



INVESTMENT STRATEGY & RESEARCH

RESEARCH BRIEF

Allocating To Unlisted Infrastructure:
Some Size Fits All

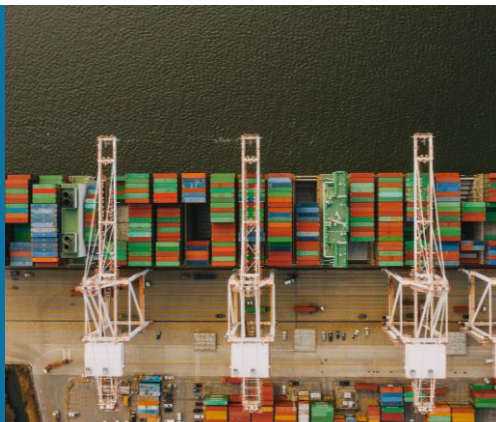
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 **PATRIZIA**

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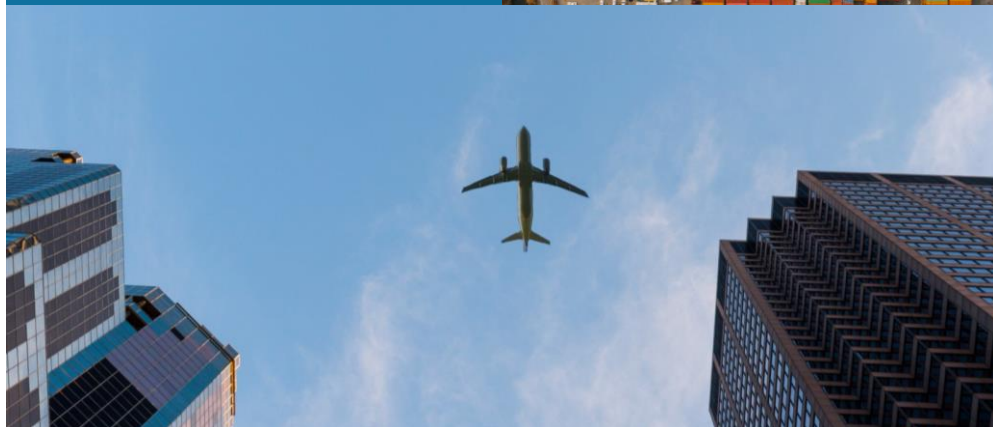
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01 Introduction

SOME SIZE FITS ALL

The father of Modern Portfolio Theory, Harry Markowitz, is reported to have said “diversification is the only free lunch.” Whilst he may have coined the term, the concept of diversifying one’s portfolio stems back well before the 1950s as investors seek asset classes that demonstrate little or no correlation to one another, to improve a portfolio’s risk return characteristics. Unlisted infrastructure is one such asset class, offering portfolios higher returns per unit of risk.

Since the turn of the 21st century, unlisted infrastructure has been a mainstream asset class for institutional investors in regions such as Canada and Australia, however, broadly speaking, investment in the unlisted infrastructure asset class in Europe by defined benefit (DB) funds stands at low levels, and is materially lower than unlisted real estate which has been an asset class staple for decades.¹ Despite its current low uptake in Europe, we note that the inclusion of unlisted infrastructure provides an investor’s portfolio with uncorrelated equity-like returns, lower volatility and shallower drawdowns. The analysis in this paper concludes that a meaningful allocation to unlisted infrastructure is an attractive consideration for long-term investors, for all target return levels tested; albeit we note that it must be balanced with liquidity and access considerations.

This brief explores the benefits of unlisted infrastructure and how to size an investment in the asset class, with the purpose being to educate investors on why they should look to diversify their portfolios with a more meaningful allocation to unlisted infrastructure.

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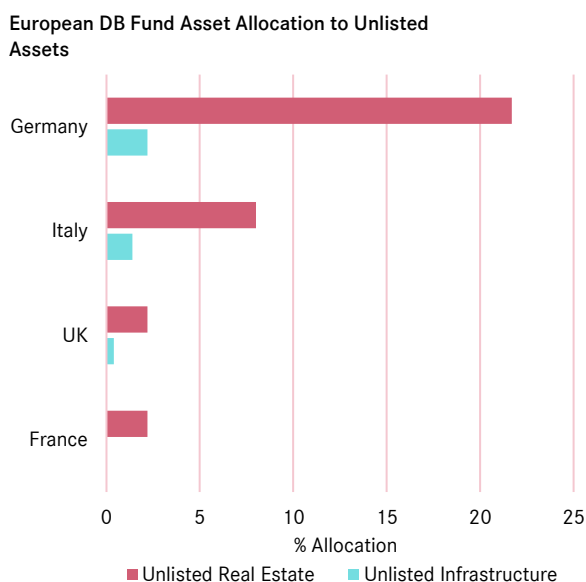
¹ Mercer (2021), European Asset Allocation Insights – DB Asset Allocation trends across the UK and Europe.

02 State of Play

UNLISTED INFRASTRUCTURE ALLOCATIONS LIMITED IN EUROPE

Despite the rapid growth in the infrastructure asset class over the last several decades, many investors around the globe are yet to make a sizable allocation to unlisted infrastructure. In Australia, one of the early adopters of infrastructure investing, institutional investors have an average infrastructure allocation of 8.6% according to the latest OECD pension survey.² But it is a different story in Europe. According to Mercer's 2021 report on European Asset Allocations, average unlisted infrastructure allocations in this region are significantly lower. As shown in Figure 1, German DB funds have an average allocation to unlisted infrastructure of just 2.2%, and in the UK, the average allocation is just 0.4%. This data also highlights that while German and UK DB funds have long invested in real assets, these allocations have historically focused on unlisted real estate.³

FIGURE 1: EUROPEAN DB FUNDS HAVE MINIMAL ALLOCATIONS TO UNLISTED INFRASTRUCTURE



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Australian institutional investors were early movers in investing in infrastructure – the average allocation is currently 8.6%. Allocations among European investors are significantly lower.



² OECD (2021) Annual Survey of Large Pension Funds and Public Pension Reserve Funds, Report on Pension Funds' Long-Term Investments.

³ Mercer (2021), European Asset Allocation Insights – DB Asset Allocation trends across the UK and Europe.

03

Street Appeal

UNLISTED INFRASTRUCTURE HAS MANY ATTRACTIVE QUALITIES

There are several benefits of unlisted infrastructure to be explored within this brief: uncorrelated returns, stable cash flows, drawdown protection when appropriately levered, and resilience in an inflationary environment. This analysis explores the validity of these claims for an investment universe detailed in Figure 2.

FIGURE 2: ASSET CLASS UNIVERSE



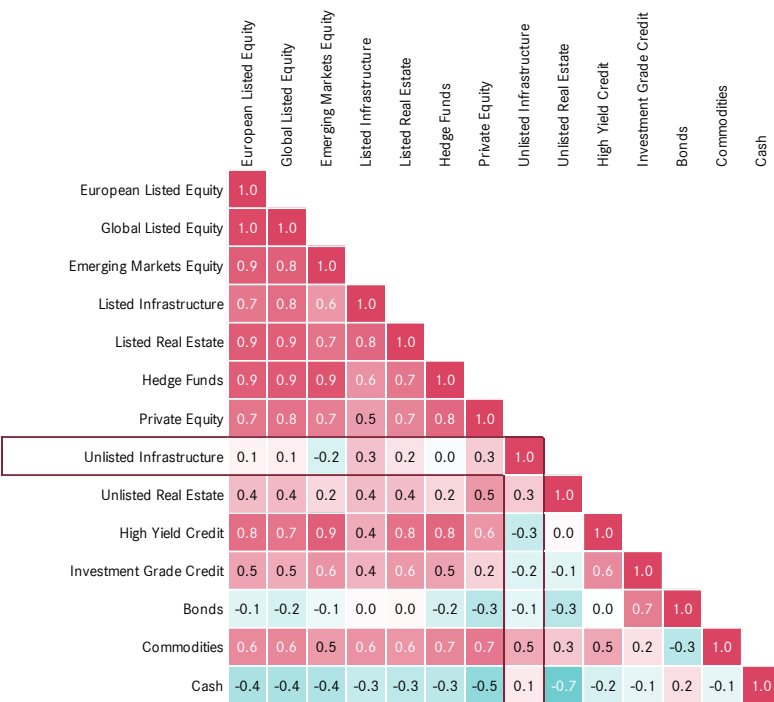
Source: PATRIZIA

UNCORRELATED AND FAVOURABLE RISK ADJUSTED RETURNS

The correlation matrix of returns (Figure 3) highlights that unlisted infrastructure is broadly uncorrelated with listed markets, paving the way for improving an investor's risk return spectrum through its diversification benefits.⁴ However, this correlation will vary on an asset-to-asset basis. Assets with a higher GDP sensitivity (airports, ports) are likely to have a higher correlation to listed markets (a higher beta), whereas regulated and contracted assets with predictable cash flows (energy, utilities, water, public-private partnerships) are largely independent of listed market movements.

⁴ Returns data was gathered quarterly, from March 2008 until December 2021. All data in Euros. For a list of indices used in the analysis refer to Table 2 in the Appendix.

FIGURE 3: UNLISTED INFRASTRUCTURE IS BROADLY UNCORRELATED WITH TRADITIONAL ASSET CLASSES



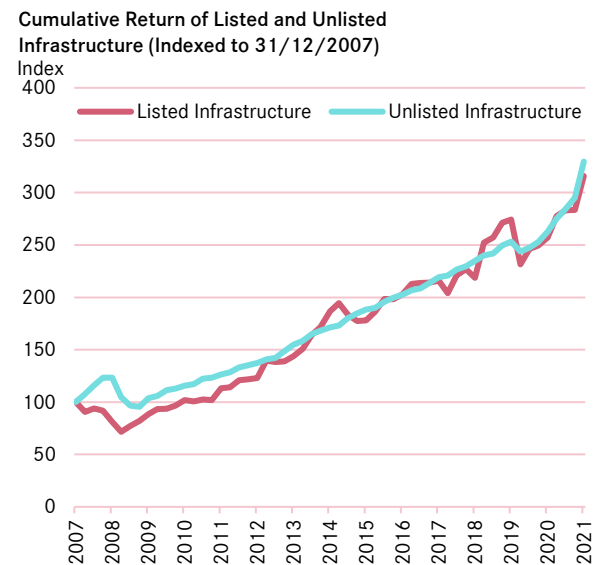
Source: PATRIZIA, Bloomberg, Preqin, MSCI

The low correlation exhibited above is also driven by methodology and timing differences in unlisted infrastructure valuations. Unlike listed equities, where valuation occurs daily through market pricing, unlisted infrastructure assets are typically valued quarterly or semi-annually using a discounted cash flow approach. The valuation is driven by cash flow forecasts and long-term market assumptions, consequently, these assets are not subject to constant and volatile swings in value, unless fundamental change has occurred. As a result, unlisted infrastructure typically enjoys lower volatility and correlation with other asset classes.

However, it is important to note that this valuation process can result in autocorrelation of returns, where one return value is contingent in part on the preceding value.⁵ One remedy is to unsmooth through a statistical method, producing a representative return series with higher volatility. This was not undertaken for this paper, as the smooth nature of returns is representative of an investor's experience with unlisted infrastructure.

Unlisted infrastructure exhibits favourable risk adjusted returns (as measured by the Sharpe ratio) within the historical series – 1.2 over the horizon tested, versus 0.5 for global listed equity and 0.9 for bonds. This is driven by equity like returns, with lower volatility arising from the valuation methodology, highlighted in Figure 4. This benefit is observed for other unlisted asset classes such as real estate and private equity.

FIGURE 4: UNLISTED INFRASTRUCTURE TRACKS A SIMILAR RETURN PATH TO LISTED INFRASTRUCTURE, WITH LESS VOLATILITY



Source: PATRIZIA, Bloomberg, Preqin

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The correlation matrix of returns highlights that unlisted infrastructure is broadly uncorrelated with listed markets, which paves the way for improving an investor's risk return spectrum through its diversification benefits.

⁵ Geltner, David. (1991). Smoothing in Appraisal-Based Returns. Journal of Real Estate Finance and Economics 4:327–345.

INFLATION RESILIENCE

Infrastructure is often considered to be an asset class that provides inflation protection. That is, infrastructure assets should be able to successfully navigate through a scenario of high inflation by passing it on to end users, thereby protecting revenues. However, inflationary environments are typically accompanied by higher interest rates, which can have a direct negative impact on cash flows due to higher debt servicing costs. Importantly, higher interest rates (in particular, higher real interest rates) are also likely to increase the discount rate, negatively impacting the current value of real assets in the eyes of investors. Given the long duration of many of these assets, this negative impact could be material.

That said, infrastructure is typically considered attractive relative to other asset classes in inflationary periods, faring better than equities and bonds, and higher yielding than cash. For investors seeking to maximise the inflation proofing qualities of infrastructure investments, this is best achieved through building a diversified portfolio of infrastructure assets that have direct linkages to CPI in their revenue, high operating margins, and operating structures not susceptible to interest rate rises. Maximising inflation linkages can be important for investors looking to liability match or preserve real returns.

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Infrastructure is an attractive asset class in inflationary periods, tending to fare better than equities and bonds, and higher yielding than cash.

The inflation protection properties of unlisted infrastructure have been detailed at length in PATRIZIA's research brief: *Inflation Protection In Infrastructure Portfolios: Not All Assets Are Cut From The Same Cloth*.

STABLE RETURNS

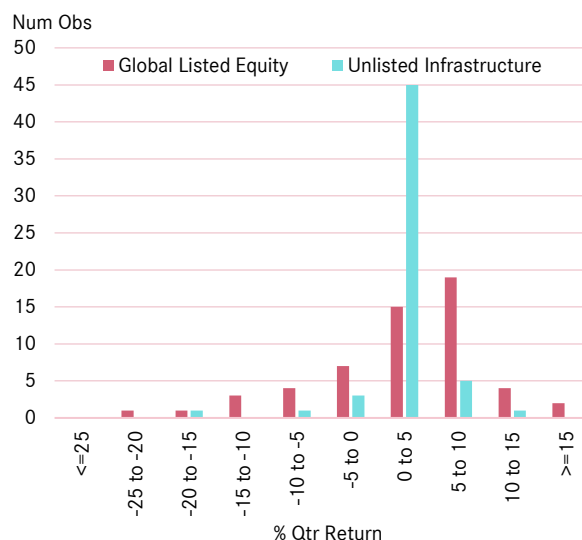
Unlisted infrastructure – in particular, contracted and regulated assets – can provide investors access to stable cash flows. Figure 5 compares the frequency of quarterly returns for global listed equity and unlisted infrastructure from 2008 until 2021 – it shows unlisted infrastructure's returns are more tightly grouped. In comparison, global listed equity has a broader range of returns to both the upside and downside. This is largely driven by the nature of the underlying assets themselves, which are often demanded consistently (energy, water, contracted assets), making them robust to economic cycles. Infrastructure assets provide dividend cash flows back to investors, which can be higher than equities, depending on the nature of the asset (PPP, contracted assets).

The appraisal-based valuation approach limits price discovery, which while representative of an investor's experience with unlisted assets, may mask the underlying volatility of the asset. Beyond fundamental changes in the asset itself, the volatility of the return series can depend on the valuation frequency, the chance that the valuation dates occur at peaks or troughs, and the lag at which valuers write up or down assets.

Both distributions have a left skew, meaning the tail is longer on the left side (strong negative returns) than the right side (strong positive returns). This co-located left skew tail is larger for global listed equity than unlisted infrastructure, though it commensurately has a higher right tail. This left tail reflects historical downside events such as the Global Financial Crisis.

FIGURE 5: UNLISTED INFRASTRUCTURE HAS MORE STABLE RETURNS THAN EQUITY

Distribution of Quarterly Returns for Listed Equity and Unlisted Infrastructure



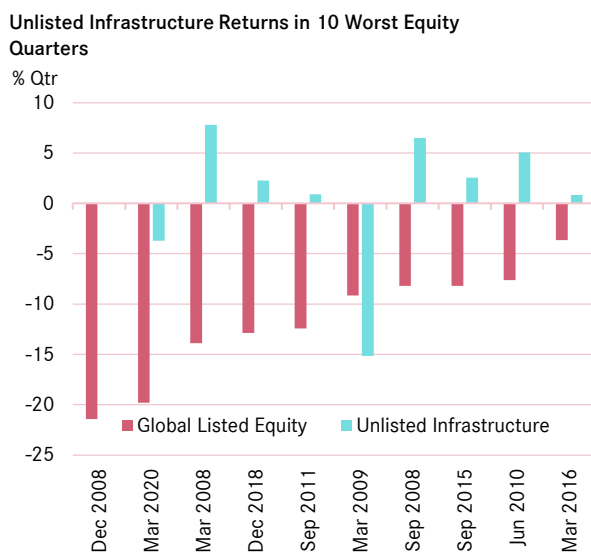
Source: PATRIZIA, Bloomberg, Preqin

DRAWDOWN PROTECTION

Unlisted infrastructure has historically provided investors with shallower drawdowns relative to listed equity markets. Figure 6 charts the returns of the 10 worst quarters for the MSCI World Net Total Return Index⁶ against the Preqin Quarterly Infrastructure Index since 2008. The figure highlights that nearly all drawdowns for the unlisted infrastructure returns are smaller than their equity counterparts, and several posted positive returns for the quarter, reiterating the low asset correlation. The lagged nature of unlisted infrastructure valuations is one driver of this low correlation, which can be seen in the chart when comparing the December 2008 and March 2009 data points. However even after accounting for this valuation lag, drawdowns are shallower for unlisted infrastructure. Global listed equity had five consecutive negative quarters through the GFC period for a cumulative drawdown of -44.1%, versus three consecutive negative quarters for unlisted infrastructure for a cumulative drawdown of -22.6%. Corresponding to the shallower drawdown, unlisted assets tend to have a gentler recovery.

Further, detracting from the benefits of stable returns during periods of market stress, unlisted infrastructure assets may become difficult and expensive to sell during these times. As such, exiting a position in these assets during market stress may often require a steep discount to net asset value.

FIGURE 6: UNLISTED INFRASTRUCTURE PROVIDES DRAWDOWN PROTECTION IN TIMES OF EQUITY MARKET STRESS



Source: PATRIZIA, Bloomberg, Preqin

Whilst noting the shallower drawdowns for unlisted infrastructure in Figure 6 above, it is important for investors to implement an appropriate capital structure for each asset, given infrastructure investments are often highly leveraged. A sensible debt level ensures that the assets can navigate times of market stress and avoid breaches to debt covenants. The data used in the modelling represents an index of infrastructure funds (and within each fund, several assets), meaning that although during the GFC the cumulative drawdown of the index was -22.6%, a small portion of infrastructure assets within the index were likely to have seen their equity position go to zero, tripping up default covenants during this period of market stress.⁷ For an investor who is accessing a fund with only a few deals, a scenario whereby one single investment is written to zero would have a significant negative impact on returns.

⁶ 50% hedged.

⁷ It is worth acknowledging that survivorship bias may exist within the series, where impaired assets are not reported to be included in the series return.

04

Weighing It All Up

OPTIMAL ALLOCATION TO UNLISTED INFRASTRUCTURE

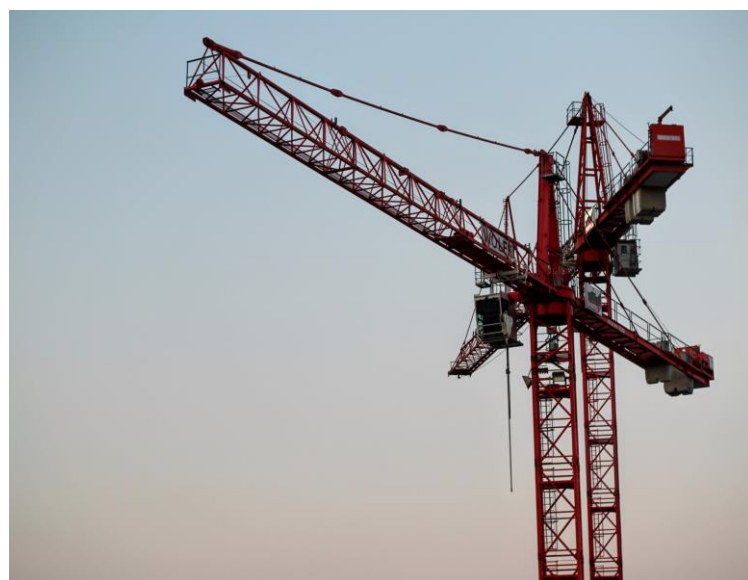
This report has highlighted the value unlisted infrastructure can introduce to a well-diversified portfolio. A question which remains for a prospective investor: how should the allocation be sized?

OPTIMISATION TECHNIQUES

Determining whether the introduction of unlisted infrastructure can add value to a portfolio first requires a subjective judgement on how value should be measured. The industry standard is to look at the expected return of the portfolio, and the risk associated with producing this return, as measured by standard deviation. Under this approach, the most well-known method for portfolio optimisation is Mean Variance Optimisation (MVO), first presented in the seminal paper *Portfolio Selection* by Harry Markowitz (1952), which revolutionised the way in which investors allocate under a risk return framework.⁸ Under this approach, the portfolio risk and return are evaluated through the incorporation of the covariance between assets, exemplifying the benefits of diversification. Each possible combination of asset weights yields a portfolio risk and return. An investor should hold asset weights which minimise risk for a given target return – solving for these weights across various return levels produces the efficient frontier.

MVO introduced an appealing optimisation framework due to its simplicity and integration with standardised and well understood financial measures: mean and variance. There are drawbacks of the approach, most significantly, that it makes an implicit assumption that asset returns are normally distributed.

The comparative benefits of optimisation using conditional value at risk (CVaR) include that it does not ignore extreme losses, and that it is not reliant on the normal distribution – which is especially important for asset returns which may be skewed or have a tail.⁹ The approach is appropriate for an investor with a longer-term investment horizon, seeking high returns and drawdown-resilient assets.



“The comparative benefits of optimisation using conditional value at risk include that it does not ignore extreme losses, and that it is not reliant on the normal distribution – which is especially important for asset returns which may be skewed or have a tail.

⁸ Markowitz, H. (1952). *Portfolio Selection*. The Journal of Finance 7(1), pp. 77-91.

⁹ Rockafellar, R.T. & Uryasev, S. (1999) *Optimization of Conditional Value-at-Risk*.

The optimisation uses the historical average return and the historical covariance matrix from 2008 to 2021, along with the asset class return series for the CVaR method; all data has been converted to euros. It is worth noting that an investor's view on forward looking returns may vary from the historical numbers, and this would impact the results.

Several constraints were added to produce a more industry pragmatic result:

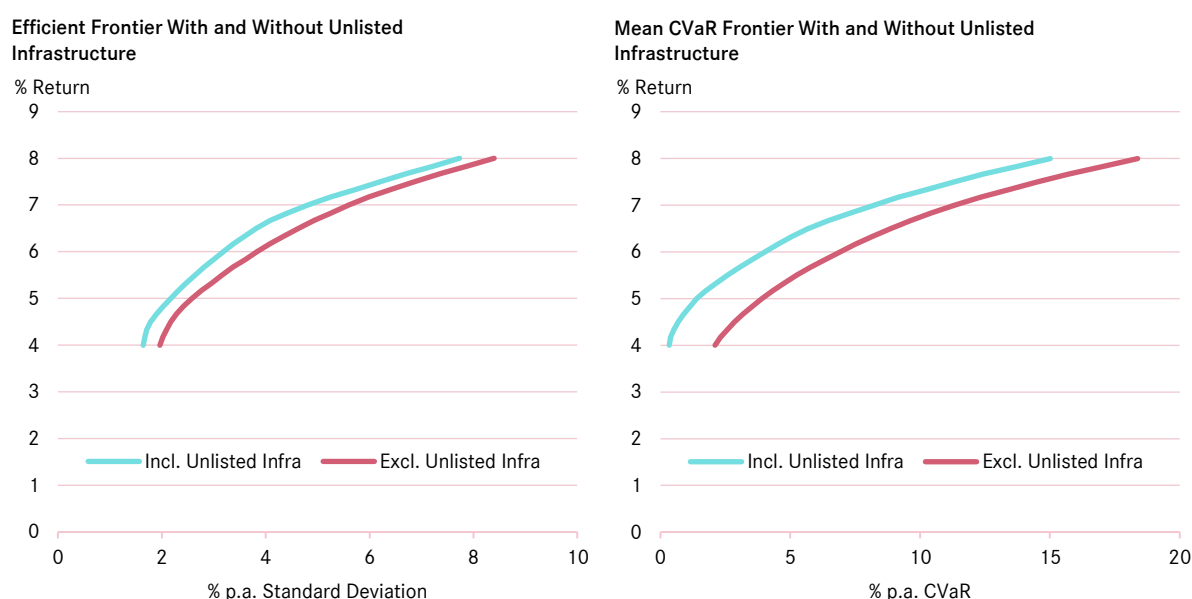
- the allocated weight to unlisted (illiquid) assets may not exceed 35%;
- the allocated weight to each unlisted (illiquid) asset may not exceed 15%;
- the allocated weight to infrastructure (listed and unlisted) may not exceed 30%;
- the allocated weight to real estate (listed and unlisted) may not exceed 30%; and
- the effective number of assets in the portfolio must be equal to five or greater.¹¹



OPTIMISATION RESULTS

Risk efficient portfolio weights for European investors with return targets of between 4% to 8% was tested in the analysis. Figure 8 shows the efficient frontiers for portfolios with and without unlisted infrastructure, under MV and MCVaR optimisation. Under both optimisation methods, the efficient frontier is expanded through the introduction of unlisted infrastructure, signifying the asset class is value accretive to an investor's portfolio with respect to improving the risk return efficiency.

FIGURE 8: UNLISTED INFRASTRUCTURE IMPROVES AN INVESTOR'S PORTFOLIO FROM A RISK RETURN LENS, UNDER BOTH OPTIMISATION TECHNIQUES



Source: PATRIZIA, Bloomberg, Preqin, MSCI

Figure 9 and Figure 10 show the optimised portfolio weights for MVO and MCVaR respectively, and how these weights vary as the return target increases. Unlisted infrastructure has a non-zero weight under both optimisation methods, for all return targets, given the asset is both high returning and it enjoys low correlation benefits against listed markets. It suggests that a meaningful allocation to unlisted infrastructure is favourable, irrespective of the investor's target return.

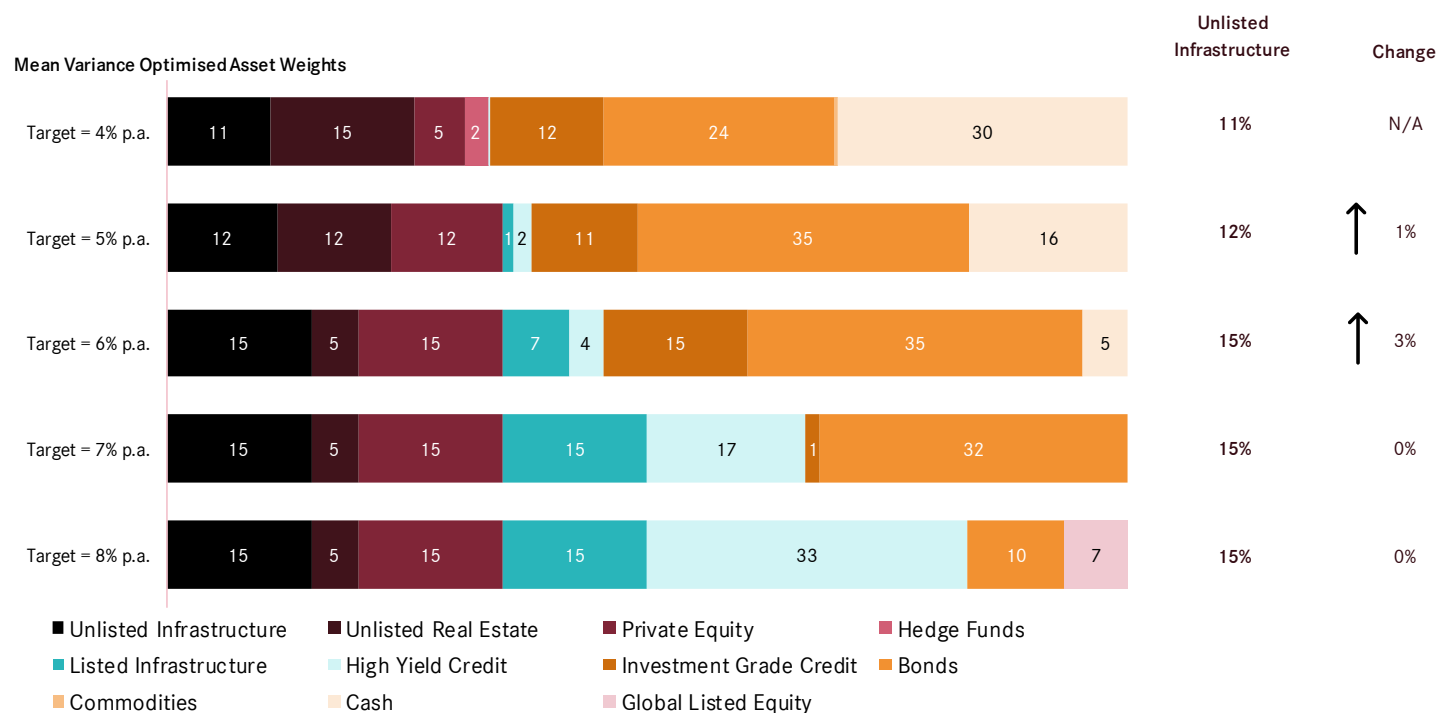
“Under both optimisation methods, the efficient frontier is expanded through the introduction of unlisted infrastructure, signifying the asset class is value accretive to an investor's portfolio with respect to improving the risk return dynamic.”

¹⁰ PyPortfolioOpt.

¹¹ Implemented through the inverse of the Herfindahl-Hirschman Index.

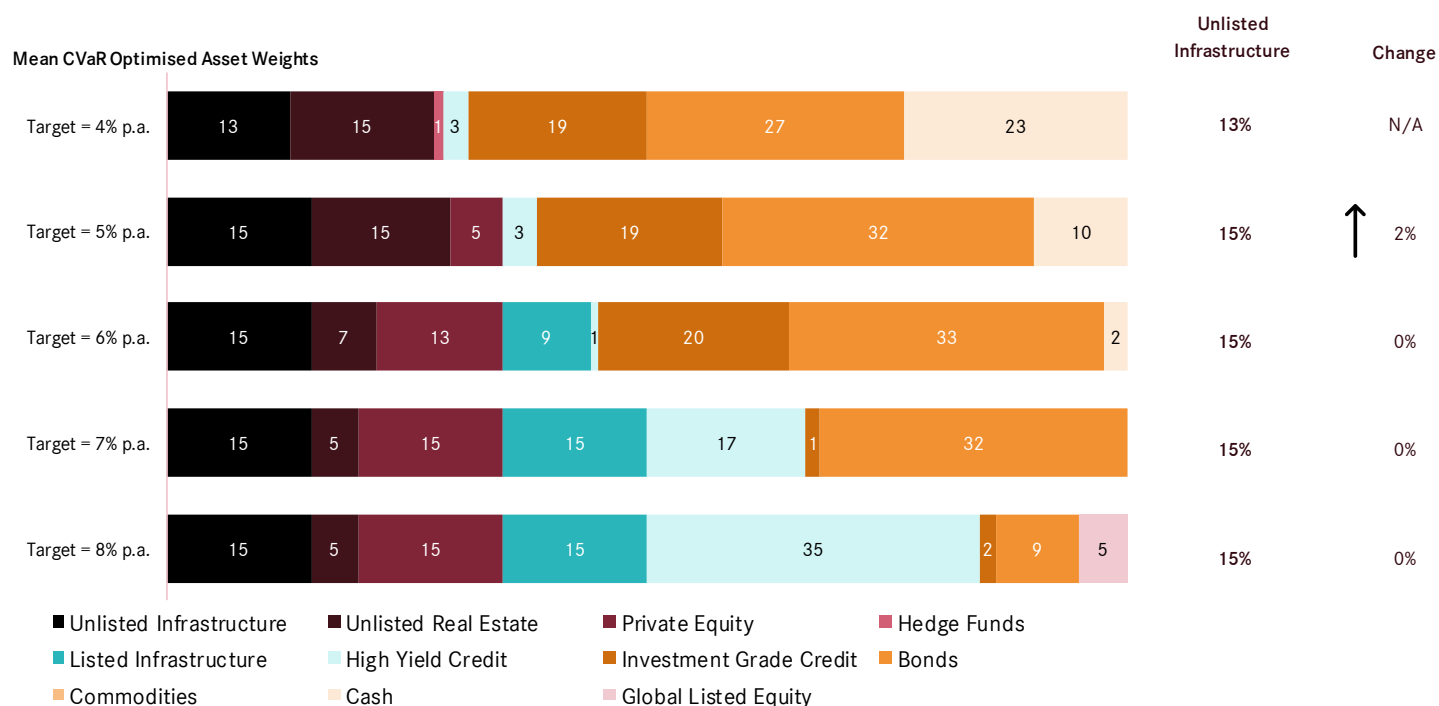
The optimisation also produces a sizable allocation to listed infrastructure at higher return targets, reflective of its return characteristics – a separate piece of work is warranted on the comparative investment merits between listed and unlisted infrastructure, which this brief does not seek to address. Global listed equity has a small allocation at higher return targets, with the optimiser preferring listed infrastructure for its higher return and lower volatility over the data horizon. Over a longer time period we would expect global listed equity to outperform listed infrastructure due to its higher beta and its larger exposure to global growth. Consequently, an investor may prefer to hold more global listed equity than the results suggest.

FIGURE 9: ASSET ALLOCATION UNDER MEAN VARIANCE OPTIMISATION



Source: PATRIZIA, Bloomberg, Preqin, MSCI

FIGURE 10: ASSET ALLOCATION UNDER MEAN CVaR OPTIMISATION



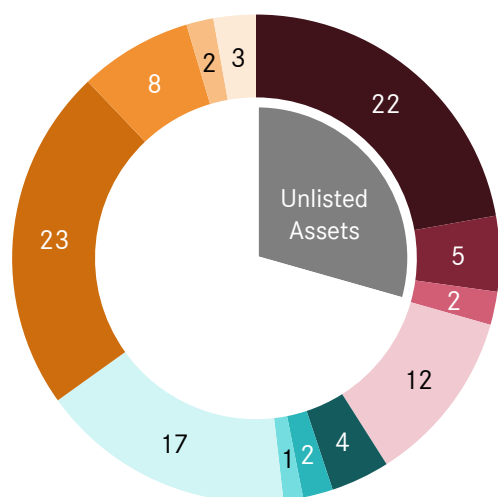
Source: PATRIZIA, Bloomberg, Preqin, MSCI

PORTFOLIO IMPLICATIONS

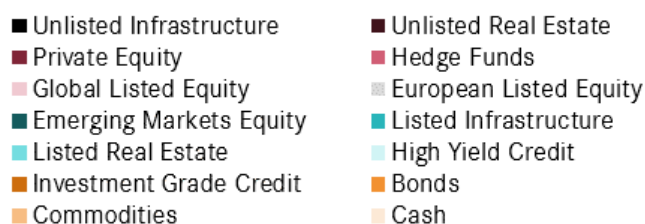
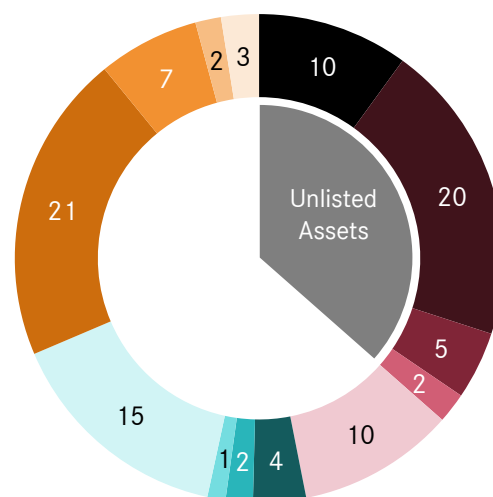
Comparative portfolio performance was evaluated between 2008 and 2021 for a fund with a zero allocation to infrastructure, and one with a 10% allocation to unlisted infrastructure (with the rest of the asset weights commensurately prorated down).^{12,13} The asset allocations of the two portfolios tested are presented in Figure 11.

FIGURE 11: ASSET ALLOCATIONS COMPARED IN THE ANALYSIS

Asset Allocation Without Unlisted Infrastructure



Asset Allocation With 10.0% Unlisted Infrastructure



Source: PATRIZIA, Mercer

TABLE 1: A 10% ALLOCATION TO UNLISTED INFRASTRUCTURE WOULD HAVE OUTPERFORMED A PORTFOLIO WITH A ZERO ALLOCATION, UNDER ALL METRICS TESTED

METRIC	WITHOUT UNLISTED INFRASTRUCTURE	WITH 10.0% UNLISTED INFRASTRUCTURE
Return (% per annum)	5.7	6.1
Standard Deviation (% per annum)	6.7	6.0
Information Ratio	0.9	1.0
Beta	0.35	0.32
Maximum Quarterly Drawdown (%)	9.5	8.6
Quarterly CVaR 5% Level (%)	7.8	6.9

Source: PATRIZIA, Mercer

Over the tested period, a portfolio would have experienced higher returns (+40 basis points per annum) and lower risk (measured through standard deviation, maximum quarterly drawdown, or CVaR) if it had held a 10% allocation to unlisted infrastructure (Table 1), versus a zero allocation to the asset class. This is not an unexpected result given the optimisation demonstrated an allocation to unlisted infrastructure was advantageous, though it does translate the theory to tangible portfolio outcomes.

¹² Fund allocation based upon a German DB Fund, obtained from Mercer's European Asset Allocation Insights Report (2021) for Defined Benefit Funds across the UK and Europe – a best effort was made to align asset classes in the analysis with the Mercer categories.

¹³ This analysis assumes constant and costless rebalancing.

05

The Road Forward

CONCLUSION

This brief has explored several benefits of unlisted infrastructure, demonstrating it has a place in a long-term investor's well-diversified portfolio. To date, investment in the asset class is small in Europe when compared to other developed economies such as Canada and Australia. Optimisation shows that the inclusion of unlisted infrastructure expands the efficient frontier, paving the way for investors to access Markowitz's free lunch of diversification.

The analysis in this paper finds that a meaningful allocation to unlisted infrastructure is an attractive consideration for long-term investors under both optimisation methods, for all target return levels tested; albeit we note that must be balanced with liquidity and access considerations. Further, it demonstrates that a sizable investment in the asset class would have improved portfolio risk and return through the period tested.

Appendix

DATA AND ASSUMPTIONS

TABLE 2: ASSET CLASS RETURN SERIES

ASSET CLASS	RETURN SERIES
European Listed Equity	MSCI Europe Net Total Return Index
Global Listed Equity	MSCI World Net Total Return Index 50% Hedged
Emerging Markets Equity	MSCI Emerging Markets Net Total Return Index 50% Hedged
Listed Infrastructure	FTSE Developed Core Infrastructure Index Total Return Index 50% Hedged
Listed Real Estate	FTSE EPRA Nareit Developed Net Total Return Index 50% Hedged
Hedge Funds	HFRI Fund Weighted Composite Index
Private Equity	Preqin Quarterly Private Equity Net Index
Unlisted Infrastructure	Preqin Quarterly Infrastructure Net Index
Unlisted Real Estate	MSCI PEPFI Funds Quarterly Property Index
High Yield Credit	ICE BofA Euro High Yield Index
Investment Grade Credit	Bloomberg Global Aggregate Credit Total Return Index 100% Hedged
Bonds	Bloomberg Global Aggregate Total Return Index 100% Hedged
Commodities	Preqin Quarterly Natural Resources Net Index
Cash	Oxford Economics Eurozone 3 Month EURIBOR



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Harrison is a member of the Investment Solutions Group and is responsible for providing asset consulting services to clients, including on their investment strategy, manager selection, and asset allocation, with a particular focus on modelling and analysis. He has a background in consulting, previously working at Deloitte where he undertook financial modelling of infrastructure and economics projects, across both the public and private sectors. Harrison has a Bachelor's Degree in Finance and Economics from the Australian National University.



Justin Webb
Managing Director, Investment Solutions

Justin leads the Investment Solutions which is responsible for providing strategic advice and building investment strategies for institutional and government clients. Justin's particular fields of expertise centre around developing and managing investment risk management strategies and developing alternative asset portfolio plans for institutional investors, focusing on liquidity and illiquid asset investment programs. Justin is a Chartered Accountant and a member of the Australian Institute of Company Directors with extensive experience in infrastructure investment, corporate finance and financial modelling together with performance analysis, reporting and alternative asset management. Justin sits on PATRIZIA's Listed and Unlisted Infrastructure Investment Committees and is a member of PATRIZIA Infrastructure's Valuation Committee.

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