chosen as it provides financial statement information for both public and private companies in the UK. According to the UK's Companies Act 2006, companies are required to submit company accounts for each financial year to Companies House, the UK's registrar of companies. The FAME database takes its financial statement information from these original accounts and provides 20 years of financial data. The result is a long-term period of analysis that includes major economic shocks.

We use the list of infrastructure firms identified by EDHEC*infra* as the infrastructure sample. This list of firms is identified from government and regulator databases as well as infrastructure news services and is cross checked to ensure the firms are conducting an infrastructure activity as defined by EDHEC*infra*'s TICCS classifications. Each firm is identified by its unique Companies House identifier number, which allows for the collection of their filings. This results in 1,089 unique firms and 21,780 firm years of infrastructure firm observations. Taking into account the date of delisting for listed companies, there are 21,737 unlisted infrastructure firm observations and 23 listed infrastructure firm observations.

For the non-infrastructure firms, we extract accounting items from those companies which are the global ultimate owner, report group financials and are incorporated in the UK (that is, in England, Scotland, Wales and Northern Ireland). This follows the approach of Michaely and Roberts (2013). To ensure that there is no overlap between infrastructure and non-infrastructure firms, we use the firms identified as infrastructure by EDHEC*infra* to filter out any infrastructure companies that appear in the FAME dataset. This results in 10,982 firms and 219,640 firm years of observations. Taking into account the date of delisting for listed companies, there are 211,857 unlisted non-infrastructure firm observations and 7,031 listed non-infrastructure firm observations.

Results

For both listed and unlisted samples, we observe that there is a statistically significant difference in operating leverage between infrastructure and non-infrastructure firms in both mean and median measures. The negative sign implies that operating leverage for infrastructure firms is lower than that of non-infrastructure firms. This supports our hypothesis that infrastructure exhibits a smaller operating leverage than non-infrastructure firms.

For unlisted firms, we also observe that infrastructure has a lower, statistically significant measure of *Tangibility*1 and a higher, statistically significant measure of *Tangibility*2 in terms of mean, and a lower, statistically significant median than non-infrastructure firms for both tangibility measures. For listed firms, we find that infrastructure has a significantly higher mean and median for *Tangibility*2, as compared to non-infrastructure.

Interestingly, for all three asset illiquidity measures, we find no statistically significant difference in means but significant differences in medians between unlisted infrastructure and non-infrastructure firms. For listed firms, in line with our hypothesis, we observe that infrastructure has lower, statistically significant measures of *Illiquidity*1 and 2. For inflexibility, we find that unlisted infrastructure has a statistically significant higher mean than unlisted non-infrastructure firms, which is in line with our hypothesis.

These results indicate that infrastructure is indeed different, possessing the characteristics as described in the infrastructure investment narrative of tangible, illiquid inflexible assets. This finding goes someway to support the infrastructure investment narrative described in Blanc-Brude (2013).

Conclusion

This research identifies infrastructure characteristics, develops measurable proxies and tests whether infrastructure possesses the special characteristics as hypothesised. It shows that the characteristics of asset tangibility, illiquidity, inflexibility and operating leverage are different for infrastructure firms. It illustrates that infrastructure firms exhibit higher asset tangibility, asset illiquidity and inflexibility and lower operating leverage than a control sample of non-infrastructure firms.

The characteristics identified and examined in this paper can go some way to understanding what makes infrastructure different as an investment. Furthermore, it is possible to employ these characteristics to provide a check on whether firms classified as infrastructure actually are infrastructure. One major issue with infrastructure investment is the lack of a commonly agreed definition.

This research can go some way to establish whether assets that have been identified as infrastructure by index providers and other researchers do actually possess the physical characteristics of infrastructure.

Note: The TICCS classification which is used to collect data and build indices by EDHECinfra aims to reflect many of the ideas expressed above.

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Towards a scientific approach to measuring ESG in infrastructure

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This article summarises some of the early findings of a comprehensive review of ESG standards initiated in the context of the Natixis/EDHECinfra research chair

The environmental, social and governance (ESG) aspects of infrastructure investments are immediately visible to investors because of their role in supporting economic and human development, from providing essential services like drinking water and electric power to households and industry to opening access to markets for goods and services.

The importance of ESG to infrastructure investors is clearly demonstrated in the 2019 EDHEC/Global Infrastructure Hub survey of 130 of the largest asset owners in the world: 35% of respondents rated achieving ESG objectives in their infrastructure portfolio as a 'first order question' alongside financial performance (Amenc et al [2019]), almost twice as many as in the 2017 survey wave (Blanc-Brude et al [2017]). The vast majority of respondents in the 2019 survey considered ESG to be either 'important' or 'somewhat important', with only 4% saying that it is 'not important'.

However, the relationship between value and ESG in infrastructure investment is complex. On the one hand, strong performance on ESG metrics may increase financial value if it reduces certain long-term risks but some ESG characteristics might also reduce financial value if they create higher exposure to other risks (eg, renewable energy projects are often exposed to subsidy risk). At the same time, infrastructure investments by their nature generate economic and social value, which may in turn increase or decrease their financial value.

Hence, the value of infrastructure investments is partly conditioned by ESG dimensions, not only because these investments involve the delivery of a valuable service, which may create value beyond the firm's balance sheet through externalities, but also to the extent that they create risks that impact financial value.

For instance, when a potable water distribution network is structured as a private company, making it an investable asset, the delivery of this public service will inevitably have economic and social impacts. This will also create risks in terms of social acceptability of tariffs or withdrawal of service, ability and willingness to pay for what is often considered a basic right, and regulatory interventions. The social, economic and financial value created by the infrastructure for its stakeholders, including the firm's owners, is a combination of these impacts and risks.

Thus, in order to grasp the role of ESG in infrastructure investment, we need a comprehensive understanding of the value of infrastructure, encompassing its social, economic and financial dimensions. This, in turn, requires a detailed typology of the ESG impacts and risks associated with different categories of infrastructure assets and the development of suitable metrics to track and compare performance at the level of individual infrastructure assets and companies.

In the past five years, several efforts to identify a suitable set of ESG indicators for infrastructure have been initiated. Many of these consolidate indicators into a compound single ESG performance score. We conducted an in-depth review of 17 of these ESG evaluation approaches and more than 650 component indicators and reporting items. In this article, we present some key findings of this review and consider the extent to which existing approaches provide useful, credible and legitimate measures of ESG for infrastructure investors. We identify some of the gaps in current efforts and conclude that the next generation of ESG standards for infrastructure investment will need to rest on a scientific and theory-based approach that explicitly links ESG indicators with the economic, social and financial value of infrastructure.

The rise of ESG standards for infrastructure investment

Infrastructure ESG standards are more about investor choices not corporate behaviour

ESG standards and reporting tools belong to a broader group of international accountability standards (IAS)[1], defined as 'voluntary predefined rules, procedures, and methods to systematically assess, measure, audit and/or communicate the social and environmental behavior and/or performance of firms' (Gilbert and Rasche [2008]; Rasche [2009]).

The development of IAS was spurred by demand from stakeholders for more demanding social and environmental standards in multinational firms' international activities, in the context of weak or non-existent national and international regulation of these issues. Gilbert et al (2015) argue that IAS are mechanisms that attempt to fill governance gaps resulting from the rise of a globalised economic system.

Without effective transnational governance to ensure that firms are responsible, accountable, transparent and uphold environmental and social standards, alternative institutions have emerged to monitor companies' ESG performance (Göbbels and Jonker [2003]; Leipziger [2010]; Paine et al [2005]; Waddock [2008]). These developments have been driven in large part by economic globalisation and outsourcing and have been concerned first and foremost with the activities of multinational corporations.

The context is somewhat different in the infrastructure sector, where only a small proportion of firms are multinationals. In the universe of investible firms tracked by EDHEC*infra*, only 8% are categorised as global assets (TICCS® taxonomy, third pillar on geo-economic exposure) out of $2.1trn of enterprise book value and more than half are national or subnational entities. Of course, some infrastructure assets are 'global businesses' such as large airports or ports, but these are a minority. Furthermore, a large proportion of investible infrastructure assets is located in countries with strong legal and regulatory regimes covering corporate governance, accounting, labour and environmental standards.

In addition, infrastructure companies in regulated industries like water supply, airports and power are also subject to sector-specific economic and operational regulation at the national level. Together, these features of infrastructure help to explain why firms in the sector have not felt the same pressure from stakeholders for additional ESG standards – there has been no regulatory vacuum akin to that for transnational firms' production activities.

However, other characteristics of infrastructure generate specific ESG risks. First, infrastructure projects are awarded through public procurement. As public projects, the transparency and fairness of the procurement process is essential to the ongoing social acceptability of the project and therefore comes under intense scrutiny, even years after contract award.

Second, projects which involve the provision of an essential public service, such as water supply, electricity or urban transit, have direct impacts on people's welfare. Tariffs, access and quality of service are politically and socially sensitive and carry the risk of discretionary political or regulatory action. Other infrastructure projects like power generation

1 Standards could be described as pieces of general advice offered to a large number of potential adopters, mostly outside the standardisation organisations. Standards are normative and prescribe what those who adopt them should do, thus requiring or restricting behaviour (Ortmann [2010]).

and waste management present risks for the health and safety of employees and local residents, generating risks of social acceptability and liability for accidents.

A new road, power plant or transmission line is planned and procured by the state or its equivalent. Once they are built and operational, their environmental, social and economic impacts are mostly given. Compared to the scope of decisions to change that is available to other firms, in terms of procurement, production technologies or labour practices, in comparison any change of behaviour of infrastructure firms is only at the margin.[2]

Infrastructure assets are designed to deliver a defined set of services, using a given technology that is selected at the project design stage and typically cannot be changed due to sunk capital costs. Thus, the design and construction stages are critical for owners and managers to make choices which can meaningfully impact the ESG profile of the infrastructure asset. Many aspects of infrastructure asset design standards are covered by existing national regulations, such as noise pollution from new roads in urban centres or wastewater discharge standards. In the majority of cases, self-imposed ESG standards are unlikely to be more stringent and, crucially for investors, there cannot be much variation of outcome within one jurisdiction.[3] However, in some cases, there may be scope for companies to go beyond regulatory minimum requirements to reduce negative social or environmental impacts. Of course within a sector there will be opportunities for improvement in performance and for laggards to catch up with leaders.

ESG considerations for infrastructure companies are therefore not only about the corporate behaviour of the (infrastructure) firm. Just as important is for infrastructure investors to know what services infrastructure companies provide and the location and nature of their assets. Indeed, given the procurement and the initial design choices made, infrastructure companies can be expected to have very significant social, economic and environmental impacts. In particular, they are key contributors to current and future climate change. They also have a well-documented impact on human and economic development.

Beyond their impact, the ESG characteristics of investments are also related to risk management. The academic literature has also explored the role of ESG in the risk management behaviour of the firm. Van Durren et al (2015) show that fund managers do take ESG aspects of the firm into consideration in their risk management process. Albuquerque et al (2019) develop a theoretical model in which a firm's efforts to increase product differentiation through higher CSR investments decreases the firm's systematic risk and increases the firm's value. They also provide empirical evidence that supports their model. Likewise, Ilhan et al (2019) discuss the 'carbon tail risks' that climate change is creating for large firms.

While various stakeholders are mostly concerned with the impact of the firm's activities, its shareholders are also concerned with potential losses, because ESG may also correspond to substantial legal, reputational, operational and financial liabilities (BlackRock and Ceres [2015]; Fortado [2017]). For example, BP's Deepwater Horizon oil spill in 2010 is an event illustrating the importance of having robust environmental policies already in place (Dyck et al [2016]). Thus, an increasing number of institutions actively engage with their constituent firms to manage the risks that are related to the ESG characteristics of the firms in which they invest.

A key role for ESG assessments of infrastructure companies is to allow for asset selection or exclusion by investors in cases of infrastructure companies and assets with specific ESG-related impacts or risks. For example, if a power plant is designed to burn coal, and coal-burning is at risk of being regulated or heavily taxed by the regulator to promote a low-carbon economy, this asset is at risk of becoming 'stranded' and its owners at risk of a significant loss. There is little that the owners of this firm can do to reduce the risk, without simply disposing of the asset. Indeed, other stakeholders who are concerned about the negative environmental impacts of the company typically want the asset to be shut down.

ESG issues for infrastructure companies thus involve both impacts and risks. In order to be useful and sufficiently comprehensive, a set of ESG indicators will need to distinguish between social, economic and environmental impacts of infrastructure assets and companies (which may be risks for other stakeholders) and the risks to which the same companies and assets are exposed due to the social, economic and environmental consequences of their activity.

ESG standards for infrastructure should leave little room for decoupling

A frequent concern in relation to voluntary ESG standards is that adoption of the standard does not always lead to a change of behaviour, a phenomenon referred to in the literature as 'decoupling': maintaining formal adherence to ESG principles while not changing activities (Meyer and Rowan [1991]: 58) or achieving standard certification without continuously complying with standard requirements (Boirai [2003]; Christmann and Taylor [2006]).

Research has shown that decoupling occurs when expectations conflict with internal managerial interests and available resources (Meyer and Rowan [1977]; Oliver [1991]). Decoupling seems particularly likely in cases where firms have a great need for stakeholder legitimacy but limited internal implementation capacity. Standards in the field of corporate social responsibility (CSR) are a case in point. Jamali (2010) found that managers consider such standards to offer a high degree of legitimacy to their organisations but are concerned that their implementation might reduce efficiency. Christmann and Taylor (2006) show that ISO 14001 is more likely to be symbolically implemented if external pressure from customers is high but monitoring practices are weak.

However, several papers have found that practice may catch up with formal adherence over time (Boxenbaum and Jonsson [2008]; Bromley and Powell [2012]; Edelman [1992]; Hallett [2010]; Sauder and Espeland [2009]; Scott [2013]; Tilcsik [2010]). For instance, decoupling in the adoption of the Equator Principles, a set of standards created by infrastructure project finance lenders, was shown to be a transitory phenomenon (Haack et al [2012]). The quality of standard monitoring and implementation appears to be essential to avoid decoupling (Gilbert et al [2015]).

Moreover, the use of ESG standards for portfolio inclusion and exclusion decisions leaves less room for decoupling, especially if key ESG considerations can be clearly identified. For example, if the fuel source of a power plant is public knowledge, investors can have a clear and easily monitored decision rule about whether or not to include the plant in their portfolio.

In order to make ESG standards for infrastructure more useful to investors and other stakeholders, better databases of infrastructure asset location, technology, environmental and social characteristics are needed. Using externally verifiable information will also reveal any inconsistency between investors' infrastructure portfolio decisions and their ESG commitments.

ESG standards for infrastructure will need to be consolidated

ESG schemes for infrastructure investment started appearing after 2006 and have proliferated since 2015. Investors are currently faced with a wide choice of alternative standards but have little clarity on their relative strengths to guide them on the selection of a suitable standard for their needs. In the coming years, infrastructure ESG standards are likely to consolidate, following the pattern of other IAS. Such initiatives have started to appear among standard providers and are also promoted by multilateral organisations like the World Bank group. Consolidation will favour ESG standards which meet the key criteria for indicators: usefulness, validity and reliability.

Several studies show that standardisation is a highly dynamic phenomenon (Brunsson et al [2012]). The research on IAS/ESG standards has shown that these initially proliferate. Kirton and Trebilcock (2004) describe how, 'Competing sets of voluntary standards struggle for dominance, as actors remain unclear about the costs of compliance, or its absence, and about when governments might intervene to impose a potentially different, mandatory regime' (Kirton and Trebilcock [2004]: 6).

While competition does encourage innovation, this multiplicity may be inefficient or ineffective if it hampers meaningful comparison across investments (Derkx and Glasbergen [2014]). Emerging gradually as a result of the uncoordinated actions of various independently operating actors, the rise of global voluntary standards can easily result in an unnecessary duplication of efforts, may undermine the stringency of standards programmes, may lead to consumer (and producer) confusion and skepticism, and may exacerbate third-party concerns regarding the credibility and legitimacy of (private) voluntary sustainability standards and certification schemes (Glasbergen [2013]). Given the international outlook of infrastructure investors, consolidation will make it easier for investors to buy and sell infrastructure companies employing a common standard of ESG assessment and reporting.

Studies of the evolution of ESG standards conclude that standard-setters often fail to explore their complementarities or aim to create convergence within categories of standards. However, the literature suggests that efforts to achieve convergence between similar ESG standards should be encouraged since the market for standards is unlikely to support a variety of competing and overlapping initiatives.

The literature shows that, as they become more dominant, 'soft' ESG standards tend to harden (Gilbert et al [2015]): they can be adopted by regulators and law makers and become a prerequisite for certain business relationships. Ignoring them may become a liability for investors as pressure from stakeholders increases and broadens.

Identifying and prioritising ESG issues for infrastructure, developing appropriate indicators and metrics through a systematic and objective process, will support the consolidation process.

2 In the medium to long term, given enough new capex, infrastructure companies can also be transformed – eg, from fossil fuel burning to renewable energy providers (see Drax in the UK) – but this is a slow and expensive process and essentially amounts to creating new infrastructure assets to replace old ones within the same corporate structure.

3 We acknowledge that this depends partly on the heterogeneity and stringency of construction rules and regulation within each jurisdiction.

In the case of ESG standards for infrastructure companies and investments, the proliferation stage of their development (which is very recent) is still ongoing.

Over the past decade, a number of standard-setting organisations in the fields of fair labour, sustainable tourism and organic agriculture, among others, have established mechanisms of coordination to address common challenges and ensure greater coherence between their efforts. While such efforts have begun, no such meta-governance arrangement has yet emerged for infrastructure ESG standards. Cooperation of this kind could benefit investors and other stakeholders.

Regulatory pressure is also increasing as policy making bodies attempt to create ESG taxonomies (EU Commission) and to promote climate change impact measurement, which will require certain metrics to be recognised and reported by regulatory entities. Central banks and prudential regulators are also increasingly interested in 'green finance', which often means infrastructure investment will require standardised definitions and qualifications of these investments under various financing schemes and mechanisms.

In the next section, we review some of the key issues emerging from a broad review of extant standards and tools to characterise the ESG profile of infrastructure companies and assets.

Key issues found in infrastructure ESG tools, standards and guiding frameworks

Infrastructure ESG reporting schemes differ with regard to important dimensions such as the content and scope of their underlying norms (Jamali [2010]; Rasche [2009]). There is no complete taxonomy of such initiatives, but we follow Gilbert et al (2015) and group them into three categories:

- ESG standards are either used for analysing specific ESG data to certify the ESG performance of companies or as frameworks that serve as a guideline for reporting ESG data;
- ESG tools are used to analyse specific ESG data to produce a specific output such as a rating, score or classification to inform the ESG performance of companies; and
- ESG guiding frameworks, which can be defined as a set of broad principles that help companies approach social, environmental and governance problems. They provide a guideline for action and serve as the foundation of values that responsible companies can attempt to live by.

We reviewed 17 commonly used tools, standards and guiding frameworks (collectively referred to as ESG schemes). These are listed in figure 1. We analysed approximately 700 disclosures and metrics used in these tools and standards to measure or proxy ESG indicators.

The schemes reviewed were selected based on expert opinions and on desk research (Solan [2019]; Hove et al [2020]). The selection of these schemes aimed to capture the broad range of approaches and metrics used in the area of infrastructure ESG and to compare the methodologies currently used to determine the ESG performance of infrastructure companies.

Key issues emerging from this review are discussed below.

Clear and consensus definitions are needed

Measuring infrastructure ESG performance requires a clear definition of both infrastructure and ESG. Extant standards and tools define and approach ESG differently. Although there are clear overlaps in the broader understanding of what constitutes an environmental, social or governance issue, there is no internationally agreed upon taxonomy detailing the ESG impacts and risks (indicators) relevant to infrastructure companies. Likewise, there is currently no consensus on suitable metrics for given ESG indicators.

Different definitions of infrastructure are also used, although standard-setters like GRESB and an increasingly large number of investors use The Infrastructure Company Classification Standard (TICCS®). Other schemes use in-house standalone definitions of infrastructure, with different degrees of overlap with TICCS. Other multi-sector schemes use industry filters such as GICS® which do not isolate infrastructure companies from equipment suppliers and other types of firms active in an industry.

At this juncture, precise and consensus definitions are necessary for regulators to refer to a standard that 'qualifies' assets as falling under one regulatory treatment or another.

Too little focus on risk: Existing schemes are biased towards measuring impact but not risk

We categorised each of the 700 disclosures and metrics in terms of E, S or G, and whether they were measures of impact or risk. Among the three pillars, the environmental pillar had the greatest coverage (48%) followed by the social pillar (28%) and then governance (24%). Most schemes focus almost entirely on reporting and measuring impacts rather than risks: 93% of disclosures are about impact, while only 7% refer to environmental, social or governance risks to which the firm might be exposed. This may be due to recognition of infrastructure's important impacts on the broader economy, perhaps combined with the frequent focus of investors on 'impact investing'.

There is a striking gap in disclosures capturing risks and frequent reference to 'risk management' in the ESG literature. Investors would clearly benefit from the development of ESG indicators adopting a risk perspective to complement impact-focused indicators.

'Materiality' needs to be based on objective criteria

The term 'materiality' is often used in the ESG reporting schemes studied to refer to the relevance and importance of certain aspects of ESG performance. Materiality criteria are introduced to reflect the fact that ESG issues will vary from one type of infrastructure company to another. For example, the materiality of aspects of governance will depend on ownership structure and regulatory arrangements; the importance of social issues will depend on the whether the company supplies essential services, among other factors, while environmental issues will depend on the nature of the activity, technology and location of assets.

In the schemes reviewed, different approaches are used to identify the set of material issues that will be counted towards a final ESG score. Each scheme includes guidelines to help undertake materiality assessments. Some broad criteria are expected to be reported (a power plant should report its carbon footprint) but the choice of method and metric used is typically open-ended (eg, Scope 1, 2 or 3 for GHG emissions) and our research shows that in the majority of cases, these self-assessments are not subject to verification or audit. A small number of schemes do require materiality assessments to be verified or audited or require that they are conducted by an accredited professional or even conduct them directly. These assessments are much more robust within their given framework.

Discretionary approaches to materiality are problematic for two reasons. First, letting companies determine the materiality of their reporting creates opportunities for them to bias results and could lead to some decoupling: when self-reporting materiality, companies have some control over the weights of different inputs that go into their ESG assessment. Second, the fact that companies find indicators to be not material suggests that indicator sets have been constructed as laundry lists containing all possible issues, rather than on the basis of a sound theoretical framework that would provide an objective basis for prioritisation and tailoring indicator sets for comparison across assets within the same category.

Materiality should be defined ex ante in terms of what first-order issues are the most relevant given the asset, technology, location and corporate structure of each infrastructure company.

ESG is not necessarily additive

The standards and taxonomies we reviewed are lists of characteristics that fall into one of two groups:

- Absolute benchmarks representing

1. List of ESG schemes reviewed

Scheme	Category	Classification system
SuRe	Standard	No classification available. It is applicable to all types of infrastructure projects.
SASB	Standard	In house classification SICS (Sustainable Industry Classification System)
GRI Standards	Standard	The GRI standards programme that will propose an in-house classification is under development.
GRESB Infrastructure Asset Assessment	Tool	TICCS (The Infrastructure Company Classification Standard)
MSCI ESG Ratings	Tool	Not applicable for ESG ratings, but MSCI infrastructure indices use GICS® (Global Industry Classification Standard)
IS Rating Scheme (Australia/New Zealand)	Tool	In-house classification
RepRisk Index and Ratings	Tool and database	Not applicable
Refinitiv ESG Scores	Tool and database	In-house classification: Thomson Reuters Business Classification (TRBC)
EU Taxonomy	Tool	Recommendations are structured around the EU's NACE (Nomenclature des Activités Économiques dans la Communauté Européenne) industry classification system
CEEQUAL (International)	Tool	No classification available. It is applicable to types of infrastructure projects.
Envision rating tool	Tool	In-house classification
Sustainability and Resilience SmartScan	Tool	No classification available. It is applicable to all types of infrastructure projects
PRI	Guiding principles	Not applicable
Equator Principles	Guiding principles	Not applicable
IFC Environmental and Social Performance Standards	Private regulatory framework	In-house classification
PPIAF	Advisory facility	In-house classification
SDGs	International development goals	Not applicable

a pre-existing categorial imperative ('It's absolutely better not to employ slaves.' 'It's absolutely better to emit less CO_2 per unit of output', etc).
- Relative benchmarks to compare companies ('Company A is relatively better at managing social concerns about its activity than Company B.' 'Company C is relatively less good at reporting its environmental impact on wildlife than other companies that have an impact on wildlife', etc)

These measures are typically not directly additive. Yet, most of the schemes reviewed in this study aim to produce a single compound score or rating that aggregates all aspects of the ESG characteristics of infrastructure companies and assets. This score is typically obtained thus: 1) list relevant (material) ESG indicators, 2) collect data to report, 3) convert this data into a single measure. Each scheme approaches these steps differently: the list of indicators and their organisation, the type of data that can be used and the way the scores or ratings are computed (absolute or relative) all differ.

However, the assumption that ESG scores can be added is not based on a coherent theoretical foundation. It is clear that a company's activities could result in environmental or other negative impacts that are not mitigated by transparent governance or high safety standards for its own workforce. The notion that certain negative impacts within a pillar can be offset by other actions (eg, carbon offsets) may be acceptable, but it is not coherent to imply that performing well on social issues somehow offsets a contribution to greenhouse gas emissions and climate change.[4]

This practice may also be a source of decoupling. Indeed, a number of issues, however 'material' in the absolute (eg, gender equality) are not direct substitutes for what should be considered first-order issues in certain infrastructure sectors (eg, burning coal in the electric power sector).

Jay Clayton, the chairman of the Securities and Exchange Commission (SEC), said as much in May 2020 when he warned about the risks of relying on simplistic ratings when considering environmental, social or governance issues as part of an investment decision. The Financial Times reported Clayton as saying, 'I have not seen circumstances where combining an analysis of E, S and G together, across a broad range of companies, for example with a 'rating' or 'score', particularly a single rating or score, would facilitate meaningful investment analysis that was not significantly over-inclusive and imprecise" (Financial Times, 28 May 2020).

Instead of taking the arithmetic mean of social, environmental and governance score, final ESG scores could be conditional on, for example, meeting minimum thresholds in each pillar that could be used to exclude assets from portfolios.

Hence, meeting objectives in the social pillar, like gender equality on the board, can be monitored and rewarded with a high social score, but should be treated as a separate filter from environmental impacts of design choice, like the fuel source for power generation technology. Likewise, exposure to physical risks due to climate change should be reported on and monitored separately from a measure of governance risk like the incidence of corrupt procurement practices.

Strike a balance between detail and cost

ESG schemes for infrastructure investment range from tools that are broad, flexible and require no user input to standards that are extremely rigorous, relatively inflexible and require extensive data collection, reporting, validation and auditing exercises. The former are relatively cheap to apply ($4,000 per year for all assets), compared to $60,000 per asset assessed for the latter. Currently, reporting cost considerations dominate the choices made by firms. The more directive, stringent and demanding standards are seldom, if ever, used. Conversely, more generic and self-reported scoring tools are growing fast, as ESG reporting becomes more de rigueur.

There is no doubt that ESG reporting is a cost for companies which they can be expected to try and minimise. However, this will be problematic for investors who require a sufficient level of detail to take informed exclusion decisions, or to respond to the concerns of their stakeholders about the environmental and social performance of portfolio firms. Only when rigorous standards become more dominant will firms consider the trade-off between reporting costs and credibility more seriously.

Towards a scientific approach to ESG in infrastructure

The recognition of the importance of ESG on the part of infrastructure investors underlines the need for high-quality ESG standards.

The work done by a number of organisations to develop and roll out such standards in a relatively short period of time has created a positive dynamic for ESG reporting and measurement in the infrastructure sector. As suggested above, such standards have identified numerous aspects that are relevant to ESG in infrastructure and proposed a range of ways to report information about them.

In line with the development of other accountability standards, ESG standards will need to move from an initial phase of innovation and experimentation towards consolidation and maturity. A set of standards is needed which is:
- Useful – relevant to goals of investors and other stakeholders;
- Credible – based on a sound theoretical foundation and objective, rigorous approaches to indicator selection and prioritisation, scientifically sound and technically robust; and
- Legitimate – developed in a way that inspires the trust of stakeholders.

Today, what is missing to drive forward the development of ESG standards for infrastructure investment and reporting is a scientific, theory-based approach to developing the indicators, sub-indicators, typology of risks and impacts and the metrics or factors that would allow documenting them.

In particular, a general theory of the value of infrastructure companies and assets, including their economic and social value, and how these dimensions interact with financial value to support the process of consolidation and refinement of indicators for the sector.

The absence of focus on risks to the firm owning the asset and the possibility of material financial losses for investors in existing ESG standards suggests that current standards are not yet fit for purpose to be integrated in prudential and risk-based investment frameworks.

The next generation of ESG standards for infrastructure investors will take into account the links between ESG and value, including economic and social value to develop more salient ESG indicators and factor taxonomies.

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4 This is also true of course outside the infrastructure sector: for example, Citigroup credit analysts highlighted in a report how companies in industries criticised by environmental or health campaigners, such as oil or tobacco, are able to get high ESG marks because the scoring systems favour companies with clear policies. They might have high scores in fair labour practices, board composition or shareholder rights that increase their overall ESG ratings (Poh [2019]), helping them compensate for their environmental scores.

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The evolution of TICCS

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An industry standard to define the infrastructure asset class

A consultation took place last year to review and develop The Infrastructure Company Classification Standard (TICCS®). It was followed by an extensive review by the TICCS Review Committee (see box) and the official publication of the TICCS 2020 Taxonomy in March 2020.

This article summarises what market participants had to say about the classification standard and how the independent TICCS Review Committee took these inputs on board and supported the creation of an updated taxonomy.

The TICCS view

TICCS is not strictly speaking a definition of what is and what is not 'infrastructure' but a taxonomy designed to organise in an objective manner the constituents of the infrastructure investment universe.

To this end, TICCS relies on a set of fundamental assumptions about what makes infrastructure companies different from other businesses. These assumptions are rooted in financial economics and academic insights into the nature of such investments.

In that sense, TICCS is normative: it is not enough to be labelled 'infrastructure' or to be 'infrastructure-like' to qualify under the taxonomy.

Instead a number of fundamental economic criteria have to be present for a company and its assets to be meaningfully designated as infrastructure:

- Single-use investment: infrastructure assets can be described as 'relationship-specific', ie, the investment required only makes sense in the context of a 'relationship' – typically a contract, licence or concession, which justifies the demand or usefulness of the investment.
- Sunk or irreversible capital investment: a relationship must exist for infrastructure investment to take place because the initial capital expenditure is 'sunk', ie, irreversibly invested and unusable for any other purpose than the one originally intended.
- Large size requiring a long repayment period: not only are infrastructure investments sunk, they must be sizeable in absolute terms, making the repayment period necessarily long (multiple decades).
- Inflexible total cost structure: operating infrastructure at its design capacity implies highly predictable fixed (operating, maintenance and capital) costs and low variable costs, resulting in an inflexible cost structure. In turn, investing in infrastructure requires a higher degree of certainty in future revenue streams, which underpins the requirement for long-term contracts, especially since infrastructure assets have little to no alternative uses.
- Infrastructure as a service: infrastructure companies have value because their assets provide a useful service to its users, the demand for which is the sole justification for the investment. Thus, despite consisting mainly of large tangible, immobile assets, the nature of infrastructure assets and the business of infrastructure companies is to provide a service.
- Not a store of value: it follows that, unlike other 'real' assets such as land, building, commodities or art, infrastructure investment cannot be considered as a store of value. Infrastructure assets must be useful (and infrastructure companies provide a service) for them to have (social, economic and financial) value.

Assets and companies that can be categorised under TICCS are expected to meet these fundamental criteria. All of them stem from the long-term and durable nature of infrastructure assets and the companies that hold them and the commitment of their owners to only recoup the value of their investment over a long time period.

TICCS takes these myriad perspectives into account and uses a four-pillar multi-criteria approach that uses a number of academic insights about the industrial nature as well as financial economics of infrastructure companies:

- A business-risk classification takes into account the financial economics of infrastructure companies, in particular the role of contracts and regulation.
- An industrial classification uses a very granular taxonomy of industrial activities, technologies and asset-level characteristics that captures the potential diversity of infrastructure companies' services and products.
- A geo-economic classification captures the degree of common economic exposure of different infrastructure companies.
- Corporate governance classification reflects the expected difference of behaviour between single-project and multi-project infrastructure ventures.

The 2019 consultation

The 2019 TICCS market consultation took place between May and September 2019. The objectives of the consultations were:

- Whether each TICCS pillar serves a clear purpose;
- Whether there are categories under each pillar that should be added, revised or removed;
- Whether any other pillars should be considered; and
- How TICCS is useful to their organisation.

One hundred and twenty responses were provided, mostly by asset owners and managers but also consultants and regulators.

Of the respondents, 69% considered TICCS 2018 to be appropriate, with no changes required. The remaining 31% of respondents had comments or

required clarifications about the classification. These comments and suggestions were then passed to the TICCS Review Committee for its consideration and expert opinion.[1]

The rest of this article includes the key January 2020 recommendations of the Review Committee and a discussion of most of the suggested changes or clarifications. Note that a number of suggestions were aggregated, and a few were excluded because they were not considered relevant.

Recommendations of the Review Committee (January 2020)

A pure taxonomy
The consultation report prompted several comments regarding hybrid business models, in which companies cross multiple classifications within the same pillar. The consensus of the TICCS committee members on the call was that the classifications should remain pure, without making accommodations for hybrids. Individual users of the TICCS classifications may use them however they want, of course, including placing companies into multiple classifications. Additionally, we may recommend publication of a Q&A document regarding suggested practices for users to classify these companies.

A granular taxonomy
The consultation report included several comments suggesting more granular classifications for the business risk and industrial classification pillars. The committee discussed that workable indices are unlikely to be possible in the near-term for classifications that get too granular, given that EDHEC currently publishes indices only where there are at least 25 constituents in a classification. The opinion of the committee is that we should allow classifications to get quite granular even if they do not contain sufficient constituents at present for an index, because users may still find the classifications useful for their internal purposes.

A normative but open taxonomy
The committee discussed whether the TICCS classifications should in principle be descriptive or normative or somewhere in between. It is apparent that many investors are expanding their definitions of infrastructure, and/or are investing in assets that may or may not have the physical and/or investment characteristics that investors look for in infrastructure. The consensus of the committee seemed to be that TICCS should be normative but open: we should work together to exclude investments that do not meet some basic guidelines to be considered infrastructure, but that we be willing to expand and shift the classifications over time. The committee agreed that these guidelines will not constitute a definition of infrastructure, but rather mere guidelines for whether an investment should be included in TICCS or not.

Note: the above is verbatim from the Review Committee's minutes. Committee members also provided detailed feedback and voted on each of the 70-plus material questions or suggestions made by the 120-plus consultation participants. What follows was edited by EDHECinfra to aggregate the comments and suggestions provided by respondents to the consultation and the Review Committee.

Consultation and review outcomes

The vast majority of respondents were happy with TICCS and found it clear and useful. Most of the comments in the consultation report were granular, focusing on specific points of specific classifications, especially within the industrial pillar.

Pillar one (Business Risk)
- 83% of respondents to the 2019 TICCS consultation considered this pillar to serve a clear purpose.
- Is more granularity needed? The committee noted that there is a trade-off between classifying information in a granular manner and the cost of doing so. We also note that when information about a business risk category may apply to any subclass (eg, index-linked or with a certain type of counterparty) then this information is an attribute of the firm in this class but does not justify creating a new subclass, since all branches of the taxonomy would then have the same subclasses.
- The committee argued that more precision is probably needed to better define terms like 'contracted', in particular with regard to how much time remains in the contract and what proportion of revenues is contracted. What about contracts that are short term but are known to be renewed automatically? Likewise, the proportion of contracted revenues and the horizon (or remaining length) of the contract were raised as needing clarification. Implementation guidelines are suggested in TICCS 2020.
- Indexed revenues: Contracted revenues may be linked to an index. While this is important to many investors in infrastructure, this is an attribute of the company's business risk classification but not a category in itself. As a result, TICCS does not distinguish between contracted revenues that are index-linked and contracted revenues that are not.
- The question of knowing whether only business volume or tariff was contracted is considered covered by the fully contracted category (BR10). This question was also raised for merchant companies but the answer remains the same.
- The nature of contract counterparties (eg, public or private) are also attributes (like indexation) of a contracted revenue stream and thus may apply to several subclasses. Moreover, the corporate or public nature of the counterparty, while highly relevant, is not a systematic discriminant between companies – ie, some corporates are more creditworthy than some governments and vice versa.
- Distinguishing between companies with contracted inputs (costs) versus contracted revenues. Business risk classifications pertain to the business model of infrastructure companies and thus focus on the nature of their revenue stream, and not on other cash flows.
- It was suggested to include mixed models combining, for example, regulated tariffs and subsidies. However, creating hybrid classifications is discouraged and public subsidies are not a relevant discriminant between types of infrastructure companies. See Review Committee main recommendations.
- Caps on revenues and minimum revenue guarantees are already covered by the price-cap regulation (BR31) and partially contracted (BR11) categories, respectively.
- Updating definitions/synonyms:
  - ◆ Feed-in tariffs (FIT) is moved to the partially contracted class (BR11) because only price is contracted while volumes are typically predictable but not contracted.
  - ◆ Tolling agreements is moved to the fully contracted class (BR10).
  - ◆ Shadow tolls: continue to be considered partially contracted from the standpoint of equity owners. A senior lender may consider a shadow toll arrangement to be fully contracted if revenues for the first traffic band cover senior debt repayments in full.
- Removed synonyms:
  - ◆ Renewable obligation certificate (ROC) is removed from the contracted category because it is a market instrument and may be found under different business models.

Pillar two (Industrial Activity)
Proportion of respondents to the 2019 TICCS consultation who answered that the following Industrial Activity super-classes served a clear purpose:
- Power (IC10) – 80%
- Environmental Services (IC20) – 67%
- Social Infrastructure (IC30) – 88%
- Energy and Water Resources (IC40) – 63%
- Data (IC50) – 73%
- Transport (IC60) – 88%
- Renewables (IC70) – 80%
- Network Utilities (IC80) – 71%

It was suggested that certain activities be re-organised within their own water super-class. The Review Committee did not provide a clear recommendation on this topic. EDHEC*infra* considered this option but concluded that the current distinction between 'network' businesses (including water utilities) and standalone assets (eg, water treatment plants) is warranted and reflects the fundamental economic mechanisms at play in infrastructure.

Suggested new asset subclasses were considered by the Review Committee and also the fundamental economic criteria described above.

To be newly included:
- Crematorium (IC304040) under Health and Social Care Service (IC3040)
- Waste Incineration (IC201040) under Waste Treatment (IC2010)
- Hight Speed Rail Lines (IC604020) under Rail Companies (IC6040)
- Freight Rail Rolling Stock (IC604030) – See 'Treatment of leases' below
- Passenger Rail Rolling Stock (IC604040) – See 'Treatment of leases' below
- LNG Ships (IC401050) under Natural Resources Transportation Companies (IC4010)
- Floating Storage Units – FSU (IC404040)
- Gaseous Waste Treatment (IC201040) under Waste Treatment (IC2010)
- Carbon Capture (IC204040) under Environmental Management (IC2040)
- Data Distribution Companies (IC8060) and Data Distribution Network (IC806010)

Suggestions not to be included:
- Water rights
- Recycling
- Air pollution
- e-waste treatment
- Food and agro projects
- Private coaching and tuition

1 2019 Consultation Results are available online: https://tinyurl.com/y8pg73gl

- Zoos
- Stevedoring, navigational aids and dredging
- Smart meters
- Electric vehicle charging
- Ferries and water-based transport
- Sea containers

Suggestions that were already covered in TICCS 2018:

- Distributed generation
- Military bases
- Senior housing
- Bus stations
- Batteries and pumped storage

Subclasses to be removed

- Amusement Parks (IC305050): do not meet the fundamental economic criteria for long-term investments.

Renaming of subclasses

- Solid Waste Treatment (IC2010) is renamed Waste Treatment to allow for gaseous waste.
- Water Treatment (IC2020) is renamed Water Supply and Treatment to reflect the inclusion of dams among others.
- Pipeline Companies (IC4010) is renamed Natural Resources Transportation Companies to accommodate LNG shipping among others

Pillar three (Geo-Economic)

- 92% of the consultation respondents found the third TICCS pillar to serve a clear purpose.
- While this this pillar could be made more granular it was felt by the Review Committee that users of TICCS would prefer taxonomies to be simple and clean with minimal overlap and were comfortable applying weights in-house.
- Implementation criteria or guidelines were felt to be needed to determine what matters the most and how to relate assets with one another. See TICCS 2020 implementation guidelines.

Pillar four (Corporate Governance)

- 69% of the consultation respondents found the fourth TICCS pillar to serve a clear purpose.
- The Review Committee agreed that the distinction between project finance and corporate entities is important.
- Choice of corporate entity: The corporate entity to be considered should be the one that best represents the infrastructure business as a whole. In other words, TICCS does not determine whether the HoldCo, BidCo or ProjCo should be considered. This is a matter of judgement to be exercised on a case-by-case basis, depending on the nature of these corporate structures. For example, if the HoldCo carries most of the debt related to the underlying investment (eg, Heathrow) then it would be considered the most relevant level for the purpose of identifying or classifying infrastructure investments.
- Role of leverage: The distinction between projects and corporates aims to capture expected differences of behaviour between firms. These differences are primarily driven by the purpose for which the firm was created and the balance between the control rights of equity owners and those of external creditors. Yet the choice of classifying firms on the basis of a 50% senior debt threshold could be arbitrary. The reference to the level of gearing is removed and replaced by a qualitative criterion about the presence of external senior debt: Creditor Oversight.
- Because this distinction is only material for project finance companies, whereas corporates almost always have senior debtors, it is only maintained for project companies (CG11 and CG12) and abolished for corporates which only have a single class (CG20).

Trans-pillar issues

- Some respondents expressed concerns about the overlap between pillars: Indeed, some classes tend to be correlated across pillars. For instance, network utilities (IC80) tend to be corporates (CG02). TICCS ignores such correlations but applying TICCS allows documenting the structure of the investment universe empirically in terms of each pillar. Thus, the largest share of the investible market on the equity side is made of corporate utilities.
- Treatment of leverage: it was suggested in the consultation that that leverage, as driver of the risk-return profile of an infrastructure investment, should be considered as discriminant between investments. The Review Committee suggested that this was relevant but not necessarily the basis for a new category of assets. EDHEC*infra* finds that leverage is not specific to any given infrastructure company. While leverage is empirically higher or lower in certain business risk, industrial or corporate governance categories, it is not specific to any of them and if also found to vary with the credit cycle, local credit markets, etc. Moreover, in the fourth TICCS pillar, the presence of senior leverage is meant to capture a different phenomenon: the extent of the oversight exercised by third-party creditors, which is fundamentally different in project and corporate finance settings.
- Treatment of leases: It is important to distinguish between finance leases (operating and maintenance costs covered by the lease for the life of the asset) and operating leases (operating and maintenance costs covered by the owner and the lease terms are short term). Only finance leases should be considered to be infrastructure investments.
- Treatment of rolling stock: only rail rolling stock, ships, aeroplanes or satellite investments that are structured as finance leases should be considered infrastructure under TICCS.
- Some respondents suggested using bank-only metrics to categorise companies such as life-cover ratios. This was rejected for the same reasons than the ones pertaining to the treatment of leverage and also because this data is typically not available to any party but the lender.
- Treatment of the firm lifecycle – should the taxonomy recognise 'greenfield' investments including the scope of works. The committee noted that this is difficult to determine empirically. It was also mentioned that construction risk is largely idiosyncratic in nature. EDHEC*infra* agrees with this view: while the greenfield stage of an investment is typically riskier and does command higher returns (see EDHEC*infra* asset pricing methodology) it is also a passing stage in the life of an infrastructure asset or company.
- Are TICCS classes and subclasses predictors of financial performance? TICCS is also about risk. However, TICCS is not designed to discriminate between pure sources of systematic risks in infrastructure companies. Rather, as a taxonomy of infrastructure companies, TICCS aims to be an exhaustive list of objective, real world, distinguishing characteristics – ie, a system to organise information about actual firms. Each TICCS pillar captures a different dimension of what makes infrastructure companies unique and relatively more homogenous. In that sense, the TICCS pillars capture differences in aggregate risk profile that represent combinations of systematic risk factors, but these are not the object of the taxonomy.

TICCS governance

The TICCS Review Committee is composed of 15–20 members, including one chairman and one secretary, that represent different aspects of the infrastructure investment ecosystem. It aims to include an equal number of asset owners (pension plans, insurers, etc) and asset managers or commercial banks as well as other standard-setting bodies, regulators and academics.

TICCS Review Committee members are formally invited by the Management Committee either at the invitation of the members or to replace members who have left. The Review Committee includes a chair and a secretary who are tacitly re-appointed each year unless they resign or a new appointment is required.

The positions taken by the members of the Review Committee are not binding with respect to EDHEC*infra*, EDHEC Business School or to their own institution. Participation on the Review Committee takes place without any remuneration or compensation and members' expenses are not reimbursed.

In 2020 members of the TICCS Review Committee include:

- Andrew Knight (RICS) – Chairman
- Avi Turetsky (Landmark Partners) – Secretary
- Mark Blair (OTTP)
- Patrick Boylan (BlackRock)
- Anne-Christine Champion (Natixis)
- James Davis (OPTrust)
- Christophe Dossarp (SOURCE)
- Marie Lam-Frendo (Global Infrastructure Hub)
- Trevor Lewis (Asian Development Bank)
- Christoph Manser (Swiss Life)
- Laurence Monnier (Aviva Investors)
- Petya Nikolova (New York City Comptroller's Office)
- Paul Shantic (CALSTRS)
- Marija Simpraga (LGIM)
- Nicholas Tan (Clifford Capital)
- Rick Walters (GRESB)

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