PORTFOLIO POSITIONS, DIVERSIFICATION & RISK OF LOSS

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BACKGROUND

ATLAS does not consider portfolio diversification, achieved purely by increasing the number of holdings, as a primary metric for controlling portfolio risk. Instead ATLAS seeks to reduce portfolio risk through controlling specific risk factors as follows:

- Valuation risk – ensuring that only assets with sufficient absolute returns are held in the portfolio
- Common factor risk – ensuring that the portfolio does not contain any material common factor exposures (e.g. to GDP or interest rates), by measuring the economic factor exposures (e.g. to GDP or interest rates) for our holdings and controlling the overall portfolio exposure.
- Asset stress risk / Idiosyncratic risk – ensure that the absolute level of idiosyncratic risk is controlled by measuring individual asset risk of loss, and controlling this also at the portfolio level

ATLAS believes that portfolios containing relatively few positions can generate superior alpha without significant exposure to risk, providing that common factor exposures and idiosyncratic risk is deeply analysed and managed. Central to our approach is the definition of risk as related to permanent impairment of returns over the long run. We do not manage short-term volatility or tracking error. ATLAS aims to give investors the best long-term returns possible, while minimizing the potential for permanent loss from either common factor exposures or stock-specific impacts.

This document sets out some of the analysis and research that supports our approach to risk control and provides some context to the alternative approaches to portfolio diversification and optimal sizing. We commence by examining the relation between portfolio risk and the number of positions from a more traditional perspective. This provides context and establishes that 5-15 stocks should suffice to limit idiosyncratic risk to acceptable levels. We then set out the ATLAS approach to risk management.

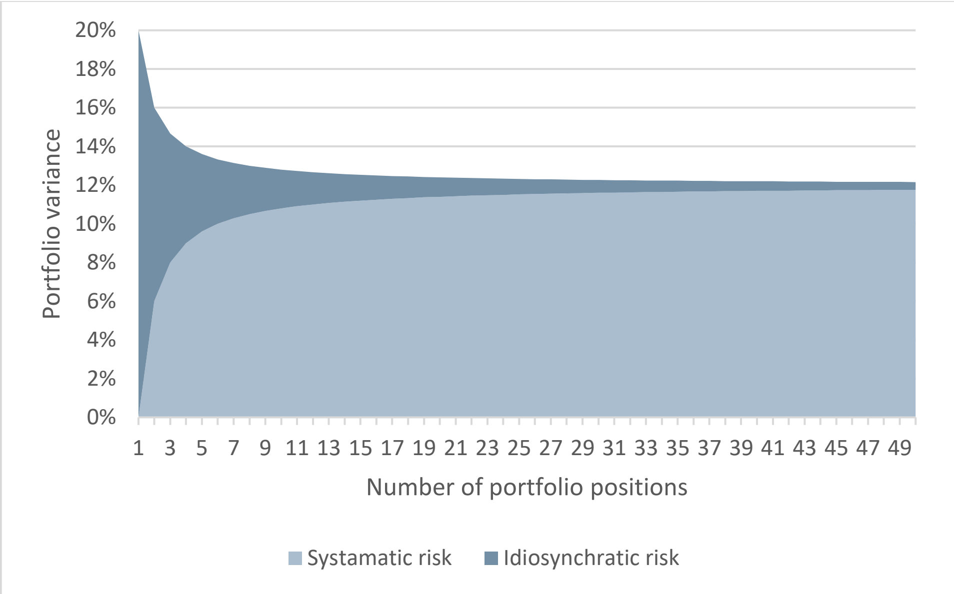
SIMPLE MODELS OF THE BENEFITS OF INCREASING PORTFOLIO POSITIONS

Modern Portfolio Theory includes a simple equation for the impact of increasing the number of positions on portfolio risk:

- Variance = sum of the squares of the individual asset variance * square of the portfolio weight + the sum of the individual asset covariances.
- Thus, for a two-stock portfolio (equally weighted at 50% each) with individual asset variance of 20% and covariance of 0.6, the portfolio variance is given by 2 * (50%^2) * 20% + 2 * (50%) * (50%) * 0.6 * 20% = 16%

If we calculate this over increasing number of positions, we get the following chart (for individual stock variance of 20% and covariance of 0.5):

Portfolio Variance outcome using different numbers of securities

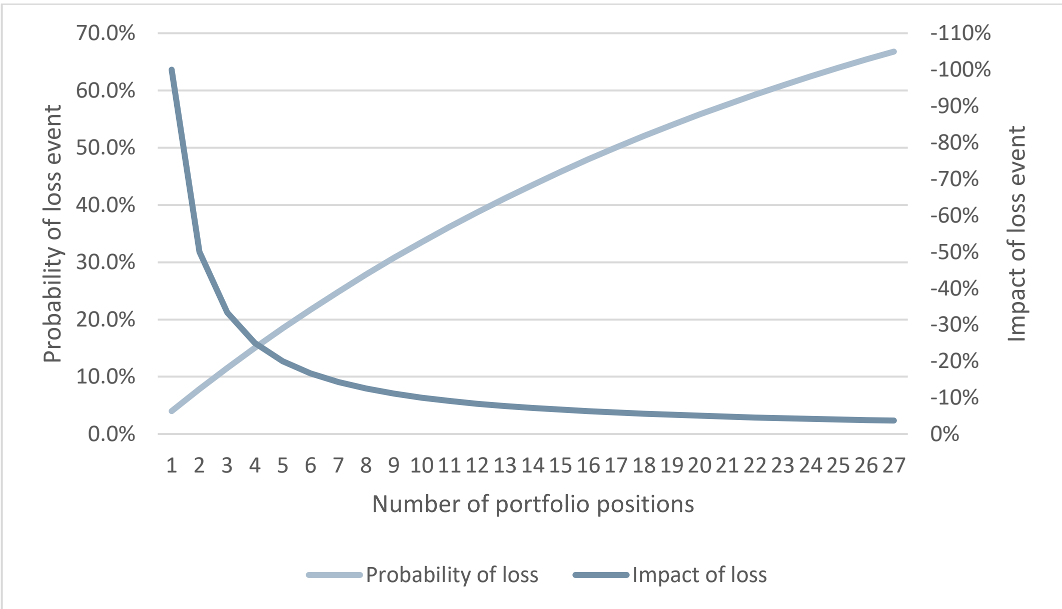


Source: ATLAS Infrastructure

This calculation is the simplest demonstration of the value of diversification as it demonstrates that adding additional positions decreases the idiosyncratic risk. It also shows that 80% of the risk reduction (defined as the reduction in variance achieved from moving from a single stock portfolio to a very diversified portfolio) is achieved with just 5 positions, 90% of the benefits with 9 positions and 95% of the benefit with 15 positions.

Although this example uses individual stock variance and portfolio variance as proxies for risk, the same impact can be shown if considering risk of loss arising from a 'tail risk' event. If we assume that we construct a portfolio from securities that have an individual risk of total loss of 1/25, and that these risks are *idiosyncratic*, then the trade off in portfolio construction is as follows:

'Tail risk' event probability and impact



Source: ATLAS Infrastructure

The impact of a loss event declines as 1/ (portfolio positions) whereas the probability of at least one asset having a loss event increased almost linearly with portfolio positions. Hence in this case there is an implied trade off whereby increasing the number of portfolio positions eventually becomes counterproductive as it increases the chance of having a loss event faster than it decreases the impact of that loss event.

PRACITICAL IMPLEMENTATION & EMPIRICAL EVIDENCE

There are a very large number of academic studies that have sought to determine the minimum portfolio size needed to achieve the benefits of diversification based on empirical evidence from markets (for example, see Equity Portfolio Diversification: How Many Stocks are Enough? Evidence from Five Developed Markets by Vitali Alexeeva, Francis Tapon for a summary). A number of these studies (Copp and Cleary, 1999; Domian et al., 2007; Benjelloun, 2010; Kryzanowski and Singh, 2010) have concluded that 50 or more portfolio positions are required to achieve diversification benefits. Conversely other studies (Evans and Archer, 1968; Jennings, 1971; Fielitz, 1974; Johnson and Shannon, 1974; Solnik, 1974; Bird and Tippett, 1986; Tang, 2004; Brands and Gallagher, 2005) have concluded that substantially fewer positions (6-15) are needed to achieve diversification.

ATLAS notes that these research outcomes are not necessarily contradictory with each other or with the simple mathematical examples shown above. The principle drivers for achieving different outcomes are as follows:

- Studies that define risk reduction purely from the perspective of reduction of variance vs the market will tend to support larger numbers of positions in a portfolio. Conversely studies that look to define diversification benefit based on reducing risk of loss have tended to conclude that fewer positions are needed
- The heterogeneity of the sample size is important. The simple models for diversification of idiosyncratic risk shown above assume that covariance is a constant across the universe. However, in practice this is not the case and the more heterogeneous the sample size, the greater the likelihood that adding additional positions reduces the average covariance across the portfolio due to diversifying common factor risks.

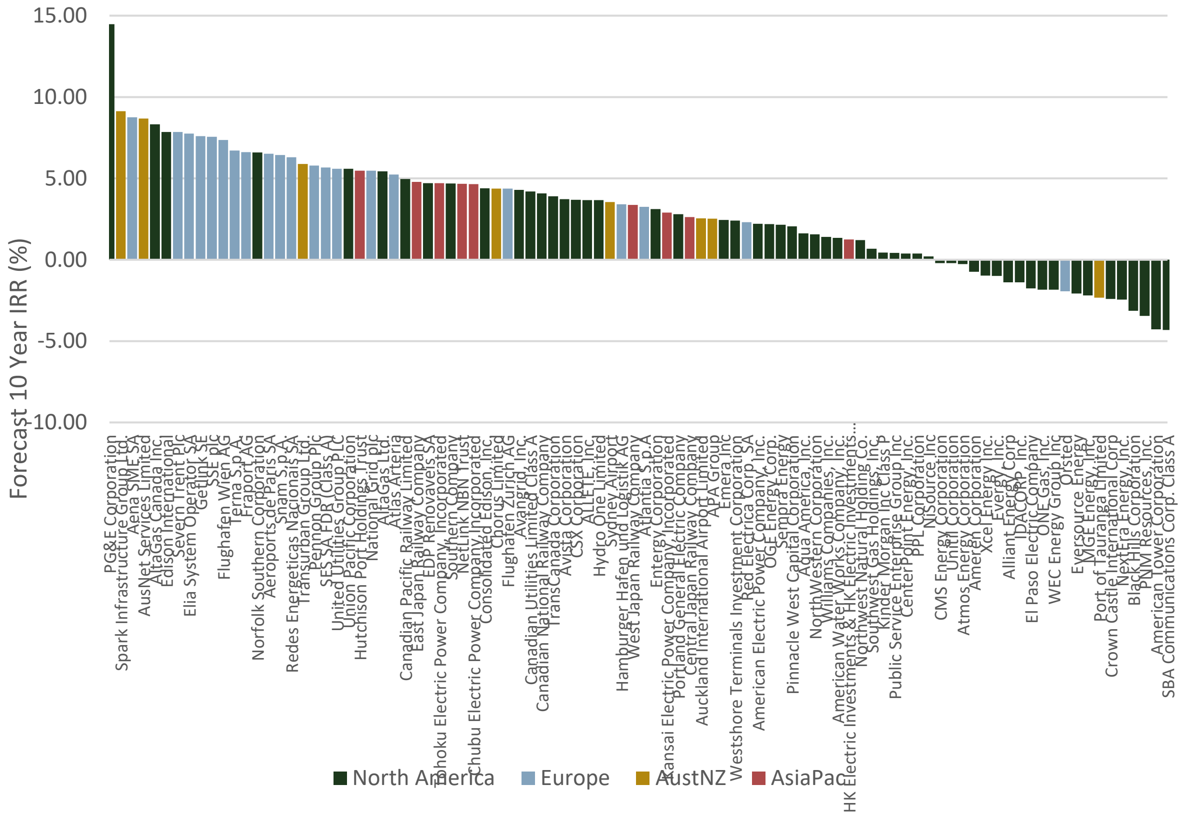
In addition, nearly all studies we have reviewed looked at selecting portfolios 'at random' from the universe and do not directly consider the impact on investor returns of having to compromise absolute returns by adding incremental positions that have lower returns than the portfolio average.

DIVERSIFICATION VS ABSOLUTE RETURN TRADE OFF

The majority of the empirical studies have focussed on the impact of number of portfolio holdings on either risk of loss or portfolio variance and tracking error vs the index. Set against the potential benefits of an increased number of portfolio positions is the potential cost of each additional holding in terms of dilution to the overall portfolio return.

For example – the current expected absolute returns for the ATLAS investment universe, ranked from highest to lowest, are as follows:

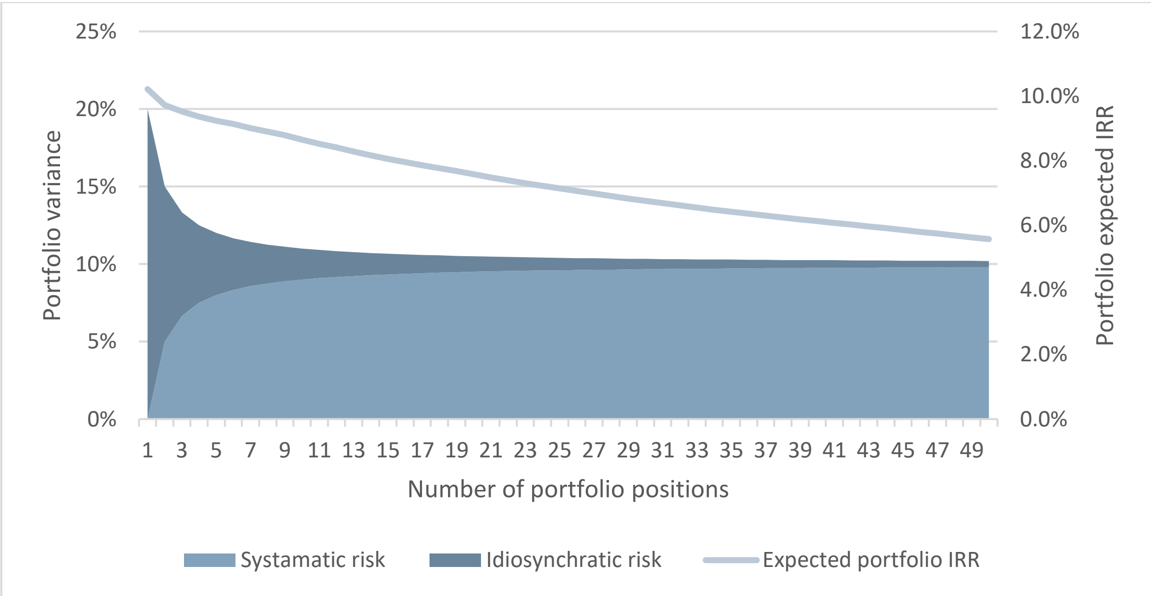
ATLAS Infrastructure universe assets ranked by expected 10yr equity IRR



Source: ATLAS Infrastructure

If we were to consider this dispersion of returns in the diversification benefit analysis, then each additional asset we would add to the portfolio will result in a reduction to the average portfolio return. The resulting trade-off would appear as follows using the simple model of portfolio variance:

Expected portfolio return and expected portfolio variance vs number of positions



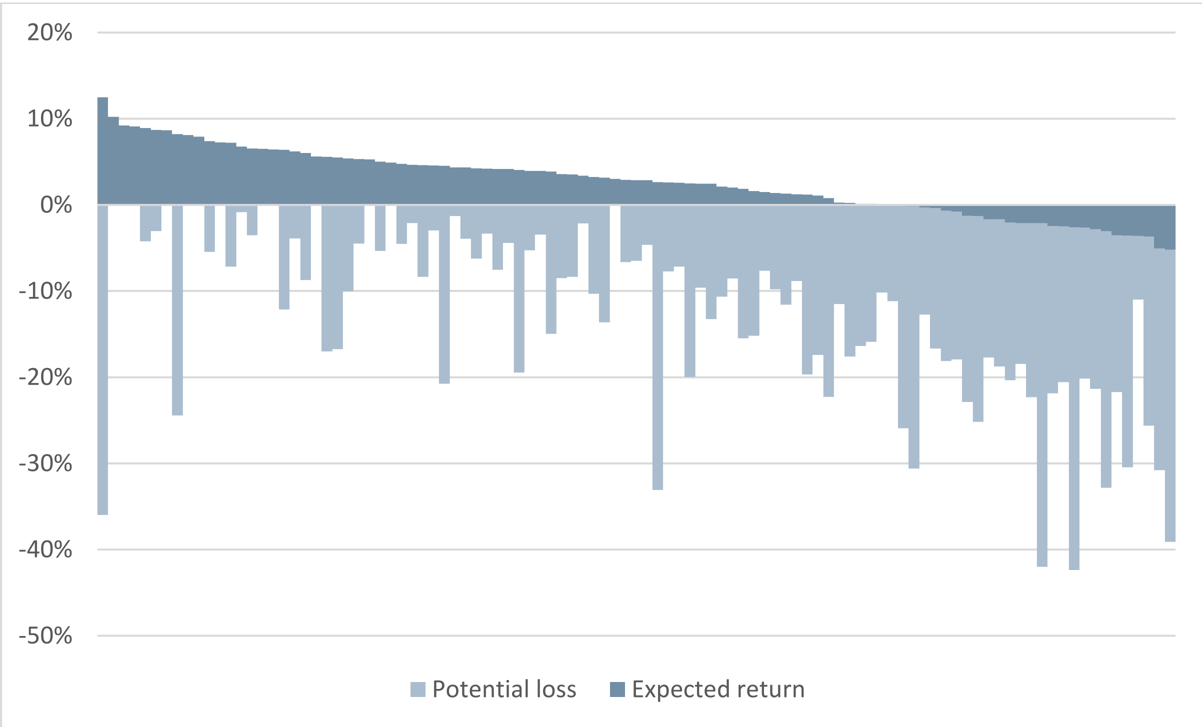
Source: ATLAS Infrastructure

VALUATION RISK IS A MATERIAL COMPONENT OF RISK OF LOSS

When considering idiosyncratic risk for a portfolio holding, the magnitude of the impact is usually a combination of event risk and valuation risk. I.e. a company that is trading at less than book value of assets that faces an unforeseen material business disruption will generally lose less capital value than a company that was trading at five time its book value.

ATLAS calculates the expected risk of loss under a stress scenario of all assets in the universe. The risk of loss ranked against expected return is as follows:

Portfolio return and expected portfolio variance vs number of positions



Source: ATLAS Infrastructure

Although there is an idiosyncratic element to the potential loss (e.g. the highest returning asset, PG&E, currently has one of the highest risks of loss given current wildfire related litigation). On balance, companies with lower expected returns will also have larger potential losses in a stress situation.

Hence, unlike the simple risk models where idiosyncratic risk is potential returns are assumed constant across the universe, using actual expected values for returns and risks provides a strong empirical argument against holding excessive portfolio positions.

IMPLICATIONS FOR ATLAS PORTFOLIO CONSTRUCTION

There are three aspects to the listed infrastructure sector and the ATLAS investment approach that are very relevant to our approach to diversification and risk reduction:

- The investment objective of ATLAS is to create portfolios for clients that generate long term, absolute real returns using listed infrastructure assets. We are not an 'index aware' manager that manages tracking error or variation vs the index, Rather, we define risk as the probability of permanent impairment of equity returns for clients, i.e. permanent loss of value over the long run.
- The listed infrastructure sector is very far from homogeneous. There are large sectors (such as US utilities) that share very similar common 'factor' exposures. Conversely, there are some assets that share almost no

common factor exposures with the investment universe. In addition, the expected return of assets varies widely across the universe along with the expected loss in a stress event.

- Given this, we assess the absolute return of each individual asset in the universe and construct portfolios that maximise the absolute return to the client, whilst directly controlling both common sources of risk and idiosyncratic company risk using our company by company risk estimates.

Given these aspects, our optimal approach to portfolio construction and risk control is as follows:

- We do not focus on variance (or volatility) reduction as a specific goal. Instead all risk measures are designed to estimate either risk to portfolio absolute return and / or risk of drawdown.
- We estimate the key common economic factor risks for each company so that we can then control these at the portfolio level, specifically with relation to economic, inflation/discount rate and climate change. We manage economic factor exposures across our holdings by running macro scenario analysis through our company models, with the assistance of our Macro Advisory Board. In this way, we minimise the risk of long-term loss from common exposures that cut across the portfolio.
- We complement this with evaluating stock-specific risk of loss using asset stress testing to proxy for idiosyncratic risk, which is also directly controlled across the portfolio.
- Our 'optimum' portfolio size is given as the number of portfolio securities after which the marginal portfolio addition would reduce absolute returns without any material improvement to portfolio risk (including common economic factor risk and asset specific risk).
- We would expect that our optimal portfolio size would be smaller than index aware 'general' equity managers given our objectives. We also expect that our optimal portfolio size will naturally move over time depending on where the best absolute returns are to be found in the universe and the level of common risk factor evidenced by the highest returning assets.

CONCLUSIONS

There is no single 'optimal' portfolio size. Depending on the investment objectives of the client, the investment approach of the manager and the nature of the investment universe, determines portfolio sizes. However, for ATLAS we have concluded:

- **Purely idiosyncratic risk is largely diversified after 5-15 positions**: Hence provided that we have not selected assets with much higher idiosyncratic risk (which we measure through asset stress testing), we should be comfortable with constructing concentrated portfolios provided that we control common factor risks
- **For a manager seeking absolute returns from listed infrastructure, increasing the number of portfolio positions is a highly inefficient way of controlling common factor risk** – the empirical evidence is clear that by simply increasing total positions, eventually common factor risk is reduced when compared to a small random sample. However, this ignores the impact on portfolio returns from adding additional securities, as it entails dipping into our 'second-best' ideas. It is much better to control common factor risk directly.
- **A core part of manager skill is understanding and estimating common factor risk** – Estimating the underlying common factor exposures of a portfolio asset is better done as a core bottom-up analysis and research skill rather than an outcome of 'quant' based factor models – hence we manage these risks with the assistance of our company models. Better understanding of common factors will directly lead to the ability to construct more efficient portfolios, that can achieve the same diversification benefits using fewer assets and therefore better returns.
- **Valuation risk is a material component of observed idiosyncratic risk** – The magnitude of portfolio loss arising from a stock specific event is often multiplied by any inherent valuation risk in that asset. Hence increasing the number of portfolio holdings can perversely start to increase risk of loss due to the impact of holding a greater number of assets with inherent valuation risk.

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