

# Infrastructure investors should abandon absolute return benchmarks

Lessons from the Covid-19 lockdowns

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## Noël Amenc

Professor of Finance, EDHEC Business School

## Frédéric Blanc-Brude

Director, EDHECinfra

## Abhishek Gupta

Investment Solution Specialist, EDHECinfra

## Leonard Lum

Analyst, EDHECinfra



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**Noël Amenc** is Professor of Finance and Associate Dean for Business Development at EDHEC Business School and the founding Chief Executive Officer of Scientific Beta. Prior to joining EDHEC Business School as founding director of EDHEC-Risk Institute, he was the Director of Research of Misys Asset Management Systems. He has published extensively in finance journals and contributed to four books on quantitative equity management, portfolio management, and alternative investments. He is a member of the editorial board of the Journal of Portfolio Management, associate editor of the Journal of Alternative Investments, and member of the advisory board of the Journal of Index Investing. He is also a member of the Finance Research Council of the Monetary Authority of Singapore. He was formerly a member of the Consultative Working Group of the European Securities and Markets Authority (ESMA) Financial Innovation Standing Committee and of the Scientific Advisory Council of the AMF (French financial regulatory authority). He holds graduate degrees in economics, finance and management and a PhD in finance.

**Frédéric Blanc-Brude** is the Director of EDHEC Infrastructure Institute, a dedicated research unit developing a unique body of applied research on infrastructure investment from the perspective of large asset owners. He is also the CEO of Scientific Infra, a provider of unlisted infrastructure equity and debt index data and analytics. He joined EDHEC-Risk Institute in 2012 after 10 years of private sector experience in the infrastructure finance field, and direct involvement in more than USD6bn of transactions. His research work focuses on asset pricing applied to highly illiquid assets and the stochastic modelling of cash flows in infrastructure projects. He has published papers in economics and finance journals, recently co-authored a book on the valuation of unlisted infrastructure equity and debt investments and is a regular contributor to the press. He is a member of the editorial board of

the *Journal of Alternative Investments*. He holds a PhD in Finance (King's College London) and degrees from the London School of Economics, the Sorbonne, and Sciences Po Paris. He is a regular contributor to the G20 working group on long-term infrastructure investment, has advised the European Insurance and Occupational Pensions Authority (EIOPA) on the prudential treatment of infrastructure investments and also represents EDHEC on the Advisory Board of the Global Infrastructure Facility of the World Bank. EDHEC*infra* was founded in 2016.

**Abhishek Gupta** is Investment Solution Specialist leading the applied research of unlisted infrastructure indices and advising solutions to prospective clients. He has asset-management industry experience, including working as a quantitative analyst with a private fund manager. He holds a Masters of Science in Financial Engineering from Nanyang Business School and a Bachelor of Technology from the Indian Institute of Technology.

**Leonard Lum** is a Data analyst. Prior to joining EDHEC*infra*, he worked for a large custodian bank providing accounting and asset services. Leonard also has experience in the fintech and insurance industry. He holds a Bachelor of Science (Honours) in Accounting and Finance from the University of London and is an associate member of CPA Australia.

# Executive Summary

This paper argues that there is no reason for investors in unlisted infrastructure to continue using absolute return or 'cash +' benchmarks. It calls for investors to abandon them and adopt market-relative benchmarks based on fair value and representative data.

This change from an absolute reference to a relative one would provide a better appreciation of the risks and performance of infrastructure investments and as such would allow taking more informed investment decisions.

We note that in a recent global survey, most of the industry supported this view. In practice however, many of them still use an absolute benchmark that fails to represent the risks of their infrastructure investments.

From the viewpoint of the state of the art in financial research, there is no reason to use absolute return benchmarks: backed by empirical evidence, we argue that infrastructure investments are not market-neutral and that investors in infrastructure cannot escape the fact that the prices they pay for assets are formed in a market, where systematic risk exists. In effect, it is for this very reason that we can speak of an infrastructure asset class. However unlisted and illiquid, infrastructure asset prices and returns, just like other listed or unlisted assets, are first made of *beta*.

In some cases, unlisted infrastructure investments can also deliver *alpha*.

To demonstrate the added value for investors and managers alike to switch to benchmark-relative infrastructure investing, we build peer-group portfolios of large asset owners and large asset managers and compare their performance to that of the broader market.

We show that investors can use market benchmarks to understand their performance during the Covid-19 lockdown episode meaningfully, but also to measure out-performance over the long run. With absolute return benchmarks, all investors will under-perform in 2020, which is just as uninformative as the pre-Covid-19 situation, when all infrastructure investors beat their absolute return benchmark every year.

We find that the two main peer groups of infrastructure investors have actually been able to deliver alpha and as such have significantly outperformed the unlisted infrastructure equity market as a whole.

This alpha, however, only exists relative to a market beta. It is illusory to pretend that it can exist by itself. And the only way to measure it is to use a market benchmark.

In practice, absolute return benchmarks have dominated unlisted infrastructure investment so far because there was little alternative. In spite of their understanding of the usefulness of using a relative benchmark, many investors in unlisted infrastructure have continued to use absolute benchmarks because they considered that available relative benchmark solutions were not adequate.

Indeed, we also show that benchmarks created using appraisals or listed proxies proved to be so unrepresentative, biased and generally inadequate that investors were left with the option of using absolute return benchmarks as the lesser evil.

However, recent progress has changed this situation and a modern approach to benchmarking unlisted infrastructure portfolios is now

Table 1: 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% VaR	Maximum drawdown	Duration (years)
Infra300	N/A	-6.37%	15.11%	12.87%	25.86%	13.75%	9.28
Contracted infrastructure	BR-1	-5.00%	15.60%	11.46%	20.70%	10.35%	7.73
Merchant infrastructure	BR-2	-9.62%	17.04%	14.83%	26.56%	21.60%	10.13
Merchant Road companies	BR-2, 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.

Table 2: Performance of Large Asset Manager and Large Asset owner Peer Groups

Total Returns	Large Asset managers	Large Asset owners	Benchmark (infra300)
2020 Q1#	-9.20%	-6.43%	-6.37%
3 years	11.55%	9.93%	6.91%
5 years	11.08%	9.43%	5.55%
10 years	19.16%	17.90%	15.11%
Market beta*	0.93	1.09	
Peer group alpha	159bp	81bp	

Source: EDHEC*infra*. The Q1 2020 return is a quarterly figure. \*Quarterly returns in local currency Q1 2010 to Q1 2020, Adjusted-R<sup>2</sup> for AM peer group is 75% and 89% for the AO peer group.

possible. More representative data and mark-to-market asset pricing are possible and have been developed in recent years.

The Covid-19 crisis has drawn attention to the risks to which particular types of infrastructure, like motorways or airports, are exposed. This has led to a stronger demand from investors and regulators to measure the impact of the crisis on the profitability of infrastructure and to better understand the impact of the crisis on different types of infrastructure assets or managers.

Naturally, absolute benchmarks cannot answer such questions since they are indifferent to market events, or the risks to which each segment of the class is expected to be exposed. It is in this context that the use of a fair, representative, market-relative benchmark for the unlisted infrastructure asset class becomes even more important.

Our results highlight the range of risk-profiles and drivers available to investors in the unlisted infrastructure space as shows in table 1.

They also show that the impact of the Covid-19 lockdowns have been very different in different

segments of the sector: returns have been impacted negatively by much lower cash flows in the transport sector, but also by interest rate movements in all sectors and by a varying uptick in the risk premia of each asset depending on their sector and individual characteristics. We detail all these effects in the paper.

We also show that equipped with proper benchmarks, investors can tell their unlisted infrastructure market beta from their portfolio alpha. Using data for the actual investments of two key peer groups (large asset managers and large asset owners) we find substantial market outperformance especially for large asset managers, as shown in table 2, as well as different impact of the Covid-19 lockdowns for each peer group.

The realisation amongst 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:

- requires documenting the risk exposures created by their infrastructure investments;

- requires benchmarking performance relative to the market index or customized benchmark that best represents these risks and creates better aligned incentives in terms of fees; and,
- allows for a better integration of infrastructure assets in the total portfolio, including for asset-liability management purpose.

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

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

With proper benchmarks numerous applications are possible that will bring unlisted infrastructure forward as a fully-fledged asset class. Courageous and insightful investors will opt for transparency and relevance by letting go of absolute benchmarks that are now outdated.

# 1. Introduction

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Today, absolute return benchmarks are the norm in the unlisted infrastructure investment sector. These benchmarks typically use a "cash +" approach including *ad hoc* risk and illiquidity premia in addition to an often equally *ad hoc* choice of risk-free rate. Still, absolute return benchmarks are completely inadequate when it comes to understanding risks, 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.

We show also that the Covid-19 lockdowns acted as a revealer of the risks embedded in infrastructure investments. After a negative shock that could not be ignored, the different risk profiles of infrastructure assets is now apparent to investors. Our analysis reveals key differences within the asset class as well as common risk factors. We describe the different impacts of Covid-19 on different types of infrastructure investments, and the range of risks that exist across the asset class.

We also analyse the determinants of the Covid-19 impact on infrastructure investment returns by differentiating between the role of cash flows, interest rates and risk premia on the valuations of unlisted infrastructure assets at the end of the first quarter of 2020.

Finally, we demonstrate the added value for investors and managers alike to switch to benchmark-relative investing in the case of unlisted infrastructure: we build peer-group

portfolios of large asset owners and large asset managers and compare their performance to that of the broader market. We show that investors can use market benchmarks to understand their performance during the Covid-19 lockdown episode meaningfully, but also to measure out-performance over the long run. With absolute return benchmarks, all investors will underperform in 2020, which is just as uninformative as the pre-Covid-19 situation, when all infrastructure investors beat their absolute return benchmark every year.

In conclusion, we argue that absolute return benchmarks served a purpose as long as too little usable 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 i.e. one that has a market benchmark.

The rest of the position paper is structured thus: section 2 raises our question 'why do infrastructure investors still use absolute return benchmarks?' Sections 3 and 4 discuss and rebuke the two main arguments in favour of using such benchmarks, namely that infrastructure investment is market-neutral and that absolute return benchmarks are the least bad option available. Next, section 5 describes how better data and asset pricing now makes market-to-market valuations of unlisted infrastructure available to investors. Using this new data, section 6 further describes the range of impacts of the Covid-19 crisis on the performance of infrastructure investments. Finally, section 7 shows that different peer groups of infrastructure investors have performed differently relative to the market during the Covid-19 lockdowns and also over longer periods of time. Section 8 concludes.

## 2. The widespread use of absolute return benchmarks in infrastructure investing

In April 2019, EDHEC*infra* published a global market survey<sup>1</sup> 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 USD10Tr 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 stylized facts about industry practices and perceptions (see Table 3).

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 to 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;
  - ➔ 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 to 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.

The use of absolute return benchmarks as also been vilified in the academic literature with regard to other alternative asset classes such as hedge funds or private equity. Waring and Siegel (2006) provide a useful summary of these critiques, and Gompers *et al* (2016) a review of the uses and abuses of absolute performance benchmarks by private equity managers.

Which begs the question: Why do investors use absolute return benchmarks when their 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 like private equity or real estate.

In addition, the choice of a more complex metric could have adverse consequences for investment teams. For instance, switching to a relative benchmark that is not representative of unlisted infrastructure like a listed infrastructure or bond index may not help portray the performance of a private infrastructure manager or team in a fair manner. Hence, there can be resistance to change.

1 - with the support of the G20's Global Infrastructure Hub



Table 3: Key results of the EDHEC*infra* Survey of Benchmarking Practices amongst Infrastructure Investors

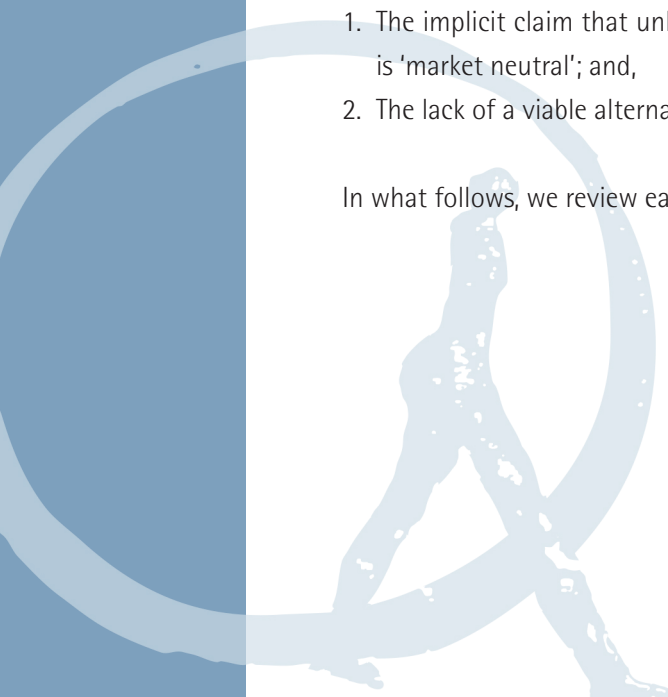
Use of Absolute and Relative Benchmarks			
Use an absolute return benchmark	70%	Risk-free + spread	50%
		CPI +spread	40%
Use a relative benchmark	30%	Listed equities infrastructure	75%
		Peer group appraisals	25%
Issues with current benchmarkss			
No challenge: the benchmark is adequate	10%	They do not 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 USD10Tr of AUM, see Amenc et al (2019).

In the end there are two main justifications for using absolute return benchmarks in infrastructure investment today:

1. The implicit claim that unlisted infrastructure is 'market neutral'; and,
2. The lack of a viable alternative.

In what follows, we review each one in turn.



### 3. 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 performance depends on asset characteristics alone and not on any systematic features, including any influence from the various markets for financial assets.

Likewise, infrastructure assets are often presented as less correlated with the business cycle 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+ companies tracked in the EDHECinfra 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 (e.g. after a recession) or because of structural shifts affecting an entire industrial sector (e.g. 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 which is not (and is usually called alpha). In its simplest form, this is the well-known capital asset pricing model or 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 than 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.

Still, a second reason for their continued use is the perceived absence of other useable benchmarks, which we discuss next.

## 4. 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 +" 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 constituent 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. Table 4 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 highlight 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 table 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 table 5).

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. Indeed, taking these data seriously implies a complete lack of correlation with other asset classes.<sup>1</sup>

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. Figure 1 provides a further illustration.

<sup>1</sup> - Incidentally, it would make the appraisal-based index itself irrelevant by the sametoken.

Table 4: MSCI Unlisted Infrastructure Index – Sector weights vs. the unlisted universe

	MSCI Global Unlisted Infrastructure	Over/Underweight	Unlisted Infrastructure Universe*
Transport	54.6%	160%	21%
Network Utilities	6.4%	-69.5%	21%
Renewables	0%	-100%	18%
Power	32.8%	118.6%	15%
Energy Resources	0%	-100%	11%
Data	2.3%	-67.1%	7%
Social infrastructure	0%	-100%	4%
Environmental Services	0%	-100%	2%
Other	3.4%	N/A	

Sources: MSCI, \*EDHECInfra Universe Standard 2020. No sector exposure data is available for the Preqin Infrastructure Index.

Table 5: 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%)	Max Drawdown	Return Correlation with MSCI World	Return Correlation with 30y Treasuries	Serial Correlation of Returns
Preqin Unlisted Infrastructure	10.41%	3.11%	2.99	1.37%	-5%	-7%	Statistically significant
MSCI Unlisted Global Infrastructure	13.42%	3.26%	3.78	0%	4.6%	-5.7%	Statistically significant
Infra300	12.03%	13.90%	0.78	14.67%	40.2%	20.4%	No serial correlation

Source: Preqin, MSCI, EDHECInfra. Correlation data from 2009 to 2019-Q3 (latest data available for the Preqin infrastructure index), All computations use quarterly USD Returns.

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 TICC<sup>®</sup> 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 table 6 and figure 2).

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 for investors to seek 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.

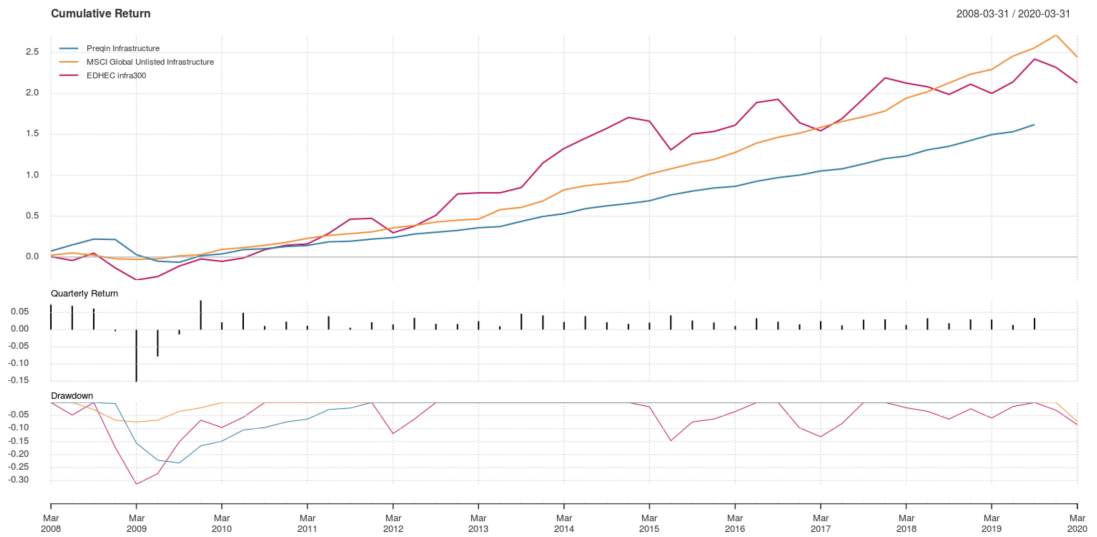
Next, we discuss how a bottom-up, mark-to-market approach to creating market indices of unlisted infrastructure is now a genuine alternative to create benchmarks of unlisted infrastructure portfolios.

Table 6: Statistical characteristics of listed infrastructure

Index	Total Return Volatility	Sharpe Ratio	Correlation with Equities
MSCI World	15.2%	0.33	N/A
S&P Global Listed infrastructure	15.45%	0.19	90%
EDHEC <i>infra</i> listed infrastructure managers proxy	14.9%	0.4	84%

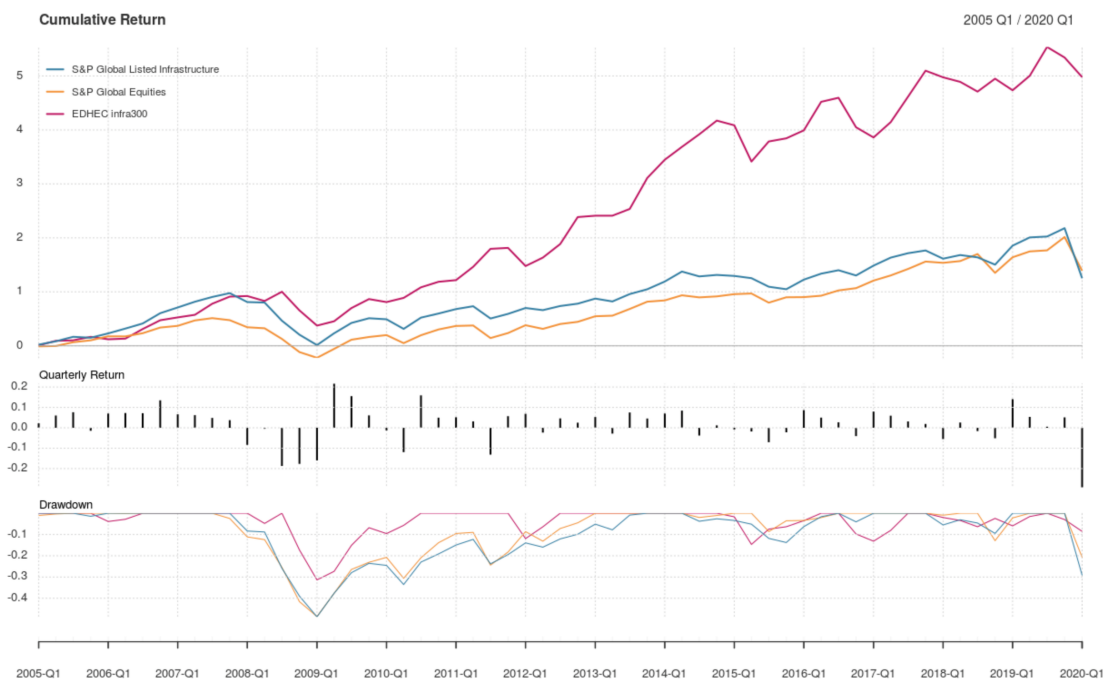
Source: Datastream, edhec.infrastructure.institute/research/listed-infrastructure - USD return data for Q1 2000 to Q1 2020.

Figure 1: Appraisal-based indices (Preqin, MSCI) of unlisted infrastructure equity and the infra300 index



USD Returns

Figure 2: Listed Equities (S&P Global Equities) Listed infrastructure (S&P Global Listed Infrastructure) and the infra300 index



USD Returns

## 5. Building better market indices of unlisted infrastructure investments

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 consensual 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 3, 4 and 5);
- We obtain an investible universe of USD2.1Tr 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.<sup>1</sup>

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 the ones 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.
- 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.

1 - See the EDHEC*infra* Universe Standard at [docs.edhecinfra.com/display/UN](https://docs.edhecinfra.com/display/UN)

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

### Measuring fair value

Some investors might ask 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, and they intend to hold them to maturity.

Indeed, one of the reasons for investing in infrastructure is to generate income rather than capital gains, perhaps with a long-term liability matching objective. Hence the frequent buy-and-hold stance taken by long-term investors in infrastructure like large asset owners.

However, if the reason for holding these investments is to collect revenue over long periods, then the present value of these future flows matters. The longer the investment/holding period the more important it becomes to know how to discount these cash flows to their present value.

Since these future cash flows are also dividends and therefore uncertain, their discounting requires knowing what the adequate risk premia should be. Any financial instrument that is purchased to receive cash flows in the future can only be valued by computing the present value of these future cash flows in a manner that incorporates both time value of money and the risk of not receiving these flows.

Moreover, if these future cash flows are used to match liabilities that are themselves discounted to their present value, not discounting the assets at the appropriate rate is not only inconsistent from an economic and accounting perspective, but also leads to an inadequate understanding of the asset-liability position of the investor.

For instance, say the risk-free rate used to discount liability side of the balance sheet was

to decrease – leading to an upward revaluation of the liabilities – not discounting the cash flows of future infrastructure income used to match liabilities on the asset side with equivalent market rates leads to the wrong assessment of the asset-liability position. In effect, this obviates the liability matching (or hedging) role of infrastructure assets.

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 to discount future cash flows. It would not occur to long-term investors not to value their corporate bond 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 expected returns (Blanc-Brude and Tran 2019, Bessem-



Figure 3: Investible Universe and infra300 Equity Index Breakdown by TICCS® Business Risk Segment (Q1 2020)

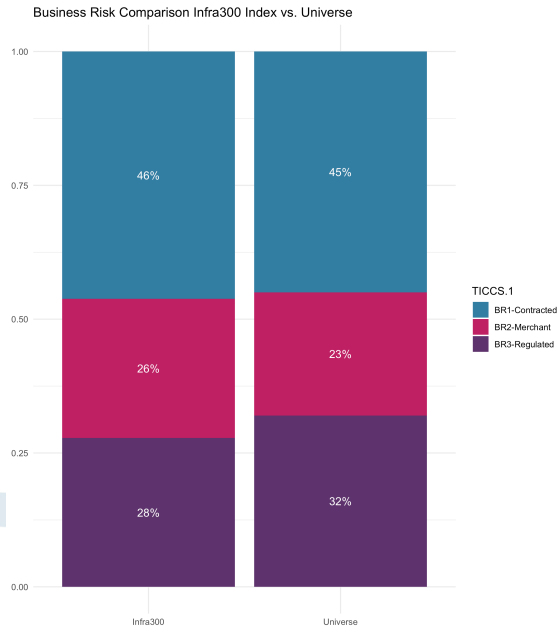


Figure 4: Investible Universe and infra300 Equity Index Breakdown by TICCS® Industrial Activity Segment (Q1 2020)

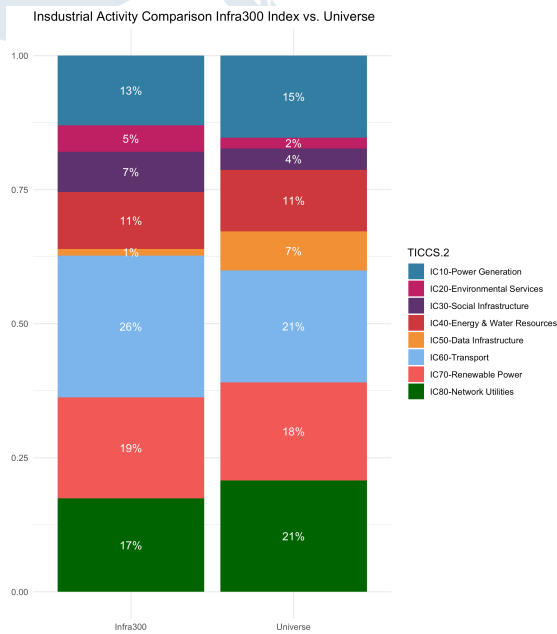
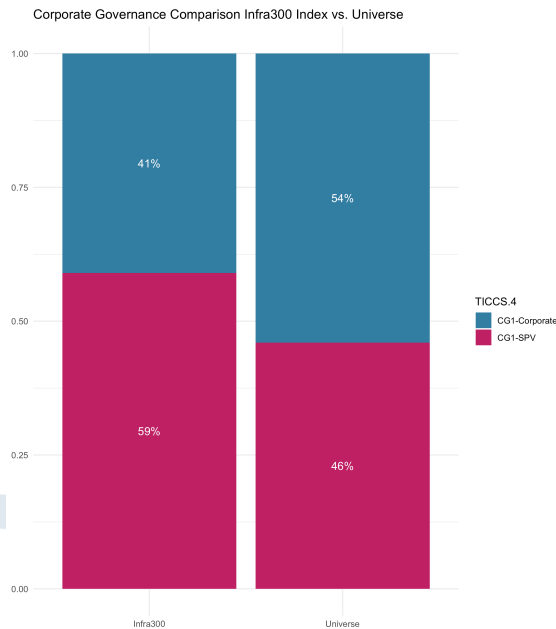


Figure 5: Figure 3 Investible Universe and infra300 Equity Index Breakdown by TICCS® Corporate Structure Segment (Q1 2020)



binder et al 2018, Bartram and Grinblatt 2018).

- 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 e.g. 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 (See EDHECinfra Asset Pricing Methodology for more technical details docs.edhecinfra.com/display/AP).

- 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 table 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. Table 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 DCF-based valuation 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 USD200bn 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 (accessible at [indices.edhecinfra.com](http://indices.edhecinfra.com)).

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



## 6. 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 some infrastructure was going to be impacted immediately. The initial phase of this crisis was not an economic shock but a state of emergency requiring nation-wide 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 to 22%<sup>1</sup> 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.

<sup>1</sup> - Global Listed Infrastructure Organisation (-17.7%), EDHEC*infra* listed infrastructure managers proxy (-22.5%)

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. Amongst these firms, the transport sector especially airports, roads and ports were even more impacted.

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 farm increased in Q1 2020 and these sectors also experienced negative returns albeit much smaller than transport projects.

Table 7 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, Table 7 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, table 7 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.

Table 7 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 3 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.

Table 7 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%.<sup>2</sup>

Next, table 7 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 (e.g. Southern Europe) during Q1 2020, while they decreased in most other countries while 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) e.g. for the assets in the airport index, risk-free rates decreased on average by 38 basis points. 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 varies across sectors and the impact of higher risk premia is compounded by the duration of each assets. Thus, while the average increase in risk premia of the merchant road sector (+88bp) is lower than that of the port sector (+114bp), 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%.

<sup>2</sup> - However, we note that this estimation as of Q1 2020 pre-dates a number of bailout schemes which will result in zero dividend policies in a number of sectors for several years and will increase this effect.

Table 7: 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 2020-2022*	-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)	13.1 years	16.7 years	12 years	10.1 years	7.7 years	8.3 years
Average change of risk-free rates (across the term structure)	~0bp	-38bp	-33bp	-28bp	-19bp	-22bp
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)	+88bp	+74bp	+114	+124bp	+109bp	+113bp
Average impact of change in premia on valuations**	-10.5%	-10%	-9.5%	-10.1%	-7.7%	-8.6%
<b>Aggregate average impact on valuations</b>	<b>-16.6%</b>	<b>-10.6%</b>	<b>-20.9%</b>	<b>-11.4%</b>	<b>-6.49%</b>	<b>-8.0%</b>

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

### 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 table 8 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 e.g. merchant roads experience higher volatility and returns than less risky business risk profiles such as social infrastructure.

Looking at extreme risk measures in table 8, 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 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-9 and is part of the long-term investment profile of infrastructure companies.

It is also important to note as well 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.

Table 9 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

Table 8: 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% VaR	Maximum drawdown	Duration (years)
Infra300	N/A	-6.37%	15.11%	12.87%	25.86%	13.75%	9.28
Contracted infrastructure	BR-1	-5.00%	15.60%	11.46%	20.70%	10.35%	7.73
Merchant infrastructure	BR-2	-9.62%	17.04%	14.83%	26.56%	21.60%	10.13
Merchant Road companies	BR-2, 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.

Table 9: Duration, Spread Volatility and Total Return Volatility of Public and Corporate Bonds compared to the infra300 Equity index

	Average Duration		Spread/ Risk Premia Volatility		Total Return Volatility	
	5-year	10-year	5-year	10-year	5-year	10-year
30-year US Treasuries	20.5 years	19.6 years	N/A		18.1%	18.5%
20-year UK Gilts	15.0 years	14.3 years	N/A		8.4%	9.0%
Long IG Corp. Bonds	14.1 years	13.9 years	20bp	21.5bp	10.2%	10.1%
Infra 300	9.9 years	9.3 years	53bp	173.5bp	12.1%	12.9%

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 computations use quarterly data.

debt exhibits a 10-year annualised total return volatility above 10% despite limited spread risk (standard deviation of credit spreads) around 20 basis points.

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 (5-year volatility). Indeed, after a transition to higher valuations in the years immediately following the 2008 financial crisis, which is one of the 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 (Table 9).

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.

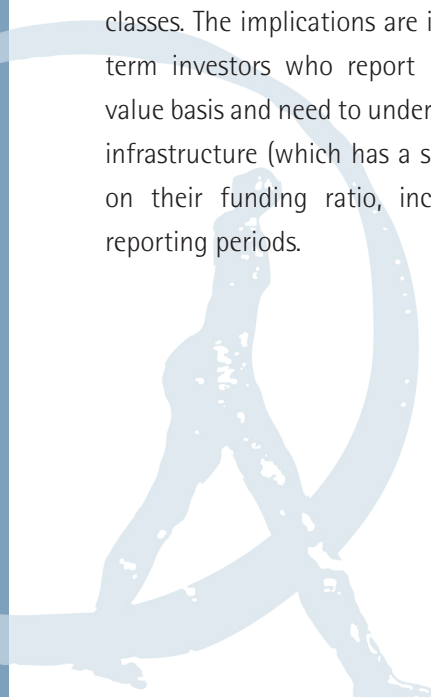
The Covid-19 lockdowns did not change the risk profile of the infrastructure assets that investors hold today. They are the same infrastructure assets than the ones they held at the end of 2019. Their long-term value, business and financial

risks are unchanged. Neither has 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 not an option anymore for asset owners or managers alike.





## 7. Benchmarking the performance of infrastructure investor peer groups

To illustrate our argument, we use the EDHECinfra index data to better understand the performance of two peer groups of infrastructure investors: large asset managers (Top AM) and large asset owners (Top AO).

Table 10 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 ten years, with 54 exits and 64 assets in the latest quarter (Q1 2020) representing USD53bn of market value and USD21 bn 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 USD47bn of market value and USD8bn 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 a fewer, larger assets and tend to hold them;
- 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.

Table 13 (appendix) shows the list of 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 is typical of what a large infrastructure fund manager would hold over a period of ten years 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 (effective number of constituents). In terms of average concentration by sector over time, the AO peer group is also the most concentrated of the two.

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

- Figure 6 shows that Top AM have a greater exposure by value to merchant assets;
- Figure 7 shows a clear bias towards transport at the expense of smaller sectors like renewables and social infrastructure.
- Figure 8 shows a small bias towards project finance (even though the majority of the portfolio is made of corporates, like the market benchmark);

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

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

Table 10: Characteristics of the two peer group portfolios and the broad market index

	Top AM	Top AO	infra300 Index
Number of constituents (since inception)	118	31	300
Number of constituents (latest quarter)	64	30	300
Number of constituents exited	54	1	115
Portfolio market cap (USD, Q1 2020)	52bn	47bn	200bn
Amount invested (USD, Q1 2020)	22bn	8bn	200bn
Overlap with benchmark (by market cap)	26%	23.5%	-
Effective number of constituents* (portfolio concentration)	19.2	7.9	300
Effective number of TICCS® industrial classes* (portfolio concentration)	6.7	4.9	13.9

\* inverse of the portfolio Herfindahl-Hirschman Index (HHI) of concentration. The mean value for Q1 2010- Q12020 is reported. TICCS® includes 29 industrial classes.

Table 11: Performance and risk metrics for both peer group portfolios and the broad market benchmark

<b>Total Returns</b>			
Horizon	Asset managers	Asset owners	Benchmark (infra300)
2020 Q1#	-9.20%	-6.43%	-6.37%
3 years	11.55%	9.93%	6.91%
5 years	11.08%	9.43%	5.55%
10 years	19.16%	17.90%	15.11%
<b>Historical volatility</b>			
Horizon	Asset managers	Asset owners	Benchmark (infra300)
3 years	14.59%	15.13%	11.28%
5 years	17.08%	17.45%	12.07%
10 years	15.83%	17.06%	12.85%
<b>Sharpe ratio*</b>			
Horizon	Asset managers	Asset owners	Benchmark (infra300)
3 years	0.75	0.61	0.56
5 years	0.62	0.50	0.41
10 years	1.14	0.99	1.10
<b>Value-at-risk**</b>			
Horizon	Asset managers	Asset owners	Benchmark (infra300)
3 years	25.02%	23.30%	20.22%
5 years	35.14%	34.98%	25.87%
10 years	25.51%	29.39%	20.57%

\* Sharpe ratio: excess returns divided by standard deviation of returns, \*\* Value-at-Risk: one-year 99.5% Cornish Fisher VaR. All figures annualised except when indicated: # quarterly return, Source: EDHECinfra.

- Figure 8 shows a small bias towards corporates, which is the opposite than in the top AM portfolio;

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

1. it is the natural market for large investors to operate in,
2. for the sake of this exercise it allows more direct comparisons between the two peer groups.

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 whole.

Table 11 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 Asset Owner 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 than the market it also manages to achieve a higher degree of diversification by number of constituents and sector exposures over time 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.

Figure 6: TICCS® Business Risk Exposures: Peer Group Portfolios vs. Unlisted Infrastructure Universe, as of Q1 2020

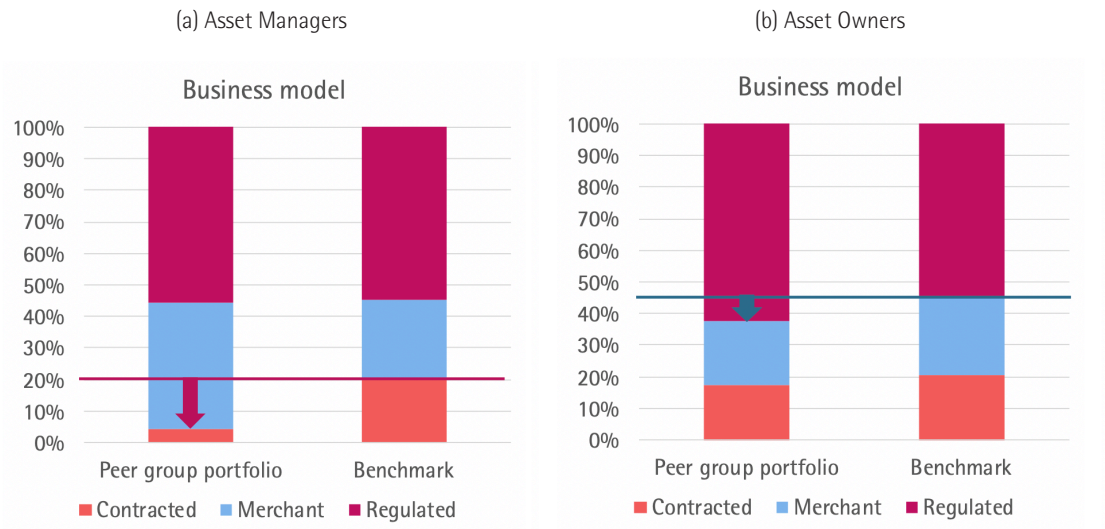


Figure 7: TICCS® Industrial Class Exposures: Peer Group Portfolios vs. Unlisted Infrastructure Universe, as of Q1 2020

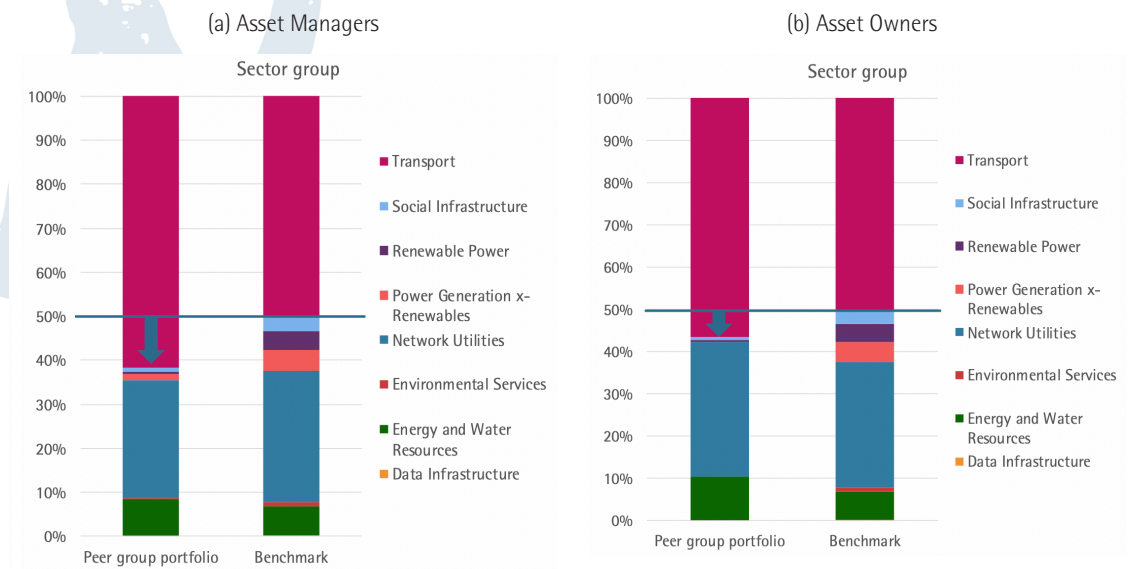
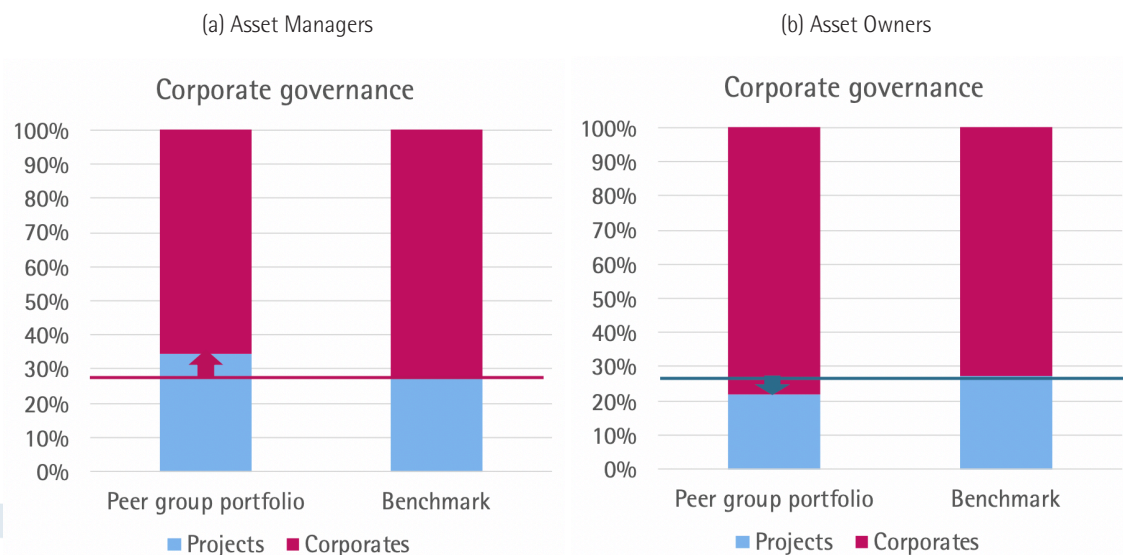


Table 12: Alpha and Beta of the Top AM and Top AO peer groups against the infra300

Peer group	Beta	Alpha
Large AM	0.93	159bp
Large AO	1.09	81bp

Quarterly returns in local currency Q1 2010 to Q1 2020.  
Adjusted-R2 for AM peer group is 75% and 89% for the AO peer group.

Figure 8: TICCS® Corporate Governance Exposures: Peer Group Portfolios vs. Unlisted Infrastructure Universe, as of Q1 2020



This reveals that while top AO experiences 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.

Next, we decompose portfolio returns in terms of systematic (beta) and idiosyncratic risks (alpha), by regressing the quarterly total returns of the two portfolios against the market benchmark (infra300) for a period of ten years. The results are robust, achieving an adjusted-R<sup>2</sup> in the range of ~70-80%.

Looking at table 12, we see that:

- Top AM have a beta below 1 and earn a much higher alpha of about 160 basis points on a quarterly basis.

- Top AO, on the other hand, are more exposed to systematic risk, as indicated by their higher beta of almost 1.1, and they earn half the alpha of top AM.

These results (which we discuss in more details in a separate paper) highlight the relevance of a benchmark-relative approach to investing in unlisted infrastructure.

It appears that large investors outperform the market but in different ways. The average large asset manager appears to generate more alpha while taking systematic risks in line with the broad market while the typical large asset owner is more exposed to market risk (higher beta) and generates lower alpha.

During the Covid-19 lockdowns however, the large asset owner peer group performed in line with the market while the large asset manager peer group did much worse, in part due to its higher exposure to investments in the merchant transport sector. Conversely, against an absolute benchmark, as the respondents of the 2019 survey said in their vast majority, is it not possible to understand the performance of these investors, or to compare them, let alone understand why they perform the way they do.

## 8. Conclusion: A viable alternative to absolute return benchmarks

The realisation amongst 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 customized 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 purpose.

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

What can infrastructure investors do this year with benchmarks absolute returns benchmarks defined as the risk-free or inflation rate plus a spread or 400 or 500 basis points? 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 bench-

marks, 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;
- 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. Courageous and insightful investors will opt for transparency and relevance by letting go of absolute benchmarks that are now outdated.

# A. Appendix: Building the peer group 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.
- We take the EDHECinfra 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 EDHECinfra 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.
- Using EDHECinfra 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 ten years from Q1 2020.

It is important to highlight that the two peer portfolios do not include all the investments made by top AO or Top AM. Instead, they are the intersection of the EDHECinfra broadmarket 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.

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 EDHECinfra platform to determine the right benchmarks
- We report local currency returns only (excluding the impact of FX on returns and volatility)
- 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
- We compute portfolios of individual equity investments in infrastructure companies (not funds) and there is no extra leverage at the portfolio level.

Table 13: Top ten weights in peer group portfolios and the broad market index

Top Asset Managers Peer Group		Top Asset Owners Peer Group		Broad Market	
Weight	Investment Name	Weight	Investment Name	Weight	Weight
	Ausgrid Group 11.4%		Scotia Gas Networks 20.8%		Heathrow Airport TopCo 7.3%
	Gatwick Airport 10.0%		Associated British Port 15.8%		Aeroportos de Portugal 3.8%
	Open Grid Europe TopCo 6.6%		Gatwick Airport 13.6%		50Hertz Transmission 3.6%
	Edinburgh Airport 5.9%		Open Grid Europe TopCo 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 Port 2.4%

Table 14: List of constituents in the Top AM Peer Group portfolio

2i Rete Gas SpA	Electricity North West	Northern Gas Networks
50Hertz Transmission GmbH	Elenia Group	North Tarrant Express I-820 and SH 121 / 183 (Segments 1 and 2A)
A2 Motorway: Nowy Tomysl to Swiecko Section	Elizabeth River Crossings Project	North Tyneside Schools PFI
A63 Salles-Saint Geours de Maremne	Energy Power Resources	NTE Segment 3
Adelaide Airport	Exeter Crown and County Courts PFI	Open Grid Europe TopCo
Affinity Water	Firenze Tram	Peel Ports
Airwave Radio System	First Hydro Company	Penwith Leisure PFI
Allenby/Connaught Accommodation	Gateway motorway and Logan motorway	Perth CBD Courts PPP
Amey Birmingham Highways PFI	Gatwick Airport	Perth International Airport
Amliden Wind Farm	George Best Belfast City Airport	Powerco
AndaSol Solar Power Project	Glasgow Schools	Regasificadora del Noroeste
Anglian Water	Goonhilly wind farm	Severn Power Station
Arlanda Express	Greater Manchester Police Stations	SH 288 Toll Lanes Expansion
Associated British Port	Hobart International Airport	Singapore Sports Hub
Ausgrid Group	Home Office & Prison Service Accommodation	Sjisjka Wind Farm
Autopista Vespucio Norte Express	HS1 high speed rail	Societa Gasdotti Italia
Autoroutes Paris-Rhin Rhone (APRR) motorway	HSL High Speed railway Link Project (Hogesnelheidslijn-Zuid)	Sorne Wind Farm
Autovia del Camino (A-12)	IH 635 Managed Lanes Project	South East Queensland (SEQ) Schools
Barnet Hospital Development	Isle of Wight Highway Maintenance PFI	South East Water
Benavente to Zamora A-66 Shadow Toll Road	L'autoroute A28	Southern Water
Bexley Schools	Linea 9 Metro Barcelona Tramo II PPP	South Europe Atlantic High-Speed Line (SEA HSL) Tours-Bordeaux High Speed Rail PPP
Birmingham Acute and Adult Psychiatric Hospitals PFI	Linea Nueve Tramo Cuatro	Sussex Custodial Centre PFI project
Bishop Auckland Hospital UK	LONDON CITY AIRPORT LIMITED	Sutton And East Surrey Water
Blackburn Hospital UK	London Luton Airport	Sutton Bridge Power Plant
Bournemouth Library	Lynn wind farm	Sydney M1 Eastern Distributor
Brisbane Airport	M40 Motorway	Tasmanian Gas Pipeline
Central Middlesex Hospital	M45 Motorway - Section B	Tauberg Wind Farm
Connect A30/A35 Limited	M5 South West Motorway	Thames Water Utilities
Connect M1-A1 Limited	M6 Birmingham Expressway	Thyssengas GmbH
Connect Project PFI	M6/M74 DBFO	Toscana Floating Storage Regasification Unit (FSRU Toscana)
Conwy Schools PFI	M8/M73/M74 Motorway Network PPP	UK Highways A55 Limited
Dalmuir Sewage Treatment Works	Madriena Red de Gas	Universal Terminal
Dalrymple Bay Coal Terminal	Marseille L2 Motorway	University of Hertfordshire Student Accommodation
Defence Headquarters Joint Operations Command Project (complex known as General John Baker Complex)	Melbourne Airport	Victorian Desalination Plant PPP
Doncaster Mental Health	Mercurio Solar Tinajeros	Wales & West Gas Networks
Drakelow Solar Farm	Metropolitan Police Specialist Training Centre (MPSTC)	Walsall Street Lighting
Ealing Schools	MoD Main Building (Whitehall Building)	Westrail
EastLink	Naples Airport	Ytterberg Wind Farm
Ecogen Energy	Newham Hospital	
Edinburgh Airport	New Tyne Crossing Project	

Table 15: List of constituents in the Top AAO Peer Group portfolio

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

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# EDHEC*infra* Publications (2015–2020)

## EDHEC*infra* Methodologies & Standards

- The Infrastructure Company Classification Standard (TICCS) - Updated March 2020
- Credit Risk Methodology - April 2020
- Infrastructure Index Methodology Standard - Updated March 2020
- Global Infrastructure Investment Data Standard - Updated March 2020
- Unlisted Infrastructure Valuation Methodology - A Modern Approach to Measuring Fair Value in Illiquid Infrastructure Investments - Updated March 2020

## Selected EDHEC Publications

- Amenc, N., F. Blanc-Brude, A. Gupta, J.-Y. Lim. "2019 Global Infrastructure Investor Survey - Benchmarking Trends and Best Practices" (April 2019)
- Whittaker, T., S. Garcia. "ESG Reporting and Financial Performance: The case of infrastructure." (March 2019)
- Blanc-Brude, F., J.-L. Yim. "The Pricing of Private Infrastructure Debt - A dynamic Approach" (February 2019)
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For more information, please contact:

Tina Chua on +65 6438 0030

or e-mail: [tina.chua@edhec.edu](mailto:tina.chua@edhec.edu)

**EDHEC Infrastructure Institute**

**EDHEC Asia-Pacific**

One George Street - #15-02

Singapore 049145

Tel.: +65 6438 0030

[edhec.infrastructure.institute](http://edhec.infrastructure.institute)