Response to EIOPA's Consultation on Standard Formula Design and Calibration for Certain Long Term Investments

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This documents presents the answers of EDHEC-Risk Institute to the questions of the discussion paper on Standard Formula Design and Calibration for Certain Long Term Investments published by the European Insurance and Occupational Pension Authority in March 2013.[1]

1 General comments

1.1 Insurers' motives to provide long-term finance

Providing long-term finance to the real economy is not a part of the mandate or mission statement of institutional investors, including insurance companies. In effect, such investors cannot be expected to have much interest in financing infrastructure or SMEs *per se*, or in channelling funds into SRI for the sole purpose of being good corporate citizens.

Institutional investors are nevertheless increasingly attracted to such investments because of the risk factors to which they provide exposure, and the extent to which increasing their exposure to the aforementioned risk factors helps them achieve their own objectives.

In the case of infrastructure, as highlighted in EIOPA's discussion paper, these investments are unlisted at the underlying level. They are also characterised by a focus on cash flows rather than capital value or indeed collateral value, since, as we argued in a recent paper (Blanc-Brude, 2013) infrastructure investments are relationship-specific and have little or no value outside of the contractual framework that allows such long-term investments to take place. The characteristics of these cash flows spring from a number of commitment mechanisms created by writing long-term contracts between the relevant parties to an infrastructure project, be they public or private.

Thus, infrastructure cash flows are expected to be stable because they have been contractually defined long in advance. As a consequence they are also expected to be less correlated with the business cycle, or even indexed on inflation, if such indexation has been included in the contractual or regulatory set up defining the investment.

There are two main reasons why insurers and other institutional investors may wish to increase their exposure to instruments yielding such cash flows: the construction of liability-hedging or -matching portfolios, and the management of short-term regulatory constraints such as solvency or funding ratios.

Instruments with a significant and well-defined duration, and yielding predictable cash flows are instrumental to build liability management portfolios, and long-term investments like infrastructure are one of the few alternatives to the bond market for such purposes. Hence, the increasing interest of insurers and other institutional investors with long-term liabilities in this type of investment.

Institutional investors are also typically required to maintain a solvency or funding ratio above a certain threshold, while applying market valuation principles to their assets. By investing a larger share of their long-term assets in unlisted instruments such as infrastructure debt or equity, they can minimise the impact of sharp market downturns, as they have experienced in recent years on multiple occasions.

1 - Available at https://eiopa.europa.eu/consultations/consultation-papers/2013-closed-consultations/april-2013/discussion-paper-on-standard-formula-design-and-calibration-for-certain-long-term-investments/index.html

Meeting long-term objectives while respecting short-term solvency constraints are the fundamental motives for insurers to acquire long-term, unlisted assets like infrastructure debt or equity.

Of course, socially responsible investment (SRI) can also be a motive to provide financing to specific sectors of the economy for an insurer but this remains a second order question i.e. faced with two opportunities with similar investment characteristics, investors may prefer the one with certain social or environmental features.

Indeed, recent academic research found no evidence that SRI investment provided any outperformance or protection from sharp market downturns compared to other investments (Amenc and Le Sourd, 2008, 2010).

The first-order problem for an insurance company remains one of asset allocation.

1.2 Asset allocation and revising the Standard Formula

The relevance of long-term investment in the Solvency-2 context springs from the motives of insurers highlighted above.

The Solvency-2 framework approaches the calculation of solvency capital requirements using building blocks representing a set of risk modules and submodules, the linear combination of which is known as the Standard Formula. By focusing on broad categories of risk factors, the Standard Formula implicitly addresses the strategic asset allocation of a typical insurer. Indeed, if they feel that the proposed risk modules and their calibration do not represent their individual situation, insurers have the choice of proposing their own risk model. The Standard Formula is thus meant to embody the average case.

It follows that justifying a revision of the Standard Formula to accommodate long-term investment in general, and infrastructure investment in particular, first requires the demonstration that such investments are relevant as a matter of strategic asset allocation for a typical insurer.

This point is implicit in other parts of the Solvency-2 framework. For example, calibrating the "Global Equities" submodule based on the MSCI World Developed Price Equity Index assumes that a typical insurer is exposed to the "market portfolio" as represented by a market-cap weighted measure like the MSCI World.[2] The use of the Standard Formula implies that the market benchmark is a sufficient approximation of the risk taken by a typical insurer.

Likewise, measuring the risk inherent to investing in long-term unlisted assets such as infrastructure debt or equity should be made with reference to a representative or "well-diversified" basket of infrastructure assets. We may refer to an infrastructure *beta* for shorthand, even though we really mean gaining exposure to a series of risk factors, as argued above.

Three questions underpin the notion of an infrastructure *beta*:

- Does it exist? In other words, can the demonstration be made of the distinctive behaviour of basket of such assets? Answering this question implies identifying what a well-diversified basket of infrastructure debt or equity might be.

2 - Market-cap indices are in fact only one of many ad hoc weighting schemes and may result in excessive concentration in a few constituents. As such, they may not be the most adequate measure of equity risk. (see Amenc et al., 2012, for a detailed analysis of the limits of cap-weighted indices)

- Is it accessible? How large is this basket and how can one become exposed to it?
- Is it relevant? Is there enough investable infrastructure in the world to be relevant at the strategic asset allocation level i.e. to invest at least a few percentage points of institutional investors' assets under management, estimated at USD85Tr in 2012.

These questions have only in part been answered so far but they are suggested more or less directly in EIOPA's discussion paper.

1.3 Defining long-term investment in infrastructure

Answering these questions first requires defining what we mean by "investing in infrastructure". Most publications on the subject highlight that there is no widely accepted definition of infrastructure, which may or may not include such sectors as telecommunications, energy, oil & gas installations, as well as roads, schools and airports or even crematorium(see Kjorstad, 2013, on this last point).

But as argued above, investing in infrastructure *per se* is not the primary motive of institutional investors. If instead, their focus is to invest in instruments yielding cash flows that have certain duration, return and risk characteristics, then the focus of the regulator should be to identify the relevant instruments and to decide how they should be treated within the Solvency-2 framework.

In its discussion paper, EIOPA correctly identifies that **long-term** investment in infrastructure may take the form of direct project financing, or investing in such projects via equity or debt funds, or through debt securitisation vehicles (EIOPA, 2013, p.35). EIOPA also highlights the role of the "look-through" principle under the Solvency-2 framework, according to which risk charges apply as if insurers had invested directly in the underlying assets used by funds or securitisation vehicles (EIOPA, 2013, p.49).

These three types of instruments are not found in equal measure today. Genuinely long-term, pass-through infrastructure equity funds seldom exist, since most "infrastructure funds" have relatively short investment period and typically use fund-level leverage (Blanc-Brude, 2013), while infrastructure debt funds and securitisation vehicles are still very new market developments that are yet to become widely available.

Thus, the limited relevance of indirect investment vehicles combined with a focus on the nature of the underlying mean that **defining long-term investment in infrastructure boils down to defining direct project financing**. Thankfully this has already been done in the context of 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)

We argue in a forthcoming paper (Blanc-Brude and Ismail, 2013a) that project financing leads to the creation of several inter-related types of financial claims, splitting the total net operating cash flow of any given project between a senior, fixed-rate claim on the one hand, and subordinated, fixed-rate and variable rate claims on the other. Hence, the SPE capital structure consists of:

- **A senior tranche** (debt): By definition, senior debt has priority over junior claims regarding the project's free cash flows, in a structure known as a 'cash flow waterfall'. Effectively, the senior tranche is built to absorb the most predictable part of a project's net operating cash flow.
- **Junior tranches** (`mezzanine' debt, quasi-equity and `pinpoint' equity) are subordinated to the senior tranche, and as such typically offer higher returns by reverse order of seniority.

  The **mezzanine tranche** typically has a higher probability of default and a higher spread than senior debt.

  Quasi-equity is effectively subordinated debt that is extended to the project by equity investors (the sponsors) to improve their own tax shield.

  As a result, paid up SPE equity often represents a minimal proportion of its capital structure and is sometimes labeled **`pinpoint' equity**. With public-private contracts that have government guaranteed revenues, pinpoint equity can be as low as one percent or less of the SPE's capital structure.

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.

If project finance senior debt is akin to a self-amortising bond paying a fixed rate of interest, project finance "equity" has a known duration and is effectively the equivalent of a floating rate note issued by the Special Purpose Entity, with a bullet repayment of the principal when the later is dissolved at the end of a project's life.

1.4 Modifying the Standard Formula: towards a project finance submodule?

We have argued that insurers are interested in long-term investments like infrastructure project debt and equity for the purposes of meeting long-term objectives and satisfying short-term constraints, and that only the characteristics of the cash flows attached to these instruments are relevant from that perspective, not the sector of the economy in which these investments take place.

It follows that a focus on infrastructure or SMEs from the point of view of the Solvency-2 framework is less important than the question of the instruments used to finance these sectors and their role at the strategic asset allocation level for insurers.

Focusing on the financing of industrial sectors by insurers may not allow the development of a robust regulatory framework since real world infrastructure and other sectors may well be financed using new instruments with different characteristics in the future, making past calibrations irrelevant.

Moreover, the growing interest of institutional investors in infrastructure investment has spurred a number of marketing initiatives by financial service and product providers which often stretch well beyond the notion of "infrastructure" advanced by, for example, by the OECD and highlighted in the EIOPA discussion paper (EIOPA, 2013, p.33).

However, a definition of infrastructure investment is not what is needed for the purposes of revising the Standard Formula. Instead, the **type of financial instruments** which have recently drawn insurance companies to the infrastructure sector is what needs to be identified and, if relevant, regulated.

In this perspective, we argue that the well-understood and documented project financing structures, as defined under Basel-2, are much more relevant to the revision of the Standard Formula than the ill-defined and changing notion of "infrastructure". Indeed, not only is project finance well-defined and easily identified, it is **a specific form of corporate governance designed to create the kind of financial instruments that insurers actually want**, but that are not currently represented in the Solvency-2 framework.

The tendency to confuse or equate Project Finance and infrastructure finance is a consequence of the overwhelming presence of infrastructure projects in the project financing sector. Project financing requires solving complex information and agency problems, which are addressed sub-optimally in standard corporate finance (Blanc-Brude and Ismail, 2013a). Comprehensive contracting and diligence are costly and, project financing tends to create high transaction costs (see for example (Dudkin and Välilä, 2005)).

Because fixed start up (or transaction) costs are high, only large capital projects can justify such costs. Infrastructure projects, with capital investment programs ranging from several millions to several billions of dollars, tend to make up the bulk of projects that are large enough to justify the transaction costs of project financing.

However, other large investment projects than infrastructure can be project financed as well, such as casinos, heavy industry, theme parks, etc. which have been delivered using similar structures for decades.

And if most project finance is infrastructure finance, the reverse is not true, and it remains to be demonstrated that other infrastructure-related investments are different from corporate debt and equity.

In a world where the number of infrastructure projects requiring financing is limited at any single point in time, project financing also offers a larger and more relevant investment universe for insurers and other institutional investors.

To conclude, Project Finance allows investors to gain specific exposure to risk factors that are highly relevant to meet their own objectives. Insofar as this exposure is distinct from the one embodied in other risk modules and sub-modules, we may refer to a project finance *beta*.

The existence of this distinctive effect, in turn, justifies revising the Standard Formula to integrate what the academic literature recognises to be a specific type of financial instruments that is expected to behave neither like corporate debt or corporate equity or private equity.

Finally, from the perspective of public policy and the question of providing long-term financing to the real economy, project financing as it is defined above has provided the bulk of the financing to new *investable* infrastructure projects over the past three decades globally. It is therefore the most relevant investment route from this perspective as well.

2 Question 17: Do you expect loans to become a more significant part of infrastructure investments by insurers in the future? What portion in terms of overall investments and term of infrastructure investments can be expected?

As noted in EIOPA's discussion paper, loans have so far made up the bulk of infrastructure project financing. Insofar as project financing remains the most appropriate and thus likely route for financing individual infrastructure projects, and given the constant average leverage of project finance vehicles historically (at 75%, see Blanc-Brude et al., 2010; Blanc-Brude and Ismail, 2013a, for a historical analysis covering almost two decades of project financing), loans are likely to remain the main form of credit made available to future infrastructure projects.

Indeed, loans play an important role in the corporate governance of project finance vehicles by allowing differential risk pricing across the project lifecycle (pre-agreed credit spread changes) and a number of covenants increasing the monitoring of the firm's managers by lenders including the possibility to intervene directly in the management of the project company (step-in rights).

To the extent that insurers are increasingly willing to invest in infrastructure debt, then most such instruments are likely to be project loans or use project loans as underlying. It follows that a better understanding of what it means for insurers to invest in infrastructure project loans is paramount in the proposed Solvency-2 calibration exercise.

3 Question 19: What kind and degree of expertise do insurers need for infrastructure investments via different vehicles? Do insurers have this kind of expertise and what developments do you expect in this respect in the future?

Infrastructure project financing is a highly specialised activity and requires equally specialised staff. Institutional investors that have made the choice of investing directly in projects (e.g. Canadian pension funds) have had to internalise this function completely. This route is costly and only open to large investors.

A number of insurers already co-invest alongside specialised lenders to which they delegate the tasks. Such lenders have sufficient internal capabilities. Nevertheless, co-investment requires frequent interaction with project finance lenders and new staff is typically required to allow these exchanges to take place, albeit not on the same scale if the deal sourcing and structuring function had been completely internalised.

Finally, specialist funds in which insurers can take a passive or silent role may not require building up very much internal expertise for investors. However, issues with reporting and transparency have been highlighted in the case of closed-ended private equity infrastructure funds built on the classic "2:20" model (Blanc-Brude, 2013).

EDHEC-Risk Institute is currently working with industry partners in the context of the Meridiam/Campbell Lutyens research Chair on infrastructure equity investments and the NATIXIS research chair on infrastructure debt instruments to develop a standardised cash flow reporting template for infrastructure investment managers in order to improve the transparency and benchmarking of infrastructure investments by institutional investors which otherwise have limited internal capabilities to evaluate such investments.

4 Question 20: What are potential data sources that might be useful to perform a calibration analysis for the investments mentioned in this section?

In a forthcoming paper (Blanc-Brude and Ismail, 2013b), we propose a simple and parsimonious method for the measurement of credit and equity risk in infrastructure project finance using only data that exists going back several decades, and could be collected on an ongoing basis looking forward.

We propose to use the Project Finance debt service cover ratio (DSCR) and debt service cash flows to derive relevant risk measures and eventually calibrate a project finance submodule.

4.1 Data: the role of debt service cover ratios in project finance

First, we distinguish between the *ex ante* and *ex post* values taken by cash flows and their associated ratios in Project Finance.

Ex ante cash flows correspond to the values agreed on in the project's financial model at financial close. On the equity side,*ex ante* cash flows consist of an initial inflow to the SPE, and a stream of dividends returned to its shareholders (outflows). On the debt side, they simply correspond to draw-downs from the project's lenders (inflows) and a series of outflows to pay fees, interests and principal back to the lenders. *Ex post* cash flows and ratios denote the realised values during the project's life.

Project financing leads to the calculation of a number of key ratios, including the debt service cover ratio (DSCR), which measures the ability of a project SPE to service its debt obligation.

The *ex post* DSCR is written:

$$DSCR_t = \frac{\text{Cash Flow Available for Debt Service (CFADS)}_t}{\text{Debt Service (Principal+Interest)}_t} \tag{1}$$

in each period t=1,2,..T for a project financing of maturity T. If the *ex post* DSCR falls below unity during any period t of the project's life, the SPE can be considered in default. If the DSCR equals unity, the SPE is just able to service its debt. 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 average *ex ante* DSCRs typically range between 1.35 and 1.40.

4.2 Towards measuring equity risk in project finance

Our intuition is that, for a simple SPE with a senior and a junior tranche, equity risk in project finance is bounded by the SPE's credit risk on one side and 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 when the SPE does not default. We propose to estimate equity risk in project finance by exploiting the self-contained characteristics of the SPE structure, and derive a measure of equity risk from one of credit risk (the DSCR).

Indeed, Project Finance equity is invested on the basis of a base case or *ex ante* dividend payments to be made over a fixed term. The base case embodies the face value of the promised return on equity. Using a benchmarking approach, we can measure relative loss as any deviation from this well-identified base case from the point of view of investors.

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

$$ESCR_t = \frac{\text{dividend}_t}{\text{dividend}_{\text{base case},t}} \tag{2}$$

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

Thus, if the base case i.e. the *ex ante* cash flows are exactly realised, the ESCR is equal to unity. Conversely, any deviation from unity signals a divergence from the equity base case. Next, since the debt tranche is senior to the equity tranche, we can write the cash flow to equity at time t as:

$$\text{dividend}_t = \text{CFADS}_t - \text{debt service}_t \tag{3}$$

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 (2) and from (3) and (1), we have:

$$ESCR_t = (DSCR_t - 1) \times \frac{\text{debt service}_{\text{base case},t}}{\text{dividend}_{\text{base case},t}} \tag{4}$$

We can thus write the probability of loss for the equity tranche as:

$$\begin{aligned} &P(ESCR_t < 1) && (5)\\ &= P\left((DSCR_t - 1)\frac{\text{debt service}_{\text{base case},t}}{\text{dividend}_{\text{base case},t}} < 1\right) && (6)\\ &= P\left(DSCR_t < \frac{\text{dividend}_{\text{base case},t}}{\text{debt service}_{\text{base case},t}} + 1\right) && (7)\end{aligned}$$

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[3].

This additional level of cover is a function of the ratio of dividends to the debt service as defined in the base case at time t. In other words, it is a function of leverage and of the amortisation profile of the SPE's senior tranche.

The ESCR, which gives a measure of equity loss/gain in project finance can thus be written as a function of the DSCR and the base case equity and debt cash flows.

As discussed above, the base case is known and documented at financial close and the DSCR is routinely monitored by lenders. Computing the ESCR thus requires minimal data input.

In a forthcoming paper (Blanc-Brude and Ismail, 2013b), we formalise this intuition and express a loss function for Project Finance equity, which in turn can be used to derive a loss density function and calculate a 99.5% Value-at-Risk. In our setting, the percentage equity loss per dollar invested l at time t for any project i is given by:

3 - While having higher than unity DSCR value implies in principle that distributions equity investors can be made, debt holders may put in place stricter protection mechanisms. In particular, debt holders may impose `lock-up' or `dividend stop' preventing equity distributions. `Lock up' levels are usually defined in terms of financial ratios such as the average DSCR (Yescombe (2002)). If at time t the $DSCR_t$ is below the given lock up ratio, no equity distribution takes place for this time period and the $ESCR_t$ is then equals to zero.

With the simplifying assumption of a single debt payment per year, the expression of probability of loss for the equity tranche can easily be modified to incorporate a `lock-up' ratio in terms of the DSCR constraint as,

$$P(ESCR_t < 1) = \\ P\left(DSCR_t < \max\left\{\frac{\text{dividend}_{\text{base case},t}}{\text{debt service}_{\text{base case},t}} + 1, \text{Lock-up}_t\right\}\right).$$

$$I_t^i = \begin{cases} 1 & \text{if } DSCR_t^i \leq 1 \\ 1 - E\bar{S}CR_t^i & \text{if } DSCR_t^i > 1 \end{cases} \quad (8)$$

where $E\bar{S}CR$ is the value of our Equity Service Cover Ratio normalised by the initial investment to account for cost variations.

The *ex post* DSCR is also a function of the *ex post* distribution of the CFADS and debt service under the base case. If there are not enough observations to build a representative distribution of the DSCR, it can be simulated using generic project financing models together with a series of assumptions to model the distribution of the CFADS. We propose such a simulation in a forthcoming paper (Blanc-Brude and Ismail, 2013b).

4.3 Towards measuring credit risk in project finance

To measure credit risk in project finance, we focus on the well-known notion of Distance to Default (DD) i.e. the number of standard deviation moves required to bring the company to the default point within a specified time horizon(Kealhofer (2003)).

For default point value of $\bar{B}$, DD is given by:

$$DD := \frac{\ln(V_0) - \ln(\bar{B})}{\sigma_V} \quad (9)$$

which can be approximated as (McNeil et al. (2005)),

$$DD \approx \frac{V_0 - \bar{B}}{\sigma_V V_0} \quad (10)$$

KMV puts forward DD as a sufficient statistic providing a rank ordering for default risk4, where the numerator in (9) expresses the firm's financial leverage reflecting financial risk while the denominator reflects its business risk. The model then proceeds by using DD to derive a measure of forward looking default probabilities within a given time period or Expected Default Frequency (EDF).

In Project Finance, we can express the notion of an event of default in terms of the Cash Flow Available for Debt Service (CFADS). At time t, default is defined as:

$$\text{Default}_t \iff \text{CFADS}_t < \text{Debt Service (Principal+Interest)}_t \quad (11)$$

Which can be defined in terms of *Ex post DSCR* defined in equation (1) as,

$$\text{Default}_t \iff DSCR \equiv \frac{\text{CFADS}_t}{\text{Debt Service (Principal+Interest)}_t} < 1 \quad (12)$$

Thus, following the definition of Distance to Default in (10), Distance to Default5 at time t can be defined as:

$$DD_t = \frac{\text{CFADS}_t - \text{Debt Service}_t}{\sigma_{\text{CFADS}_t}\text{CFADS}_t} \quad (13)$$

4 - KMV introduces a number of enchantments to the basic Merton model (Merton, 1974), such as assuming that default can happen at any time, empirically determining the default point ($\bar{B}$), and allowing for cash payouts.

5 - Note that while the definition of (10) uses the initial value of the firm V_0, it is essentially a simplification to using the firm asset value at the point of default. As such in our case, we use the corresponding value of the firm at time t instead of at initial time 0.

Rearranging the above expression, we obtain,

$$
\begin{aligned}
DD_t &= \frac{1}{\sigma_{\text{CFADS}_t}}(1-\frac{\text{Debt Service}_t}{\text{CFADS}_t}) &(14)\\
&= \frac{1}{\sigma_{\text{CFADS}_t}}(1-\frac{1}{\frac{\text{CFADS}_t}{\text{Debt Service}_t}}) &(15)\\
&= \frac{1}{\sigma_{\text{CFADS}_t}}(1-\frac{1}{DSCR_t}) &(16)
\end{aligned}
$$

Thus, Distance to Default in Project Finance is a function of the DSCR which reflects the financial risk of the project in addition to the variation of the project cash flow (*CFADS*), reflecting its business risk. DD_t is an increasing function in *DSCR*, and a decreasing function in *CFADS* variability measured by its standard deviation.

The expression can be further simplified, noting that the $CFADS = DSCR_t \times \text{Debt Service}_t$. Since the debt service is determined *ex ante*:

$$\sigma_{\text{CFADS}_t} = \sigma_{DSCR_t}\text{Debt Service}_t \qquad (17)$$

Substituting in (16),

$$DD_t = \frac{1}{\sigma_{DSCR_t}\text{Debt Service}_t}(1-\frac{1}{DSCR_t}) \qquad (18)$$

Still, distance to default is not a complete measure of probabilities of default (*PD*s).

There are two ways to derives *PD*s from *DD* values. The first one requires to impose a functional form or distributional assumptions on the deriving variable (in our case *CFADS*), in which case firm value is typically assumed to follow a log normal process. Given the value of *DD*, the *PD* corresponds to the area under the normal distribution below the *DD* point.

The second option follows the KMV model and uses econometrics to determine the relationship between *DD* and *PD*s, and to derive the corresponding mapping. This mapping allows the direct derivation of *PD*s based on any calculated value of *DD*.

4.4 The role of bank monitoring for data collection in infrastructure project finance

Thus, by using data items that have been used and collected for decades in the context of infrastructure project financing, we can derive powerful measures of equity and credit risk to help build benchmarks and calibrate the relevant submodules.

EDHEC-Risk Institute is currently developing the theoretical and methodological tools as well as collecting the data that will allow these advances to take place in the near future.

5 Question 21: Do you have any suggestions how market data for listed infrastructure could be used for calibrating infrastructure project equity? What would be suitable indices and subsets of the infrastructure project universe? Why would the risk profiles be comparable?

We have argued (Blanc-Brude, 2013) and EIOPA also reported in its discussion paper (EIOPA, 2013, p.46), that listed infrastructure investments have been hard to define and that the so-called infrastructure indices have had a very variable performance including systematic under-performance of standard market-cap benchmarks since 2009.

However, there is little to be learned about listed infrastructure from such indices because they rely on *ad hoc* stock selection methodologies, mostly based on sector classifications or keyword searches, and a market capitalisation weighting scheme, which leads to over concentrating the effect of just a few very large stocks (see Amenc et al., 2012, for a critical review or market capitalisation in listed benchmarks).

Listed infrastructure products suffer from a continued focus on tangible infrastructure assets i.e. labelling stocks as 'infrastructure' because they involve roads, airports or power plants, while ignoring the contractual and regulatory regimes that allow them to operate as businesses and effectively define their investment characteristics. Instead, listed data should be used to try and proxy the systematic drivers of performance and risk found at the underlying level.

EIOPA notes in its discussion paper our previous point that one of the most significant risk factors at play in infrastructure projects was their revenue risk model (Blanc-Brude, 2013): infrastructure project either receive fully pre-contracted revenues (this is known as the "availability payment" model), or a combination of highly predictable and risky income stream (as embodied by shadow tolling arrangements or power purchasing agreements covering a fraction of a project's capacity), or they can be fully exposed to commercial risks.

Indeed, revenue risk is a promising dimension to try and capture the different characteristics of infrastructure project finance since an 'availability payment' variable is shown to partly explain the variance of credit spreads, the likelihood of defaults or project leverage with a high degree of statistical significance.

Building on the role of revenue risk, we circulated an example in early 2013 using market data for listed firms investing in one type of infrastructure project company, which has been reproduced in the EIOPA discussion (EIOPA (2013))6 . We return to this example in more details below.

5.1 A basket of PFI equity investment

We consider listed entities solely investing equity in the special purposes companies that are created to deliver social infrastructure. Only a few listed funds invest in these projects but they present the characteristic of seeking exposure to a particular kind of public-private contract. In the UK, such contracts are called PFI or Public Finance Initiative. In France they are called Contrats de Partenriat (CP). In Canada and the US, P3s. In the EIOPA discussion paper, these investments are referred to as "social infrastructure", following the OECD typology.

6 - Annex 2 of EIOPA (2013) is incorrectly attributed to another source

Social infrastructure projects are all characterised by a long-term commitment from the public sector to pay a pre-agreed income for several decades as long as a certain public service is delivered according to an output specification. These contracts transfer all risks of construction, operations and maintenance to the investors and use project financing through a dedicated SPEs financed with an average of 10% equity and 90% senior debt (Blanc-Brude et al., 2010).

Project construction and operating risks are managed by the SPE and further transferred to subcontractors through fixed priced, date certain contracts. Even if project specific risks are not completely transferrable *ex post*, these are idiosyncratic risks. In a recent paper, we show for example that construction risk transfer is effective in project finance and that a sample of 77 projects exhibits zero median cost overruns, in sharp contrast with the outcome of infrastructure procurement directly by the public sector (Blanc-Brude and Makovsek, 2013).

Furthermore, we know that social infrastructure investments are small enough to allow investors to contemplate diversified portfolios without having to invest very large amounts (see Blanc-Brude, 2012a, for a discussion of the lot size problem with infrastructure equity).

From the point of view of the public sector, the arrangement is akin to rate of return swap: the public sector receives a set stream of public service and pays a fixed price while the firm receives a pre-agreed income and faces variable costs.

We built an equally weighted portfolio of four listed investment firms that are *solely* occupied with purchasing equity stakes in social infrastructure SPEs receiving fully contracted revenues as described above. The four firms, listed on the London Stock Exchange, are:

- HICL Infrastructure ("HICL")
- John Laing Infrastructure fund ("JLIF")
- GCP Infrastructure Investors ("GCP")
- International Public Partnerships ("INPP")

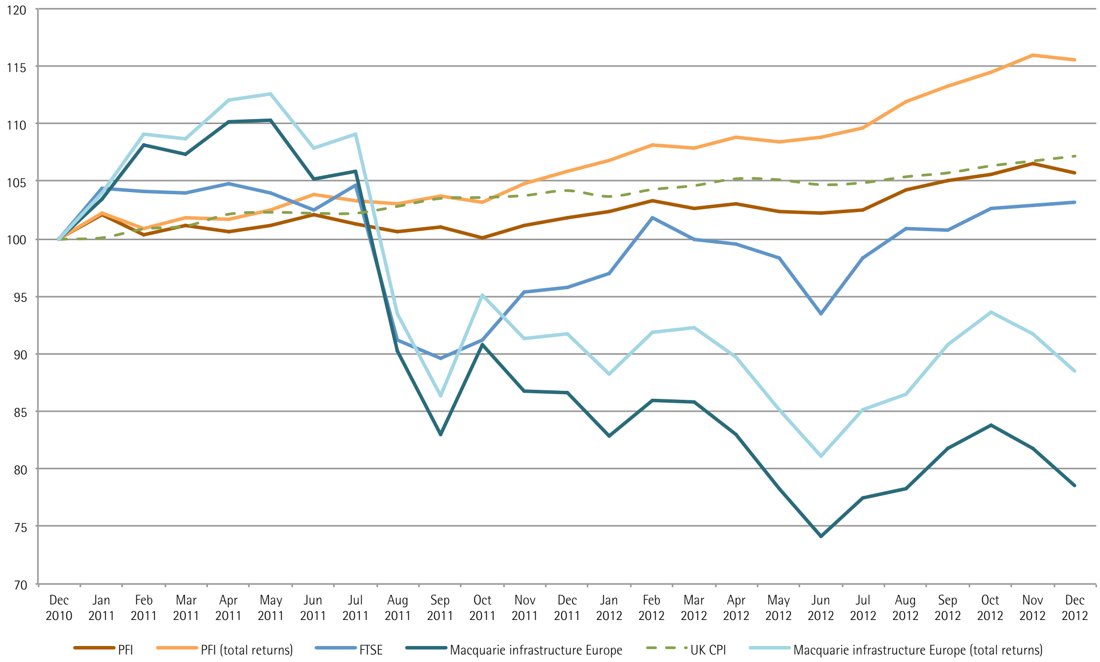
Together they represent a total investment in more than 220 SPEs, all of which collect availability payments from public sector clients. This "PFI portfolio" had a market capitalisation in excess of GBP2.5bn in December 2012.

5.2 Performance

All four firms have only been listed recently (the oldest one, HICL, was listed in 2006). Figure 1 and table 1 illustrate their equally weighted market performance over the 2010-12 period.

While this is a very short time series, the ability of this portfolio to replicate the implied risk/reward ratio of the underlying and to perform better than both the market-cap benchmark but also the thematic 'infrastructure index' is striking. Its performance is also highly correlated with the UK consumer price index. Indeed, the income stream of PFI projects is typically indexed on inflation.

Figure 1: Performance of the PFI portfolio, 2010-2012



Source: Datastream and author's calculations, annualised monthly data

Table 1: Performance metrics of the PFI portfolio, 2010-2012

	PFI index	Macquarie Infrastructure Index Europe	FTSE All Shares
Return	2.86%	-11.36%	1.61%
Risk	3.00%	17.44%	12.48%
Sharpe Ratio	0.945	(0.65)	0.13
Market beta	0.094	0.98	n.a.
99.5% VaR	9.46%	56.29%	30.55%
Total return	7.52%	-5.89%	5.02%
Risk	3.04%	17.47%	12.50%
Sharpe Ratio	2.470	(0.34)	0.40
99.5% VaR	4.07%	50.89%	27.17%

Source: Datastream and author's calculations, annualised monthly data

5.3 Representativity

While this can only be considered to be an illustrative example, it suggests that focusing on the systematic drivers of risk and returns at the underlying level i.e. the contractual framework that characterises SPEs, allows the capture of a more relevant effect than using listed data based on the sectoral or physical featured of infrastructure investments.

This remains however a small-size example from which it is not yet possible to generalise.

The literature on the convergence between unlisted private equity and public markets suggests that a larger universe of listed funds investing solely in project finance SPEs with well-defined revenue risk characteristics (including riskier ones than the PFI) could eventually be considered to provide an adequate proxy of unlisted investments.

However, such a large scale development of the listed infrastructure sector can seem unlikely in the short to medium term, and the need to develop an unlisted benchmark remains.

The development of the theoretical background, methodology and data collection leading to the creation of an unlisted infrastructure project finance equity benchmark are amongst the objectives of the Meridiam/Campbell Luytens/EDHEC-Risk Institute research chair on infrastructure equity investment.

6 Question 22: Consider the following statement: "The high degree of leverage often used in infrastructure project finance results in a high sensitivity of equity values to changes in the total value of the project and thus a high overall risk". Do you disagree? Why?

To the extent that the above statement implies that there is no difference of risk level between standard corporate equity and project finance equity for a given level of balance sheet leverage, we, and most existing academic literature on the subject, disagree.

In its discussion paper, EIOPA highlights the point we made in a recent paper (Blanc-Brude, 2013), according to which high leverage in project finance is a sign of low asset risk, as also argued byBrealey et al. (1996), Esty (1999a, 2003, 1999b) and Kleimeier and Megginson (2005) before us.

Referring to a study by Moody's (2013), EIOPA also remarks that: "Moody's project finance bank loans' default and recovery rates study shows that, although infrastructure project are at the lower end of the default rate spectrum within project finance, they do not exhibit higher leverage ratios, suggesting that those issues are uncorrelated." (EIOPA, 2013, p.40)

We could not find any reference to the variability of leverage ratios in project finance vehicles in the Moody's study referenced in EIOPA's paper, and thus cannot decide whether these issues are "uncorrelated", especially without any evidence of the statistical significance of such correlation.

Instead, we propose to distinguish between the following two questions to better understand the relationship between leverage and equity risk in project finance:

- The role of leverage in project finance in comparison with corporate finance, and
- The role of leverage within the project finance universe.

6.1 Project finance vs. corporate finance leverage

EIOPA argues: "basic corporate finance theory states that – other things being equal - the more an entity is leveraged, the more sensitive to asset profitability its return on equity is" (EIOPA, 2013, p.40).

While this statement is unproblematic in isolation, it is also insufficient for the purpose of this discussion, which focuses on relative risk levels between different types of instruments and how they should be treated from a regulatory standpoint. If leverage has, on average, am equivalent impact on equity risk in project finance as in standard corporate finance, then project financing vehicles should be similar to other corporate vehicles.

However, this is not the case because the use of project financing creates a specific form of corporate governance, which introduces a *double selection bias* in the type of investment to be financed. Project financing creates a unique type of firm, with a finite investment horizon, which we call the "single-project firm". It is fundamentally different from the type of firm identified in the corporate finance literature, which invests in multiple projects over an infinite horizon.

6.1.1 Project finance is a unique form of corporate governance

To address EIOPA's comment in full, we first draw a few points from the theory of the firm to better highlight the difference between "basic" corporate finance and project finance.

Jensen and Meckling (1976) discuss the nature of the firm as groups of security holders with diverging interests because some parties receive a defaultable fixed income while others receive a variable, residual income. Thus, shareholders and debt holders may have diverging incentives. Since shareholders obtain any payoff in excess of debt service, they have an incentive to take risks to increase dividends, including accepting risky, negative net present value (NPV) projects, thus increasing the credit risk to which debt holders are exposed.

Jensen and Meckling (1976) also suggest that aligning managers and shareholders' interests is complicated by the fixed nature of wages, leading to an *effort problem*. If effort is costly for managers and wages are fixed, managers will minimise their effort, instead of exerting effort to improve cost control within the firm for example.

However, these authors also point out that debt can become an instrument to resolve agency issues such as conflicts of incentives between shareholder and managers. In the free cash flow theory, managers may divert free cash flows for their own purposes and benefits, including growing the firm beyond its efficient size in order to maximise free cash flow. But under the authors' "control hypothesis", if debt is a significant component of the capital structure, then the free cash flow left at the discretion of managers is limited. Hence, debt can reduce agency costs.

Grossman and Hart (1982) take this idea further and examine the impact of the risk of bankruptcy on management when salary incentives and the threat of external takeover are not sufficient to discipline the firm's management and minimise agency costs. If the probability of bankruptcy is made an inverse function of the level of managerial effort, then managers stand to lose whatever benefits they are entitled to and will thus be more likely to exert efforts to maximise the firm's profits. Thus, while increasing firm leverage increases the likelihood of bankruptcy in the event of low or inadequate managerial effort, higher leverage can also be a disciplining mechanism.

Thus, even in "basic" corporate finance, firm leverage is understood to have an endogenous impact on the riskiness of the firm, suggesting that higher leverage can have multiple effects countervailing effects on default probability and credit risk.

Grossman and Hart (1982) point out that while the firm's financial structure is likely to influence its profit maximisation behaviour, shareholders are seldom in a position to choose the firm's capital structure. However, these authors note that the firm's management may choose to increase balance sheet leverage by itself to *signal* their commitment to profit maximisation, leading to higher market valuation. This may be driven by compensation schemes linked to the firm's value, the objective of minimising hostile takeovers and, crucially, the objective of raising more capital.

Thus, the use of debt in the firm's capital structure can be equated with a pre-commitment or bonding mechanism (Grossman and Hart, 1982, p.109) i.e. a mechanism by which it would be very costly for the debt issuer not to perform by exerting the optimal level of effort.

Likewise, the role of high leverage in project finance can be interpreted as a signalling and commitment mechanism by which the SPE's owners commit to creating the optimal incentive scheme to minimise credit risk, short of which they are almost certain to lose everything.

We add that if commitment mechanisms deal with moral hazard (inducing optional effort) in agency problems, they also address issues of adverse selection of the agent since optimal risk transfer should lead to the self-selection of agents that are best able to manage risk and control costs.

In a recent paper, we discuss risk transfer from the public to the private sector in PFI contracts, its impact on self-selection by private bidders and the resulting 'separating equilibrium' i.e. only the best firms choose to enter into complex and risky contracts via a dedicated project finance SPE. We show empirically that only the largest types of firms choose to bid for PFI projects, which requires the use of project financing (Blanc-Brude, 2012b).

6.1.2 A double investment selection bias

In fact, the corporate finance literature has long acknowledged that project financing addresses some of the agency problems found in public and private organisations and that reduce efficiency (Brealey et al., 1996; John and John, 1991). Through a series of contractual commitments agreed *ex ante*, high powered incentives are created i.e. contracts transfer risk to change incentives and address moral hazard.

The role of leverage and the relationship between leverage and asset risk in project finance should be understood in the context of addressing the agency issues found in the traditional financing of the firm.

High project leverage plays a disciplining role since the SPE's free-cash flow is pre-allocated contractually and by the virtue of the seniority of debt instruments in the capital structure. Thus, cash flows cannot be used at will by managers or shareholders.

In fact, lenders have very extensive rights to current and future free cash flow through covenants like 'cash sweeps', a debt contract clause stipulating that all available free cash flow in a given period must be allocated to service debt once a certain term to maturity is reached or in some pre-agreed event; or step-in rights, by which they can replace the project's manager with one of their choosing.

Thus, the occurrence of separately incorporated and highly leveraged firms or SPEs leads to two important conclusions:

First, the decision to use a separate incorporation of the project is a *choice* made by its shareholders. Thus, while high leverage clearly plays a disciplining role, it is self-imposed. Following Grossman and Hart (1982), it is appealing to interpret this choice of a highly leveraged financial structure as a form of signalling by shareholders to lenders, that they are willing to be exposed to potentially high losses (equity wipe-out) if they do not manage the project very well.

Moreover, despite being 'empty shells', SPEs have managers (i.e. directors) who receive compensation for sitting on the board of each firm. Their interests are thus aligned with that of the lenders: they must control costs and maintain a high credit quality at all times in order not to lose their compensation.

Second, in contrast to classic corporate finance, the final *decision to leverage* the SPE is effectively taken by the lenders, not its management. Since the SPE is dedicated to realising a standalone investment the decision to finance is more binary from the point of view of the lender than in the case of relationship banking: lenders can opt-out without directly jeopardising existing client relationships.

Project finance should thus be understood as a project selection process: large projects are incorporated separately and highly leveraged because they are low risk projects that generate sufficient free cash flows to service large amounts of debt financing.

It is insufficient to say that high leverage is justified because 'debt is cheaper than equity'. In project finance, leverage is high because asset risk is low (see Esty, 2003).

This is not very different from the manager selection problem in the theory of the firm: increasing the chances of bankruptcy by increasing leverage, because it transfers risk to managers, should lead to the self-selection of the best managers (adverse section) and the optimal level of managerial effort (moral hazard).

Likewise, using project financing to finance individual projects should lead to the selection of the best projects for which the optimal incentive structure has been put in place.

6.1.3 The single project firm

Project finance thus uses financial structuring to **create a specific type of firm** in which contracts create credible commitment mechanisms, including credible threats, to optimise the classic agency problem found in the financing of the standard corporation (Brealey et al., 1996). These mechanisms result from the dominant role played by debt financing *ex ante* (pre-investment) and *ex post*.

The decision to create and leverage a dedicated firm or SPE can be understood as a joint signalling and selection decision by the firm and its lenders in a context where asymmetrical information normally leads to moral hazard and adverse selection in the decision to finance the firm.

Crucially, the Project Finance SPE is dedicated to delivering a single project and starts repaying its debt almost immediately. Hence, the leveraging of its balance sheet is not constant but decreases over time until it eventually reaches zero.

Our "single project firm" thus differs from the average firm in at least two ways:

- It has a finite life and a single mandate, typically to invest in the construction and operation of a given infrastructure project for a set number of years.
- It is initially highly leveraged but spends its entire life de-leveraging, hence a very dynamic risk profile.

The combination of high initial leverage and continuous de-leveraging also has the effect of counter-balancing the impact of long-term uncertainty on asset values.

Merton (1974) had foreseen this phenomenon. For firms with low levels of initial leverage, increasing the term of investments (e.g. longer loan maturities) only leads to higher credit risk. However, for firms with high initial leverage, continuous de-leveraging tends to reduce credit risk, up to a point where this effect more than offsets that of higher risk introduced by longer maturities (see also Sorge and Gadanecz, 2004, p.47, for a technical discussion of this point).

It follows that project finance debt exhibits a pattern of predictable credit risk migration from around "BBB" to "A" over a period of ten years, during which default rates decrease continuously, to reach near-zero levels, as reported by Moody's (2013).

Thus, the contention that project finance equity is very risk because of SPE's high leverage ignores the role of project financing in creating investment selection mechanisms that are biased towards highly predictable cash flows, and the fact that after a few years, most projects have already significantly de-leveraged.

6.2 Leverage levels between project financing transactions

Returning to EIOPA's point about the link between leverage and credit risk between different sub-categories of project financing, existing research confirms that projects that exhibit lower credit risk are systematically more leveraged.

This is easily shown by making a distinction between projects that receive a fixed revenue stream or availability payments, usually from the public sector, and those that are exposed to some degree of commercial risk. The first type of project, of which the British PFI is the best example, is typically leveraged up to 90% with senior debt, while the remaining capital is provided by subordinated sponsor debt and "pinpoint" equity (see above). In its default rate study, Moody's reports that such projects have marginal default rates of 0.5% in any given year during the first ten years of their lifecycle (Moody's 2013), or the equivalent of an A rating, beyond which no default has ever been observed in the 800 PFI contracts that have been signed in the UK since 1992.

We also documented in several empirical studies that projects corresponding to such low levels of revenue risk also have a lower cost of capital in the form of lower credit spreads with very high statistical significance (Blanc-Brude and Strange, 2007; Blanc-Brude and Ismail, 2013a), further highlighting that higher leverage here coincides with relatively lower credit risk compared with other project finance structures.

Indeed, those projects that are exposed to commercial risks (e.g. toll roads with traffic risk) are found to have systematically lower levels of leverage (we report a historical average of 75-78% in Blanc-Brude et al. (2010) and Blanc-Brude and Ismail (2013a)) while they do have higher default probabilities as reported by both Moody's (2013) and Standard & Poor's (2004) ranging from BBB in their early years to A, roughly a decade after origination. Thus, in terms of relative credit risk, both comparing project finance debt with corporate debt, and also comparing between project financing structures, higher leverage can be interpreted as signalling lower asset risk. Importantly, the high leverage of project finance SPEs is not designed to last, and the continuous de-leveraging of the single-project firm leads to an improving credit risk profile over time.

6.3 How risky is equity in project finance?

To conclude, we return to the role of leverage and equity risk in project finance. It can be argued that for a given level of asset risk (e.g. a combination of construction, operating and revenue risk in a given country) higher leverage results in a higher sensitivity of the equity tranche. This is self-evident, but does not lead to any useful conclusion regarding the regulatory treatment of infrastructure project finance equity vis-à-vis other forms of corporate equity.

If however, it is understood that highly leveraged project financing structures *signal* low asset risk because, as we have argued above, total asset risk is endogenous to the financing decision, then two equally leveraged corporate and project finance structures cannot be considered to represent the same level of equity risk.

It follows that project finance equity risk must be measured independently. We highlight a simple methodology to do so in our answer to question 20.

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