LONG-TERM INVESTMENT IN INFRASTRUCTURE

and the Demand for Benchmarks

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In this paper, we argue that long-term investment in thinly traded assets like infrastructure projects increases investors' demand for investment performance monitoring, which also increases the need for new performance measurement tools. Long-term investment benchmarks are critical in order to match the supply and demand of long-term capital, improve asset allocation outcomes for investors and support the development of the economy. We highlight significant methodological challenges to the development of performance measures that are both useful to long-term investors and prudential regulators, and consistent with modern asset pricing theory, and we propose several directions for new research.[1]

Matching the huge demand for capital in infrastructure projects around the world with the available supply of long-term funds by institutional investors, be they pension funds, insurers or sovereign wealth funds, has never been so high on the international policy agenda. This momentum, illustrated by the recent focus on long-term investment in infrastructure by the G20, coincides with the steadily growing investment appetite from the same investors for unlisted and illiquid assets. However, fully fledged investment solutions demonstrating the benefits of long-term infrastructure investment for institutional investors remain elusive and documenting the investment characteristics of these assets has become a pressing issue.

Increasing asset allocations to long-term investment in infrastructure requires that *investors* know what risk and performance to expect over time and in different economic environments, and that *regulators* understand what risks investors are taking. As a consequence, benchmarking the expected behaviour of long-term infrastructure investments is necessary to allow investors to fully integrate these assets into their asset-liability management strategies, and calibrate the risk-based regulatory frameworks that make these investments possible (or not) for large institutional investors. *The information created with such benchmarks would be instrumental in helping to match the supply and demand of long-term capital*.

Still, the need for benchmarks of long-term investment in infrastructure may seem incongruous at first. After all, infrastructure projects are lumpy and highly idiosyncratic endeavours. If every project is different, what can investors learn from a benchmark?

However, in modern finance, asset allocation is not about picking individual investments, but instead focuses on investing in groups of reasonably homogenous assets giving access to *remunerated risk factors*. The performance of each of these groups can be evidenced by a benchmark.

Indeed, long-term investment in infrastructure assets is related to a broader trend among institutional investors towards: improving portfolio diversification or seeking higher returns through alternative investments; investing increasingly outside of public capital markets, to find sufficiently long-dated instruments with a more attractive performance than government bonds; and investing in inflation-linked securities other than low-yielding Treasury Inflation Protected Securities (TIPS). One of the key features of these emerging investment choices is the decision to buy assets that are infrequently traded and to hold them until maturity.

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In the absence of long-term investment benchmarks, the growing interest of investors for infrastructure investment has been motivated by what we call the 'infrastructure investment narrative' (Blanc-Brude 2013), i.e. the notion that infrastructure projects uniquely combine the following characteristics:

> low price-elasticity of demand for service, hence low correlation with the business cycle

> monopoly power, hence pricing power, hence an inflation hedge

> predictable and substantial free cash flow

> attractive risk-adjusted cash flows, available over long periods

> access to unlisted, illiquid financial assets.

That is, investing in infrastructure implies:

> improved diversification

> better liability-hedging, including inflation protection

> less volatility than capital market instruments.

Of course, this narrative is in fact a *model*, i.e. it describes the expected characteristics of the *average* infrastructure project. Individual projects in specific jurisdictions, relying on one or other form of contractual or regulatory arrangement, may only have some or none of the above characteristics.

Today, the *infrastructure investment narrative* is the only available 'benchmark', albeit one that does not rely on any empirical observations, for investors considering investing in infrastructure and who need to form return expectations and make allocation decisions.

A quantitative analysis of the above narrative has now become necessary to help answer investors' most basic and pressing question: is the decision to invest in illiquid infrastructure debt or equity a relevant one from an asset allocation perspective?

In what follows, we discuss why long-term investment in thinly traded assets like infrastructure projects increases investors' demand for investment performance monitoring and how recent developments in asset management practices — in particular the rise of the so-called Canadian model — suggest that this demand is not being met by investment service providers. We argue for the creation of dedicated benchmarks for long-term investment in infrastructure and discuss some of the methodological challenges to develop performance measures that are both useful to long-term investors and prudential regulators and consistent with modern asset pricing theory. We also highlight a way forward in the conclusion.

Long-term investing and the demand for monitoring

The intertemporal monitoring demand

Long-term investment can be defined in terms of investor horizon or instrument characteristics. Long-term investors intend to hold securities over multiple trading periods, possibly until maturity. Long-term instruments are characterised by the unavailability of a fair instantaneous payoff: trades are infrequent and investing requires patience.[2] Unlisted infrastructure investment thus requires both long-term investors and instruments.

Long-term investment also leads to an increase in the demand for monitoring on the part of investors. Two motives explain this *intertemporal monitoring demand*: first, the opportunity to improve firm performance as an active shareholder with a long-term horizon; and second, the difficulty of measuring and benchmarking the performance of infrequently traded assets.

Recent research on the impact of longer investment horizons on monitoring demand with *frequently* traded assets allows us to isolate the two motives. In public markets, investors have a choice between monitoring and trading (Shleifer and Vishny 1986). Long-term ownership is expected to create incentives to engage in corporate monitoring and thus to specialise more in monitoring than in trading. Chidambaran and John (1998) argue that a long-term investment horizon creates incentives to improve shareholder value by imposing disciplinary mechanisms

on managers to align their interests with shareholders, and leads to 'relationship investing'. Chen et al. (2007), Elyasiani and Jia (2008, 2010), Elyasiani et al. (2010) and Attig et al. (2012) among others, find that concentrated holdings by independent institutional investors *with a long-term horizon* leads to increased monitoring and is related to better public firm performance.

Thus, investors' demand for firm monitoring is an increasing function of their investment horizon. But if long-term equity investors tend to be active shareholders, they are also passive investors whose asset allocation decisions require forming long-term expectations about risk and returns, i.e. investment benchmarks. In the case of frequently traded assets, market prices provide the basis for the formation of these expectations. In effect, private monitoring efforts by large block holders contribute to market efficiency, since they also benefit other stockholders. In turn, the market also provides monitoring benefits to long-term investors by processing information that is not available privately (see Holmström and Tirole 1993 for a discussion).

Likewise, investing in *infrequently* traded assets requires a longer investment horizon, hence it is a *de facto* asset allocation decision for investors. However, without the feedback of market prices, the formation of long-term expectations about risk and returns is less straightforward. It follows that long-term investment in unlisted assets must further increase investors' monitoring demand. In effect, meeting investor's demand for the continuous monitoring of the performance of unlisted firms determines the extent to which they are able to invest in such assets. First, because a better understanding of performance is necessary to achieve effective and efficient allocations, but also because inadequate performance measurement leads to a regulatory dead-end: when faced with unknown quantities, prudential regulation penalises long-term unlisted bets, further distorting allocation decisions.

Hence, for investors to make *substantial* investments in unlisted firms, such as infrastructure equity or debt, they have to be in a position to make a strategic asset allocation decision and this, in turn, requires ongoing performance monitoring of comparable assets because of the lack of market price feedback.

Unlisted equity and the failure of delegated monitoring

Selecting and monitoring unlisted, illiquid firms also requires specialist knowledge and should typically lead investors to delegate this process to investment managers.

Unfortunately for long-term investors in infrastructure, the current delegation model inherited from the private equity fund sector mostly fails to respond to their intertemporal monitoring demand. Existing research on PE performance overwhelmingly concludes that the self-reported net asset values (NAV), internal rates of return (IRR) and investment multiples reported by PE managers are both inaccurate and inadequate.

Inaccuracy springs from the tendency of PE managers to report their performance opportunistically (see Jenkinson et al. 2013 for a recent study). Meanwhile, PE performance metrics are inadequate. In their comprehensive critique of the performance monitoring of typical private equity funds, Phalippou and Gottschalg (2009) find that pooling individual investments and funds' IRRs also creates misleading results because IRRs cannot be averaged. The authors also find a large negative correlation between duration and performance in private equity funds, which, combined with the incentive to time cash flows strategically, tends to create an upward bias in reported performance and creates incentives to exit investments quickly. Likewise, Jenkinson et al. (2013) find that current reported IRRs are poor predictors of the ultimate returns of PE funds.[3]

Self-reported IRRs and multiples are also grossly inadequate for the purpose of asset and risk management, in particular making any long-term asset allocation decision. As long as PE was a subplot of the alternative investment space, the absence of a clear benchmark did not stop investors from committing funds to such 'absolute return' strategies. However, the growing interest in unlisted assets like infrastructure among large institutional investors with long investment horizons now raises the important need to determine unlisted equity performance.

The end of delegation?

With unsatisfactory performance measurement and monitoring by PE managers as well as potentially misaligned reporting incentives, a number of large institutional investors no longer make long-term investments in unlisted firms and instead internalise the function of acquiring and managing infrequently traded assets such as real estate, industrial firms (which is still often called 'private equity') or infrastructure. Today, this tendency to invest directly in illiquid assets is most pronounced among Canadian pension funds, a few large European pension funds and sovereign wealth funds.

In effect, the largest investors have resorted to internalising the investment and monitoring functions necessary to access and benefit from unlisted equity. This is because long-term investment in unlisted firms leads to significantly increased demands for performance monitoring, and the PE industry has been mostly incapable of or unwilling to provide better monitoring to investors, particularly the kind of performance measure that would be meaningful from an asset allocation perspective.

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However, this is not necessarily an improvement. Task delegation to a specialist agent should be efficiency improving, and because information asymmetries between investors and managers can be so large that they can destroy all the benefits from delegation, many investors have decided to exit delegated PE altogether. Nevertheless, internalising creates other costs, in particular, as discussed by Blanc-Brude (2013), it can be difficult to create a well-diversified portfolio of large illiquid assets such as infrastructure project equity. Moreover, this approach is only available to very large investors, who can bear the cost of deal sourcing and the ongoing management of their portfolio companies.

Faced with a retreat from such large accounts as the Canadian pension industry, why are PE managers not offering to improve their monitoring and reporting so that investors can benefit from delegation while making well-informed asset allocation choices?

One explanation is that in a world where some PE managers are capable of making the costly effort to deliver high quality services and others are not, if information asymmetries between investors and managers are sufficiently large, both types of managers tend to 'pool' together, offer only the low effort service and charge the same high fees.[4]

Nevertheless, some managers are already evolving towards new private infrastructure equity fund models allowing investors to gain the kind of longer-term exposure they require. Moreover, the tendency for institutional investors to create large or very large unlisted equity allocations is a recent development and the need to monitor and benchmark performance has only recently become more pressing.

But the failure of the PE industry to provide satisfactory monitoring for large investors is also a collective action problem: most of the necessary information is privately disseminated, and data collection, when it exists, is very ad hoc, i.e. it is not designed to answer investors or regulators questions. While PE managers could be more transparent and aim to provide performance measures that are more relevant to long-term investors, taken individually, none of them has access to enough information to answer the long-term infrastructure asset allocation question.

Building long-term infrastructure investment benchmarks

Objectives

The objective of building long-term investment benchmarks is simply to create the performance measures that investors and regulators need. This includes measures of expected return that reflect the dynamic nature of infrastructure projects' risk profile, adequate risk measures for portfolio management, including conditional value-at-risk, and measures of correlations between assets and between a basket of infrastructure investments and other asset classes.

Today, none of these measures is available to long-term investors in infrastructure. Indeed, creating relevant performance measures is not without difficulties. We discuss two of the most significant ones below.

Two challenges

Building a performance measurement framework of unlisted infrastructure project equity stakes must address two important challenges: the absence of large samples of empirical observations; and the absence of a unique pricing measure.

The absence of market prices

Two types of data can be used to value financial assets: transaction prices or cash flows. Transaction prices have an intuitive appeal since they are expected to embody the cumulative value of a stream of dividends discounted at the required cost of equity.

However, in the case of long-term equity investment in infrastructure projects, transaction price data is mostly unavailable: we can observe the initial investment decision of equity holders when new project companies are created, which may be interpreted as a price signal corresponding to a given expected dividend cash flow. However, unlike other types of unlisted investment such as venture capital, infrastructure project companies seldom lead to multiple financing rounds and even less frequently to IPOs.

Secondary market sales of infrastructure project equity do occur, but in a context where such assets are mostly held to maturity by long-term investors, they are relatively rare and observing secondary sales of infrastructure project equity stakes is unlikely to yield representative samples of asset prices.[5]

Indeed, if we were to estimate the determinants of private infrastructure equity prices empirically, we would like to control for different project-level risk factors explaining the *average difference* in price between projects (i.e. the cross-section of prices), as well as the change of risk profile that we expect to see in standalone projects, characterised by both deleveraging and the sequential resolution of uncertainty across their lifecycle (i.e. times series of prices). Observing representative samples of secondary market equity prices would require enough data at each point in the 20- or 30-year lifecycle of infrastructure projects in each annual investment period. Thus, any observable sample of secondary market infrastructure equity prices is likely to be affected by severe biases.

The absence of a unique pricing measure

The absence of a unique price for a given investment in unlisted infrastructure springs from the fact that there is no traded equivalent to the payoff of infrastructure project equity or debt. If a portfolio of traded assets, which are uniquely priced in (weakly) efficient markets, can be built so that it always replicates the payoff of unlisted infrastructure instruments over their multi-decade lifecycle, then unlisted infrastructure assets can be uniquely priced (assuming no arbitrage).

If, however, this is the not the case, then all or part of the required return on equity for a given unlisted infrastructure project is a function of investor preferences for risk, duration, inflation hedging etc., and there is no unique pricing measure (the law of one price does not apply).

With incomplete markets, since some assets are not fully spanned by traded securities, individual investors can arrive at *different valuations of the same asset*. The proportion of returns that cannot be explained by traded factors may thus lie within a *range of expected returns or discount rates*, determined by individual investors preferences. From this perspective, the often-mentioned illiquidity premium expected by investors in unlisted assets *need not be unique*. While *relatively* illiquid but traded instruments can yield a unique illiquidity premium[6] unlisted assets may command a different illiquidity premium for different types of investors. Thus, large bid/ask spreads may persist for investments in private infrastructure projects.

Solutions

Addressing these issues requires new research involving both academia and the financial industry.

The need for cash flow models

Today, limited infrastructure project dividend data have been aggregated. They are scattered among numerous private investors, and little or no effort has been made to construct a database of these cash flows. Building this database is a necessary step towards properly documenting the expected value and volatility of dividend cash flows in infrastructure equity stakes.

Nevertheless, it must noted that even with such a database, empirical observations about infrastructure equity cash flows will remain truncated in time and limited in the cross-section.

First, observed dividend time series are incomplete: by definition, the immense majority of infrastructure projects currently investable are far from having reached the end of their lives. Hence, most of these cash flows remain in the future for which very little, if any, comparable investments currently exist. Indeed, in the cross section, the type of infrastructure projects that have been financed in the past has changed and is not necessarily representative of investment opportunities today.

Thus, even if year-23 dividends for projects that were financed 24 years ago can be observed today, they may not be good predictors of dividends in projects financed three years ago, 20 years from now. For example, projects financed in the early 1990s may have been in sectors where fewer projects exist today (e.g. telecoms) or rely on contractual structures or technologies that are not relevant to long-term investors in infrastructure today (e.g. coal-fired power).

Data paucity is an endemic dimension of our valuation problem, i.e. *we must start from the premise that we cannot observe enough data to simply derive prices empirically*. Instead, we have to acknowledge a position of relative ignorance and aim to build into our approach the possibility of improving or updating our knowledge as new observations become available.

Hence, implementing a valuation framework for long-term investors in infrastructure equity requires combining observable investment decisions with a model of expected cash flows and conditional volatility, i.e. a model, or series of models, capturing what we can know about the distribution of infrastructure project dividends today, and the best available approximation of what we do not know.

Bayesian inference for long-term investment

If data paucity is an endemic feature of long-term investment in illiquid, unlisted assets like infrastructure, then it ought to be integrated in the performance measurement framework. In particular, frequency-based estimation techniques are unlikely to produce robust results from truncated and severely biased datasets.

Instead, Bayesian inference provides a more powerful approach and can become an integral part of valuation and risk models when considering assets that can only be priced conditionally to available information today.

Investors and regulators should not have to wait for large samples of transaction prices or cash flows to materialise before considering what the characteristics of long-term investing in infrastructure might be. There may never be enough data.

Given the limited availability of project cash flow data, Bayesian inference can help *optimise the use of available information* about infrastructure projects, including how they are structured financially, which business models they correspond to etc., to build an ex ante view of the distribution of their dividends, i.e. our best guess before we can observe more data. Moreover, the option to update our knowledge, forces us to ask what data needs to be collected today and tomorrow, i.e. to standardise data collection.

Towards intersubjective pricing measures

Asset pricing is also an area in which new research is needed to better benchmark the performance of long-term investments.

Indeed, pricing measures may not be unique when markets are incomplete, but purely subjective approaches such as the expected utility or indifference pricing framework, while internally consistent, are limited because they does not take into account the possibility of 'market review' (Carr et al. 2001).

In other words, while the presence of incomplete markets warrants taking subjective valuations into account, the expected utility framework is strictly subjective, whereas the market dynamics of unlisted equity investments call for a more intersubjective understanding of price formation.

For example, if a new type of investor (e.g. less risk averse) enters long-term infrastructure equity market, the *range* of observable valuations may change. Likewise, if some investors want to increase their allocations to unlisted assets, given the limited available stock of investable infrastructure projects at a given point in time, *their* valuations will rise, but not that of others (who may sell). Finally, if infrastructure equity returns can gradually be better hedged using traded assets, then individual subjective valuations should converge towards a unique pricing measure.

Thus, while the price of a given unlisted infrastructure equity investment is unlikely to be unique and probably lies within a range that at least partly reflects investor's subjective preferences, this range of values is not unlimited and must be *bounded* by the same investor preferences at one point in time.

The literature on pricing bounds and approximate arbitrage thus needs to be operationalised to allow capturing price ranges (for equivalent assets) at different points in time. Recent applications can be found in Blanc-Brude and Hasan (2014) and Blanc-Brude et al. (2014).

Conclusion: A roadmap

To conclude, much remains to be done to satisfy long-term investors' and regulators' increasing demands for benchmarking of infrastructure. In Blanc-Brude (2014), we highlight a roadmap of necessary steps towards the creation of such benchmarks.

At the underlying asset level, this roadmap first requires focusing on well-defined financial instruments used to invest in infrastructure projects (as opposed to ill-defined industrial sectors e.g. power, roads etc.). Next, adequate asset pricing models have to be designed that take into account data paucity and the absence of unique price measures upfront. Then, a parsimonious and realistic data collection standard can be determined and turned into a reporting tool for long-term investment infrastructure. Thanks to this standardisation effort, a central database of project cash flows can be created and maintained. Finally, at the portfolio level, different 'building blocks' representing individual exposures to infrastructure projects can be combined to design investment strategies in infrastructure and the performance benchmarks that correspond to them.

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Notes

1. Financial support from NATIXIS, Meridiam Infrastructure and Campbell-Lutyens is acknowledged.

2. As opposed to a distressed sale.

3. Using fund IRRs also reveals a well-documented identification problem, i.e. the same cash flows may be returned to investors while individual assets have opposite betas and, if alpha is allowed to be positive, the identification problem only grows. In effect, direct IRRs comparisons requires making assumptions about the functional form of fund return distributions and on such assumptions being constant across time and between funds (Korteweg and Sorensen 2007).

4. This is a standard result of agency theory known as a 'pooling equilibrium' (see Laffont and Martimort 2002).

5. Secondary sales by private equity funds may also not be representative of 'fair' value when such sales occur between funds operated by the same managers.

6. For example, small cap stocks are less liquid than large caps and tend to command an illiquidity premium (see Amihud et al. 2013 for a recent international study).

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