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INSIGHT

The impact of unlisted infrastructure assets on portfolios

May 2021

ECONOMIC INSIGHT

Introduction

It appears the global low interest rate environment is continuing to spur investor appetite for alternative asset classes – like unlisted infrastructure – that can offer potentially higher risk-adjusted returns. This comes at a time of increased uncertainty around the return outlook for 'traditional' asset classes, notably equity and fixed income. Indeed, we believe the diversification benefits of alternative asset classes are likely to be highly sought after as we enter the post-recession global economic environment.

We explored the investment implications of this "lower for longer" interest rate world in a 2019 white paper called The case for 'mid-risk' assets in a 'lower for longer' interest rate world (Oct 2019). In particular, we showed how the characteristics of illiquid assets (like infrastructure) – solid, less volatile returns that have relatively low correlation to liquid markets – are attractive to investors, and that including unlisted infrastructure in a portfolio that also holds equities, bonds, property and cash can provide diversification benefits. In our view the policy experience of the COVID-recession only reinforces these themes.

This article is an abridged version of our recent white paper, *The impact of infrastructure on portfolio efficiency and diversification (Mar 2021)*[1] that demonstrates that including unlisted infrastructure in an investment portfolio can also have a positive impact on portfolio risk-/volatility-adjusted returns. Similarly, the paper demonstrates how excluding unlisted infrastructure from a portfolio, and an over-reliance on traditional asset classes of fixed income and equites, risks leading to a less efficient portfolio than may otherwise be the case.

The framework we employed to analyse portfolio efficiency is the mean-variance optimisation (MVO) approach as introduced by Markowitz (1952)[2]. Details of how we structured our analysis and a discussion of some of the limitations associated with this analysis can be found in Breakout Boxes on pages 6 and 7.

[1] The full version of the white paper is available on request.
[2] Markowitz, H. (1952). Portfolio Selection. The Journal of Finance, 77-91.

Main benefits of unlisted infrastructure's low correlation with other major asset classes

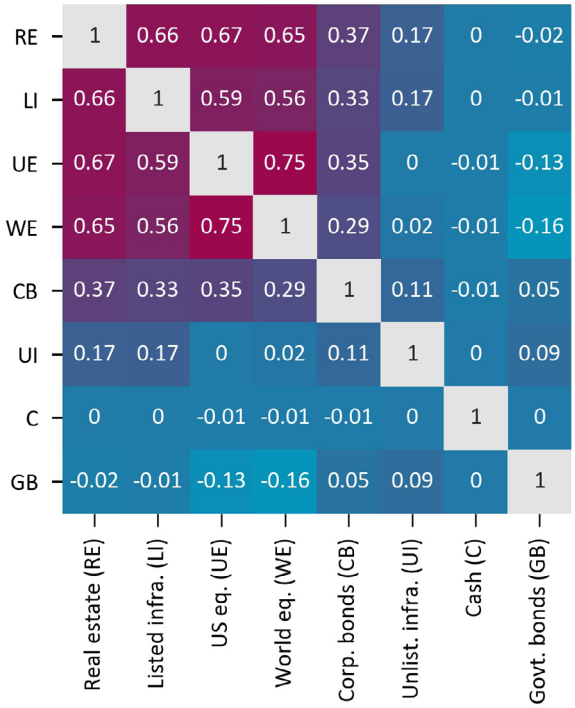
One of the key underpinnings of our research is the historical lack of correlation of unlisted infrastructure returns with the returns of other major asset classes as we demonstrate in Figure 1. This is a key factor in driving the diversification benefits of this asset class and is a robust longer term assumption that characterises the five-year period that is the focus of our work (refer to Breakout Box 2 on page 7 for further details around the data used).

Unlisted infrastructure stands out in the correlation matrix in Figure 1 due to its low correlation with equities and only a weak positive correlation (on average) with the remaining asset classes[3]. This low correlation is one of the key drivers improving a portfolio's risk-return characteristics when including unlisted infrastructure.

Interestingly, the correlation between unlisted infrastructure and listed infrastructure is also low. This is because listed infrastructure really provides hybrid infrastructure and equity exposure, whereas unlisted infrastructure may be viewed as more of a 'pure play' asset class.

FIGURE 1 QUARTERLY RETURN CORRELATIONS[4]

Unlisted infrastructure returns have been largely uncorrelated with that of other assets



Source: IFM Investors. For illustrative purposes only. Refer to Breakout Box 2 for more details.

The potential benefits of including (or increasing) unlisted infrastructure in a portfolio

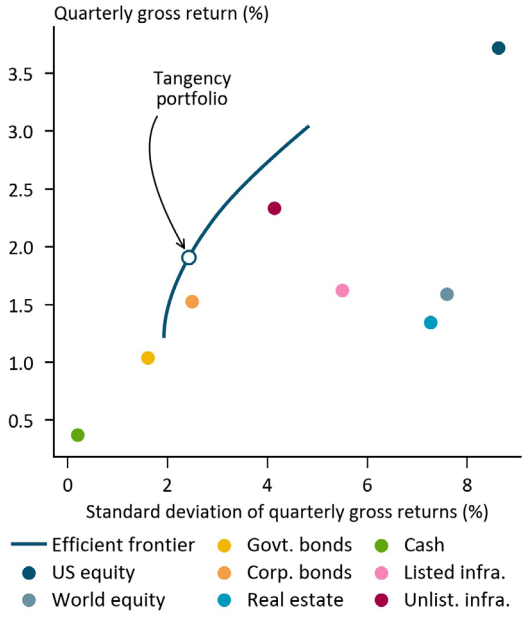
The main results of our analysis are shown in the following diagrams. Figure 2 details the risk-return characteristics of each asset class, with unlisted infrastructure delivering solid quarterly returns but with relatively low volatility. Figure 3 shows the efficient frontier for our asset universe and the tangency portfolio (highest Sharpe ratio portfolio) associated with this efficient frontier.

FIGURE 2 ASSET RISK-RETURN CHARACTERISTICS

Asset	Quarterly gross[5] return (%)	Quarterly gross return vol. (%)
Cash	0.4	0.2
Govt. bonds	1.0	1.6
List. real estate	1.3	7.3
Corp. bonds	1.5	2.5
List. infra	1.6	5.5
World equities	1.6	7.6
Unlist. infra	2.3	4.1
US equities	3.7	8.6

Source: Bloomberg, EDHEC, IFM Investors. For illustrative purposes only. Refer to Breakout Box 2 for more details.

FIGURE 3 EFFICIENT FRONTIER AND ASSET RISK AND RETURNS



Source: IFM Investors. For illustrative purposes only. Refer to Breakout Box 2 for more details.

[3] These weak positive correlations are unsurprising: real estate and unlisted infrastructure have similarities in valuation methodologies and returns (notably bond yields and CPI); listed infrastructure and unlisted infrastructure may be valued differently but the underlying assets are the same; and some correlation with bond returns is to be expected given the inverse relationship between infrastructure valuations and bond yields/risk free rates.

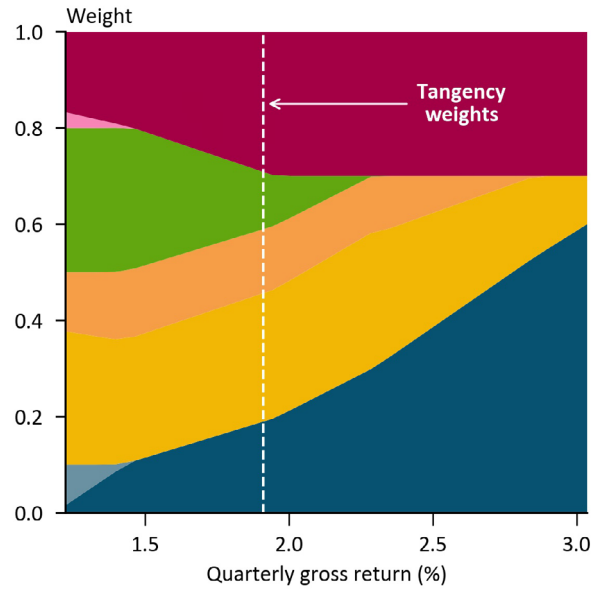
[4] Past correlations are not indicative of future correlations, which may vary.

[5] All returns references in this paper are to gross returns before fees and taxes except unlisted infrastructure where the benchmark is calculated using a 30% weight to IFM's Global Infrastructure Portfolio which is post fees

Figure 4 is derived from the efficient frontier and shows portfolio asset allocation weights for a given level of quarterly return. Importantly, the full asset universe assigns a significant portfolio weight to unlisted infrastructure, supporting our view that this asset class has the potential to improve portfolio risk-adjusted returns.

The asset weights at the tangency portfolio represent extreme allocations, with about 30% invested in unlisted infrastructure, 20% in equities (World and US) and 40% in fixed income (government and corporate bonds). Whilst the equity weight is within the range of most investor asset allocations, it would represent an extreme underweight that is not realistic as investors are attracted to the depth, liquidity and diversification of these markets. The bond weight is possible, but characteristic of a defensive portfolio rather than a balanced one, and unlisted infrastructure is likely too high given most investors' limitations on portfolio exposure to illiquid assets.

FIGURE 4 EFFICIENT FRONTIER ALLOCATIONS

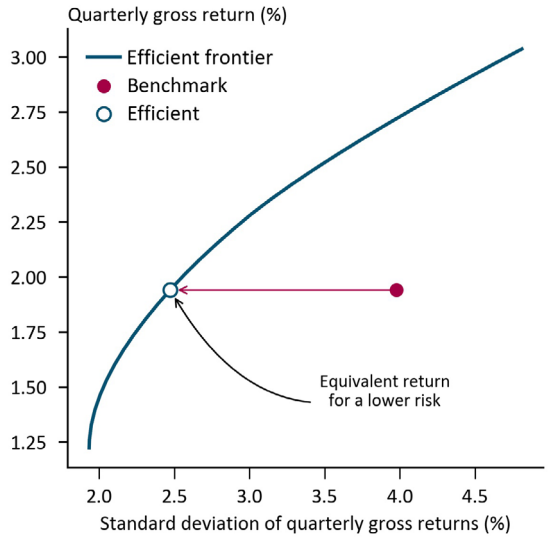


Source: IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details.

To insert more realism into the analysis, we introduced a 'benchmark' portfolio based on the aggregate typical asset allocation of a domestic superannuation fund or global pension fund[6]. We adjust the prevailing allocations to match our chosen universe by prorating exposure to unlisted equity (4.2%) and unlisted real estate (5.4%) – which we do not include in this analysis – across the other asset classes. This benchmark allocates 52.4% to equities (26.2% US equities, 26.2% World equities), 24.0% to fixed income (12.0% government bonds, 12.0% corporate bonds), 3.0% to listed real estate, 13.7% to cash and 6.9% to infrastructure (1.6% listed infrastructure, 5.3% unlisted infrastructure)[7].

Figure 5 plots the gross performance of this benchmark portfolio compared to our efficient frontier. It shows that the current benchmark portfolio is not the most efficient – it is possible to achieve an equivalent expected gross return for a significantly lower risk from a portfolio on the efficient frontier. One of the key factors contributing to the lower risk-adjusted returns of the benchmark is the relatively low weight invested in unlisted infrastructure.

FIGURE 5 BENCHMARK VERSUS EFFICIENT PORTFOLIO



Source: IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details.

In our analysis, the full asset universe assigns a significant portfolio weight to unlisted infrastructure, supporting our view that this asset class has the potential to improve portfolio risk adjusted returns.

[6] Data were as of Q3 2020 and retrieved from https://www.apra.gov.au/quarterly-superannuation-statistics
[7] These weights reflect the APRA regulated superannuation system as a whole, it is notable that 'retail' funds have a lower allocation to unlisted infrastructure and 'Industry' funds a much higher one.

Improving portfolio efficiency with asset allocation

Asset allocation is one of the key determinants of portfolio performance. This is of particular interest to investors who are underweight unlisted infrastructure or those seeking to increase exposure to this asset class.

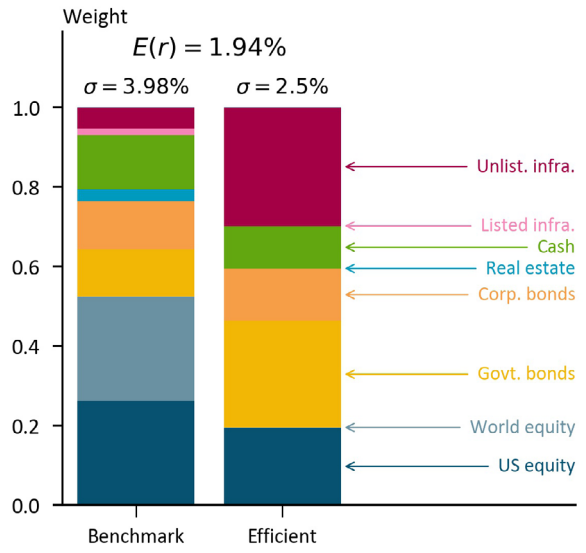
Figure 6 compares the allocations of the benchmark and efficient portfolios taken from Figure 5. Whilst both portfolios are expected to return 1.94%qoq, the benchmark portfolio has a quarterly return standard deviation of 3.98% compared to just 2.50% for the corresponding efficient portfolio. The primary difference in asset allocation between the benchmark and the efficient portfolio is a move away from equities and into unlisted infrastructure and fixed income.

The optimal portfolio also includes a significant weight to unlisted infrastructure which is higher than the average weight currently held by most global pension funds and even most Australian super funds (who have often had a higher exposure to unlisted infrastructure than the global average) – this suggests portfolios may benefit from an asset allocation strategy that aimed to increase exposure to unlisted infrastructure.

Whilst potentially instructive, the comparison of the benchmark to the efficient portfolio is not entirely evenhanded: we are comparing the performance of a portfolio chosen ex-ante to maximise risk-adjusted returns subject to institutional constraints on a number of factors (the benchmark portfolio in Figure 5) to the performance of a portfolio chosen ex-post explicitly aimed at minimising risk for a given target return (the efficient portfolio in Figure 5). Implicit in this approach is the belief that history will – more or less – repeat itself.

To reinforce our argument that unlisted infrastructure can potentially improve portfolio efficiency – and to address some of the concerns around ex-ante versus ex-post optimisation – we took another approach. This involves analysing the impact of incrementally increasing the weight of unlisted infrastructure from 0% to 70%[8] whilst keeping the relative proportions of the other asset classes fixed in relation to one another. This approach limits the impact of changing relative weights in other asset classes and supports our previous conclusion: a higher allocation to unlisted infrastructure can potentially improve portfolio efficiency by improving risk-adjusted returns (refer to Figure 7).

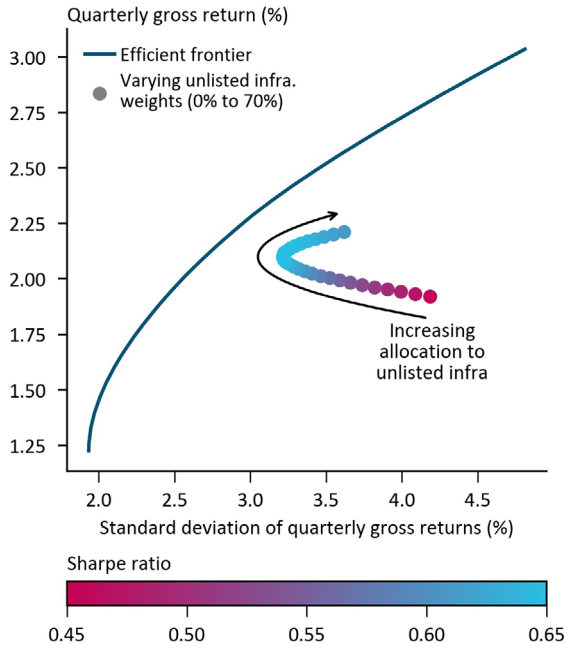
FIGURE 6 BENCHMARK AND EFFICIENT PORTFOLIO ASSET WEIGHTS



Source: IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details.

The optimal portfolio also includes a significant weight to unlisted infrastructure which is higher than the average weight currently held by most global pension funds.

FIGURE 7 IMPACT OF HIGHER UNLISTED INFRASTRUCTURE EXPOSURE



Source: IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details.

[8] For example, in the original benchmark equities accounted for 52.4% of the allocation which translates to 55.3% of the ex-unlisted infrastructure allocation. Accordingly, with the unlisted infrastructure allocation set to zero we have 55.4% (differences due to rounding) allocated to equities but with the unlisted infrastructure allocation at 70% we have 16.6% allocated to equities.

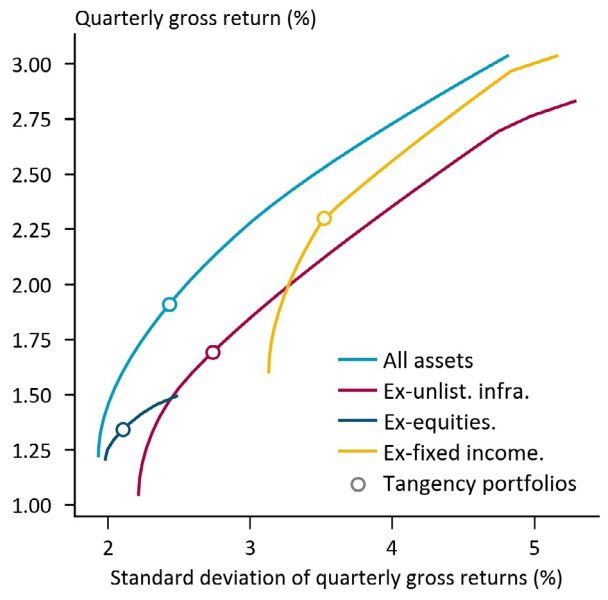
The counterfactual: excluding unlisted infrastructure from a portfolio

Another way to compare the potential impact of including unlisted infrastructure from a portfolio perspective is to look at efficient frontiers with other key asset classes excluded. To do this, we analysed four universes - All assets, Ex-unlisted infrastructure, Ex-equities and Ex-fixed income – and obtained some interesting results as shown in Figure 8:

- The 'All assets' efficient frontier provided superior risk-adjusted returns across all volatilities when compared to all the ex-assets efficient frontiers.
- Removing defensive fixed income improved returns but the associated increase in volatility more than offsets the improved return outcomes such that risk-adjusted returns are overall impacted negatively.
- Removing equites materially reduced portfolio volatility but the associated reduction in returns more than offset the lower volatility such that risk-adjusted returns were negatively impacted.
- The ex-unlisted infrastructure efficient frontier is arguably the worst performer overall as it is most consistently dominated by the other efficient frontiers and has the lowest tangency portfolio Sharpe ratio of the four asset universes as shown in Figure 9.

In the context of this framework we can conclude that excluding unlisted infrastructure from a portfolio has similar impacts on portfolio risk-adjusted returns as excluding fixed income or equites – assets that historically command a significant weight.

FIGURE 8 EFS WITH ASSET CLASSES EXCLUDED



Source: IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details.

FIGURE 9 ASSET UNIVERSE TANGENCY PORTFOLIO PERFORMANCE

Universe	Quarterly gross[9] return (%)	Quarterly gross return vol. (%)	Sharpe ratio
All assets	1.9	2.4	0.78
Ex-fixed income	2.3	3.5	0.65
Ex-equities	1.3	2.1	0.64
Ex-unlist. Infra	1.7	2.7	0.62

Source: Bloomberg, EDHEC, IFM Investors. For illustrative purposes only.
Refer to Breakout Box 2 for more details

A case for the alternative to be not so

We have demonstrated the potential positive impacts that unlisted infrastructure can have on a portfolio by applying a relatively intuitive framework that is widely used in the investment profession.

Our analysis suggests that unlisted infrastructure does have the potential to contribute to improved risk-return outcomes from a portfolio perspective. This adds to the relatively small but growing body of literature supporting what is already relatively well known: unlisted infrastructure has the potential to provide solid returns in a low-yielding world that can facilitate effective portfolio diversification and contribute to improved risk-adjusted returns.

Significant investor interest in unlisted infrastructure can also be seen in the strong demand for quality assets and the volume of capital seeking to be deployed in the sector. So, in our view, investment in this asset class is moving out of the 'alternatives' category and sitting beside other unlisted asset classes such as unlisted property.

This is especially true for long-term patient capital where infrastructure portfolios can provide a strong foundation for relatively stable long term returns.

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[9] All returns references in this paper are to gross returns before fees and taxes except unlisted infrastructure where the benchmark is calculated using a 30% weight to IFM's Global Infrastructure Portfolio which is post fees.

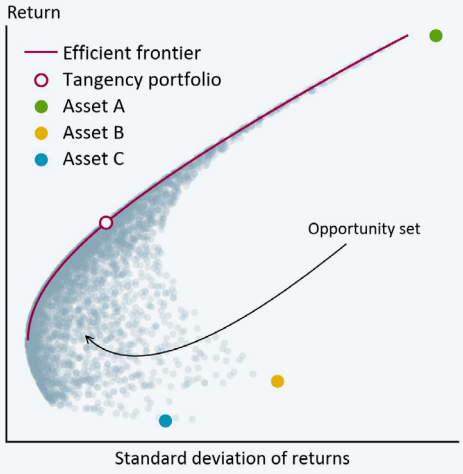
Background to our analysis

The framework we employed to analyse portfolio efficiency is the mean-variance optimisation (MVO) approach as introduced by Markowitz (1952). This involved calculating what weight/allocation should be invested in each asset to create a portfolio that minimises the 'risk' – or more accurately the volatility of returns – for a given return target (subject to certain constraints). Applying this analysis over a range of target returns yields the 'efficient frontier' which is the set of 'optimal' portfolios (in a risk-return sense) that dominate both the individual assets that comprise the portfolio and all other possible portfolios (the 'opportunity set'). It must be noted that this approach assumes that return volatility is the only source of risk faced by investors. This is – of course – an oversimplification. Volatility should be considered only as a broad proxy for risk, and even when viewed through this prism it is important to acknowledge that the appropriateness of volatility as a risk proxy varies from asset to asset. This point is particularly relevant when considering unlisted assets given that other risks not captured by return variance tend to be more pronounced in the unlisted space than the listed space (e.g. liquidity risk).

Figure 10 provides a stylised example of MVO based on a portfolio of three hypothetical assets (A, B, and C). The prominent solid points indicate the risk-return characteristics of these individual assets and the shaded coloured dots are the risk-return characteristics of random portfolios constructed from a combination of these three assets (a sample of the opportunity set). The red curve is the efficient frontier and moving along this curve reflects an investor's relative risk appetite and how much additional portfolio risk/volatility they are willing to tolerate. These moves may be motivated by an investor's view on broader macroeconomic conditions and their impact on the various asset classes. Moving away from the curve to the opportunity set of less efficient portfolios may be motivated by other constraints placed on the investor's asset allocation.

One special portfolio on the efficient frontier is the 'tangency portfolio', which has the highest excess return per unit of risk (in other words, the portfolio with the highest Sharpe ratio). This point (assuming no other constraints) represents the highest risk-adjusted return available to an investor.

FIGURE 10 STYLISED EFFICIENT FRONTIER



Source: IFM Investors. For illustrative purposes only.

It is important to note that MVO does have limitations. In particular, it can produce estimation errors because it is sensitive to the inputs used. These inputs include a vector of expected returns and an expected return covariance matrix. To get ideal results from MVO in a forward looking sense, one needs to forecast the returns of each asset under examination, the variance of returns for each asset under examination and the covariance of the returns of every asset with every other asset over the expected holding period. Making forecasts like this is fiendishly difficult, so in practice historical estimates of these parameters are often used. Implicit in this approach is the assumption that the future will be like the past (at least to some degree). In financial markets, that is rarely the case, so the estimated parameters will likely be different to the true population parameters. This estimation error manifests in traditional MVO often performing poorly when suggesting forward looking allocations, with small changes in parameters often resulting in significant changes to optimal allocations. It is worth noting, however, that we are not applying MVO in this context to suggest an optimal forward looking asset allocation. We are using MVO as a framework within which to examine the potential benefits of including unlisted infrastructure in a portfolio.

A number of statistical adjustments have been suggested to increase the usefulness of MVO in practice. These include Ledoit-Wolf shrinkage, the Black-Litterman Model and introducing constraints on asset weights. We have applied Ledoit-Wolf shrinkage and have imposed constraints on asset weights in this analysis but we have not included the Black-Litterman approach as it is beyond the scope of this paper[10]. Further details of our statistical methods are contained in the full white paper.

[10] All returns references in this paper are to gross returns before fees and taxes except unlisted infrastructure where the benchmark is calculated using a 30% weight to IFM's Global Infrastructure Portfolio which is post fees.

Data used in our analysis

Our analysis assumes that the universe of available asset classes includes equities, fixed income, real estate, cash and infrastructure. The constraints that we impose on the model include: 1) weights sum to one; 2) short positions are prohibited; 3) strategic asset allocation is restricted by the following asset class ranges:

- at least 10% and at most 60% invested in equities which includes US and World (ex-US) equities;
- at least 10% and at most 40% invested in fixed income which includes government bonds and corporate bonds;
- between 0% and 30% invested in cash;
- between 0% and 30% invested in infrastructure which includes listed and unlisted infrastructure;
- between 0% and 10% must be invested in real estate)

These assets covered circa 87% of the assets that the Australian Superannuation industry invests in and is broadly reflective of the Global pension fund space[11]. We used five years of quarterly gross return data over the period Q1 2016 to Q4 2020 (20 return observations) to estimate our key inputs: the geometric mean quarterly gross return for each asset over the period, the sample standard deviation of asset gross returns over the period and the correlations between asset gross returns over the period. Our choice to use only the previous five years of data was largely informed by the observation that over the 2008-2015 period there was a shift to a generally higher price regime in unlisted infrastructure as an asset class[12]. Prices appear to have stabilised post-2015 and it is unlikely that the strong performance of unlisted infrastructure over the 2008-2015 period is representative of the expected future performance of the asset class. We would also assert that the post-Global Financial Crisis period represents a shift to a lower growth paradigm for the global economy that is characterised by unprecedentedly accommodative monetary policy settings. The relatively short time frame of analysis is trying to capture this shift while providing for robust analysis.

One challenge we faced in our analysis was finding an appropriate performance proxy for unlisted infrastructure as the traditional approaches all have shortcomings:

- **Absolute return or 'cash plus' benchmarks**[13] – often viewed as the 'least bad' option, but their use implicitly assumes that unlisted infrastructure is market-neutral (i.e. that asset performance is independent of all systematic features and any broader economic environment) which is unrealistic.
- **Listed indices** – poor proxies for unlisted infrastructure as they tend to be highly correlated with listed equities and behave more like a subset/style within listed equities, as opposed to a distinct asset class.
- **Appraisal based methods** - limited usefulness, primarily because they have 'smoothed returns', potentially resulting in artificially low volatility of returns and low correlation with other asset classes.

To address these concerns, EDHECinfra (a venture of the EDHEC Business School) recently launched the infra300 index. This index is a marked-to-market index calculated using a statistical model that leverages actual transaction prices to calibrate model parameters[14].

After much examination of the alternatives we selected an equally weighted mix of the returns of the infra300 index and GIP as our unlisted infrastructure proxy as we had no good reason to believe that one index is more representative of the unlisted infrastructure space than the other in a return sense. However, in terms of the risk statistics (variance and covariance) for our proxy we weighted the infra300 index more heavily (70%) and GIP less heavily (30%) as GIP is more like an appraisal based index[15] and hence its volatility measures may be problematic when used as a proxy. This 'hybrid' approach to the lack of a standard benchmark for unlisted infrastructure gives what we believe are robust results that are representative of the asset class.

[11] Data were as of Q3 2020 and retrieved from https://www.apra.gov.au/quarterly-superannuation-statistics
[12] EDHEC Infrastructure Institute. (2019, January). Which Factors Explain Unlisted Infrastructure Asset Prices. Retrieved from https://edhec.infrastructure.institute/wp-content/uploads/publications/blanc-brude_and_tran_2019.pdf
[13] See https://edhec.infrastructure.institute/wp-content/uploads/2019/04/EDHECinfra_GIH_2019_Survey.pdf
[14] More detail on listed, appraisal based, and EDHECinfra's marked-to-market approach is provided in Appendix 2 of the full white paper.
[15] While independent valuers take into account a range of market factors these are part of the process rather than the dominant factor.

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IFM-3MAY2021-1587557

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