Infrastructure Research Note

12th January 2009

Allocating capital to UK infrastructure investments

- **Investor interest in infrastructure investment has gained momentum in recent years. With increasing capital flows expected in the future, a crucial issue is the optimal allocation of capital to this asset class; not only against competing asset classes but also for the different investment segments.**
- **Simple allocation models are proposed for allocating investor capital to infrastructure investments. This is motivated by infrastructure's distinctive different risk-return features against competing asset classes.**
- **The analysis highlights the potential for diversification benefits when: i) augmenting a balanced portfolio of traditional asset classes with unlisted infrastructure; and ii) investing in both direct and listed infrastructure.**
- **These models are considered valuable tools in formulating strategies for investment structures which jointly invest in listed and direct asset markets.**
- **Empirically estimated target allocations were obtained using historical return data. In a balanced portfolio setting, the model assigns a significant allocation to UI. The augmentation of the balanced portfolio with UI enhances portfolio risk-adjusted performance. In a hybrid portfolio, estimated target allocations, on average, for direct and listed infrastructure are 80% and 20% respectively**
- **Tactical allocations will be influenced by varying market conditions. In times of excess listed market volatility, such as the present period, the model suggests a greater allocation to direct infrastructure.**

1. Introduction

Interest in infrastructure as an investment asset class has gained momentum over recent years with investors attracted by some of its key characteristics such as providing a sustainable long-term income yield (which is generally inflation hedged) and diversification benefits (due to relatively low correlation against competing asset classes).

With increasing capital expected to flow into this asset class in the future, a crucial issue is the optimal allocation of capital to infrastructure investment; not only in the context of competing asset classes but also the different forms of infrastructure investment, i.e., listed versus unlisted.

Such capital allocation issues are usually addressed via the application of asset allocation models. These models can also be constructed at a sector level for a given asset class.

This research note presents simple allocation models for allocating investor capital to infrastructure investments for the UK market.

2. Features of selected investment asset classes

A central feature of asset allocation models is the construction of an efficient portfolio frontier (via an application of an optimisation procedure), and subsequently determining the optimal allocation of capital across asset classes.

To undertake the optimisation procedure, three sets of information are required for each asset class. These include an estimate of: i) the expected return; ii) expected covariance of returns and, iii) the correlations between returns. Estimates for these three information sets are commonly based on historical values. Adopting this approach, estimates are based on a historical ten year time period using monthly returns.

A brief discussion of each of these three information sets is given below in the context of four asset classes for the UK investment market. These include: bonds (a proxy for fixed income), shares, listed infrastructure and unlisted infrastructure.

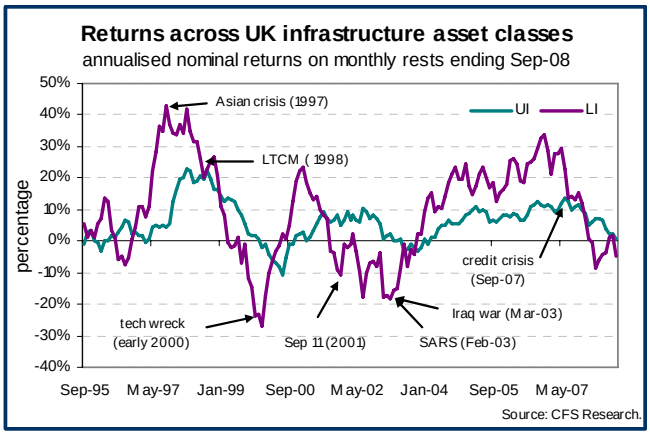
Investment returns

Investment in infrastructure can take two forms: direct (or unlisted) and listed. Direct investment can be via the acquisition of physical assets or investment via an unlisted fund. In contrast, listed infrastructure (LI) refers to investment in infrastructure assets held in listed companies or listed funds which are traded on a public stock exchange. Importantly, investment characteristics between the two investment segments are different, at least, over the short and medium term. Returns for listed infrastructure are underpinned by underlying asset market drivers but also influenced to a greater extent by capital market conditions. Investment in unlisted infrastructure is more suitable for institutional investors while their listed counterparts are mainly aimed at retail investors.

Currently, there is no index series available for UK unlisted infrastructure returns. Consequently, in this study we make use of a synthetically estimated return series for unlisted infrastructure which draws on information from unlisted Australian infrastructure returns[1]. In contrast, return indices for listed infrastructure investments are readily available. The return profile for listed infrastructure is based on the UBS Infrastructure and Utilities Accumulation Index.

Figure 1A shows rolling annualised logged returns for the two infrastructure asset classes. While both asset classes appear to generally display similar movements, LI returns exhibit a much more pronounced cyclical profile than UI returns. Disparity in returns is evident at the time of the Asian crisis (late 1997) and long term capital markets (LTCM, in late 1998), the tech wreck (in early 2000), Sep 11th (in 2001), and the recent downturn reflecting the impact of the global credit crisis (since late 2007). In all, such disparities in the return series reflect differences in: valuation method (i.e., appraisal-based versus marked to market); repricing profiles; and exposure to market influences.

Figure 1A

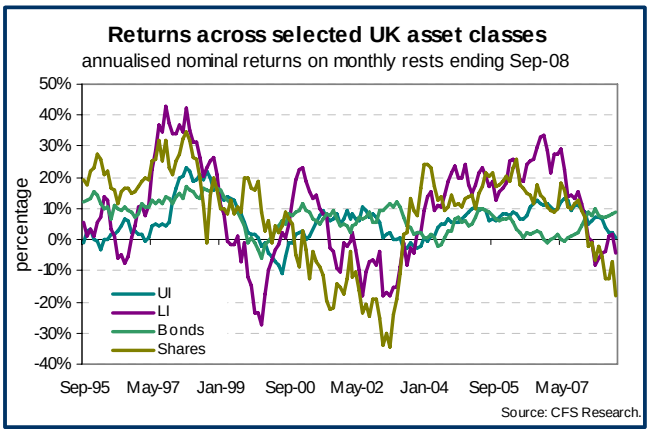


Comparing infrastructure to traditional investments, Figure 1B shows rolling annualised returns for LI and UI investments against bonds (fixed interest) and shares. Shares are represented by the FTSE 100 accumulation

[1] For a detailed explanation of the series refer to CFS Infrastructure Research Paper: Constructing an investment return series for the UK unlisted infrastructure market: estimation and application, dated 10th December 2008.

index while the bond series is based on the J.P. Morgan Securities International Government Bond Index. Notably, returns for LI appear to closely track returns for shares. In contrast, returns for bonds and UI are less variable and have relatively similar return profiles.

Figure 1B



Return volatility

The second information set refers to variance information across asset classes. When this variance information is grouped together, it is often referred to as the covariance matrix. The covariance matrix can be interpreted as denoting the joint risk across asset returns.

The covariance matrix was estimated using a 10 year sample period[2] ending September 2007. The estimated covariance matrix across the four asset classes is reported in Table 1. Both shares and LI deliver similar variance values while bonds and UI deliver markedly lower variance values. Furthermore, investing in unlisted infrastructure delivers a lower return volatility than listed infrastructure as the variance of listed infrastructure is about twice as large as that of unlisted infrastructure. The greater volatility exhibited by listed infrastructure is attributable to share market volatility.

Table 1

COVARIANCE MATRIX
Last 10 years ending Sep-2007

	UI	LI	Bonds	Shares
UI	**0.00295**	**0.00067**	**0.00018**	**0.00162**
LI	0.00067	**0.01517**	**0.00081**	**0.00653**
Bonds	0.00018	0.00081	**0.00165**	**-0.00122**
Shares	0.00162	0.00653	-0.00122	**0.01917**

[2] The estimation period was chosen to end in September 2007 rather than September 2008 to isolate the impact of the current credit crisis which began around August 2007.

Return correlations

The third set of information is the correlation matrix. The correlation value between two series is commonly given by the correlation coefficient which is a number between -1 and 1. It measures the strength of the linear relationship between the two variables. A value of 1 implies perfect positive correlation, -1 implies perfect negative correlation, while 0 implies no correlation.

The correlation matrix is important as it gives rise to diversification benefits. Diversification benefits arise when the portfolio risk can be reduced beyond that of any individual portfolio assets. Hence, efforts to achieve such benefits commonly involve mixing asset classes with different risk and return characteristics such that they exhibit negative or low correlation values. The closer the correlation value is to -1, the greater is the potential for diversification benefits.

Table 2 reports estimated pair wise return correlation values across fixed interest (or bonds), shares and the two infrastructure asset classes over the last 10 years ending September 2007. Across listed and unlisted infrastructure investment, the correlation value is not negative but low at 0.10; implying that the two return series tend to weakly move together. This suggests that diversification benefits are obtainable by holding a mixture of direct and listed infrastructure exposure as it reduces the portfolio risk.

Table 2

CORRELATION MATRIX
Last 10 years ending Sep-2007

	UI	LI	Bonds	Shares
UI	**1.000**	**0.100**	**0.081**	**0.216**
LI	0.100	**1.000**	**0.161**	**0.383**
Bonds	0.081	0.161	**1.000**	**-0.216**
Shares	0.216	0.383	-0.216	**1.000**

3. Portfolio construction

Key considerations for portfolio construction include: 1) defining the investment portfolio; 2) estimating the frontier; and 3) determining strategic allocations.

Portfolio types

Defining investment portfolios depends on the investment mandate. For instance, portfolios may be defined by a combination of asset/sector type, geographical (country) exposure, investment vehicle and risk profiles. This study considers two types of portfolios for evaluating the role of infrastructure investments. These include: i) a balanced portfolio comprising of bonds, shares, listed and unlisted

infrastructure; and ii) a hybrid portfolio comprising of listed and unlisted infrastructure investments.

Estimation of efficient frontier

Using the three information sets one can estimate portfolio frontier using an optimisation procedure. Note; the objective of the optimisation procedure is to produce a set of weights (i.e., asset allocations) such that the portfolio variance is minimised subject to a set of allocation constraints for a given portfolio return.

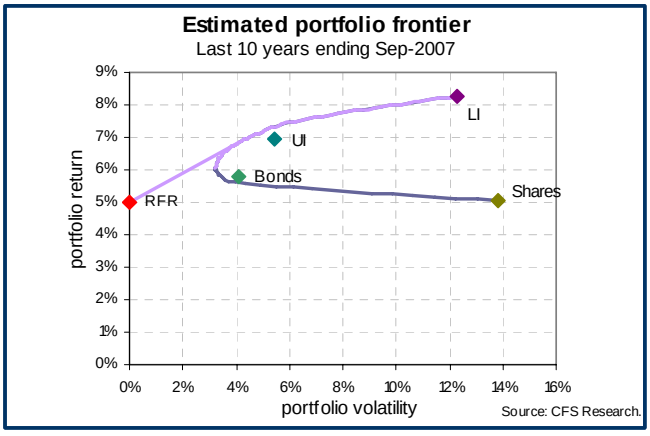
Determining strategic allocations

Once estimating the portfolio frontier one can then use this to determine the appropriate strategic[3] (or target) allocations across asset classes. Strategic allocations are based on a risk-adjusted performance measure. The appealing feature of such a measure is that it attempts to encapsulate the trade-off between risk and return. Risk-adjusted return quantifies a given unit of return per unit of risk. Whilst a portfolio may have a very high total return, the associated risk with that return is also of importance when considering an investor's risk tolerance. One such measure is the modified Sharpe ratio (MSR); the ratio of portfolio return to portfolio standard deviation.

Balanced portfolio comprising of bonds, shares, listed and unlisted infrastructure investments

Focusing on the four asset portfolio, Figure 2 shows the estimated feasible frontier. The frontier is augmented with the risk-free rate (RFR) which extends the frontier to the vertical line.

Figure 2



As mentioned earlier, bonds and UI are clustered together while LI and shares are clustered in the same volatility region. Interestingly, while the estimated frontier displays the conventional shape, both listed and unlisted infrastructure deliver higher returns over the ten year sample period than bonds and shares. This reflects the earlier and rapid decline of shares against LI whilst the bond rate generally hovered between 4.0-5.5%.

With reference to the efficient frontier, the strategic (or the optimal) allocation can be determined by finding the maximum value of the SR ratio along the frontier. Based on this criterion, estimated optimal weight allocations across asset classes for various sample periods are reported in Table 3. Different sample periods were selected to gauge the sensitivity of results to time. Notably, the model awards significant allocations to both bonds and UI due to their superior risk-adjusted return profiles over LI and shares. Furthermore, allocations to UI have been generally rising over time at the expense of bonds. It's also worth mentioning that the lower values for the portfolio MSR, especially for the period ending 2008, reflects the rapid and significant decline in asset returns.

Table 3

Optimal portfolio asset weights

estimates based on historical ten year sample periods ending:

	Sep-08	Sep-07	Sep-06	Sep-05	Sep-04
asset class			optimal weights		
UI	31%	34%	25%	22%	22%
LI	2%	3%	2%	0%	0%
Bonds	63%	59%	67%	71%	71%
Shares	4%	4%	6%	7%	6%
Total	100%	100%	100%	100%	100%
portfolio performance measures					
return	4.9%	6.2%	6.9%	7.3%	7.5%
volatility	3.1%	3.3%	3.4%	3.5%	3.6%
MSR	1.58	1.90	2.01	2.09	2.07

Source: CFS Research. Note: MSR refers to Modified Sharpe Ratio.

The influence of unlisted infrastructure

To further gauge the influence of UI on the portfolio, the portfolio frontier was re-estimated with UI excluded from the balanced portfolio. The two estimated efficient frontiers (with and without UI) are shown in Figure 3. Notably, when unlisted infrastructure is augmented in the balanced portfolio, the frontier bulges out towards the top-left area of the risk-reward space; suggesting enhanced risk-adjusted returns. This is further highlighted in Table 4 which shows that the optimal allocation (including UI) produces a higher MSR of 1.9 as opposed to 1.6 for the portfolio excluding UI. Furthermore, as noted earlier, the increased allocation to UI mainly comes at the expense of bonds.

[3] A strategic asset allocation is comprised of a base portfolio mix of assets aimed at delivering on the longer-term investment objective.

Figure 3

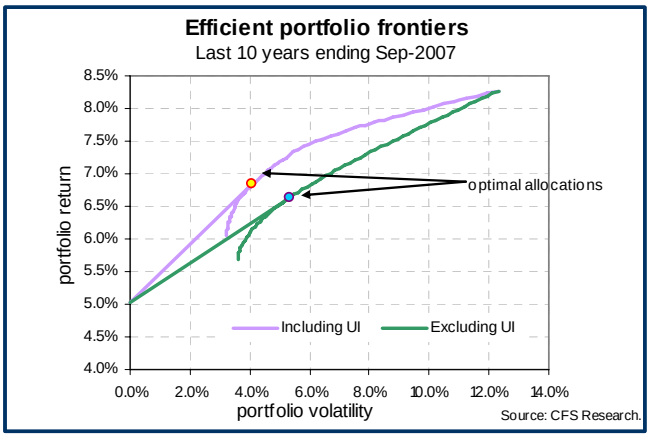


Table 4

Impact of infrastructure investment on portfolios

Last 10 years ending Sep-2007

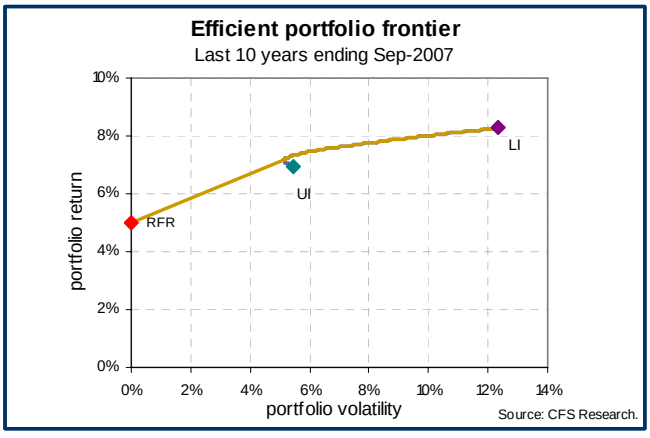
asset class	MSR	portfolio allocations	
		with UI	without UI
Unlisted infrastructure (UI)	1.28	34.1%	n.a.
Listed infrastructure (LI)	0.67	2.9%	2.8%
Bonds	1.42	58.6%	86.5%
Shares	0.36	4.4%	10.7%
Portfolio		100.0%	100.0%
MSR		1.90	1.59

Source: CFS Research. Note: MSR refers to Modified Sharpe Ratio.

Portfolios comprising of listed and unlisted infrastructure investments

Focusing on the two infrastructure asset portfolio, Figure 4 shows the risk-return fro both the UI and LI assets and the resulting estimated efficient frontier. While LI delivers a higher return over UI, it is also matched by a commensurately higher level of risk such that the MSR will be greater for UI.

Figure 4



Based on the frontier, the estimated optimal weight allocations for direct and listed infrastructure, reported in Table 5, are approximately 85% and 15% respectively. To gauge the robustness of these optimal weights, the exercise was repeated for a variety of ten year sample periods. Based on these estimates, optimal weights for direct and listed infrastructure investments are, on average, 80% and 20% respectively. The increased allocation to direct infrastructure over more recent sample periods reflects the recent downturn in the listed sector relative to the unlisted sector (as noted in Figure 1A) and increased volatility in the general listed equity markets associated with the credit crisis.

Table 5

Optimal portfolio asset weights

estimates based on historical ten year sample periods ending

	Sep-08	Sep-07	Sep-06	Sep-05	Sep-04
asset class			optimal weights		
UI	84%	84%	72%	78%	78%
LI	16%	16%	28%	22%	22%
Total	100%	100%	100%	100%	100%
portfolio performance measures					
return	4.9%	7.2%	7.7%	6.2%	5.4%
volatility	5.1%	5.1%	5.7%	5.5%	5.7%
modified sharpe ratios (MSR)					
UI	0.88	1.28	1.07	0.99	0.82
LI	0.46	0.67	0.89	0.62	0.50
Combined	0.96	1.39	1.36	1.14	0.94

Source: CFS Research. Note: MSR is the quotient of return to volatility.

Table 5 further highlights the potential for portfolio diversification benefits. Looking at the MSR statistics, one notes that this measure is higher when both infrastructure segments are combined. This suggests that investors seeking risk-adjusted return can enhance their investment objectives by having exposure to infrastructure across both investment segments.

4. Summary remarks

Simple allocation models were proposed for allocating investor capital to infrastructure investment; both in a balanced portfolio and a hybrid portfolio. These models are considered valuable tools, providing a basis for formulating allocation strategies across infrastructure investment classes to reap out-performance based on diversification benefits.

Estimated target allocations were obtained using historical return data. In a balanced portfolio setting, the model assigns a significant allocation to UI. The augmentation of the balanced portfolio with UI

enhances portfolio risk-adjusted performance. In a hybrid portfolio setting, estimated target allocations, on average, for direct and listed infrastructure are 80% and 20% respectively. Note that short-term tactical allocations can be made which differ to these target weights as dictated by the prevailing market conditions for each class of the infrastructure investment landscape.

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