Measuring risk in unlisted infrastructure equity investments

Theoretical framework and data collection requirements

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1 Introduction

This paper contributes to the current debate about the regulatory treatment of long-term investment, and, in particular, the measure of equity risk in infrastructure investments.

This issue has been highlighted in a public letter (Faull, 2012) from the European Commission to the European Insurance and Occupational Pensions Authority (EIOPA) in the proposed prudential capital requirements under the Solvency-2 regime. Indeed, in its Green Paper on the long-term financing of the European Economy, the Commission suggests that accommodating long-term financing may require reviewing insurance and pension fund regulation (EU Commission, 2013).

In this paper, we propose a methodology to measure the risk of unlisted infrastructure equity investments *at the underlying level*. This methodology relies on theoretical insights but is also designed to use standardised cash flow data, which either already is or could be collected in a systematic manner by investors in infrastructure equity and their managers.

We propose to use the Basel-2 definition of project finance (BIS, 2005) to define "infrastructure equity" as the most junior instrument in a project financing structure. While this is a restrictive definition of underlying infrastructure equity investments, it is also our assessment that limited-recourse project financing is the main format to structure long-term infrastructure projects both historically and looking forward.

Hence, focusing on the risk profile of project finance equity investment allows us to rely on a clear definition of the relevant instruments, in the knowledge that they are also the most representative.

Crucially, since we are discussing the question of infrastructure equity risk in the context of the prudential regulation of institutional investors, we argue that the relevant definition is one that focuses on the characteristics of well-identified financial instruments (as opposed to tangible assets) that do not overlap with existing dimensions of risk-based regulation, for example listed and private equity, or corporate bonds. The literature has long argued that project finance is a unique form of corporate governance that is designed to allow specific long-term investments to take place.

Next, since infrastructure equity is not a traded asset and may be held for long periods of time, we take a Bayesian approach to risk measurement and distinguish between investors' *prior* about infrastructure equity risk, which springs from the investment *base case* and *expected* variations from the base case equity payouts, and their *posterior*, which can only be built once empirical observations have been made.

For example, a project that has performed according to the base case for several periods *ex post* may be considered more likely to deliver base case cash flows in the future. But investors' *posterior* probability distribution of cash flows may also be used to form a new *prior* about another comparable investment. With enough reliable and comparable observations, investors may even be able *benchmark* their expectations to such knowledge.

One of the advantages of focusing on the role of investors' base case and expected variations from the base case is to allow the measurement of equity risk without explicitly valuing the asset. Indeed, asset valuation is part of the subjective decision taken by investors when they agree to invest on the premise of the base case, in an "incomplete" market i.e. a market without traded assets. Any deviation from the subjective valuation which is implicit in the base case represents "equity risk."

Operationally, our approach is parsimonious and uses a minimum amount of standardised inputs: for comparable investments, *ex ante* (base case) and *expected* (a priori) or *ex post* cash flows, along with default or "lock-up" frequencies at each point in an infrastructure project's life, are sufficient to derive upside and downside measures, including value-at-risk measures that are also relevant in the Solvency-2 context for example.

In the current absence of *ex post* observations, we illustrate our approach by building two examples of a *prior* for generic infrastructure projects.

Finally, the paper proposes a detailed **data collection or reporting standard** that would allow for widespread and consistent data collection and implementation of this methodology.

In what follows, section 2 proposes a universally acceptable definition of infrastructure equity investments that is also relevant from the point of view of institutional investors and prudential regulation. In section 3, we present our approach to measure infrastructure equity risk in an intuitive manner before formalising our methodology in section 4. Section 5 uses Monte Carlo simulation to illustrate the expected equity risk profile of two generic types of infrastructure projects. Section 6 discusses wider implications in terms of data collection and reporting requirements to build benchmarks of infrastructure equity investment. It also discusses the potential regulatory implications with particular reference to Solvency-2.

2 Defining unlisted infrastructure equity

2.1 A question of relevance

The OECD has put forward a definition of tangible infrastructure, which reads like a long list of industrial sectors and sub-sectors: power plants, roads, water treatment, &c (OECD, 2002). But from an investment and regulatory perspective, a clear definition of what is meant by "infrastructure" remains elusive.

In a recent review of existing academic and industry research on the subject (see Blanc-Brude, 2013), we show that most existing equity investment products labeled "infrastructure", be they listed or unlisted, are at least one step removed from tangible infrastructure assets, and often have investment characteristics that makes them hard to distinguish from other existing investment categories, such as private equity as in the case of unlisted "infrastructure funds" or "low beta, large cap" i.e. listed utilities.

This opens the question of the *relevance of infrastructure equity investment for institutional investors*, which are often suggested as alternative sources of financing for the well-documented funding gap of future infrastructure investment demand.

From an investment management perspective, infrastructure equity investment is only relevant if it can improve *asset allocation* decisions, which remain institutional investors' first-order problem.[1]

Indeed, it can be unclear how investing in a limited number of industrial sectors (see the OECD definition for a full list) via vehicles that may be listed or not, have variable investment horizons, and are more or less leveraged, necessarily creates any new investment opportunity for a large and well-diversified investor.

In theory, addressing the question of whether an allocation to infrastructure equity makes sense for an institutional investor requires the identification of remunerated and investable risk factors. In practice, it means identifying the investment characteristics of well-defined financial instruments (as opposed to ill-defined tangible assets).

As a pre-requisite before we can discuss unlisted equity portfolios or investment funds, this paper proposes to focus on the characteristics of infrastructure equity investments as an *underlying* i.e. the risk profile of equity investments in generic, unlisted infrastructure projects.

Next, we propose a definition of infrastructure equity investment which is both universally recognised, captures the bulk of past and future underlying investments, and is relevant from an asset or risk allocation perspective because it refers to a financial asset.

2.2 Project finance equity as the underlying

We propose to equate infrastructure investment with *project finance* i.e. the financing of a special purpose entity (SPE) dedicated to the construction and operation of a new infrastructure project over a given period, typically 25-30 years.

1 - Numerous research papers have demonstrated the primacy of asset allocation in investment management. Asset allocation explains most of the variability of investment outcomes (see for example Ibbotson and Kaplan, 2000).

Indeed, most infrastructure investment and the immense majority of new or `greenfield' projects are financed using such structures.[2]

Crucially, while limiting our analysis to project financing may exclude a limited number of investment opportunities that may reasonably be labelled as "infrastructure", Project Finance benefits from a clear and universally recognised definition since the Basel-2 Capital Accord.

> "Project finance (PF) is a method of funding in which investors look primarily to the revenues generated by a single project, both as the source of repayment and as security for the exposure. In such transactions, investors are usually paid solely or almost exclusively out of the money generated by the contracts for the facility's output, such as the electricity sold by a power plant. The borrower is usually a Special Purpose Entity (SPE) that is not permitted to perform any function other than developing, owning, and operating the installation. The consequence is that repayment depends primarily on the project's cash flow and on the collateral value of the project's assets." (BIS, 2005)

Hence, by focusing on project finance, we capture the bulk of private infrastructure financing and gain a clear definition of what may be invested in.

Project finance creates the opportunity to invest in a single-project firm with a pre-defined lifespan. Before the financing decision can been taken, the SPE has to demonstrate its financial viability with a high degree of probability. In the process, two inter-related types of financial claims are created, splitting the free cash flow of the firm between a *senior claim* and one or more *subordinated claims*.

- The senior claim or "tranche" is a debt instrument, which has priority over more junior claims over the project's free cash flow, in a structure sometimes known as a cash flow "waterfall". This tranche is built to absorb the most predictable part of a project's free cash flow.
- Junior tranches include debt instruments (e.g. mezzanine) and a *residual* claim tranche known as project "equity", despite the fact that is has a fixed term.

Taken as a whole, the claims that constitute an instance of project financing can be interpreted as a portfolio of inter-linked bonds, with different maturities and grace periods, some paying a fixed rate of interest and some paying a variable rate of interest.

This comparison with a bond portfolio is all the more relevant that, in the majority of cases, the SPE does not own any tangible assets, or owns assets that are so `relationship-specific' that they have little or no value outside of the contractual framework that justifies the SPE's existence. In Project finance, contracts suffice to explain the existence of enforceable and valuable claims. (see Blanc-Brude, 2013; Blanc-Brude and Ismail, 2013b, for a detailed discussion of the governance function of project financing).

Finally, an unique feature of project financing is the role of *initial* financial leverage (at financial close). In a recent paper, we find that senior project debt in infrastructure project finance between 1994 and 2012 averages 75% and can be as high as 90% (Blanc-Brude and Ismail, 2013b).

2 - We estimate that more than USD3Tr of project financing was closed worldwide between 1995 and 2012 (Blanc-Brude and Ismail, 2013b).

Previous research has typically concluded that the high leverage observed in project finance is a sign of *low* asset risk (Esty, 2003) i.e. lenders agree to provide most of the necessary funds because the probability of repayment is very high. In other words, the `split' of the project's cash flows between senior (low risk) and junior (riskier) instruments allows a *larger* senior tranche if cash flows are *more* predictable.

Still, while credit risk is indeed documented to be low in project finance (Blanc-Brude and Ismail, 2013a; Moody's, 2013), the impact of leverage on *equity risk* has not been studied in great depth.

In particular, while the SPE is highly leveraged at the beginning of its life, it begins to repay its debt almost immediately and cannot borrow again (except to refinance its outstanding debt). It is thus in a continued state of de-leveraging.

This feature applied to a single-project firm is important to understand the equity risk profile in project finance. Sorge (2011), following an insight from Merton (1974) suggests that two effects impact long-term risk in project finance: longer maturities are less likely to be repaid but continued de-leveraging has the opposite effect. For firms with a high level of initial leverage, the later effect can be strong enough to offset the impact of the long-term on investment risk.

We develop this insight for equity risk in project finance in section 3.

3 Intuition

3.1 A structural approach

A direct empirical or reduced form approach to documenting project finance equity risk entails observing cash flows to equity in a large number of projects over long periods of time, perhaps controlling for a number of systematic[3] risk factors explaining cash flow variability.

Today, this approach is limited by the paucity of available data but also by the difficulty to build sufficiently representative datasets. Infrastructure investment is lumpy and only happens in some places, some of the time. Relying only on observed equity cash flow data is also likely to imply large sample biases driven by the history of infrastructure investment e.g. merchant power projects, numerous in the United States, or telecom projects, frequent in the 1990s, have historically been a significant part of the project financing sector, but have also all but disappeared since the early 21st century. Finally, numerous infrastructure projects remain too young to offer sufficiently long time-series.

Crucially, in the absence of a traded asset, the valuation of these cash flows (and any measure of risk and loss) is not easily determined.

Instead, we propose a more structural approach, building on the systematic financial structuring of SPEs to *derive the dynamics of the equity tranche*. Once specified, the relationship between different cash flows can be either backtested with empirical observations, or predicted using a set of assumptions about the distribution of certain cash flow ratios.

Our *intuition* is that, for a simple SPE with a senior and a junior tranche, equity risk is bounded by the SPE's credit risk on one side, and by the project's total investment risk on the other.

We know that if the SPE defaults on its debt obligation, no payment will be made to equity in that period. The difficulty is estimating equity risk i.e. the variability of the equity payoff, when the SPE does *not* default.

3.2 Setting

Since we ultimately aim to answer an asset allocation question, we focus on a generic but realistic project financing structure to achieve the highest degree of generality in our conclusions: a simple fully non-recourse project finance structure with a senior tranche (debt) and a junior one (equity).

This SPE enters into a long-term contract with the public sector according to which it must build and operate a large infrastructure project for several decades. At the expiration of the contract, the senior tranche is expected to have been repaid in full for several years (this is known as the loan "tail" and is instrumental in explaining the risk profile of the equity tranche), the SPE is dissolved and the paid up equity returned to shareholders. This SPE does not own any tangible assets (i.e. the infrastructure in question becomes public property as soon as it is built).

3 - statistically significant

The senior tranche yields a spread above pre-agreed base interest rate. The equity tranche pays a stream of dividends which are effectively a residual claim on the project's free cash flows after debt service.4

For our purpose it is useful to distinguish between the *ex ante*, *expected* and *ex post* values taken by the cash flows and their associated ratios.

Ex ante cash flows are the values agreed by investors in the project's financial model at financial close. In other words they are *notional* and often *contractual* values. These cash flows may be risky and deviate from their *ex ante* values. In turn, *expected* cash flows are the mean values of the probability distributions that investors attribute to *ex ante* cash flows. Finally, *ex post* cash flows denote realised and observed values.

In project financing, each tranche in the SPE financial structure is the object of an explicit *ex ante* formulated scenario or "base case" agreed at financial close. The "bank base case" (senior lenders) may be slightly different than the "sponsor base case" (equity investors) but they tend to be close matches.

Project finance cash flows *are* risky and investors must form expectations of what they may be before they invest. Base case or *ex ante* cash flows and investors' expectations about deviations from the base case are combined to form the Bayesian *prior*5 about the investment to be made.

Hence, we can approach equity risk in project finance as the occurrence of different cash flows than the ones specified in the base case i.e. a change in the NPV of dividends compared the NPV of the base case.

More specifically, if we define the downside risk of infrastructure equity as a **drop in the net asset value** (NAV) of the equity of a project finance SPE6, we can write the equity loss function L at time t as

$$L_t = \max(\mathrm{NAV}_{basecase,t} - \mathrm{NAV}_t, 0) \tag{1}$$

Since the typical SPE does not own any tangible assets, its NAV can be expressed solely as a function of future equity cash flows, that is, the net present value (NPV) of future dividends. Equation 1 is re-written:

$$L_t = \max(\mathrm{NPV}_{basecase,t} - \mathrm{NPV}_t, 0) \tag{2}$$

where NPV_t is the sum of discounted cash flows to equity (dividends) over the period $[t, T]$, less the initial investment value.

Clearly, the base case plays an important role in this setting. Together with investors' expected cash flows it forms a *prior*, which also reflects the rate of return required by investors to participate in the financing of the project in the first place.

In the next section, we formalise our intuition and how deviations from the equity base case may be measured and calibrated using standardised cash flow ratios.

Note that focusing on the role of the base case allows the measurement of equity risk or loss, without explicitly valuing the investment, which is part of the subjective decision taken by investors when agreeing

4 - We introduce the 'lock-up' ratio in section 4

5 - In Bayesian statistical inference, a prior probability distribution of an uncertain quantity X is the probability distribution expressing the uncertainty about X before any empirical observations can be made.

6 - This is the Solvency-2 definition of equity risk

to invest on the premise of this base case. Risk is simply the expected or observed deviation from a base case, which may be valued differently from one investor to another in incomplete markets.

4 Formalisation

4.1 A measure of equity risk

4.1.1 Defining equity risk

As argued above, project finance equity is invested on the basis of a base case or *ex ante* dividend payments to be made over a fixed term. This base case is the central element of the investor's *prior* about asset value. Any expected or observed deviation from *ex ante* cash flows is equity risk, whether it is on the upside or the downside.

This *prior* may also be updated at each point in time, as *ex post* cash flows are observed, and agents may form a *posterior* probability distribution i.e. a conditional distribution of the remaining uncertain quantity (dividends during the rest of the project's life) given existing observations. For example, a project that has performed according to the base case for several periods *ex post* may be considered to be more likely to continue to deliver base case cash flows in the future.

Of course this *posterior* probability distribution may also be used to form a new *prior* about another comparable investment. With enough reliable and comparable observations, investors may even *benchmark* their expectations to such a *posterior*.

Hence, we define the Equity Service Cover Ratio (ESCR) as:

$$ESCR_t = \frac{\text{dividend}_t}{\text{dividend}_{\text{base case},t}} \tag{3}$$

where, dividend_t is either the *expected* or the *ex post* cash flow to equity at time t and, $\text{dividend}_{basecase,t}$ is the *ex ante* cash flow to equity at time t defined in the base case in each period t=1,2,..T for a project financing of maturity T.

4.1.2 Accounting for project construction risk

Our measure of equity risk measure should also take into account potential variations of initial capital costs. Indeed, an important consideration in infrastructure investment is the risk of construction cost overruns and completion delays, or "construction risk". While this risk has been documented to be low and well-managed in privately financed infrastructure projects (Blanc-Brude and Makovsek, 2013), it cannot be ignored especially from the point of view of the junior equity investor.

In the very unlikely case of high construction cost overruns, the SPE would default and the project would stop. In our setting all equity investment would be lost.7

In the more interesting but rare case of limited construction cost overruns that have to be borne by the SPE, we assume that shareholders have to `top up' their equity tranche i.e. inject additional capital. To account for this, we propose to calculate a **normalised** *ESCR* or $E\bar{S}CR$, accounting for the variability of the initial investment.

7 - In such an extreme situation, equity investors may however receive compensation from the construction contractor.

For a stream of cash flow to equity X_t^i in each future state of the world i at time t, from equation 3, we can write,

$$ESCR_t^i = \frac{X_t^i}{X_t^0} \tag{4}$$

the equity service cover ratio at time t for scenario i, with X_t^0 the base case dividend at time t.

Next, the normalised ESCR is written:

$$\begin{aligned} E\bar{S}CR_t^i &= \frac{X_t^i}{X_0^i} / \frac{X_t^0}{X_0^0} && (5) \\ &= \frac{X_t^i}{X_t^0} / \frac{X_0^i}{X_0^0} && (6) \\ &= ESCR_t^i / \frac{X_0^i}{X_0^0} && (7) \end{aligned}$$

For X_0^0 the initial equity investments in the base case and X_0^i the initial equity investments for scenario i. If there is no construction risk, $ESCR = E\bar{S}CR$.

4.1.3 Accounting for project credit risk

By design, project finance equity is the most junior claim and cannot receive any cash flow in the event of the SPE defaulting on its senior debt. However, we note that even in the absence of a default of payment to senior creditors, equity investors may not receive dividends because senior lenders also typically impose a "lock-up" or "dividend stop" condition preventing equity distributions when default likelihood is considered to be high.8

Equity lock up thresholds are usually defined in terms of financial ratios such as the debt service cover ratio (DSCR). We return to the role of the DSCR extensively in section 4.4. Suffice to note for now that below a certain level of free cash flow, even if debt service payments can still be made *as per* the base case, and some free cash flow remains available after debt service, equity investors may be "locked up" and receive no payoff at this time.9

The percentage equity loss per dollar invested, l, at time t for scenario i, assuming no default until $t-1$, is thus:

$$l_t^i = \begin{cases} 1 & \text{if equity lock-up or senior debt default} \\ 1 - E\bar{S}CR_t^i & \text{if no lock-up nor default} \end{cases} \tag{8}$$

4.1.4 The *prior* equity loss function

l_t^i defines the *per-period* loss given a base case and a set of scenarios or states of the world i, themselves determined by a collection of risk factors. While this may provide some insights about the level and evolution of the risk profile of infrastructure equity investments during a project's life, it is not in itself a measure of equity risk *in the following periods*.

In particular, in order to measure equity downside risk, we must derive a forward-looking loss function as defined in equation 2.

8 - We thank Julien Touati and Thierry Déau for suggesting this idea.

9 - Investors may nevertheless receive the locked-up dividends at a later date, if the SPE improves its financial position.

To form a *prior* about L_t, we need to compute the difference between base case or *ex ante* NPV_t and the *expected* value of NPV_t. Next, we show that these values can be computed using $\bar{ESCR}_t$.

Ex ante NPV

The present value of base case dividends normalised by the initial investment at time t is

$$\bar{PV}_t^0 = \sum_{i=t}^{T} \frac{\frac{X_i^0}{X_0^0}}{(1+r_i)^i} \tag{9}$$

where r_i is the discount rate. We discuss the appropriate discount rate in the *prior* below in section 4.1.5.

The *ex ante* NPV or NPV^0 is the PV minus 1, since $\bar{PV}_t^0$ is a normalised value.

$$NPV_t^0 = \bar{PV}_t^0 - 1 \tag{10}$$

Expected NPV

The PV of dividends at time t, in scenario i is:

$$PV_t^i = \sum_{i=t}^{T} \frac{X_i^i}{(1+r_i)^i} \tag{11}$$

Normalising by the initial investment, we obtain:

$$\bar{PV}_t^i = \frac{\sum_{t=i}^{T} \frac{X_i^i}{(1+r_i)^i}}{X_0^i} \tag{12}$$

$$= \sum_{t=i}^{T} \frac{\frac{X_i^i}{X_0^i}}{(1+r_i)^i} \tag{13}$$

$$= \sum_{t=i}^{T} \frac{\bar{ESCR}_t^i \times \frac{X_i^0}{X_0^0}}{(1+r_i)^i} \tag{14}$$

And in expected value we have

$$E(\bar{PV}_t^i) = \sum_{i=t}^{T} \frac{E(\bar{ESCR}_t) \times \frac{X_i^0}{X_0^0}}{(1+r_i)^i} \times (1-k_t) \tag{15}$$

where k_t is the probability of no dividend payment (either due to lock-up or project default), that is, the probability of observing no dividend payout at time t. Note that the probability of default and of emergence form default are both included in k_t. We return to this in details in section 4.4.3.

Next, we discuss the choice of discount factors that may be used to compute *ex ante* and *expected* NPV.

4.1.5 Choice of discount factors

The implied return profile of the base case

Project finance equity is essentially similar to subordinated debt. Thus, we propose the use of the yield y on the equity investments implied by the base case as the appropriate discount factor approximating the unknown interest rate term structure of the SPE's junior tranche.

The yield is defined as the interest rate satisfying:

$$V_0 = \sum_{t=1}^{T} \frac{X_t^0}{(1+y)^t} \tag{16}$$

With $V_0 = X_0^0$, the base case initial equity investment value, and X_t^0 are the base case dividends, a yield value y or equity IRR can be computed.

Thus, in the *prior*, the expected PV at time 0 normalised by the initial investment defined in equation 15 is written:

$$\bar{PV}_0 = \sum_{t=1}^{T} \frac{E(\bar{ESCR}_t) \times \frac{X_t^0}{X_0^0}}{(1+y)^t} \times (1-k_t) \tag{17}$$

and the expected loss per unit of dollar invested at time 0 is the difference between the initial investment value and the sum of expected future cash flows discounted at the yield rate

$$\bar{L}_0 = \max(1 - \bar{PV}_0, 0) \tag{18}$$

Discount factors at time t

To calculate the expected loss as time t, the relevant series of the yield to maturity, that is, the series V_t, y_t for $t = \{1, 2, \cdots, T-1\}$has to be calculated.

Consistency dictates that investment value at time t should equal the discounted sum of asset value and base case dividend at time $t+1$, so that

$$V_t = \frac{X_{t+1}^0 + V_{t+1}}{1 + y_t} \tag{19}$$

Thus, given V_t and y_t together with the base case, V_{t+1} can be calculated as:

$$V_{t+1} = (1 + y_t)V_t - X_{t+1}^0 \tag{20}$$

Having obtained the initial investment value at time $t+1$, the yield to maturity y_{t+1} can be computed iteratively as the yield implied by the base case with payments $\{X_{t+2}^0, \cdots X_T^0\}$ for the initial investment value V_{t+1}.

From equation 17, the normalised expected PV at time t is written,

$$\bar{PV}_t = \sum_{i=t+1}^{T} \frac{E(\bar{ESCR}_i) \times \frac{X_i^0}{X_0^0}}{(1+y_t)^{(i-t)}} \times (1-k_t) \tag{21}$$

and the expected loss value per unit of dollar invested is,

$$\bar{L}_t = \max(1 - \bar{PV}_t, 0) \tag{22}$$

4.2 Expected equity loss and value-at-risk

We can now rewrite and compute the equity loss function defined in equation 2 as:

$$L_t = \max(NPV_t^0 - NPV_t, 0) \tag{23}$$

In the *prior*, expected equity loss is the difference between the expected NPV defined by equation 21 ($NPV_t = \bar{PV}_t - 1$) and that of the base case or *ex ante* NPV defined by equation 10.

Finally, the one-year 99.5% value-at-risk of infrastructure equity at time t, VaR_t, can be computed as the 0.5% quantile of L_t.

We have shown above that the *prior* expected value of L_t can be computed using base case (X^0_t) and expected (X^i_t) equity cash flows in each state of the world, as well as the values of k_t, the probability of lock-up and y_t the yield to maturity implied by the base case. We discuss the implications of these result for data collection in next section.

4.3 Data collection implications

The results above can inform the data collection requirements of investors or the regulator if they want to document the risk profile of unlisted infrastructure equity investments.

In the prior, that is before making any observations, the data necessary to derive L_t and calculate $E(L_t)$ and VaR_t consists of:

- The dividend payout base case X^0
- Expected cash flows to equity X^i in each state of the world i
- The probability of equity payout $(1 - k_t)$ in each period

Ex post, X^i_t may be updated with a large sample of observed equity cash flows, where i does not denote a state of the world or scenario but an individual observation or project. In turn, this sample could be used to form a *posterior* view on the expected distribution of $ESCR_t$.

Likewise, the value of k_t may be inferred from observing the occurrence of discrete "events of lock-up" and, assuming a binomial distribution, derive an updated probability measure conditional on observations made for comparable investments.

As we argued in section 3, such data is often not readily available from infrastructure equity investors and concerns about sample size and biases suggest that *ex post* values must be used carefully when updating *prior* beliefs about the risk profile of infrastructure equity.

Nevertheless, consistent and widespread data collection of *ex ante* and *ex post* equity cash flows would improve the ability of investors and regulators to update the *prior* and form better expectations of equity risk in infrastructure project finance.

We return to this in section 6 when we discuss a cash flow reporting requirement that could help standardise the way information is collected and aggregated regarding unlisted equity investments in infrastructure projects.

Finally, in the next section, we propose an alternative approach to compute L_t as a function of infrastructure projects' credit dynamics i.e. without observing cash flows to equity.

4.4 Alternative route: from a credit to an equity risk measure

In this section, we show that the value of $ES\bar{C}R_t$ can be expressed as a function of a commonly used cash flow ratio in project finance: the debt service cover ratio (DSCR).

4.4.1 Debt service cover ratio, default and recovery

The DSCR measures the ability of a project SPE to service its debt obligation. The *ex post* DSCR is written:

$$DSCR_t = \frac{\text{Cash Flow Available for Debt Service (CFADS)}_t}{\text{Debt Service (Principal+Interest)}_t} \tag{24}$$

in each period t=1,2,..T for a project financing of maturity T.

If the DSCR equals unity, the SPE is just able to service only its debt. In effect, this ratio can be interpreted as an alternative measure of `distance to default' in project finance.

Lenders typically require the *ex ante* DSCR to be higher than unity, not only to create a credit risk buffer but also because the SPE should, on average, be able to pay dividends once its debt obligations have been met. Gatti (2012) reports that lifetime average *ex ante* DSCRs in project finance typically range between 1.35 and 1.40.

If the DSCR falls below unity during any period t of the project's life, the SPE can unequivocally be considered in default.

The default point in project finance at time t can thus be defined as:

$$DSCR_t = 1$$

And since the DSCR provides an unambiguous estimate of the default point of infrastructure project finance debt[10] , its probability of default at time t can be written:

$$p_t = \Pr(DSCR_t < 1 | DSCR_{t-1} \geq 1) \tag{25}$$

i.e. it is the probability that the DSCR reaches the default point that time conditional on surviving from previous period (see Blanc-Brude and Ismail, 2013a, for an analysis of credit risk in project finance).

The probability distribution of $DSCR_t$ also informs the probability of emergence from default at time t or q_t: the probability of observing a DSCR higher than the default point in a given period, conditional to having observed a DSCR below the default point in the previous period, or:

$$q_t = \Pr(DSCR_t \geq 1 | DSCR_{t-1} < 1) \tag{26}$$

This is important given the frequent role of workouts and restructurings in to allow SPEs to emerge from default and resume senior debt service, which explains the high recovery rates observed in project finance (see for example Moody's, 2013).

4.4.2 DSCR, equity lockup & ESCR

Since the debt tranche is senior to the equity tranche, we can write the cash flow to equity at time t as:

$$\text{dividend}_t = \text{CFADS}_t - \text{debt service}_t \tag{27}$$

10 - Because events of defaults are not just defaults of payments but may also consist of covenants breaches for example, a more accurate formulae would be $DSCR_t = 1.x$ with $x \geq 0$. We use the default point of 1 for simplicity

Unless there is a refinancing, debt service at time t follows an amortisation schedule specified in the base case i.e. it is the same in every scenario, given no default. Substituting into (3) and from (27) and (24), we have:

$$ESCR_t = (DSCR_t - 1) \times \frac{\text{debt service}_{\text{base case},t}}{\text{dividend}_{\text{base case},t}} \tag{28}$$

We can thus write the probability of loss for the equity tranche, assuming no default up to time t, as:

$$\begin{aligned} & P(ESCR_t < 1) & (29)\\ &= P\left((DSCR_t - 1)\frac{\text{debt service}_{\text{base case},t}}{\text{dividend}_{\text{base case},t}} < 1\right) & (30)\\ &= P\left(DSCR_t < \frac{\text{dividend}_{\text{base case},t}}{\text{debt service}_{\text{base case},t}} + 1\right) & (31) \end{aligned}$$

Thus, while a DSCR higher than unity is required for the SPE not to default, the equity tranche must meet a higher but *related* cover ratio in order not to suffer any loss.

The expression of probability of loss for the equity tranche can be modified to incorporate the lock-up ratio in terms of the DSCR constraint as,

$$\begin{aligned} & P(ESCR_t < 1) & (32)\\ &= P\left(DSCR_t < \max\left\{\frac{\text{dividend}_{\text{base case},t}}{\text{debt service}_{\text{base case},t}} + 1, 1.x_t\right\}\right). & (33) \end{aligned}$$

Where $1.x_t$, for $x \geq 0$, is the lock-up threshold at time t.

Thus, $ESCR_t$**, which gives a measure of equity loss/gain in project finance can be written as a function of** $DSCR_t$ **and the base case equity and debt cash flows.**

4.4.3 Probability of default, emergence and lock-up

The *prior* determination of k_t or P($DSCR_t < 1.x$), the probability of no equity payout may be computed if the distribution of $DSCR_t$ is known. Alternatively, the probability of equity payout $(1 - k_t)$ can be calculated from the probabilities of default p_t and of emergence from default q_t.

This dividend payout probability $(1 - k_t)$ or $P(DSCR_t > 1.x)$, can be decomposed into two parts:

- The probability that a project has survived (not gone bankrupt) at time t, and
- The probability of having survived but to be "locked-up" at time t.

Thus,

$$1 - k_t = P(DSCR_t > 1) - P(1 < DSCR_t < 1.x) \tag{34}$$

Survival at time t is itself a function of the probability of default p_t and the probability of emergence from default q_t defined above[11]. Substituting in equation 34, is written as

$$P(DSCR_t > 1.x) = 1 - p_t \frac{1}{1 + p_{t-1}q_t/(1 - p_{t-1})} - P(1 < DSCR_t < 1.x) \tag{35}$$

11 - We assume that projects default only once in their lifetime and either emerge in the next period or never

5 Illustrative simulation

Having defined how expected equity loss, value-at-risk and the probability of lock-up may be calculated, we design a numerical simulation to illustrate our results.

5.1 Approach and objectives

Our approach consists of assuming values for the mean and variance of $DSCR_t$, initial SPE leverage, a debt ammortisation profile, the length of the senior debt "tail"[12] and the lock-up ratio. These variables are well-documented in project finance and it is possible to make "reasonable" assumptions about them (see for example Gatti, 2012; Blanc-Brude et al., 2010).

Based on these assumptions, we compute an equity cash flow base case as well as *expected* equity cash flows in order to derive a *prior* distribution of $ESCR_t$. Indeed, the simulation generates values at each point in the life of a population of projects, but employing assumptions that are made at one point in time, say time 0, and without making any empirical observations.

As we have discussed above, once information about the realised states of the world becomes available (at t_2, t_3, &c.), this prior may be updated to form new expectations, conditional on the available information. Nevertheless, in this simulation we do not try to update the prior as this requires running nested simulations, introducing unnecessary complexity in what remains an illustration of the output of our methodology.

5.2 Setting

The numerical simulation is set up thus: first, assuming a total investment normalised at 100, a 20-year base case debt service (principal and interest) D_t is derived from the proposed average leverage value and the choice of ammortisation profile. Senior debt is given a 2-year tail.

Next, using the relationship between $DSCR_t$ and $CFADS_t$ described in equation 24, the mean and variance of $CFADS_t$ are derived. With these results, the simulation is performed using an assumed functional form for the distribution of $CFADS_t$.

Based on the distribution of the CFADS at time t, 100,000 Monte Carlo runs are performed to compute the values of X_t^i (as the simulated $CFADS_t$ values less the values of D_t of the base case) and $ESCR_t^i$ as described by equation 4.

For each run, if the project defaults at time t as defined in equation 25, we consider the conditional probability of emergence in $t+1$ as defined in equation 26, which is a function of the distribution of $DSCR_{t+1}$. If the project does not emerge from default in at $t+1$, it is considered bankrupt and excluded from the next run.

Having made a (strong) assumption about the functional form of the DSCR distribution, the outputs of the simulation are thus:

12 - The difference between the project's life and the maturity of its senior debt

- The base case is the *average* of the assumed distribution of $CFADS_t$, which is itself a function of assumptions made about the distribution of $DSCR_t$ (see section 5.3);
- G_t the expected gain at time t is the average discounted value of *above*-base case equity cash flows at time t, expressed as function of the base case at time t;
- L_t, the loss at time t is the average discounted value of *below*-base case equity cash flows at time t, expressed as function of the base case at time t;
- VaR_t is the 0.5% quantile or 99.5% value-at-risk at time t of L_t.
- p_t, the probability of default at time t in the *prior*, is computed as the ratio of simulated defaults ($DSCR_t < 1$) to that of surviving loans at time t;
- q_t, the probability of emergence from default at time t in the *prior*, is computed as the ratio of simulated emerging defaults ($DSCR_t$>1) at time t within the defaulted population at time $t-1$;
- $P(1 < DSCR_t < 1.x)$, the probability of equity lock-up at time t in the *prior* and is calculated as the ratio of simulated lock-ups ($1 < DSCR < 1.x$) to that of surviving loans at time t.

5.3 Assumptions

We make similar assumptions than in our related paper on credit risk in project finance (Blanc-Brude and Ismail, 2013a) to allow for a direct comparison of results.

Table 1 summarises the main assumptions made in our simulation. As discussed above, the key assumption is to assume a functional form for the distribution of $CFADS_t$, in this case the lognormal distribution.

The second important set of assumption made consists of the mean value of $DSCR_t$, its rate of change and its variance. We examine two generic cases described in table 2.

1. **Increasing and increasingly volatile** $DSCR_t$: this is the most generic case of project financing. As the SPE de-leverages, its DSCR is expected to increase, however, in the *prior* revenue and costs also become more uncertain, resulting in a higher volatility of the DSCR as t increases as shown on figure 1.[13] This profile corresponds to numerous projects which have an increasingly uncertain future, especially on the revenue side, but are also expected to de-risk with time, starting form a high initial level of leverage. The implied base base cash flows to equity are represented on figure 2 including the impact of the tail on equity payoffs. Toll roads and power plant projects are typically structured this way. We label this case "generic economic infrastructure project".

2. **Constant and stable** $DSCR_t$: the second case under consideration is more representative of the so-called "social infrastructure" model i.e. the SPE financing is structured so that the expected value of $DSCR_t$ is constant. This is frequent practice for school projects in the UK for example. A constant DCSR is a choice made by lenders in the structuration of the financing, which we interpret as signalling a constant *expected* risk profile (otherwise lenders can always structure a project so that the DCSR increases with time). If the risk profile is assumed to be constant then the volatility of $DSCR_t$ must be constant as well, as shown on figure 3. Figure 4 illustrates the constant profile of base case equity cash flows until senior debt is fully repaid in year 20.

13 - Of course, an updated view of the volatility of $DSCR_t$ may be taken *ex post*

Table 1: General assumptions

Variable	Assumption
CFADS distribution	Lognormal
SPE t_0 leverage	75%
Ammortisation profile	constant at an interest rate of 6%
Debt Maturity	20 years
Project life	22 years
Project "tail"	2 years
Lock-up ratio	DSCR=1.1
Average DSCR	1.45
Default	Can only happen once between t_1 and T
Emergence from default	Can only happen at t conditional on default at $t-1$

Figure 1: $DSCR_t$ expected value $\pm$ one standard deviation, generic 20-year economic infrastructure project debt

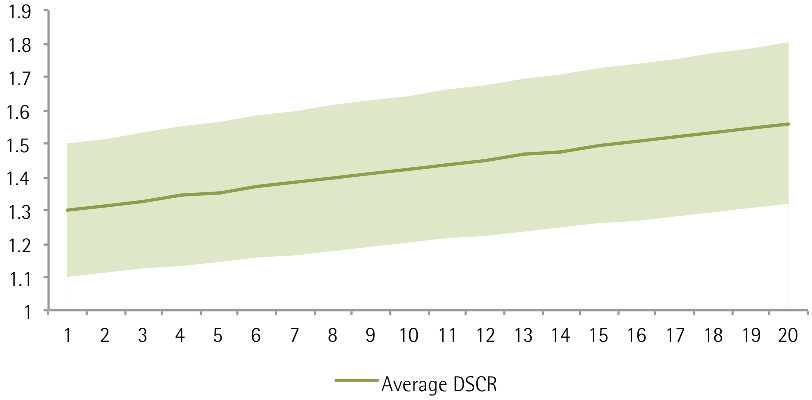


Figure 2: Base case equity cash flows at time t, generic 22-year economic infrastructure project, m$

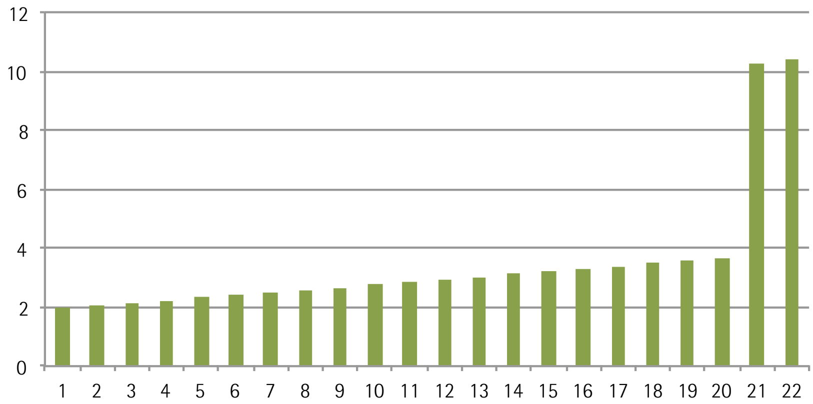


Table 2: $DSCR_t$ assumptions

Variable	Generic economic infrastructure project	Generic social infrastructure project
$DSCR_0$	1.3	1.25
$DSCR_T$	1.6	1.25
$\Delta DSCR_t$	linear from t_0 to T	no change
$\sigma DSCR_t$	0.2	0.1
$\sigma^2 DSCR_0$	0.04	0.01
$\Delta\sigma^2 DSCR_t$	+0.1%	no change

Figure 3: $DSCR_t$ expected value $\pm$ one standard deviation, generic 20-year social infrastructure project debt

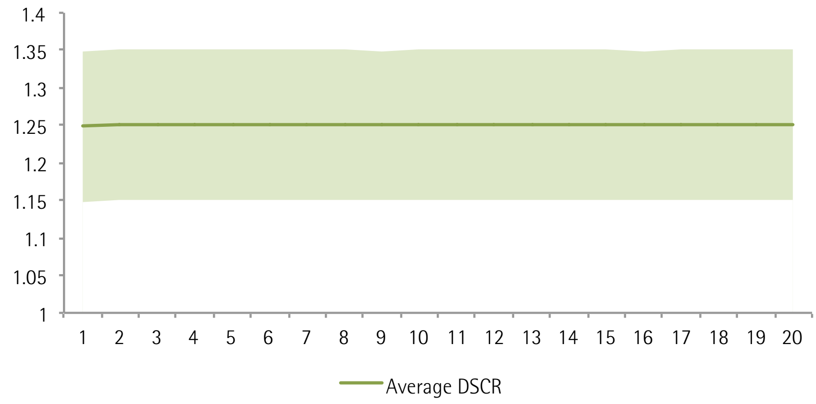
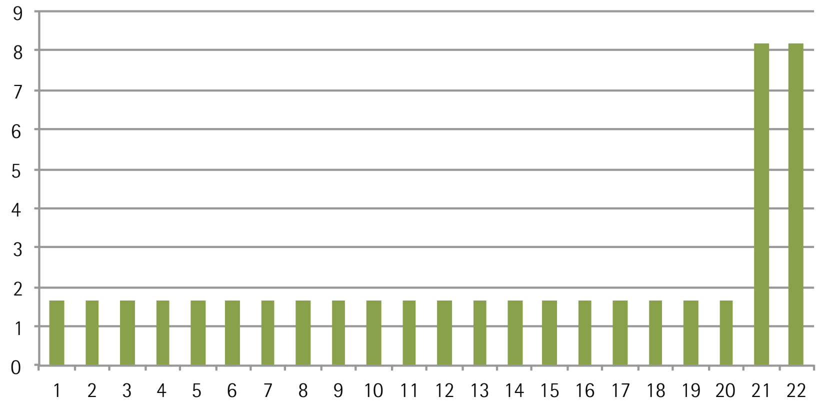


Figure 4: Base case equity cash flows at time t, generic 22-year social infrastructure project, m$



5.4 Results

The results of our simulation show that, given the assumptions used to form the prior, two off-setting mechanisms can be expected to drive the **size of expected and extreme losses** in infrastructure equity investment:

- As time passes, asset value (the discounted sum of future equity cash flows) decreases and the *relative size* of a one-period loss increases.
- At the same time, the number of potential future events of default or lock-up decreases with the number of remaining periods. Since the expected loss is a function of all such potential events, its *absolute size* decreases with time.

The combination of these two mechanisms can lead to a non-linearity in the equity risk profile if the balance of the two effects is reversed at one point in the project lifecycle. Hence, it may result in a very dynamic risk profile, as anticipated in Merton (1974). We discuss this in more details below.

Moreover, these two mechanisms are combined with the impact of changes in the expected DSCR and its volatility, which drive the evolution of default, emergence and lock-up frequencies.

5.4.1 Generic economic infrastructure project

Figure 5 shows the default and lock-up dynamics of a generic economic infrastructure project.

Figure 5: Probabilities of default and lockup at time t, 20-year maturity, generic 22-year economic infrastructure project

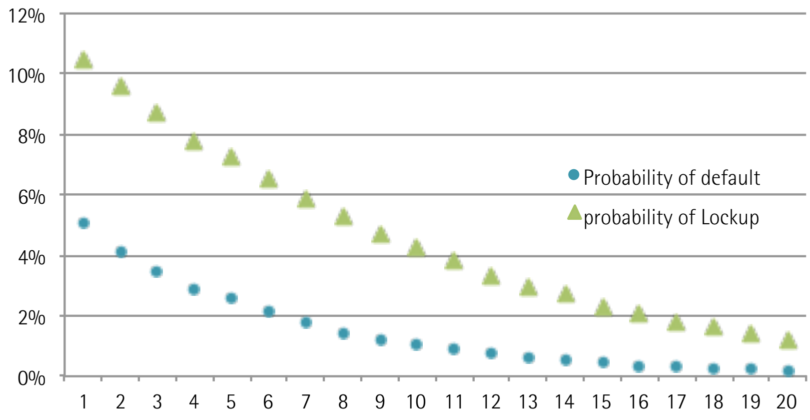
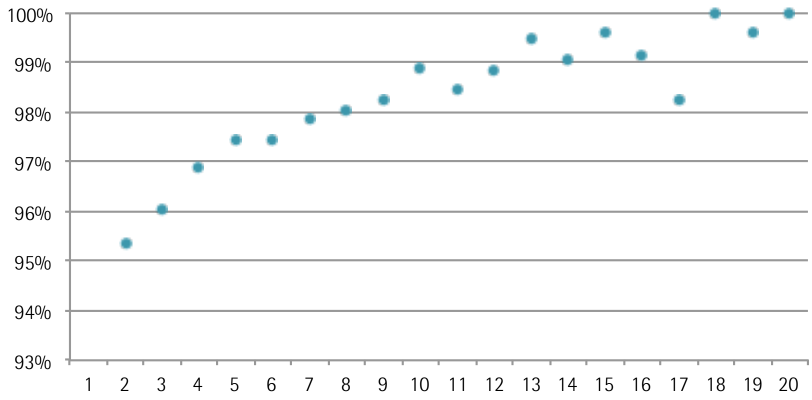


Figure 6: Probabilities of emergence at time t, 20-year maturity, generic 20-year economic infrastructure project



As we expect given the increasing values of $DSCR_t$, and also reported by Moody's (2013), the likelihood of default p_t is a decreasing function of time and the likelihood of lock-up follows a similar pattern.

Figure 7 illustrate the upside and downside arising from expected deviations from the base case. The two effects mentioned above are at play in combination with the effect or equity lock-up. Higher losses and gains are expected in earlier years because of the higher probability of default and lower probability of emergence from default during that period (this is the result of assuming a lower DSCR during earlier years). Moreover, because equity lock-up is also more likely in earlier years, expected losses are higher than expected gains during that period.

This dynamic is reversed after year 10, when the combined impact of lower probabilities of default and higher probabilities of emergence from default driven by an increasing expected DSCR leads to higher potential upside.

Such is the size of the effect of decreasing default and increasing emergence frequencies (implying lower probabilities of equity lock-up), that the reduction of the expected loss absolute size dominates the later years, except in the last year when the relative loss increases dramatically both because of the shrinking size of the asset and the increase in the relative size of the last year loss.

Finally, figure 8 highlights the impact of these mechanisms on extreme losses. In early years, default likelihood is at its peak and emergence at its lowest point. However, extreme losses quickly diminish in size as the DSCR trends up.

Figure 7: Average equity upside and downside, generic 22-year economic infrastructure project

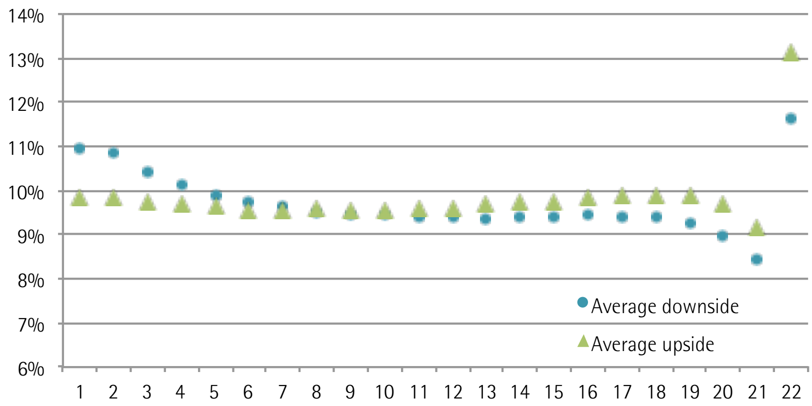
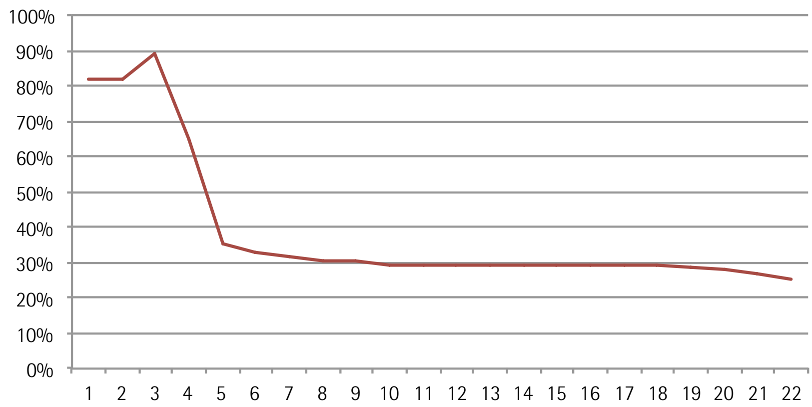


Figure 8: 99.5% equity value-at-risk at time t, generic 22-year economic infrastructure project



5.4.2 Generic social infrastructure project

The second case highlight the difference between projects that have an increasing expected risk profile signalled by a higher expected DSCR and those that have a constant expected risk profile, in great part because of their limited revenue risk.

Hence, a social infrastructure project with a constant $DSCR_t$ also exhibits constant default, emergence and lock-up frequencies, as figure 9 and 10 show. As we discuss in more depth in Blanc-Brude and Ismail (2013a), with a constant DSCR and DSCR volatility, the values of p_t and q_t (and therefore that of k_t as well) fluctuate randomly around their long-term average.

We note that our assumptions imply an expected default frequency of 0.3% in any given year, which is very similar to the empirical observations reported by Moody's (2013) for PPP/PFI projects.

With a lock-up threshold at DSCR=1.1, the lock-up probability is significantly higher than p_t and constant. Hence, the asymmetry between expected loss and expected gain is preserved during the entire life of the equity investment until senior debt is repaid as figure 11 illustrates. In this case, the average risk profile does not benefit from the positive impact of falling default probability and a rising likelihood of emergence.

Nevertheless, expected losses and gains tend to decrease with time as the absolute size of expected losses (gains) is reduced, and with the exception of the last year of the tail due to the relative size effect.

Figure 9: Probabilities of default and lockup at time t, 20-year maturity, generic 22-year social infrastructure project

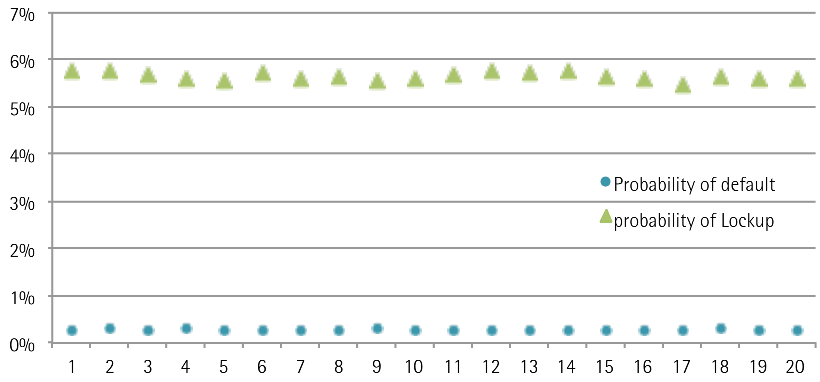


Figure 10: Probabilities of emergence at time t, 20-year maturity, generic 20-year social infrastructure project

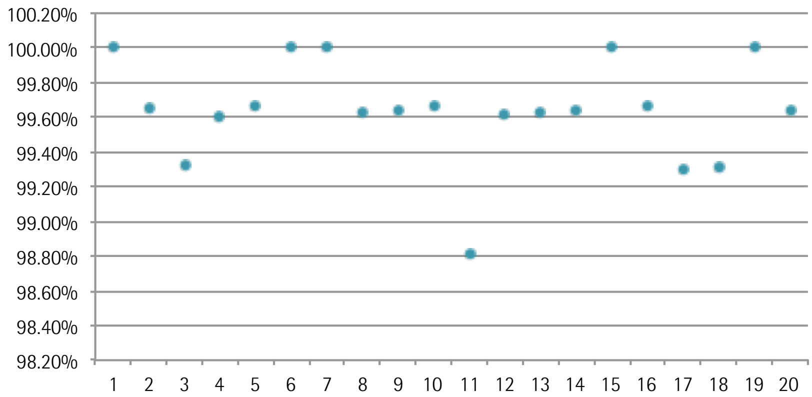
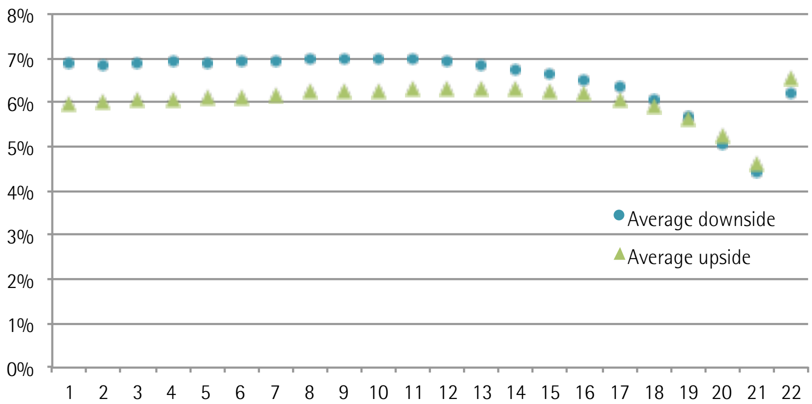
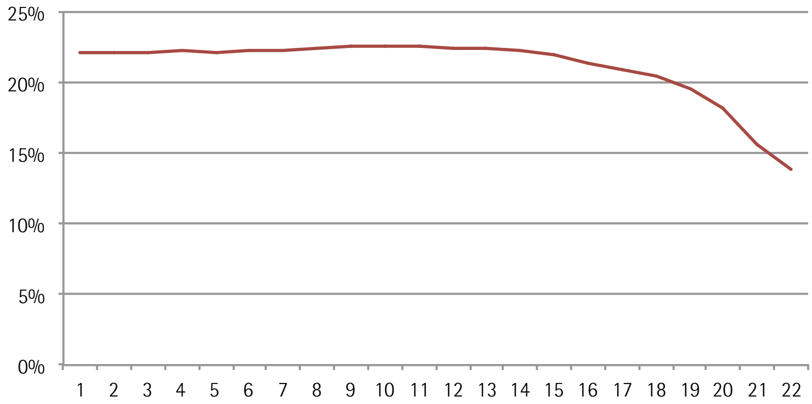


Figure 11: Average equity upside and downside, generic 22-year social infrastructure project



Also because default and emergence frequencies are constant, extreme losses follow a smooth and decreasing pattern, as shown on figure 12.

Figure 12: 99.5% equity value-at-risk at time t, generic 22-year social infrastructure project



6 Conclusion and discussion

In this paper, we propose a simple method for estimating infrastructure equity risk defined as infrastructure project finance equity. Using the *ex ante* equity base case as the foundation of investors' *prior* about value and risk in such projects, we can measure equity risk defined as any deviation of expected future cash flow from the base case.

The investment base case also has the property of implying the investors' required return, and can thus be used to derive the relevant discount factors and compute an equity loss function (downside risk) taking into account the risk-weighted value of future cash flows.

We also note that focusing on the *ex ante* base case allows the measurement of equity risk, without having to explicitly value the asset, since this value is implied in the subjective decision taken by investors when agreeing to invest on the premise of this base case. Risk is simply the expected or observed deviation from a base case, which may be valued differently from one investor to another in incomplete markets.

This *prior* may also be updated at each point in time, as *ex post* cash flows are observed, and agents may form a *posterior* probability distribution i.e. a conditional distribution of the remaining uncertain quantity given existing observations.

Moreover this *posterior* probability distribution may also be used to form a new *prior* about another comparable investment. With enough reliable and comparable observations, investors may even *benchmark* their expectations to this knowledge.

In the next section, we discuss the implications of these results for the standardisation of data collection and the opportunity to create investment benchmarks for infrastructure equity. In section 6.2 we also briefly discuss the implications for the regulation of such investments under the Solvency-2 framework.

6.1 Implications for data collection and benchmarking

The simplicity and parsimony of our proposed methodology suggests that if efforts can be made to collect data that can be used to apply our ideas, substantial progress can be made to understand and indeed benchmark the risk profile of infrastructure equity investments.

The necessary data consists first and foremost of:

- Base case or *ex ante* equity cash flows in each period
- Either the expected or observed equity cash flows in each period
- Whether the equity is "locked-up" in each period

Alternatively, debt cash flows may be used, especially

- Base case senior debt cash flows (as well as base case equity cash flows) in each period
- Either the expected or observed debt service cover ratio (DSCR) in each period

We have shown above that the distribution of $DSCR_t$ can be used to derive $ESCR_t$ as well as the default, emergence and lock-up frequencies.

However, beyond the question of reporting cash flows and cash flow ratios, lies that of the coherence of the population to be studied. If the relevant cash flows could be observed for the universe of project finance vehicles, it is likely that the distribution of $ESCR_t$ and that of its related cousin the $DSCR_t$ would be multi-modal i.e. systematic risk factors explain the expected value and variance of $ESCR_t$ for different sub-populations of the project finance universe.

Our example simulation in section 5 illustrates this idea since it finds a different risk profile for a generic project that has a rising but increasingly volatile DSCR than for one with a constant DSCR profile.

Intuitively, given previous research on the drivers of credit spreads in project finance for example (see Blanc-Brude and Strange, 2007; Blanc-Brude and Ismail, 2013b), we expect project revenue risk to be such a systematic factor. SPEs with more uncertain long-term revenues are less leveraged and have to de-leverage faster because debt repayment is more uncertain. Indeed, a rising DSCR implies relatively higher probabilities of default in the earlier part of the project.

It follows that, whether equity or debt cash flows, each observation should include data about such systemic drivers of cash flow volatility in project finance. These factors will play an important role in identifying the different sub-populations of project finance investments by level of risk.

In the appendix, we propose a list of cash flow items and SPE-specific factors which one should expect to drive systematic risk in infrastructure equity i.e. in statistical terms, we expect these factors to explain the mean and variance of $ESCR_t$ with a high degree of statistical significance.

The difference between collecting expected and observed equity cash flows, i.e. the opportunity to move form a *prior* about infrastructure equity risk to a *posterior* or a view on equity risk conditional on observing *ex post* deviations from the base case, is instrumental regarding the creation of an investment benchmark.

Indeed, information about the observed distribution of $ESCR_t$, if it is made public, should lead to a convergence of investor's expectations with regard to existing and future investments.

It should also inform the prudential regulation of certain investors in infrastructure equity such as insurers under Solvency-2, which we discuss next.

6.2 Implications for Solvency-2

6.2.1 Infrastructure equity under Solvency-2

As of mid-2013, the Solvency-2 documentation makes no meaningful reference to infrastructure investments. Hence, as a long-term and mostly unrated investment, infrastructure equity is implicitly considered as `risky' and accordingly are subject to high capital charges.

Under the current proposed framework, the Solvency Capital Ratio (SCR) must correspond to the 99.5% Value-at-Risk (VaR)[14] of the *basic own funds* (assets in excess of liabilities) for an insurance or reinsurance company over a one year period.

Under the Standard Formula stipulated in the Solvency-2 Directive, the SCR is calculated by aggregating individual risk components using linear correlation techniques to arrive to the overall SCR. The Market Risk module is one of these components and includes a number of sub-modules, including one corresponding to equity investment.

In this setup, equity risk arises from the level changes or volatility in the equity price. Considering the net asset value (NAV) of an insurance company, the capital requirement for equity risk *i* is calculated as:

$$Mkt_{eq,i} = \max(\Delta NAV | \text{equity shock}_i; 0)$$

where equity shock is a given drop in the equity value.

Thus, equity risk gives rise to a capital requirement which is a function of the effect on the firm's NAV in the event of the equity shock.

Solvency-2 distinguishes between Global Equities, listed in regulated markets in the EEA[15] member countries or the OECD[16], and Other Equities corresponding to everything else: emerging market listed equities, non-listed equities, hedge funds and other investments not included elsewhere in the market risk module. Under the current calibration of the Standard Formula, global equities receive a maximum equity shock of 39%, and other equities 49%. In other words, the one-year 99.5% VaR of the global and other equity markets are estimated to be a 39% and 49% respectively.

Thus, under the current proposed Solvency-2 treatment of equity investments, infrastructure project finance equity falls in the 'other' equity category, is subjected to a shock scenario of 49% and assumed to be perfectly correlated with listed and unlisted private equity, hedge funds or listed real estate trusts and to be correlated with global equities at a level of 75%.

6.2.2 Calibrating infrastructure equity risk

While our simulation is for illustrative purposes only and relies on a number of assumptions, not least the lognormal distribution of the CFADS, it suggests that the current Solvency-2 treatment of infrastructure equity is inadequate under the `other equity' sub-module.

First, this sub-module does not account for the dynamic risk profile of infrastructure project finance equity, in particular, the impact of de-leveraging.

Second, in all likelihood, it overestimates the 99.5% VaR of infrastructure equity and the implied equity shock to be applied in the calculation of the SCR.

The data collection and benchmarking effort mentioned above should be instrumental in delivering a more accurate calibration of infrastructure equity risk.

14 - 99.5% Value-at-Risk over a one year period is equivalent of a level of capital that would result in 1 in 200 probability of insolvency over a one-year time period.

15 - European Economic Area.

16 - Organisation for Economics Cooperation and Development.

7 Appendix: Cash flow reporting requirements

Table 3 describes the key data items that need to be collected to establish the distribution of $ESCR_t$ in project finance along with its potential statistical determinants.

Table 3: SPE level data

Data type	Description
Cash flows	1. Base case equity inflows and dividends in each period 2. Observed inflows and dividends in each period 3. Whether equity is locked-up in each period (y/n) 4. Whether senior debt is in default in each period (y/n)
Calendar items	1. Financial close date 3. Construction completion date 2. Contract/concession duration 3. Final debt maturity date (all facilities) and tail
Risk factors	*1. Revenue model*
	a. price: indexed & guaranteed, guaranteed or market price b. volume: contracted (public or commercial), part contracted/ part merchant (proportion) or merchant only *2. Input cost risk* (including fuel, labour, technology)
	a. Price (as above) b. Volume (as above) *3. Construction risk*
	a. Construction phase: y/n b. Single fixed-price, fixed-date EPC contract: y/n c. Mega-structure: y/n (e.g. Messina Straight bridge) *4. Counter-party risk*
	a. Off-taker rating b. Public or private
Financial factors	1. Total capex 2. Initial leverage 3. Debt ammortisation profile
Other factors	1. Industrial sector 2. Country of SPE operations 3. Project capacity and units (e.g. million-vehicle km, number of hospital beds, megawatts, &c.)

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