Building a risk-adjusted benchmark of long-term investment in infrastructure

Current and future work of the EDHEC/MERIDIAM Research Chair

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Agenda

1. Why a benchmark of private infrastructure investment?
2. Empirical challenges
3. Existing approaches (and why they are inadequate)
4. A roadmap to build adequate measures of expected performance
5. Solutions
6. Required data and data pooling by investors

Why a benchmark?

1. Two key reasons to invest in private infrastructure
   - → Liability-driven investment
   - → Diversifying away from capital market volatility
2. Benchmarks can help to:
   - → Address the asset allocation question (*risk*, *returns*, *correlations*)
   - → Integrate infrastructure investment in an asset-liability framework (*duration*)
   - → Better calibrate risk-based prudential frameworks (*extreme risk measures*)

Empirical challenges

- Endemic data paucity:
  1. Too few primary and secondary transactions to observe representative *prices*
  2. Too few representative times series of *cash flows* spanning the entire life of infrastructure projects.
- The absence of a unique pricing measure
  1. Markets for long-term illiquid assets are incomplete...
  2. Different investors value the same private infrastructure project differently

  $\rightarrow$ The "illiquidity premium" is partly a subjective question
- Solutions:
  1. Acknowledge upfront that not enough data can be collected to address this question from a purely econometric or 'reduced form' angle
     $\rightarrow$ we need to rely on forward looking **cash flow models** to determine expected returns (so we have to mark to model);
  2. Build such models to allows simple updating (calibration) procedures as and when new data becomes available;
  3. Acknowledge that there exists a range of values for the same asset and allow the pricing framework to capture this range.

Existing approaches (and why they are inadequate)

Existing approaches to measure the performance of private (unlisted) equity investments fall into two categories: 1) not-so-serious 2) more serious but not adapted to infrastructure

- Not-so-serious approaches include
  1. Building a benchmark using self-reported IRRs and NAVs from "infrastructure funds" (2:20 PE funds)
  2. Building portfolios of listed "infrastructure" stocks
- More serious approaches include methods developed for RE, PE and VC
  1. Repeat sales (Cochrane, 2005; Woodward, 2004; Korteweg and Sorensen, 2007)
  2. Public market equivalents (Ljungqvist and Richardson, 2003; Kaplan and Schoar, 2005; Phalippou and Gottschalg, 2009)
  3. Factor decomposition from cash flows (Driessen et al., 2012; Ang et al., 2013)

  $\rightarrow$ These methods often make assumptions that are ill-suited to infrastructure (e.g. constant betas, unique prices)

  $\rightarrow$ Crucially they assume enough data (spanning the entire investment period) can be observed **today**... but we know this is not the case of infrastructure projects.

A roadmap

We propose to address this problem step-by-step, with a clear goal: to produce a (series of) benchmark measure(s) that actually answers investors and regulators questions:

1. Define relevant financial instruments used to finance infrastructure projects
2. Create adequate asset pricing models taking their characteristics into account
3. Determine what data needs to be collected to implement this framework while keeping the cost of data collection to a minimum
4. Create a infrastructure investment reporting standard from the input (required data) and outputs (performance measures) of the previous two steps
5. Actively collect the relevant data
6. Determine how correlations between assets should be modelled and calibrated and build reference portfolios for the purpose of asset allocation and prudential regulation
7. Produce "benchmark" performance measures at regular intervals by collecting the necessary data on an ongoing basis

The rationale and challenges of implementing this roadmap are described in a recent EDHEC-Risk Institute position paper (Blanc-Brude, 2014).

A roadmap: update

We propose to address this problem step-by-step with a clear goal: to produce a (series of) benchmark measure(s) that actually answers investors and regulators questions:

- ✓ Define relevant financial instruments used to finance infrastructure projects
- ✓ Create adequate asset pricing models taking their characteristics into account (non-recourse project financing, illiquidity)
- ✓ Determine what data needs to be collected to use this framework while keeping the cost of data collection to a minimum
- → Create a infrastructure investment reporting standard from the input (required data) and outputs (performance measures) of the previous two steps
- → Actively collect the relevant data

1. Determine how correlations between assets should be modelled and calibrated and build reference portfolios for the purpose of asset allocation and prudential regulation
2. Produce "benchmark" performance measures at regular intervals by collecting the necessary data on an ongoing basis

The last two points are part of the work of the third year of the Meridiam/Campbell Lutyens Research Chair at EDHEC.

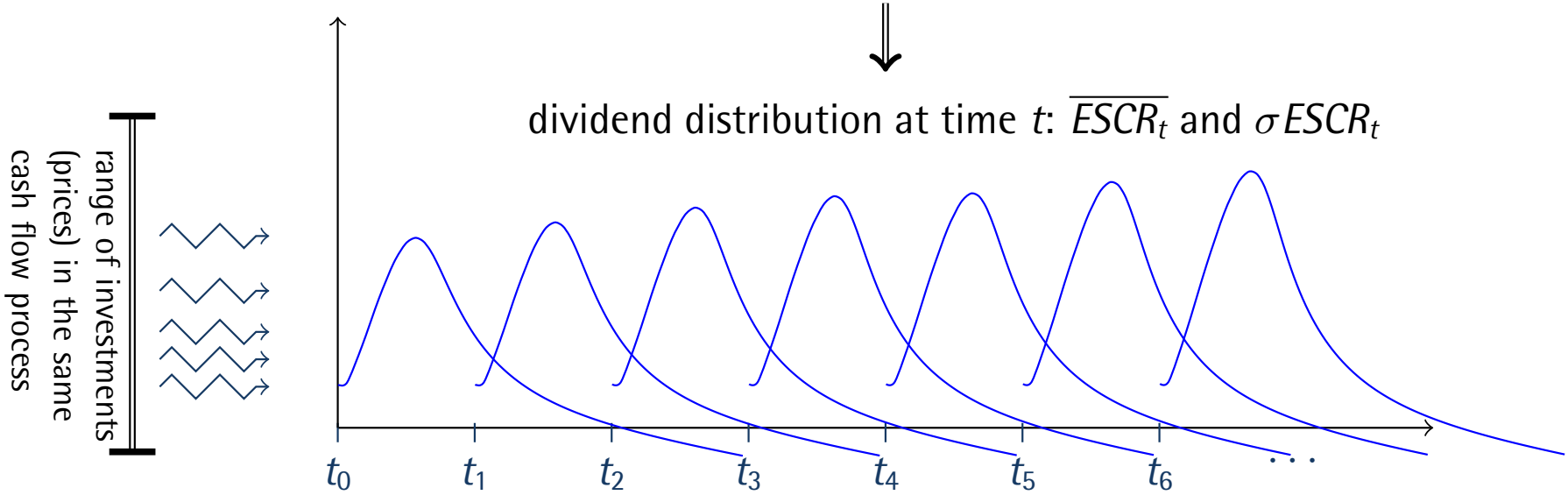
Measuring equity value and risk in private infrastructure projects

Forthcoming Publication of the Meridiam and Campbell Lutyens Research Chair at EDHEC

Intuition

- We want to express a classic DCF model *in terms that can help us meet the empirical challenge described above* (no enough data, no unique prices)
- The appropriate discount rate is not unique but must reflect the change in risk profile of the project i.e. there is a *term structure of discount rates*;
- We cannot observe investors' discount rates, but *if* we know (can observe) *the distribution of dividends (mean/variance) and the initial investment value*, we can derive the term structure of discount rates **implied by the investment value and the distribution of dividends** plus an "error" term;
- If we observe numerous investments in similar projects (same dividend distribution) at the same point in time, we can derive a range of values (bounds), representative of market dynamics;
- As time passes and dividends are realised, the view on expected dividends and dividend volatility can be revised (updated), and period returns, loss and duration measures computed.
  - $\rightarrow$ Eventually, realised returns can be decomposed using the usual multi-factor models.

$$ESCR_t = \frac{Dividend_t}{\text{Base Case Dividend}_t}$$



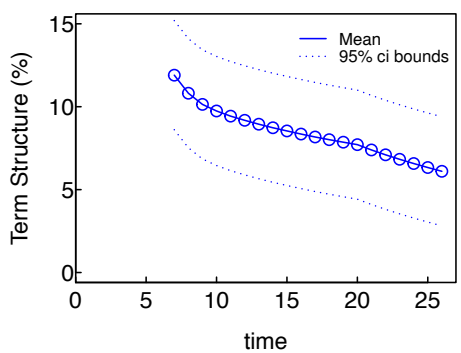
State-Space Model

observation equation: $P_t = ESCR_t C_t^0 \sum_{\tau=1}^{T} exp\left(\sum_{j=1}^{\tau} (g_{t+j}^0 + E_t(escr_{t+j})) - \sum_{i=0}^{\tau-1} r_{t+i} \right) + \epsilon_{1,t}$

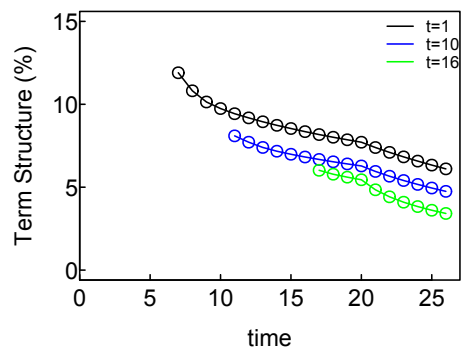
state equation: $(r_{t+i})_{i=0}^{T-1} = (\gamma_{1,t+i}.\sigma ESCR_{t+i} + \gamma_{2,t+i}.r_{t+i-1} + \epsilon_{t+i})_{i=0}^{T-1} + \epsilon_{2,i}$

Kalman Filter

Range of implied term structures

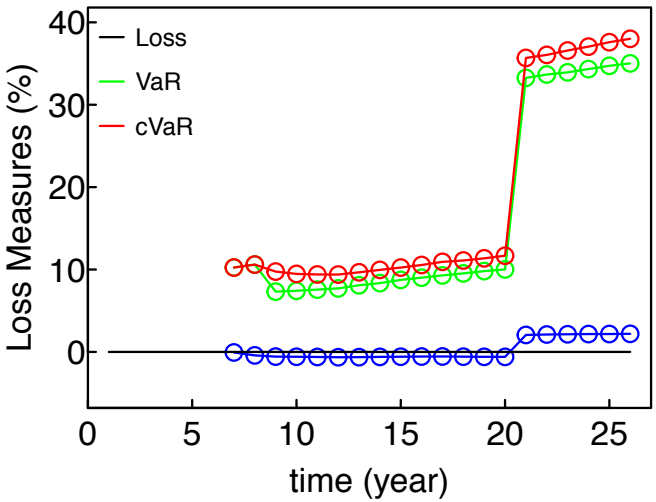


Evolution of implied term structure

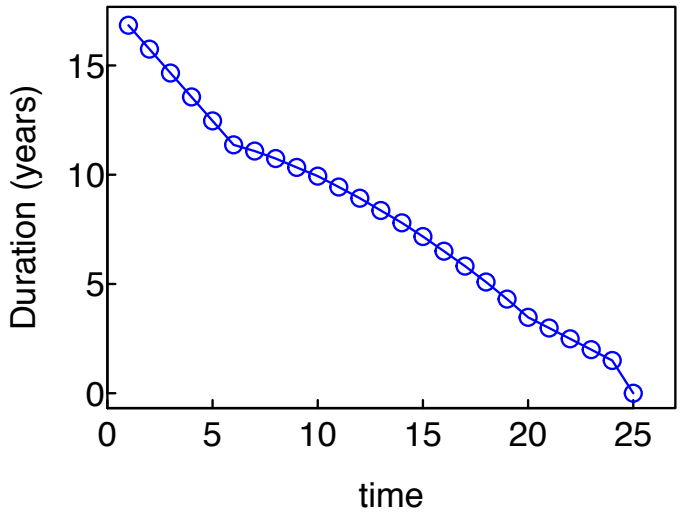


From valuation to performance measures

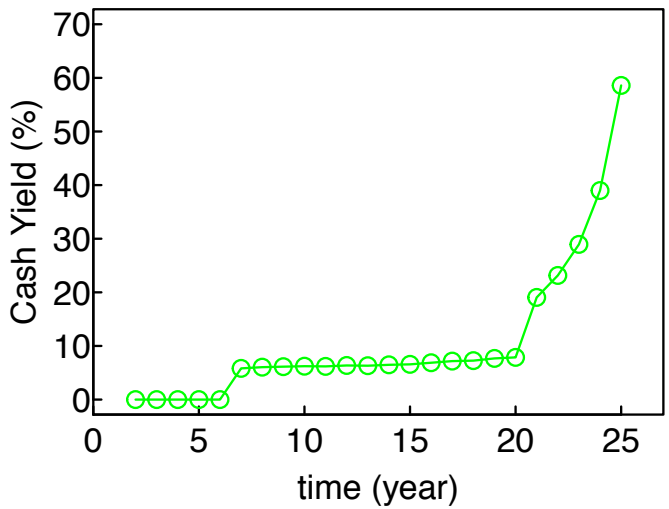
Risk measures



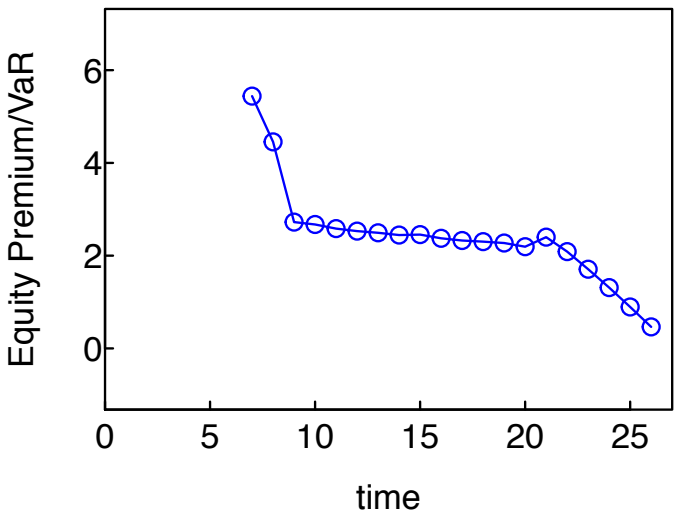
(Option implied) duration



Cash yield



Performance: Excess return to VaR



Second intuition

- We just assumed that we could know the distribution of future dividends...
- $\overline{ESCR}_t$ (times the base case) is a measure of **expected dividends** and $\sigma ESCR_t$ is a direct measure of **cash flow volatility**;
- Knowing or modelling this *single metric* over a 30-year period is more or less difficult for different types of infrastructure investments;
- In numerous cases (especially infrastructure project finance) it can be done *very convincingly* and *calibrated* as best as possible using existing data.
- In fact we argue that there are families of projects corresponding to a homogenous distribution of $ESCR_t$
  - ⋆ **The structuring decision is a quasi-price signal**
  - A degree of generalisation is possible and the investable universe of projects can be partitioned into a finite number of generic families of *comparable investments.*
- With not enough data, it is easier to determine the *ex ante* dynamics of $ESCR_t$ for individual families of homogenous project financing structures.

Conclusions: required data

- Using our approach, all the relevant metrics addressing the asset class and prudential questions can be computed
- We can also monitor market dynamics through the regular assessment of the *range* of valuations implied by observable deal values
- The required inputs are observable, chiefly
  1. A well-defined and documented investment base case (dividend forecast) at the time of investment
  2. Actual dividends and revisions of the base case
  3. The parameters required to model expected dividends beyond the point where they can be observed

  $\rightarrow$ In the case of infrastructure project finance, these are the elements which define homogenous families of risky cash flows i.e. leverage, DSCR dynamics and tail value
- The more data we collect for each family of cash flow models, the more accurate our estimates of expected dividends and dividend volatility (Bayesian inference)
- This data exists, is routinely collected and can be aggregated using a standardised format, which can also become a reporting tool for investors.

$\star$ see (Blanc-Brude et al., 2014) for a the full list of required data to be collected

Conclusions: required cooperation

- This is fundamentally a project about *cooperation* between long-term investors.
- Successful long-term investment in infrastructure requires exchanging information and working together to achieve better diversification benefits: a *club good*.
- ⋆ The data collection stage:
  1. We have defined the data that needs to be collected to answer the questions that are required to create an infrastructure asset class.
  2. We are collecting data on a strictly anonymised and confidential basis
  3. This data will be used to calibrate expected performance measures for the benefit of the financial industry and the calibration of prudential risk model.
  4. It can also be used to compute independent valuations, returns and risk measures for contributing investors' individual portfolios, including for the purpose of regulatory compliance.

EDHEC/Meridiam & Campbell Lutyens Research Chair

Value & Risk in Long-Term Infrastructure Equity Investments
Asset pricing framework and data collection requirements, *EDHEC-Risk Institute Publications*

Frédéric Blanc-Brude & Majid Hasan
Forthcoming 2014

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