Equity Risk Premia

Key points

- **Standard approaches** in public markets consists of estimating risk factor loadings (*betas*) first, then risk factor prices (*lambdas*). This is the standard Fama-McBeth approach used to develop numerous factor models.
- With private, illiquid assets, factor loadings can be estimated using a bottom-up approach and the firm's financials and other relevant and observable characteristics.
- Next, using realised secondary market transactions or a well-defined listed proxy, observable **expected returns (e.g. deal IRRs) can be decomposed into time series of risk factor premia**.
- Finally, once risk factor premia have been estimated for each valuation date, **a firm-specific, mark-to-market risk-premia** can be computed for any private assets for which factor loadings (e.g. financials) are observable at that time.
- EDHEC*infra* uses **5 key risk factors** (Size, Profits, Investment, Leverage and Term) and a range of control variables to estimate the price of systematic risk factors in the private infrastructure equity market.

Standard Approach in Public Markets

The premise that a limited number of factors explains the majority of investment risk found in financial securities makes the development of robust and persistent factor models of returns an important part of investment-risk management.

With frequent trading and observable prices and returns, factor models can be used to decompose portfolio risk according to common factor exposures and to assess how much of the portfolio's returns are attributable to each common factor exposure.

The standard approach in both academic and industry factor models is the two-step regression method put forward by Fama & McBeth or FMB[1].

- In a first step, asset returns are regressed against one or more factor time series to determine factor exposures or *betas*.
- In a second step, the cross-section of portfolio returns is regressed against factor exposures at each time step, to give a time series of risk premia coefficients for each factor. FMB then averages each factor coefficient to get a time series of factor prices (lambdas).

Hence, the FMB approach consists of estimating two sets of coefficients, since both the asset betas or factor loadings *and* the market prices of each risk factor in the APT pricing equation (see (Modern Approach:3)) are unknown and must be estimated using time series of asset prices/returns. Once individual factor loadings have been estimated over time, factor prices (*lambdas*) are estimated in the cross section of returns given estimated asset betas.

This is possible because individual security prices are observable over time in sufficiently long time series as well as in the cross section in sufficiently large numbers. FMB uses the two dimensions of the data available to estimates first the betas and then the lambdas of the APT framework.

Application to Private Markets

With illiquid financial assets, too few trades are available to decompose individual asset returns into exposures to common sources of risk over time and estimate asset betas. However, if individual factor exposures can be estimated or assumed directly and a minimum number of transaction prices can be observed in each time period, risk-factor prices (lambdas) can still be estimated in the cross section of expected returns.

An approximate cross section of expected returns

Say that, in any given period, a number of **primary and secondary transactions are observable** in the market for unlisted infrastructure investments (this is a requirement of the condition to be observing a *principal market* in the sense of IFRS 13).

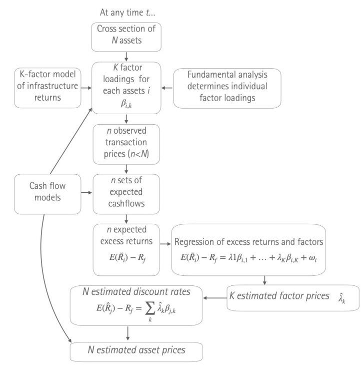
As long as sufficient information about the expected cash flows to equity or debt holders can be obtained or estimated, at any time t we have:

$$P_i = \frac{\sum_{t=1}^{T} CF_t}{\left(1 + (R_f + E(\widetilde{R}_i))\right)^t}$$

for primary or secondary investment P_i in asset i, paying CF_t until time T. $R_f + E(\widetilde{R}_i)$ is the approximate expected internal rate of return (IRR) at time t.

Using standard root-finding techniques (see technical appendix), $E(\widetilde{R}_i)$, an estimate of the expected rate of (excess) return for the entire life of the investment, can be derived.

Figure 1: A diagram summarising the estimation of risk factor premia for unlisted infrastructure assets



Video Tutorial

Watch a 2-minute video highlighting our approach to asset pricing using a multi-factor model in illiquid markets: here.

References

1. 1

Hence, a cross section of expected returns is observable in each period. These estimates are noisy because they are solely derived from initial and secondary investment values and expected cash flows. Cash-flow forecasts are characterised by measurement errors, and we know that cash-flow timings and size can have a dramatic impact on IRRs.

Moreover, only a fraction of the investments representing the broad market at time t are the object of observable transactions at that time. Hence, only a subset of approximate excess returns $E(\tilde{R}_i)$ is available in each period.

The cross section of factor prices

Once a cross section of approximate expected returns is known, it can be regressed against individual asset factor loadings (betas) to estimate individual factor prices ($\hat{\lambda}_k$) in the cross section, at that point in time. Thus, we have:

$$\tilde{R}_i - R_f = \gamma_i = \lambda 1 \beta_{i,1} + \cdots + \lambda_K \beta_{i,K} + \omega_i$$

where ω_i is the measurement noise introduced when estimating the risk premia γ_i. In other words, using the APT equation, we can write estimated excess returns at time t as a function of factor loading and factor prices plus some measurement error.

Using a range of statistical techniques (e.g. Bayesian regressions) the value of λ_i can be estimated for observable transactions at time t (the cross section of transactions).

Estimated $\hat{\lambda}_k$ then gives us new estimates of expected excess returns $\hat{\gamma}_j$ for all assets j in the relevant period in accordance with their individual betas, including those assets for which no transaction prices were available at the time, so that:

$$\hat{\gamma}_j = \sum_k \hat{\lambda}_k \beta_{j,k}$$

Hence, our approach consists of predicting the prices of risk factors that apply to assets with certain characteristics even though they have not been traded in the relevant period.

Choice of Factors for Unlisted Infrastructure Equity

The following systematic **five key risk factors** are used by EDHEC*infra* to estimate the a model of the expected returns using observable market prices as inputs, as well as several **control (dummy) variables** that account for sector and business model specific effects.

Factor Name	**Factor Definition**	**Factor Interpretation**
Size	Total Assets	Larger infrastructure companies are more illiquid and complex than relatively smaller ones. The size factor systematically attracts a **positive** premia.
Profit	Return on Assets before Tax	More profitable firms are more valuable. Higher profits thus tend to attract a lower premia. The factor premia or λ is **negative**. As a result, during the greenfield phase, when profits are also negative, or in periods of distress, this factor carries a **positive premia**.
Investment	Capex *over* Total Assets	During the development or greenfield phase of infrastructure companies, relatively large capital costs are incurred and sunk. This is a riskier period and a higher ration of capital expenditure to size attracts a higher expected return i.e. a **positive risk premia**.
Leverage	Total Senior Liabilities *over* Total Assets	Likewise, controlling for other effects, higher leverage signals higher risk and is characterised by a **positive risk premia**.
Term	20-year public bond yield *minus* 3-month public bond yield	The slope of the yield curve can be a good proxy of country risk, both political and macro-economic. The term spread is computed as the time of each valuation, using the relevant curve in the country of the investment. A higher term spread is characterised by a **positive risk premia** and thus a higher aggregate risk premia.
TICCS® Business Risk	Merchant, Regulated or Contracted control variables	Controlling for business risk families as defined in TICCS® shows that merchant companies systematically attract a higher risk premia i.e. expected returns are higher in riskier segments of the infrastructure market.
TICCS® Sector	Industrial activity superclass or class control variables	Likewise, a few sectors are found to have systematically higher or lower expected returns even after controlling for the effect of the factors described above e.g. renewable energy projects have systematically lower returns (or higher prices) even for similar size, profits, leverage. etc.