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The term structure of credit spreads in project finance

by Marco Sorge* and Blaise Gadanecz*

Monetary and Economic Department

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* Bank for International Settlements

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Abstract

This paper analyses the peculiar nature of credit risk in project finance by means of a comparative econometric analysis of ex ante credit spreads for a large cross section of international loans and bonds between 1993 and 2001 in both industrialised and emerging countries.

Our main contribution relates to the analysis of the term structure of credit spreads for project finance loans compared to other loans and bonds. For both investment-grade and speculative-grade bonds used for purposes other than project financing, we find that the term structure of credit spreads can reasonably be approximated by a linear positive function of maturity, once other relevant micro and macro risk factors have been controlled for. For project finance loans, instead, we show that the term structure of credit spreads is hump-shaped. This result applies to both industrialised as well as emerging countries and appears robust to a large number of sensitivity tests, controlling also for possible sample selection bias or endogeneity of maturity choice. We emphasise a number of key features of project finance structures that might underlie this finding. In particular, we illustrate the mechanisms by which higher leverage, short-term liquidity concerns due to the exclusive reliance on project cash flows as well as the sequential resolution of risks along various project advancement stages might all alleviate the perceived risk of longer-maturity project finance loans.

This paper offers a number of policy implications. It provides a cross-country assessment of the risk-mitigating role of explicit or implicit guarantees from multilateral development banks and export credit agencies in project finance. It also makes a number of suggestions for bank regulators on how to effectively align capital requirements with the actual term structure of credit risk in project finance. In particular, our results indicate that a linear maturity adjustment to regulatory capital with slope inversely related to the probability of default might not be applicable to project finance exposures. We acknowledge, however, that introducing different maturity adjustments for different asset classes, while improving the risk sensitivity of capital requirements, would also add to the complexity of their implementation.

Keywords: project finance, term structure of credit spreads, political risk, capital requirements.

JEL codes: F34, G12, G28, G32.

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1. Introduction[1]

Over the last 30 years project finance has been an important source of funding for public and private ventures around the world. The modern history of project finance begins in the 1970s with the successful development of the North Sea oilfields. Since then, this form of financing has been used extensively in various industries, such as natural resources, power and transportation. Its geographical spread has been worldwide, including advanced and, especially, emerging economies.[2]

In spite of its worldwide reach and several decades of history, a number of key issues regarding the specific risk determinants of project finance, vis-à-vis other forms of financing, remain largely unresolved. In particular, recent research has suggested that project finance loans might be fundamentally different from other syndicated credits.[3]

This paper aims at identifying the specific risk drivers and risk mitigants of project finance loans by means of a comparative econometric analysis of ex ante credit spreads for a large cross section of international loans and bonds between 1993 and 2001 in both industrialised and emerging countries.

Our main contribution relates to the analysis of the term structure of credit spreads for project finance loans compared to other loans and bonds.

Recent empirical literature[4] on the term structure of bond spreads has emphasised how using a heterogenous sample of bonds to identify an aggregate relationship between spread and maturity might be misleading if credits of longer or shorter maturity are fundamentally different in a number of other relevant risk characteristics, which need to be controlled for. Therefore, we have chosen to analyse the pricing of our cross section of loans and bonds within a multivariate regression framework, focusing on the spread-maturity relationship while controlling for other relevant micro or macro risk factors that might also affect the spread.

An upward-sloping regression line appears to fit quite well the relationship between maturity and spread for both non-project finance loans and bonds. In particular, we find that the difference in the shape of the term structures of investment grade versus speculative grade bonds (as noted by much of the literature on the term structure of bond spreads) largely disappears.[5]

For project finance loans, on the other hand, a linear model does not appear to capture the relationship between spread and maturity appropriately. Unlike Kleimeier and Megginson (2000), we find no significant linear relationship between spread and maturity for project finance loans.

We emphasise the main peculiarities of project finance compared to traditional corporate finance and identify several economic rationales that might explain why we should expect a different shape of the term structure of credit spreads for project finance. In particular, we show how short-term liquidity concerns due to the exclusive reliance on project cash flows, higher leverage ratios, as well as the sequential resolution of risks over project advancement stages, may lead to a non-linear relationship between spread and maturity in project finance. Employing a number of alternative functional forms, we conclude that the term structure of credit spreads in project finance is hump-shaped. This result applies to both industrialised and emerging market borrowers.

In our subsample of emerging market borrowers, we also find that political risk and political risk guarantees[6] have a significant impact on credit spreads for project finance loans. The availability of

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[1] Corresponding author: Marco Sorge, Bank for International Settlements, Centralbahnplatz 2, CH-4002 Basel, Switzerland. E-mail: marco.sorge@bis.org. We would like to thank seminar participants at the Bank for International Settlements for their helpful comments. The views expressed in this paper are the authors' own and do not necessarily reflect those of the Bank for International Settlements or the Basel Committee on Banking Supervision.

[2] For more details on the history and growth of project finance, see Sorge (2004) and Esty and Christov (2002).

[3] See Hainz and Kleimeier (2003) and Kleimeier and Megginson (2000).

[4] See, for example, Helwege and Turner (1999) and He et al (2000).

[5] This complements recent findings for example in Helwege and Turner (1999).

[6] "Political risk" includes the risks of expropriation, currency convertibility and transferability, political violence, unanticipated changes in regulations, and failure of state-owned suppliers or customers to fulfil their contractual obligations. This paper explicitly distinguishes political risk guarantees from other third-party guarantees. See Section 3.3.1 for more details.

such explicit or implicit forms of risk mitigation appears to reduce ex ante credit spreads by almost one third on average (ie by about 50 bp from an average spread in our sample of project finance loans of about 150 bp). In emerging markets, we also find evidence that commercial lenders are more likely to commit for longer maturities if they obtain political risk guarantees from multilateral development banks or export credit agencies. In fact, the explicit or implicit cover provided by bilateral or multilateral agencies appears to dampen the perceived risk of longer-maturity loans, thus exacerbating the hump-shaped behaviour of the term structure of credit spreads for this asset class. However, controlling for the interaction between maturity and agency guarantees, we find that the term structure of credit spreads would still be hump-shaped even in the absence of agency guarantees. This confirms our hypothesis that it must be due to more fundamental characteristics of project financing structures.

Our sample period is 1993-2001, which was a time of considerable financial turmoil for emerging countries. We cannot rule out that in those years a flight to quality might have left many borrowers in emerging countries credit-rationed and that, as a consequence, the probability of observing project finance deals with relevant pricing information (ie our sample selection) might not be random but rather co-determined by the same risk characteristics that enter our pricing regressions. In order to ensure that our estimates are unbiased, we use a generalised Tobit model to analyse the probability of signing a deal or not, along with the pricing decision simultaneously.[7] Overall, our results appear robust to a large number of sensitivity tests controlling for possible simultaneity of spread and maturity decisions, different loan covenants and amortisation schedules, bond ratings, floating versus fixed rate pricing as well as shortening the range of maturities analysed.

Our analysis has several policy implications. It provides a cross-country assessment of the risk-mitigating role of explicit or implicit guarantees from multilateral development banks and export credit agencies in project finance. It also offers a number of suggestions for bank regulators on how to effectively align capital requirements with the actual term structure of credit risk in project finance. In particular, our results suggest that a linear maturity adjustment to regulatory capital with slope inversely related to the probability of default might not be applicable to project finance exposures. We acknowledge, however, that introducing different maturity adjustments for different asset classes, while improving the risk sensitivity of capital requirements, would also add to the complexity of their implementation. As more ex-post data become available, further empirical research in this area might be useful to bank capital regulators in order to provide market participants with the incentives for a prudent and, at the same time, efficient allocation of resources across asset classes. This is particularly important, given the predominant role of internationally active banks in project finance and the fundamental contribution of project finance to economic growth especially in emerging economies.

This paper is organised as follows. Section 2 illustrates the main peculiarities of project finance and identifies several economic rationales for why we should expect a different term structure of credit spreads for this asset class compared to other loans or bonds. Section 3 contains the core empirical analysis, including data and variables description, methodology, results and several robustness checks. Section 4 offers a number of suggestions for bank regulators on how to effectively align capital requirements with the term structure of credit risk in project finance. Section 5 lays out directions for further research, while Section 6 summarises the main findings and concludes.

2. Theory and existing literature

2.1 Corporate bonds

Most of the empirical literature on the term structure of credit spreads has so far concentrated on corporate bonds. On average, the term structure of credit spreads for investment grade bonds appears upward-sloping (see Table 1), in line with the intuition that lenders should get a higher remuneration for being exposed to risk for a longer period of time. This is consistent with the findings of the systematic analyses in Jones et al (1984), Sarig and Warga (1989) and He et al (2000).

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[7] Following the approach of Heckman (1979), also used in a somewhat similar setting by Eichengreen and Mody (2000).

On the other hand, the shape of the term structure of credit spreads for non-investment grade bonds has been somewhat more controversial.

Early studies of the term structure of credit risk noted how lower-rated issuers tended to have wider credit spreads that narrowed with maturity. Conversely, higher-rated firms showed narrower credit spreads that widened with maturity.

This pattern was first explained in the literature by "crisis at maturity" models.[8] With sufficiently high leverage ratios, firms may be able to service the interest payments on their debt far from the maturity date, but may encounter refinancing problems as their near-term debt matures. Their increased risk of a crisis at maturity is reflected in higher spreads at shorter maturities.

A further explanation for the possibility of a negative relationship between credit spreads and maturity has been provided by the risk neutral bond pricing literature in terms of "survival bias". In Fons' (1994) words: "Over the long term, surviving low-rated issuers tend to rise to the middle ratings, middle-rated firms tend to stay middle-rated and top-rated firms tend to slip to the middle ratings. This pattern has implications for the term structure of credit risk."

Given the documented high variance in credit quality among speculative-grade issuers, a recent strand of the literature has emphasised the importance of constructing a homogenous sample of bonds in order to study the term structure of credit spreads. Helwege and Turner (1999) argue that the findings in many previous studies of the term structure of credit spreads reflect a sample selection bias due to better-quality speculative grade issuers tending to issue longer-term bonds. When the spreads of all speculative grade issuers are averaged, this bias might induce a spurious downward slope in the spread curves. By matching bonds by issuer and ratings, they conclude that spread curves for B- and BB-rated US industrial issues are actually upward-sloping (contrary to the cross-sectional studies of Sarig and Warga (1989) and Fons (1987)). He et al (2000) refine this matching method and expand the set of ratings examined. They confirm that BB- and B-rated firms mostly show upward-sloping term structures of credit spreads, whereas only spread curves for CCC- and CC-rated firms are downward-sloping. Collin-Dufresne and Goldstein (2001) provide theoretical support to these findings. They show that an upward sloping term structure of credit spreads for speculative-grade debt is consistent with an extension of Merton's (1974) framework, where firms adjust outstanding debt levels in response to changes in firm value, thus generating mean-reverting leverage ratios.

What emerges from this literature is that attempting to establish an aggregate relationship between spread and maturity using a highly heterogenous sample of bonds, without controlling for different risk characteristics of individual issues (other than maturity), might lead to misleading results.

This paper will therefore take a multivariate regression approach, attempting to analyse the spread-maturity relationship, controlling for other relevant micro or macro risk factors that might affect the spread. Our goal is not to explain patterns in the observed term structure of credit spreads in terms of latent factors, nor is it our intention to build a forecasting model for pricing purposes. Our primary objective is to understand the economics underlying the term structure of ex ante credit spreads as derived from a large cross-section of international loans and bonds. We focus on the scarcely researched area of project finance, while using non-project finance loans and bonds as benchmarks for comparison.

2.2 Project finance

A limited body of literature exists analysing the pros and cons of project finance in the context of a firm's optimal capital structure.[9] Project finance is usually defined as limited or non-recourse financing of a new project through the establishment of a (separately incorporated) vehicle company.

The reliance on non-recourse debt represents one of the key differences between project finance and traditional corporate finance. In corporate finance, the primary source of repayment for investors and creditors is the sponsoring company, backed by its entire balance sheet, not the project alone. Even if

[8] See, for example Johnson (1967).

[9] For example: Shah and Thakor (1987), Kensinger and Martin (1988), John and John (1991), Chemmanur and John (1992), and Brealey et al (1996) and Esty (2003a).

an individual project fails, creditors will still retain a significant level of comfort in being repaid depending on the overall strength of the sponsor's balance sheet. In project finance, on the other hand, if the project fails, investors can expect significant losses even if it is sponsored by a AAA-rated company or government.

Limited or no recourse to the sponsors' balance sheets and exclusive reliance on the project's assets and cash flows make the credit risk faced by the lenders very project-specific, with little scope for diversification. Furthermore, loan repayments are subject to potential liquidity constraints facing the project company, especially during the construction phase.

On the other hand, the possibility of funding projects with 70% and more non-recourse debt is attractive to the sponsors for a number of reasons. In fact, project finance allows them to share in potentially large revenues while committing relatively little equity. Moreover, deconsolidating projects off balance sheet makes it possible for the sponsors to preserve their corporate debt capacity and keep their cost of funding low. A further reason for the sponsors to consider project finance is that the risks of the new project will remain separate from their other activities, avoiding any potential "risk contamination".[10]

Along with non-recourse debt, another key feature of project financing is the extensive network of contractual agreements (see Graph 1) that is developed to suit any particular project structure. Various project risks are usually allocated to those parties best suited to appraise and control them (construction risk is borne by the contractor, the risk of insufficient demand for the project output by the purchaser, etc). The literature has emphasised how creating a project-specific governance system makes it possible to reduce potential agency conflicts between ownership and control and to align incentives and deter opportunistic behaviour of the various parties involved in the common venture.[11] On the other hand, structuring deals involving a complicated nexus of contracts involves high legal and transaction costs and can be relatively time-consuming compared to other forms of financing.

Due to these peculiar characteristics, project finance has been especially used to fund large-scale capital-intensive projects generating hard currency cash flows, for example from internationally traded commodities (eg power plants). In fact, this type of projects allows sponsors to enjoy the benefits of non-recourse debt and extensive contracting, while minimising the related risks to lenders. In particular, structuring large projects – as opposed to several smaller deals - reduces overall legal and transaction costs thanks to economies of scale. Furthermore, financing projects with considerable capital assets that produce hard currency cash flows increases collateral value and reduces lenders' exposure to exchange rate risks.

On the other hand, financing large-scale hard currency generating projects leaves lenders naturally more exposed to political risk[12] and sovereign risk in general. Host governments might have a keen interest in the high-profile projects being funded and might fail to renew concession agreements, change regulations or even expropriate project assets and cash flows to gain political rents or access to hard currency during economic downturns. In order to cope with these risks, project finance is making increasing use of larger syndicates and third-party guarantees, in particular political risk guarantees. Their role as risk mitigants will be studied in greater depth in our empirical analysis.

Large-scale capital-intensive projects usually require substantial investments up front and only start to generate revenues after a relatively long construction period. Therefore, matching debt repayment

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[10] See Esty (2003a)

[11] A recent paper by Morellec (2004) shows how the agency costs of managerial discretion can lead to optimal capital structures in corporate finance with low leverage levels. Project finance is special in the sense that it can achieve high leverage ratios by setting up an extensive contractual framework to address agency conflicts.

[12] Hainz and Kleimeier (2003) find that the higher the political risk of a country, the larger the fraction of project finance loans among all syndicated loans. They use a set of indices provided by *Euromoney* and by the EBRD to proxy for three broad categories of "political risk". The first category includes the risks of expropriation, currency convertibility and transferability, and political violence, including war, sabotage or terrorism. The second category covers risks of unanticipated changes in regulations or failure by the government to implement tariff adjustments because of political considerations. Finally, the third category includes quasi-commercial risks arising when the project faces state-owned suppliers or customers whose ability or willingness to fulfil their contractual obligations towards the project is questionable.

obligations with project revenue cash flows implies that, on average, project finance is characterized by much longer maturities compared to other forms of financing.[13]

Are longer maturities perceived by lenders as a risk per se? This question is crucial to understanding the peculiar nature of credit risk in project finance but has remained so far largely unexplored. In particular, given the peculiar characteristics of project finance discussed above, should we expect the term structure of credit spreads for project finance loans to behave differently from that of other loans or bonds? We will first illustrate below a few conceptual reasons why we believe that this should indeed be the case. In Section 3, we will then attempt to substantiate our claim empirically. In particular, we will test the hypothesis of a concave, possibly hump-shaped, term structure of credit spreads for project finance loans.

2.2.1 Short-term liquidity risk

Projects usually only start to generate revenues after a relatively long construction period. As loan repayment relies primarily on the project's cash flows, obtaining credit at longer maturities might be critical to ensure a project's financial viability.

The stylised example in the appendix shows how liquidity constraints can affect the term structure of credit risk in project finance. In particular, we have assumed that a syndicate of lenders represents the principal source of financing for a project, which has no recourse to the sponsor for cash but depends primarily on its own cash flows for servicing its amortising debt. Then shortening the maturity of the loan implies larger debt repayments due in the early stages of the project. This might, ceteris paribus, exacerbate the project company's liquidity constraints, thus increasing the risk of default. This suggests, therefore, that a standard upward-sloping relationship between maturity and credit risk might not apply to project finance.

2.2.2 Sequential resolution of risks over project advancement stages

While the so-called "security package" often provides lenders with partial guarantees from sponsors and other third parties, the main sources of repayment for project finance loans remain the project assets and cash flows. As a consequence, project lenders usually exercise a much more active control and supervision over the project's advancement than would traditional corporate lenders. The latter would rely more closely on the overall strength of the obligor's consolidated balance sheet, its history and projections, usually synthesised by credit ratings. Project lenders are on the other hand, much more exposed to the risks of the specific venture they are funding and their evolution over time.

Projects usually go through construction, setup and operation phases, each of them characterised by specific risks and risk mitigants. A large part of the risk is often due to the price volatility in the markets where the project will sell its output (eg energy prices in the case of power plants). However, practically anything else can potentially go wrong especially in the construction or the setup phases such that the project might not even become operational.

Therefore, it might be the case that extending loan maturities for any additional year after the scheduled time for the project to be completely operational might drive up ex-ante risk premia but only at a decreasing rate. This is consistent with the hypothesis of sequential resolution of uncertainty as in Wilson (1980 and 1982) and would imply a concave term structure of ex ante credit spreads in project finance (see the Appendix for more analytical details).

2.2.3 Leverage ratios

Project finance deals are usually characterised by significantly higher leverage ratios compared to other loan or bond financing structures (see Table 2 and Graph 2). Does higher leverage play a role in explaining the term structure of credit spreads for project finance?

[13] See, for example, Kleimeier and Megginson (2000).

As described in more detail in the appendix, Merton's (1974) contingent claims approach suggests that highly leveraged obligors, typical of project financing, might exhibit a hump-shaped term structure of credit spreads. This is due to the fact that a higher leverage ratio changes the degree of moneyness in the option pricing framework. The intuition is that, with very high leverage ratios, the transfer of value from debt holders to equity holders, which typically occurs as maturity (and therefore overall uncertainty) increases, will at some point come to an end. At the limit, if lenders funded almost 100% of the assets of the project, it would be nearly impossible to distinguish between the risks faced by equity holders and debt holders. In fact, to some extent project financing can be thought of as a hybrid between debt and equity.

2.2.4 Political risk insurance

As mentioned earlier, political risk is a major concern for project finance. Lenders often seek protection from political risk by obtaining explicit or implicit guarantees from multilateral development banks or export credit agencies. A number of complex structures exist to protect lenders from various types of political risk, eg expropriation, war, transfer and convertibility.

While these all represent separate sources of risk and in principle should not directly affect the term structure of credit spreads, we detect a significant correlation between longer-maturity lending and the availability of political risk guarantees in our sample in emerging countries. In other words, it appears that commercial lenders are more likely to commit to longer maturities in emerging countries under the umbrella of multilateral development banks or export credit agencies.

Once the varying degree of political risk involved in different projects is controlled for and the usually low cost of the insurance is netted out, the availability or not of a guarantee might significantly mitigate the risk perceived by lenders on longer-term exposures and therefore reduce loan spreads at the long end of the term structure. If indeed it is true that political risk guarantees are most often associated with longer maturities, then the hump-shaped term structure might simply be due to political-risk-insured long-term loans being perceived as safer than uninsured short-term loans, ceteris paribus. In the empirical analysis that follows, we will therefore analyse the relationship between spread and maturity of project finance loans both including and excluding agency guarantees, i.e. controlling for the potential interaction between the availability of political risk guarantees and the term structure of credit spreads in project finance.

3. A comparative analysis of ex ante credit spreads in the international loan and bond markets

3.1 Data

Our sample consists of individual bonds and loans extracted from the Loanware and Bondware databases compiled by Dealogic, a primary market information provider on individual syndicated credit facilities and securities. Information is available on the micro characteristics of the loans and bonds (eg amount, maturity, currency, pricing) and of the borrowers (eg name, nationality, business sector).

Additionally, we control for the macroeconomic conditions (eg solvency, liquidity, economic growth, political factors) prevailing in the country of the borrower or issuer at the time of signing of the loan or the issuing of the bond, as well as for global macroeconomic factors (such as the stance of US monetary policy). For this purpose, we use variables mainly from the IMF's *World Economic Outlook* database, the Institute of International Finance's developing country database and the OECD's *World Economic Outlook*. We linked the macroeconomic variables and the microeconomic information contained in the bonds and loans databases on the country and the date. For instance, for a bond issued by a Korean corporation in 1995, our real GDP growth variable represents Korea's real economic growth for 1995.

Assembling and linking a dataset containing all micro- and macroeconomic variables (described below) yielded 31,521 active observations. The sample covers the 1993-2001 period and includes borrowers and issuers from both industrialised and emerging countries (see Tables A1 and A2 in the Appendix).

In order to disentangle any peculiarities of project finance loans as described in previous sections, we will carry out our empirical analysis comparing three subsamples: (1) project finance loans, (2) other loans - including corporate control, capital structure,[14] general corporate purpose, property and transport finance loans - and (3) bonds.

We begin by introducing our dependent variable (Section 3.2) and will then briefly illustrate both the micro- and the macro-economic explanatory variables that enter our regressions (Section 3.3). More details on our baseline specification are contained in the appendix.

3.2 Loan and bond pricing

For loans, our dependent variable is the spread paid by the borrower over Libor, the three-month London inter-bank offered rate. For bonds, the dependent variable is the spread at launch, defined as the margin yielded by the security at issue above a comparable risk-free government security.

Both measures are admittedly imperfect proxies for the ex ante credit risk attached to international loans and bonds. In particular, the spread over Libor does not represent the full economic cost of credit, as additional pricing factors, such as commitment fees, underwriting fees, participation fees and utilisation fees are typically charged during loan syndications and indeed during the whole lifetime of the loan. Some of these fees are not directly imputable to credit risk but cover various costs involved in the arrangement of the loan transaction. Others are charged to the borrowers as a function of their creditworthiness and of the disbursement and repayment pattern of the loan. Bonds also carry fees, but they tend to be paid up front and are mostly related to issuance costs.

However, given the scarcity of secondary market prices and in the absence of a time series of balance sheet or ratings data on the borrowers[15] and of actual loan disbursement/repayment information, the spread over Libor for loans and the spread at launch for bonds have become standard pricing measures in the literature.

While admittedly far from perfect,[16] the comparability of our pricing variables across loans and bonds can be enhanced by making the following two adjustments.

First, bonds typically carry a spread over a benchmark government (eg US Treasury) security, while the benchmark in the case of loans priced off Libor is a three-month interbank rate. As such, the difference between the two benchmarks represents that between unsecured short-term bank risk (typically Aa) and a risk-free government rate. This difference averaged 45 basis points and had a standard deviation of 21 basis points during our sample period. Following the approach of Thomas and Wang (2004), we adjust for the risk difference of the bond and loan benchmarks by adding to the Libor spread of the loans the difference between the three-month Libor and the three-month US Treasury bill at the time when the loans were granted.

Second, as loans are priced over a three month rate while bonds tend to be priced off longer-term benchmarks, we will include as additional control in our regressions the slope of the US Treasury yield curve (calculated, following Thomas and Wang (2004), as the difference between the five-year and the

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[14] Corporate control loans would typically include M&A loans, while capital structure loans would comprise facilities signed for restructuring purposes. The list of base purpose codes included in the various loan purpose groupings is shown in the Appendix.

[15] One also has to remember that the repayment probability of a project finance loan is only indirectly related to the creditworthiness of the project sponsors. As mentioned earlier, limited or non-recourse financing makes the project's assets and cash flows the primary source of loan repayment. In other words, the corporate backing for project finance facilities is very different from that for corporate finance loans or bonds. Ignoring this distinction might be misleading.

[16] In particular, we are aware that most bonds are fixed rate while loans are priced over a floating base rate. Furthermore, bonds and loans might have quite different covenants. In Section 3.5.6 of the robustness checks, we re-estimate our baseline regressions including dummies that attempt to control for these differences. These results confirm the main conclusions of our analysis.
We should also point out that in this study we benchmark our analysis of project finance against both bonds and loans used for purposes other than project financing. It is interesting to note that our results in Section 3.4.1 regarding the term structure of credit spreads are actually quite similar for both our bond and our loan benchmarks. This suggests that what matters for the term structure is not any differences in covenants or fixed vs. floating rates between loans and bonds, but rather the peculiar features of project finance that distinguish this asset class not only from bonds but also from all other types of syndicated loans.

three-month constant maturity US Treasury yields at the time of the signing of the loan or the issuing of the bond - see below).

3.3 Risk factors

3.3.1 Microeconomic explanatory variables

Our microeconomic explanatory variables pertain to the maturity and size of bonds or loans, the existence of risk mitigants and any specific characteristics of the business sector of the borrower.

Maturity indicates the lifetime of the loan or the bond, expressed in years. As discussed above, there are several reasons why the relationship between spreads and maturity might be non-linear in the case of project finance; therefore we will include several linear and non-linear forms of this explanatory variable in the model, also interacting it with dummies indicating the availability of third-party guarantees.

We also controlled for *loan and bond size*. To the extent that more creditworthy borrowers are able to arrange larger loans or bond issues, one would expect a negative relationship between pricing and loan or bond size (Eichengreen and Mody (1997,1998), Kleimeier and Megginson (2000)).

We computed dummies to indicate the presence of *risk mitigants*, such as *collateral* or *guarantees.* In order to single out the impact on credit spreads of political risk insurance, we distinguish between guarantees extended by multilateral development institutions or bilateral export credit agencies, and those offered by other third parties.[17] Kleimeier and Megginson (2000) report that while third-party guarantees reduce the spread on most syndicated loans, the effect of collateralisable assets depends on the type of credit. In the literature, the findings about the effects of risk mitigants on debt pricing are mixed (Smith (1980), Bester (1985), Besanko and Thakor (1987), Smith and Warner (1979), Berger and Udell (1990)). We also control for the presence of *an implicit guarantee arising from ownership*: this can be the case if the borrower is the subsidiary of a multinational corporation, even in the absence of an explicit pledge from the owner.

We calculated dummies to identify 10 *borrower business groups* that we might expect to have different risk characteristics and therefore to incur different pricing: construction and property, financial services (banks), financial services (non-banks), high-tech industries, infrastructure-related industries, services provided to the population, services provided by the state, traditional industry, transportation, and utilities firms. This classification is obtained grouping the 188 borrower business sectors in Loanware as described in the Appendix.

Finally, for loans only, we include as explanatory variables the *number of banks providing funds in the syndicate*, and a dummy for *bilateral loans* (with only one lending bank). This is done in order to assess the extent to which risk is being shared among many institutions as opposed to the case where the syndicate is small and the terms of the loan reflect more the special relationship of the borrower with the lender.

3.3.2 Macroeconomic explanatory variables

The pricing of loans and bonds might be significantly affected by several sources of macroeconomic risk and political risk as well as global trends in investors' risk aversion. We therefore control also for a

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[17] While governmental or multilateral agencies (eg IFC, EBRD, ADB, IDB) typically offer political risk guarantees, other guarantors instead provide cover against the general business risks that might lead to non-repayment. Political risk guarantees can either take the form of an explicit pledge or insurance, or can also be implicit. The explicit guarantee is a formal insurance contract against specific political risk events (transfer and convertibility, expropriation, host government changing regulation, war, etc). The "implicit guarantee" works as follows. The financing is typically divided into tranches, one of which is underwritten by the agency. The borrower cannot default on any tranche without defaulting on the agency tranche as well. The agency represents a G10 government or development bank with a recognised preferred creditor status. Defaulting on the agency has additional political and financial costs that the host country would not want to incur since agencies are usually lenders of last resort for host countries in financial distress. The list of all governmental and multilateral agencies considered for defining our agency guarantee variable is provided in the Appendix. For more details on the use and availability of political risk insurance or multilateral agency guarantees in general, see IIF (1995, 1997).

number of macroeconomic factors pertaining to the country of the borrower (real GDP growth, inflation, investment to GDP, credit to GDP, current account balance to GDP, and debt service to exports)[18] and for structural risks relating to the corruption of the political system (using the corruption index provided by Transparency International[19]). Finally, we also include in our pricing regressions the yield on three-year US Treasury bills, the slope of the US Treasury yield curve and the JPMorgan Emerging Market Sovereign Bond Index. [20]

The inclusion of the *slope of the US Treasury yield curve* (obtained as the difference between the five-year and the three-month constant maturity US Treasury yields) is motivated by two reasons. First, it corrects for the fact that bond and loan spreads might be measured over base rates of different maturities (see the discussion in section 3.2), and, second, it controls for varying inflation expectations, which might have a differential impact on the pricing of fixed vs. floating rate debt. Finally, the *JPMorgan Emerging Market Sovereign Bond Index* is a proxy for general investor sentiment towards emerging country risk. We expect this variable to be positively related with spreads, as borrowers might be penalised with higher loan and bond spreads when there is general adverse market sentiment towards emerging markets.

3.4 Results

3.4.1 Non-project finance bonds and loans

Table 3 models (1a) and (2a) report regression results when we estimate our baseline specification for our sample of non-project finance bonds and loans, respectively.

A linear positive relationship between spread and maturity appears strongly significant in both samples, in line with the intuition that lenders should get a higher remuneration for being exposed to risk for a longer period of time. We find a negative coefficient on loan and bond size, consistent with Kleimeier and Megginson (2000) and Eichengreen and Mody (1997,1998). This could suggest that more creditworthy borrowers are granted larger loans and/or that there are significant economies of scale for banks to arrange larger syndicated credit facilities. Ceteris paribus, bonds and loans in the banking and transportation sectors carry a discount whereas high-tech borrowers are perceived as being more risky.

Among the macroeconomic variables, the coefficients on the ratio of domestic credit and investment to GDP can be explained in the framework of Sachs (1984) and Edwards (1983), i.e. high investment can be perceived as a risk-mitigating signal of future improvement in the economy whereas an excessive level of domestic credit to GDP appears to be more conducive to fears about credit booms (the quantitative effect of this latter variable on the spread - albeit significant – is, however, relatively small). A negative coefficient on the current account to GDP ratio suggests that large current account deficits are a concern for investors and are therefore associated with higher spreads. Furthermore, a steeper US Treasury yield curve is associated with lower spreads, whereas - as expected - lenders appear to charge a premium on borrowers from countries characterised by higher political risk (as proxied by the corruption index).

Bonds and loans appear to behave differently, however, as to the relative terms of credit granted to borrowers in the construction and property or traditional industry sectors as well as regards the importance of third-party guarantees. The positive large coefficient on agency guarantees for bonds is

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[18] These indicators measure the pace of economic growth in the country of the borrower and its sustainability. They proxy for the country's domestic and external solvency and might therefore explain the component of loan and bond spreads due to country or macroeconomic risk. See Altunbaş and Gadanecz (2003) for more motivation and discussion of the expected signs of individual regressors with additional references to the literature.

[19] Transparency International assigns a score of 0 to 10 to most countries of the world, standardising a number of corruption surveys conducted by public and private institutions and consisting of questions about issues such as bribing of public officials, kickbacks in public procurement, or embezzlement of public funds. For a description of the methodology, and the full dataset, please refer to www.transparency.org.

[20] The general level of world interest rates has been found to be an important determinant of the pricing of international bonds and loans by a number of recent studies including, for example, Eichengreen and Mody (1998) and Kamin and Von Kleist (1999).

somewhat misleading as very few observations in our sample of bonds do in fact benefit from such guarantees. Taken together with the small coefficient on other guarantees, these results suggest that third-party guarantees do not play a major role for bonds. On the contrary, the effect of third-party guarantees in mitigating both commercial and non-commercial sources of risk appears more significant for loans (and even more important for project finance loans, as we will see later).

Finally, consistent with our priors, higher inflation is associated with higher bond spreads while bond issuers from the non-bank financial sector as well as utility and state sectors enjoy a relatively cheaper cost of borrowing. Loans to borrowers in the population services sector appear relatively more expensive. In accordance with previous findings in the literature, secured loans actually carry a premium, as the need for collateral is associated with higher perceived risk, whereas bilateral loans are relatively cheaper, due to more favourable conditions obtained by borrowers through their relationship with their core banks. Moreover, we find that higher real GDP growth is perceived to enhance the creditworthiness of borrowers from a given country and is therefore associated with lower loan spreads.

Our main conclusion so far is that, when all other micro and macro risk factors are controlled for, a linear positive relationship between spread and maturity shows up very significant for both bonds and loans used for purposes other than project financing.

This result is robust across bonds of different ratings. The component-plus-residual plots[21] shown in Graph 3 depict the partial relationship between bond spreads and maturities, once all other micro- and macroeconomic risk components included in our baseline regression have been controlled for. Graphs 4a and 4b refer to the subsamples of investment grade and speculative grade bonds, respectively.

Much of the literature on the term structure of bond spreads had found this relationship to be positive for investment grade but generally negative or hump-shaped for speculative grade bonds (see Section 2). Graphs 4a and 4b instead suggest that, using a multivariate regression framework, the difference in the shape of the term structures of investment grade versus speculative grade bonds largely disappears.[22]

Using the results obtained in this section as benchmarks, we will now turn our attention to analysing in the next paragraph the term structure of credit spreads for project finance loans.

3.4.2 Project finance loans

Table 3 model (3a) reports our baseline regression results for the sample of project finance loans. Some of the coefficient estimates show the same sign as described in the analysis of other loans and bonds. We will therefore concentrate here only on the results that appear to differentiate project finance loans from other loans and bonds.

Kleimeier and Megginson (2000) had noted how project finance loans are generally characterised by larger syndicates compared to other syndicated credits. Our positive significant coefficient on the dummy for bilateral deals confirms our prior that sharing the uncertainty connected with project finance among a higher number of participants has an important risk-mitigating effect. The same paper had also found a negative and significant relationship between loan spreads and size for most syndicated credits, except for project finance loans. Our results instead suggest that also in project finance, ceteris paribus, larger loans are generally cheaper.

Our main results, however, focus on the roles of maturity and political risk insurance.

Kleimeier and Megginson (2000) find a significant positive relationship between spread and maturity for all syndicated loans except for project finance. In the subsample of project finance loans, the same coefficient turns up instead significant and negative. Ceteris paribus, longer-maturity project finance loans appear to be associated with lower credit spreads. The authors characterise this finding as "surprising" and leave it largely as an open question.

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[21] For more details on component-plus-residual plots, see Larson and McCleary (1972).

[22] This complements recent findings for example in Helwege and Turner (1999).

Controlling for a broader set of other micro and macro risk factors, we find no significant linear relationship between spread and maturity for project finance loans.

The economic rationales described in Section 2 lead us to verify the hypothesis of a hump-shaped term structure of credit spreads for project finance. We therefore augment our baseline multiple regression with non-linear maturity components.

Table 4 model (6a) reports regression results where maturity enters both on its own and in logarithmic form. We have also attempted alternative quadratic or square-root specifications (not reported). Regardless of which non-linear functional form is chosen, a robust hump-shaped relationship between spread and maturity is found and plotted in Graph 5a. Moreover, likelihood ratio tests indicate that the augmented non-linear regressions significantly improve the fit of our baseline linear regression in Table 3 model (3a).

Table 5 shows how a hump-shaped term structure of credit spreads applies to both our industrialised and emerging countries subsamples. For emerging country borrowers, we have included the JPMorgan Emerging Market Sovereign Bond Index as additional regressor. As expected, we find it significantly and positively related to the risk premium required by investors in these markets. Results in Table 5 also suggest that while corruption is not a significant problem in industrialised countries, lenders financing projects in emerging markets systematically charge a higher premium on borrowers from countries characterised by a more corrupt political system.[23]

A comparison with our benchmark results in the previous section suggests that a hump-shaped term structure of credit spreads constitutes a specific feature of credit risk in project finance. In Table 4 models (4a) and (5a) we augment our baseline regression results for non-project finance bonds and loans, respectively, including the natural logarithm of maturity as an additional regressor to test for the presence of any non-linear effects of maturity on spreads. The logarithmic term turns out insignificant for loans and only enters the bond regression if we consider bonds with maturity beyond 20 years.[24] Also, due to the limited role of guarantees for bonds noted earlier, we find interaction terms of maturity with third-party guarantees to be insignificant in both linear and non-linear specifications.

On the other hand, our results suggest that third-party guarantees - and in particular political risk guarantees - play an important role in project finance especially in emerging countries. On our full sample, agency guarantees appear on average to significantly reduce the spread attached to project finance deals by about 50 basis points, ceteris paribus (see Table 3 model (3a) and Table 4 model (6a)). When we re-estimate our baseline regression only on our emerging countries subsample, coefficients on the corruption index as well as on third-party guarantees are even larger in magnitude (see Table 5 model (6b)).

We also find evidence that the availability of agency guarantees effectively lengthens maturities of project finance loans especially in emerging markets.[25] In our project finance sample, the unconditional correlation between maturity and the dummy for agency guarantees is positive and significant. Moreover, the median maturity for loans with an agency guarantee increases to 12 years from a median of only 7.5 years for the whole sample of loans with and without agency guarantees.

In Table 5 model (6d) we test therefore whether the hump-shaped relationship we found between spread and maturity is robust to the inclusion of an interaction term between maturity and agency guarantees. The interaction term turns out negative and highly significant. Consistent with our hypothesis in Section 2.2.1, this suggests that the correlation between longer maturities and the

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[23] This complements the result in Esty (2003b), who finds that project finance loan spreads are higher in countries with weak creditor rights and poor legal enforcement. He also finds that, in order to seek protection against sovereign risks, project sponsors often resort to more expensive foreign bank financing, given also the scarce availability of domestic capital.

[24] The positive coefficient on the linear maturity component suggests that there is no hump in the term structure of bond spreads as found instead for project finance loans in model (6a). The term structure of bond spreads as estimated in regression (4a) can be fitted by an upward-sloping straight line with an R^2 exceeding 0.95 (i.e. it is essentially linear, as shown in Graph 3).

[25] The World Bank has recently launched a programme of partial credit guarantees that cover only against default events occurring in the later years of a loan. Providing the private sector with the incentives to lengthen the maturity of project finance loans in emerging countries has become an explicit objective of development institutions.

availability of agency guarantees does contribute to dampening the perceived risk of long-term project finance loans, thus exacerbating the hump-shaped behaviour of the term structure of credit spreads for this asset class (see the lower curve in Graph 6a). However, even controlling for the interaction with agency guarantees in Table 5 model (6d), the coefficient estimates on both the linear and the non-linear maturity regressors remain substantially unchanged. In other words, we find that the term structure of credit spreads would still be hump-shaped even in the absence of agency guarantees (see the upper curve in Graph 6a). This confirms our hypothesis that it must be due to more fundamental characteristics of project financing structures.

3.5 Robustness checks

3.5.1 Sample selection.

As described in Section 3.1 and further illustrated in the appendix, our sample includes loans and bonds signed/issued by borrowers in both industrialized and emerging countries over the years 1993-2001. Given that the second half of the 1990s was a time of considerable financial turmoil, in particular for emerging countries, we cannot rule out that a flight to quality might have left many borrowers in these countries credit-rationed. As a result, the probability of observing project finance deals with relevant pricing information (i.e. our sample selection) might not be random but rather somewhat determined by the same risk characteristics that enter our pricing regressions.

Therefore, in order to ensure that our estimates are unbiased, we resort to a generalised Tobit model, following Heckman (1979). We perform maximum likelihood estimations on our emerging countries sample of our linear (3a) and non-linear (6a) model specifications simultaneously with a probit selection equation where the probability of signing a loan is expressed as a function of either macroeconomic variables or year dummies. To construct the dependent binary variable for this selection equation, we first consider all those emerging countries whose borrowers were able to obtain loans at least once during the period under review between 1993 and 2001. We subsequently allocate ones and zeros, respectively, to each year-country pair according to whether the country was present on the market in that year or not.

The system can then be expressed as follows:

loan spread	=	α MICRO + β MACRO + ε	(9)
Probability of observing loan from borrower of a given country in a given year	=	α (MACRO variables or YEAR dummies) + ε	(10)

Results are reported in Table 6. We identify several macroeconomic factors as significant determinants of borrower market access. Among these, real economic growth, investment to GDP, domestic credit to GDP, inflation and the EMBI sovereign bond index influence market access in the expected way. In other words, market access becomes more difficult when macroeconomic conditions deteriorate, as shown by these indicators. Somewhat counterintuitively, the ratio of debt service to exports is found to increase the likelihood of market access (a similar result is reported by Eichengreen and Mody (2000)).

Our specifications using year dummies consistently indicate that 1997 and 2000 were the years where emerging country borrowers enjoyed better access to the syndicated loan market. In all model specifications, except (3b), the Wald tests lead us to reject the hypothesis of equations (9) and (10) above being independent, pointing to the presence of selection bias. However, despite loan pricing and borrower market access being simultaneously determined, re-estimates of the models controlling for this selection bias do not appear to yield results fundamentally different from the ordinary least squares estimation (see Table 6). In particular, our conclusions about the hump-shaped term structure of credit spreads appear robust to sample selection bias.

3.5.2. Endogeneity

We subsequently wish to check whether our results are affected by the potential endogeneity of maturity. Indeed, one could conceive the case of riskier borrowers only being able to obtain shorter-maturity loans or to issue shorter-maturity bonds. In other words, lenders' maturity and spread decisions may be co-determined. To perform this robustness check, we follow the approach of Davidson and MacKinnon (1993). We first run one or several auxiliary regression(s) where maturity, and any of its non-linear transformations (logarithmic, square, square root), are expressed as a function of all exogenous micro- and macroeconomic variables listed in the baseline regression featured in the Appendix. We save the residuals from these regressions, which we then add to the list of independent variables in order to re-estimate our main regression models (1a)–(6a).

More precisely, for each of the pricing regressions reported in Tables 3 and 4 of the form:

$$\text{spread} = \alpha 1 \text{ MICRO} + \beta 1 \text{ MACRO} + \varepsilon 1 \qquad (11)$$

we first run one or several of the following auxiliary regression(s), where maturity and its non-linear transformation(s) are pulled out from the MICRO vector of equation (11) and appear now on the left-hand side, as shown below:

$$\text{maturity} = \alpha 2 \text{ MICRO} + \beta 2 \text{ MACRO} + \varepsilon 2 \qquad (12)$$

$$\ln(\text{maturity}) = \alpha 3 \text{ MICRO} + \beta 3 \text{ MACRO} + \varepsilon 3 \qquad (13)$$

We then re-estimate equation (11), adding the residuals obtained from models (12) and (13) as required by the version of model (11) that we are checking for endogeneity. We always include ε2 corresponding to the residual from the maturity regression itself, plus, if necessary, ε3 as required by the presence of any non-linear transformation of maturity on the right-hand side of equation (11).

Tables 7 and 8 report results from re-estimating regressions in Tables 3 and 4 to control for endogeneity bias. Residuals ε2 and ε3 are never significant. In other words, we find no evidence of endogeneity bias in our estimates. This seems to suggest that even if loan spreads and market access (as a zero-one dummy – see the previous section) appear co-determined, the same does not necessarily hold for loan spreads and maturities.

Finally, while standard error estimates are biased due to the inclusion of estimated residuals, our augmented regressions reported in Tables 7 and 8 provide consistent estimates of the α and β coefficients above, confirming our main results reported in Tables 3 and 4.

3.5.3 Loan amortisation schedules

While bonds usually have bullet repayments, a significant share of loans and especially project finance loans are instead characterised by amortising repayment schedules. As an additional robustness check, we therefore entertain the possibility that differing loan-amortising paths might affect our results about the impact of maturity on credit spreads. The Loanware dataset has only incomplete information on loan-amortising schedules. It does suggest, however, that while project finance loans have mostly amortising repayment patterns, non-project finance syndicated loans within our sample period are almost as likely to be amortising as bullets.[26]

Table 9 reports regression results when we add to our baseline linear and non-linear specifications for project finance loans an additional dummy equal to 1 for loans with bullet repayment and 0 for amortizing loans. We also include its interactions with maturity to check if the term structure of credit spreads for bullet loans has a significantly different level or slope than for amortising loans.

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[26] If amortising repayment schedules were to be driving the hump-shaped term structure of credit risk, then non-project finance syndicated loans would have to show a similar pattern.

Neither dummy is significant. Results suggest that the shape of the term structure is not significantly affected by differing repayment patterns. Overall, models (3e) and (6h) in Table 9 confirm our coefficient estimates in our baseline models (3a) and (6a).

3.5.4 Bond ratings

The results reported in models (1a) and (4a) estimated on bonds appear robust to the inclusion of bond ratings. The re-estimations of these models, reported in Table 10 as models (1c) and (4c), have been performed by augmenting the initial specifications with dummy variables corresponding to various ratings classes as defined by Standard & Poor’s, from AAA down to D. In these alternative specifications, the coefficients on the micro- and macroeconomic variables are largely consistent with the original versions. As expected, the ratings dummies corresponding to higher credit quality are significantly associated with lower spreads (with the magnitude of the discount diminishing as one goes down the ratings scale), whereas some of the worse ratings classes, CCC and D, are found to be characterised by wider spreads.

3.5.5 Project finance loans with maturity up to 20 years

As an additional robustness check, we wish to test the sensitivity of our results to the choice of the range of maturities analysed. So far we have estimated our term structure over all maturities for which we have observations in our dataset. One could argue, however, that the number of observations available decreases at longer maturities and this might affect our precision in estimating the long end of the term structure.

Therefore, we have re-estimated our project finance regressions (3a), (6a), (6b) and (6c) on the subsample of project finance loans with maturities up to and including 20 years. The results, reported in Tables 11 and 12 as models (3f), (6i), (6j) and (6k) respectively, are largely consistent with the original versions. Graph 5b plots the full sample partial relationship between spread and maturity, controlling for all other micro and macro risk factors. The non-linear relationship estimated in model (6i) for the sample up to 20-year maturity is represented by the dotted line, which sits exactly on top of the original curve estimated in model (6a) for the full maturity range. We conclude that the hump-shaped term structure of credit spreads we have identified for project finance loans is robust to restricting the range of maturities analysed.

3.5.6 Loan covenants and floating rate bonds

Further robustness checks were carried out to test whether the presence of any covenants, and the type of interest rate (fixed versus floating), had an effect on the term structure of credit spreads.

With regard to covenants, it is common for the pricing of loans to include clauses that tie the spread to various corporate events, such as changes in ratings or defaults. Our baseline models (2a), (3a) and (6a) were re-estimated after adding a dummy variable controlling for the presence of such clauses and their interaction with maturity. The results reported in Table 13 show that the term structure of credit spreads is robust to the inclusion of this factor in the model. Indeed, the dummy variable indicating the existence of covenants, as well as its interaction with maturity, are generally insignificant, whereas the coefficients on the macro and micro risk factors are largely the same (in sign and in significance) as in the original specification.

While the sample used for estimation contains almost exclusively floating rate loans, nearly 80% of bonds have a fixed rate. We wish to test whether pricing is significantly different for fixed versus floating rate instruments, in particular as regards the term structure. Therefore, we re-estimate models (1a), (1c), (4a) and (4c) including a dummy variable indicating that the bond is floating rate and an interaction of that dummy variable with maturity. These new results are reported in Table 14. There appears to be a significant discount in the pricing of floating rate bonds (lower intercept), possibly reflecting the insurance, which the floating base offers against future interest rate fluctuations affecting either the asset or the liability side of the lender’s balance sheet. The interaction term between floating rate and maturity is, on the other hand, significant and positive in models (1d) and (4d) and not significant in models (1e) and (4e), confirming that pricing off a floating base is no reason per se to expect a less steep or even hump-shaped term structure of credit spreads. Overall, these results suggest that ignoring loan covenants and differences between fixed and floating rates does not bias the main conclusions of our analysis.

4. Policy Implications

The results of this paper have several policy implications. We will first introduce in Section 4.1 the debate on whether or not political risk guarantees should be recognised as effective risk mitigation in computing regulatory capital requirements. Our results indicate that political risk and political risk guarantees have a significant impact on ex ante credit spreads of project finance loans in emerging countries.

In Section 4.2, we will focus more explicitly on the problem of aligning the term structure of regulatory capital requirements with the term structure of credit risk in project finance. In particular, our results suggest that a linear maturity adjustment to regulatory capital - albeit a good approximation for bonds and other loans - might be less applicable to project finance exposures. The assumption of a linear term structure of capital requirements, with slope inversely related to the probability of default, could in fact open a window for regulatory capital arbitrage and lead to potential distortions in bank lending decisions. We include a numerical example in the appendix in order to further illustrate this point.

4.1 The risk-mitigating role of multilateral development banks and export credit agencies in project finance.

The project finance industry suggests that regulatory capital relief should be granted to transactions cofinanced by export credit agencies or by multilateral development banks (like so-called B-loans[27]). As illustrated in the appendix, most of these financing structures do not provide lenders with a legal guarantee against non-repayment due to specific risks. Hence, they would not fall into the general category of formal credit guarantees providing risk mitigation. However, even if no formal credit guarantee is provided to lenders, the de facto preferred creditor status of multilateral development banks is perceived to protect loans from the risk of non-repayment due to "political risks", such as transfer and convertibility, war and expropriation.[28]

The treatment of either explicit or implicit political risk guarantees within a regulatory capital framework is no easy task. In fact, such guarantees generally extend to the full amount of the loan, but only against very specific non-commercial sources of risk. Therefore, granting full capital relief to the entire guaranteed exposure appears inappropriate: on the other hand, it is not obvious how to distinguish between covered and uncovered portions of any given exposure. In particular for implicit guarantees, it is even harder to verify the nature and extent of risk mitigation in the absence of any formal contractual arrangement spelling out the terms of the credit protection. Moreover, the available evidence on actual default rates for project finance loans is still rather limited. [29]

This paper has shown how political risk and political risk guarantees are a distinctive feature of project finance, especially in emerging countries. While non-project finance bonds and loans seldom make use of this type of risk mitigation, we have found that political risk and political risk insurance (including co-financing structures like B-loans) have a significant impact on credit spreads for project finance loans. The availability of such explicit or implicit forms of risk mitigation appears to reduce the spread by almost one third on average (i.e. by about 50 bp from an average spread in our sample of project

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[27] B-loans are syndicated loans where a small "A tranche" is financed directly with funds from the multilateral development bank, while the "B tranche" is participated by private banks and investors. The multilateral development bank, however, is the lender of record for the full amount of the loan, i.e. a default by the borrower on any tranche constitutes a default to the multilateral development bank.

[28] Multilateral development banks point out that their special relationship with host governments, which are also their shareholders, facilitates the resolution of any problems that might arise in the regulatory or policy environment and put a project in danger. It can also ensure collateral protection in countries where the legal system is not very reliable. Additionally, before being approved for co-financing, projects are subject to detailed appraisals and thorough evaluation by the multilateral development banks, including several financial and non-financial aspects. For more details on B-loan structures and political risk mitigation, see the *Comments on the New Basel Capital Accord* by the International Finance Corporation (World Bank), published at: http://www.bis.org/bcbs/ca/intfincor.pdf

[29] In response to the requests for feedback by the Basel Committee on Banking Supervision, several leading commercial banks have recently joined forces in a consortium to investigate the ex post default performance of their combined project finance portfolios. They have asked Standard & Poor's Risk Solutions, the consulting arm of the rating agency, to analyse the historical probability of default and loss-given-default across their project finance exposures. This represents the most significant effort so far in producing a comprehensive default database for project finance loans.

finance loans of about 150 bp - see our estimates of the coefficient on agency guarantees reported, for example, in Table 4 model (6a)). Although consistent with previous findings in Sorge (2003), these results need to be viewed with some caution, as they are based on ex ante measures of credit risk, given the scarce availability for project finance loans of secondary prices or ex-post default or loss rates.

In the next section, we will show how the results of this paper can be useful in the design of a methodology that takes into account the role of political risk mitigation (and more generally any form of risk mitigation), while at the same time aligning capital requirements with the actual term structure of credit risk in project finance.

4.2 Aligning the maturity adjustment to capital requirements with the actual term structure of credit risk in project finance

In the context of the current debate about risk-sensitive capital requirements, the role of maturity as a specific component of credit risk can be explicitly incorporated into a general regulatory capital formula as follows:

$$\text{Risk-sensitive capital requirement} = f\,(PD, LGD, EAD, M) \qquad (14)$$

where: PD is the 1-year probability of default, LGD is the loss-given-default, EAD is the exposure at default and M indicates remaining maturity.

Two key assumptions are generally made about the impact of maturity per se on risk-sensitive capital requirements:

1) ceteris paribus, credit risk can be viewed as increasing proportionally with maturity, therefore the maturity adjustment to risk-sensitive capital requirements is assumed to be linear (within a range of maturities up to n years) ;[30]

2) ceteris paribus, the maturity adjustment on any given exposure is steeper, the lower its probability of default (within an intermediate range of PDs).[31]

The results of this paper cast some doubt on the applicability of the two assumptions above in the case of project finance.

Regarding assumption (1), our analysis of the term structure of credit spreads across loans and bonds shows that a linear maturity adjustment to capital requirements - albeit a fair approximation for bonds and other loans - might be less applicable to project finance exposures (see the estimated hump-shaped relationship plotted in Graph 5a).

As for assumption (2), results plotted in Graph 6a would suggest against having a steeper maturity adjustment for safer project finance loans (for example those benefiting from political risk guarantees, as shown in the graph).

[30] Within a mark to market approach to credit risk, a credit deterioration short of default is presumed to reduce a loan's value, generating an implicit credit loss. Within this framework, the sensitivity of a loan's end-of-horizon value to a credit quality deterioration short of default is dependent on its maturity: for a given downgrade short of default, longer-maturity loans will tend to display a greater change in end-of-horizon value. As a consequence, maturity tends to have a substantial influence on economic capital with longer-maturity loans requiring greater economic capital, other things equal. In general, for a low range of maturities up to n years, a linear relationship between maturity and credit risk is viewed as a reasonable approximation (for eg n=5 in the Basel II framework).

[31] The rationale for this can be best understood by conceptually decomposing the total risk on any given exposure into two parts: first, the probability that the obligor defaults; and second, the risk that the latter probability might increase over time (credit quality migration). The first component is incorporated in the PD estimate. The second component, on the other hand, is what the maturity adjustment is supposed to cover for. Intuitively, credits that are already rated very low (= very high PD) have little room to be further downgraded short of default (little room for PD to increase and asset value to decrease). For low-risk assets, instead, most of the risk is made up by the second component since their PDs are very close to 0. This is basically the rationale for requiring a steeper maturity adjustment for lower-risk exposures.

A graphical representation might help to further illustrate this point. Assume the upper curve in Graph 6b represents the actual term structure of credit risk for a project finance loan at origination without agency guarantees (as estimated in Table 5 model (6d) and plotted in Graph 6a). Given the loan's risk characteristics and in particular its probability of default, let the schedule BOB be the corresponding term structure of regulatory capital requirements based on equation (14). Both are plotted as a function of maturity T.[32]

Consider now instead project finance loans with agency guarantees. As we had already seen in Graph 6a, the term structure of credit risk shifts down as indicated by the lower curve in Graph 6b. How will the term structure of capital requirements change? In the framework of equation (14), recognising any form of risk mitigation (including agency guarantees) by reducing the probability of default has two effects. On the one hand, the whole schedule BOB shifts down to B'O'B'. On the other hand, given assumption (2), over a range of PDs relevant for project financing, the segment O'B' will be steeper than OB. In other words, while the actual term structure of credit risk flattens down, the slope of the maturity adjustment to regulatory capital will instead increase. As shown by the arrows in Graph 6b, this might lead to a greater misalignment between the term structure of regulatory capital requirements and the actual profile of the underlying risk.

We include a numerical example in the appendix in order to further illustrate this point. In particular, based on our regression results, we show how a simple reduction of the default probability in equation (14) might not be an effective way to recognise the risk mitigation potential of political risk insurance. In fact, the resulting steeper maturity adjustment (represented by the segment O'B' in Graph 6b) could ultimately offset[33] the benefit of the political risk mitigation offered by multilateral development banks and export credit agencies on long-term co-financed facilities (like B-loans). Ceteris paribus, regulatory capital arbitrage could induce banks to reallocate their portfolio away from long-term project finance commitments into more short-term exposures which might not be necessarily safer.

5. Directions for further research

This paper lends itself to a number of natural extensions. First, using ex-post default data, future research might shed more light on the applicability of assumption (2) in the previous section across different asset classes. Our regression results indicate that - controlling for common micro and macro risk factors - the sensitivity of ex ante credit risk to increasing maturity appears actually lower for investment grade bonds compared to speculative grade bonds (we estimate a coefficient on maturity for investment grade bonds that is less than half of the corresponding coefficient estimated for speculative grade bonds).

Second, future research might investigate whether, in the computation of capital requirements for certain asset classes, it might be useful to take into consideration additional relevant parameters such as original maturity (and not only remaining maturity). In the framework of the stylised regulatory capital formula shown in equation (14), two loans with the same remaining maturity, one of which just signed and the other already outstanding for several years, would, ceteris paribus, be assigned the same maturity adjustment. Conversely, loans with the same remaining maturity might exhibit fundamentally different residual risk profiles depending on how long they have been outstanding. In fact, this might especially be the case for project finance loans. For the reasons discussed in Section 2 and in particular due to the sequential resolution of uncertainty, a project finance loan that has been outstanding and performing for some time might show little remaining risk: at that point in the life of the loan, differences in residual maturity might have only a relatively small effect on its credit risk. As a consequence, we expect the residual term structure of credit risk to become, ceteris paribus, less

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[32] We do not intend here to compare directly ex-ante spreads based on original maturity with ex-post capital requirements based on remaining maturity. What we compare, instead, are proxies for the ex ante term structures of credit risk attached to a project finance loan by the market and by a regulatory capital formula like (14) at origination (i.e. when original maturity = remaining maturity).

[33] From the perspective of lenders maximising risk-adjusted return on capital (see the numerical example in the Appendix for more details).

steep for loans that have been outstanding for several years.[34] Therefore, it might be worth to evaluate the possibility of introducing years outstanding (and therefore original maturity) as an additional parameter in the regulatory capital formula.[35]

Finally, it remains to be explored to what extent any of the results of this paper might extend to other forms of cash flow based finance, besides project finance, such as loans whose repayment is dependent on the receipt of specific cash flow streams from commercial real estate.

6. Conclusion

This paper analyses within a multiple regression framework the relationship between ex ante spread and maturity for a large cross section of international loans and bonds.

We show that, for bonds and loans used for purposes other than project financing, the term structure of credit spreads can reasonably be approximated by a linear function of maturity, once other relevant micro and macro risk factors have been controlled for. In particular, using a multivariate regression framework, we find that the difference in the shape of the term structures of investment grade versus speculative grade bonds (as noted by much of the literature on the term structure of bond spreads) largely disappears.[36]

For project finance, on the other hand, we show that a linear model is not able to capture a statistically significant relationship between spread and maturity. Employing a number of alternative functional forms, we conclude that the term structure of credit spreads in project finance is hump-shaped. This result applies to both our industrialised and our emerging market sample of borrowers and appears robust to a number of sensitivity tests regarding sample selection, endogeneity, maturity range, repayment schedules, bond ratings, loan covenants and differences between fixed versus floating rate instruments.

We emphasise a number of key features of project finance structures that might underlie this finding. In particular, we illustrate the mechanisms by which higher leverage, short-term liquidity concerns due to the exclusive reliance on project cash flows as well as the sequential resolution of risks along various project advancement stages might all alleviate the perceived risk of longer-maturity project finance loans.

This paper also confirms that political risk and political risk guarantees play an important role in project finance, especially in emerging countries. While other loans and bonds seldom make use of this type of risk mitigation, we find that political risk and political risk insurance (including co-financing structures like B-loans) have a significant impact on credit spreads for project finance loans. The availability of such explicit or implicit forms of risk mitigation appears to reduce ex ante credit spreads by almost one third on average (i.e. by about 50 bp from an average spread in our sample of project finance loans of about 150 bp). In emerging markets, we also find evidence that commercial lenders are more likely to commit for longer maturities if they obtain political risk guarantees from multilateral development banks or export credit agencies. In fact, the explicit or implicit cover provided by bilateral or multilateral agencies appears to dampen the perceived risk of longer-maturity loans, thus exacerbating the hump-shaped behaviour of the term structure of credit spreads for this asset class. However, controlling for the interaction between maturity and agency guarantees, we find that the term structure of credit spreads would still be hump-shaped even in the absence of agency guarantees. This confirms our hypothesis that it must be due to more fundamental characteristics of project financing structures.

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[34] Recall the simple equation: $\text{CUMPROB}(a, m) = 1 - \prod_{t=1}^{m}\left[1 - \text{MARGPROB}(a+t)\right]$, which yields the probability that a credit exposure of vintage “a” (i.e. “a” years after origination) defaults before the remaining maturity of “m” years. Cumulating a decreasing path of marginal default probabilities over the moving time span between “a” and “m” yields cumulative default curves that become significantly less steep for credits that have been outstanding for several years (higher “a”) as opposed to new issues.

[35] Or simply tabulating values for the maturity adjustment in a double-entry matrix based on both remaining maturity and years elapsed since origination.

[36] This complements recent findings for example in Helwege and Turner (1999).

As additional results of our analysis, we find recent patterns observed in the pricing and volumes of project finance loans to be very sensitive to: a) macro-indicators of the host country creditworthiness as well as of the cyclical stance of the world economy; b) the risk-sharing function of larger syndicates; and c) the preferential treatment granted to borrowers in the financial services or state-owned sectors.

Finally, this paper offers a number of suggestions for bank regulators on how to effectively align capital requirements with the term structure of credit risk in project finance. In particular, our results suggest that a linear maturity adjustment - albeit a good approximation for bonds and other loans in general - might be less applicable to project finance exposures. We illustrate through a numerical example how the assumption of a linear term structure of capital requirements, with slope inversely related to the probability of default, could in fact open a window for regulatory capital arbitrage and lead to potential distortions in bank lending decisions. We acknowledge, however, that introducing different maturity adjustments for different asset classes, while improving the risk sensitivity of capital requirements, might at the same time add to the complexity of their implementation.

As more project finance data become available (including secondary prices, leverage ratios and ex post default or loss rates), further analysis is needed to test any of the hypotheses of Section 2.2 more directly, as well as to verify the applicability of assumption (2) in section 4.2 across different credit markets. Finally, future research might investigate whether, in the computation of capital requirements for certain asset classes, it might be useful to take into consideration additional relevant parameters such as original maturity (and not only remaining maturity).

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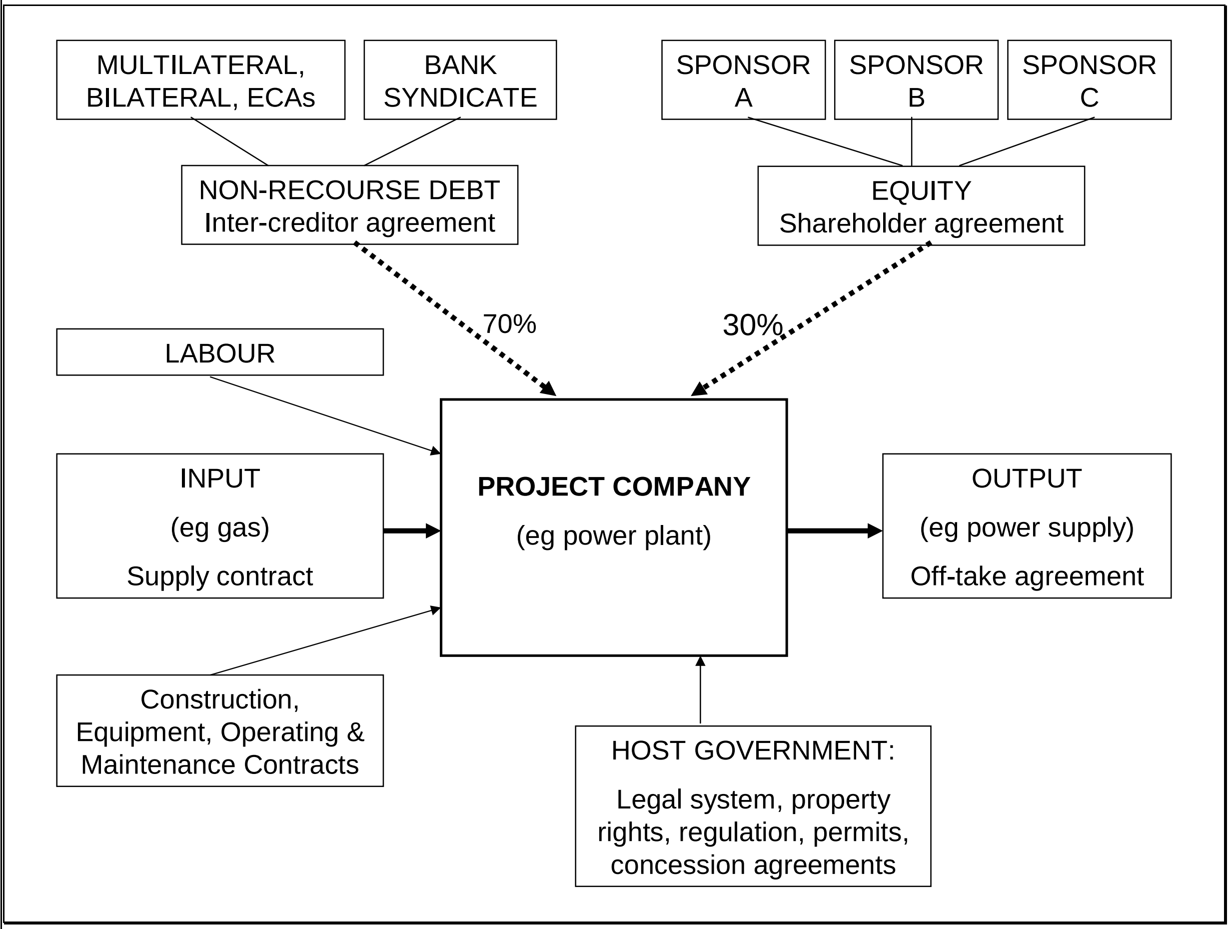
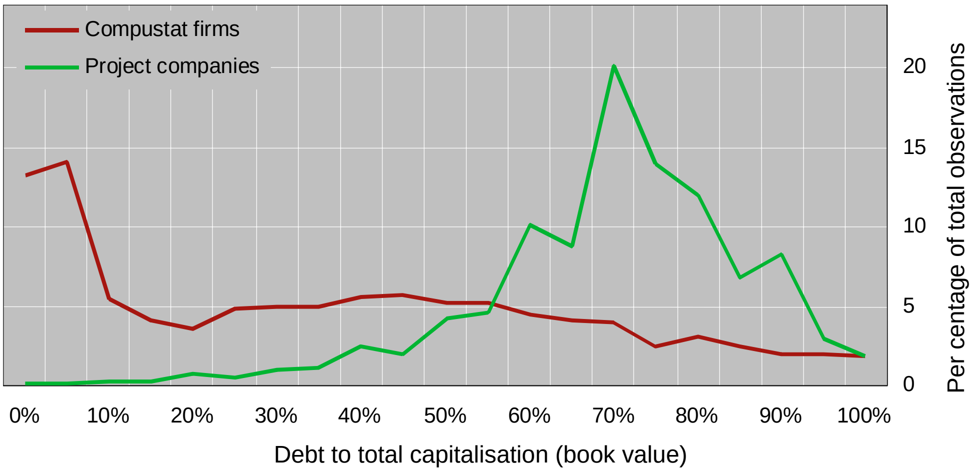
GRAPHS AND TABLES

Graph 1 - Typical project structure



Source: Adapted from Esty (2003a).

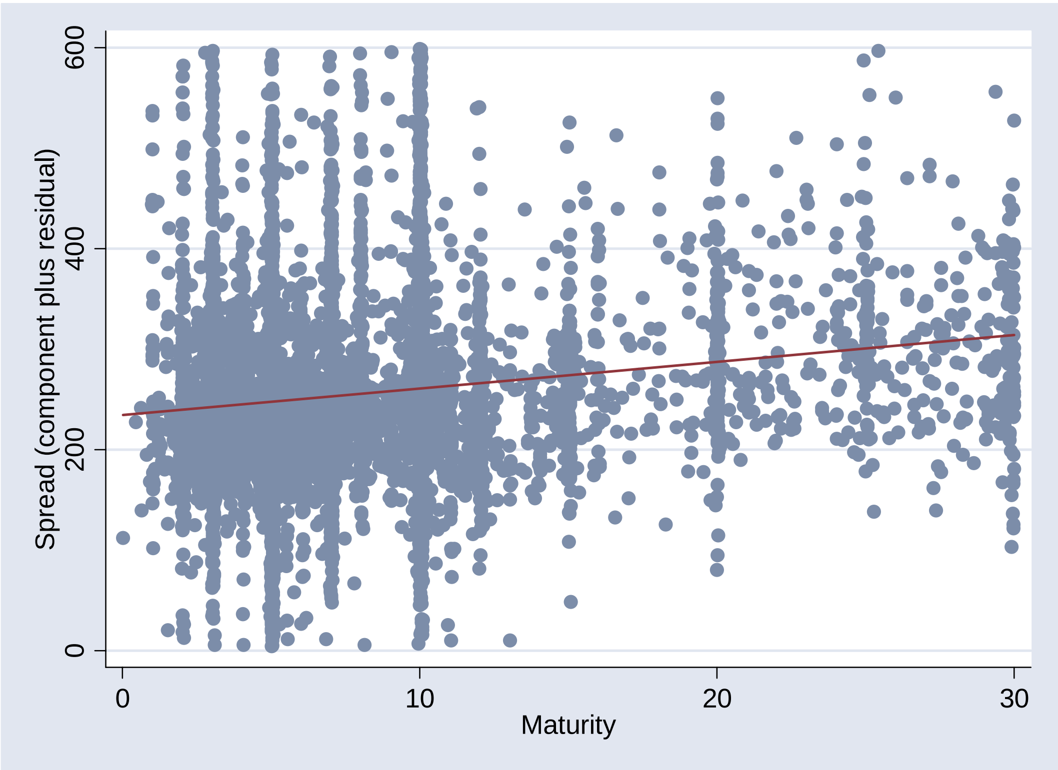
Graph 2 - Debt to total capitalisation ratios: project companies vs corporations[1]



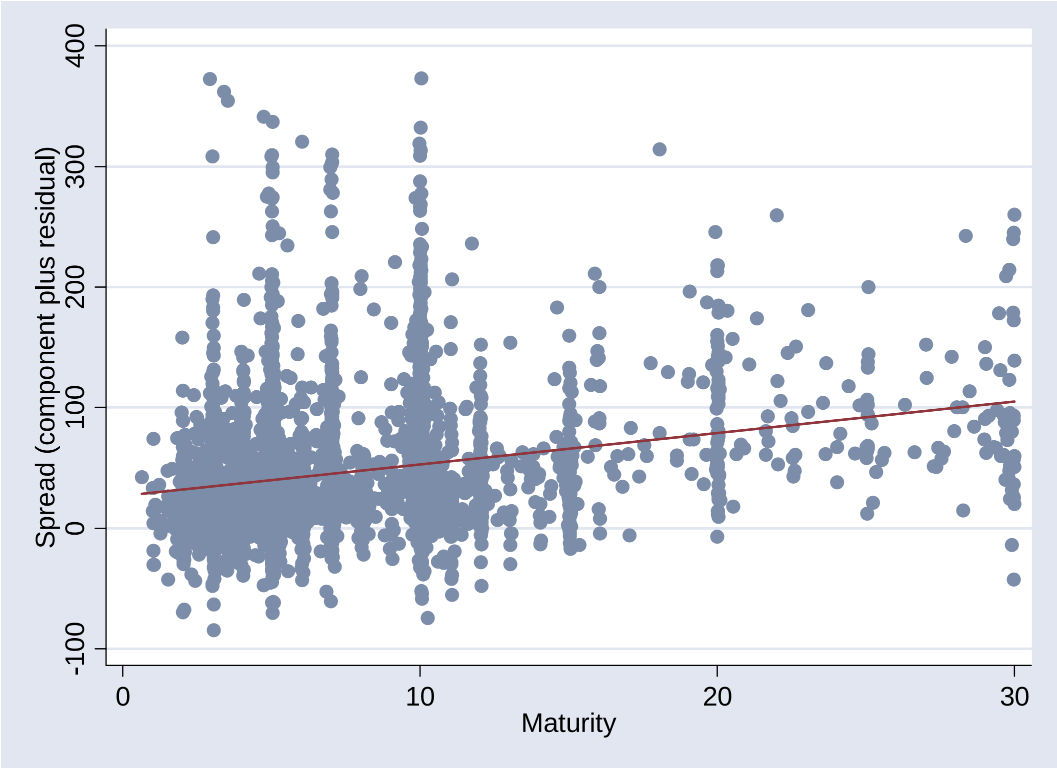
[1] Corporations are 1,799 Compustat firms with total assets between $100 million and $2 billion in 2001. Project companies are listed in Thomson Financial Securities Data Project Finance Database (TFSD), financed between 1990 and 2001 (1,050 companies).

Source: Adapted from Esty (2003a).

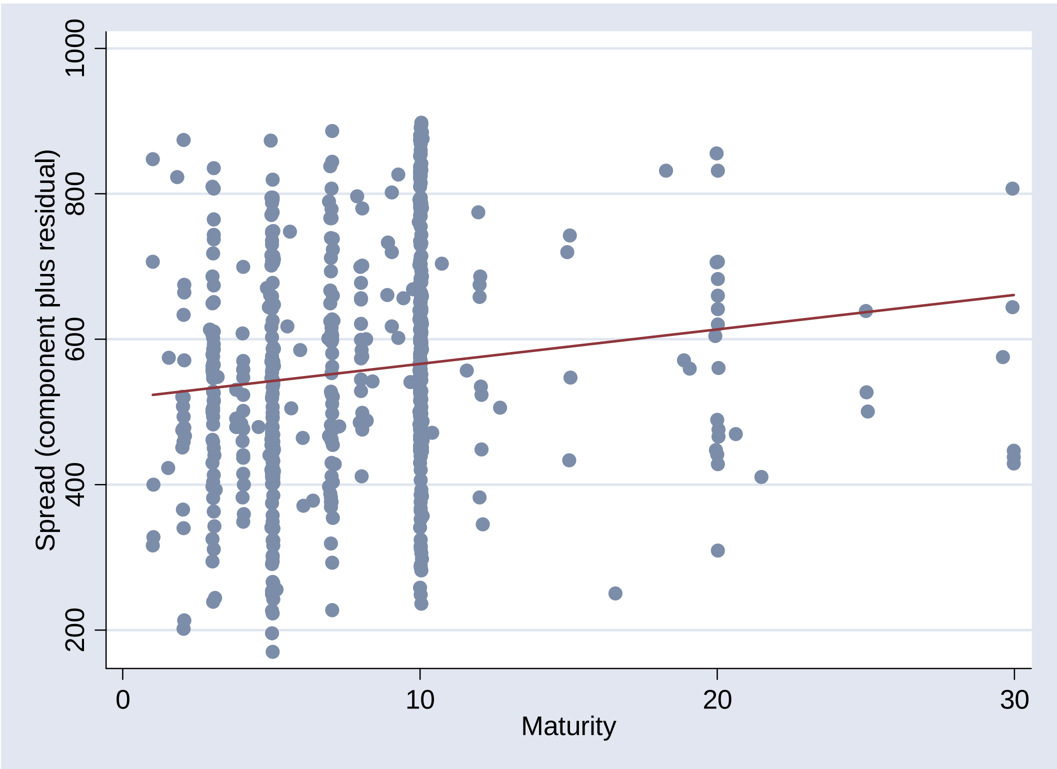
Graph 3 - Term structure of bond spreads



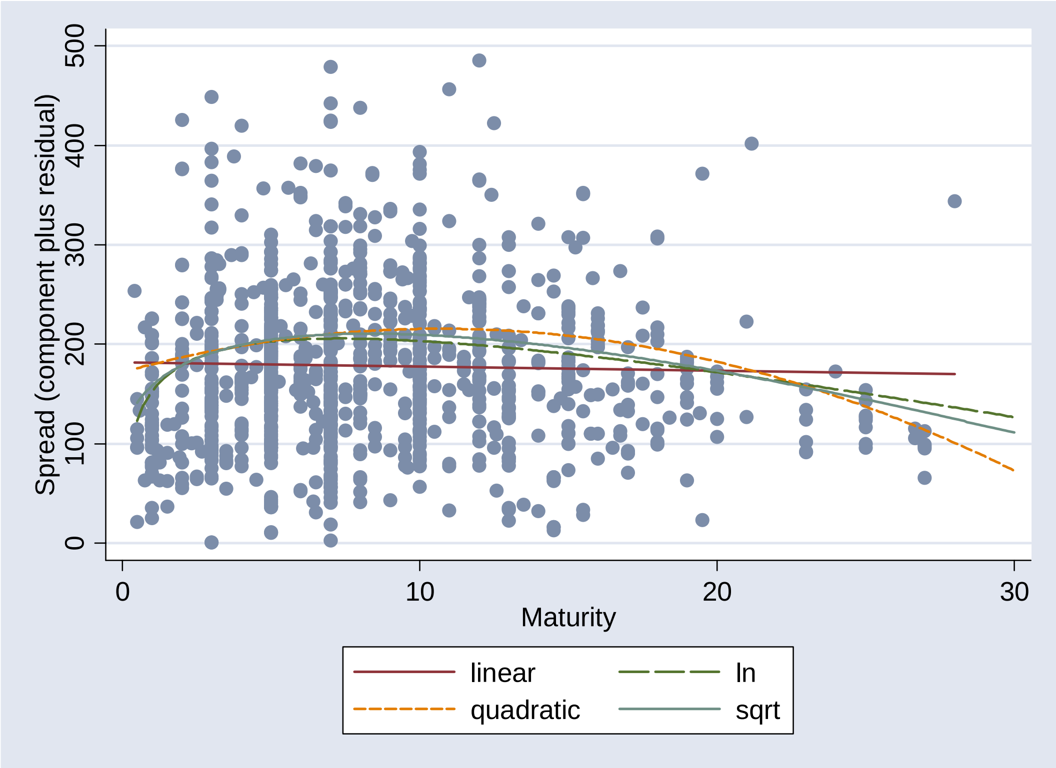
Graph 4a - Term structure of bond spreads - investment grade bonds



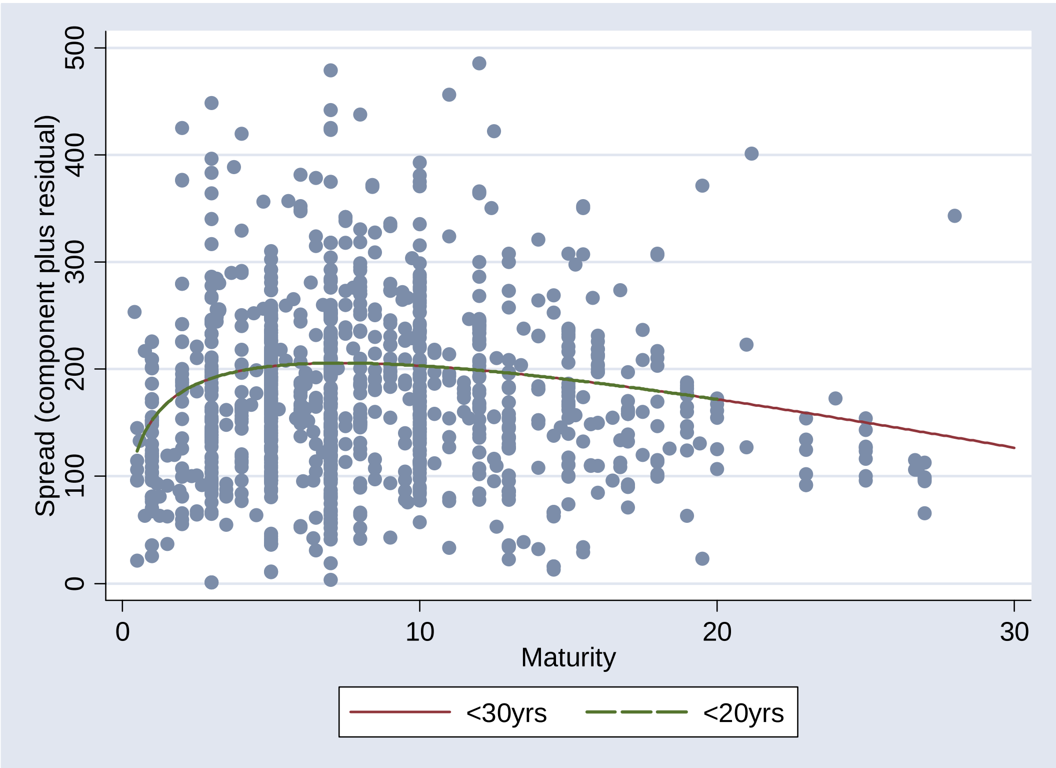
Graph 4b - Term structure of bond spreads - speculative grade bonds



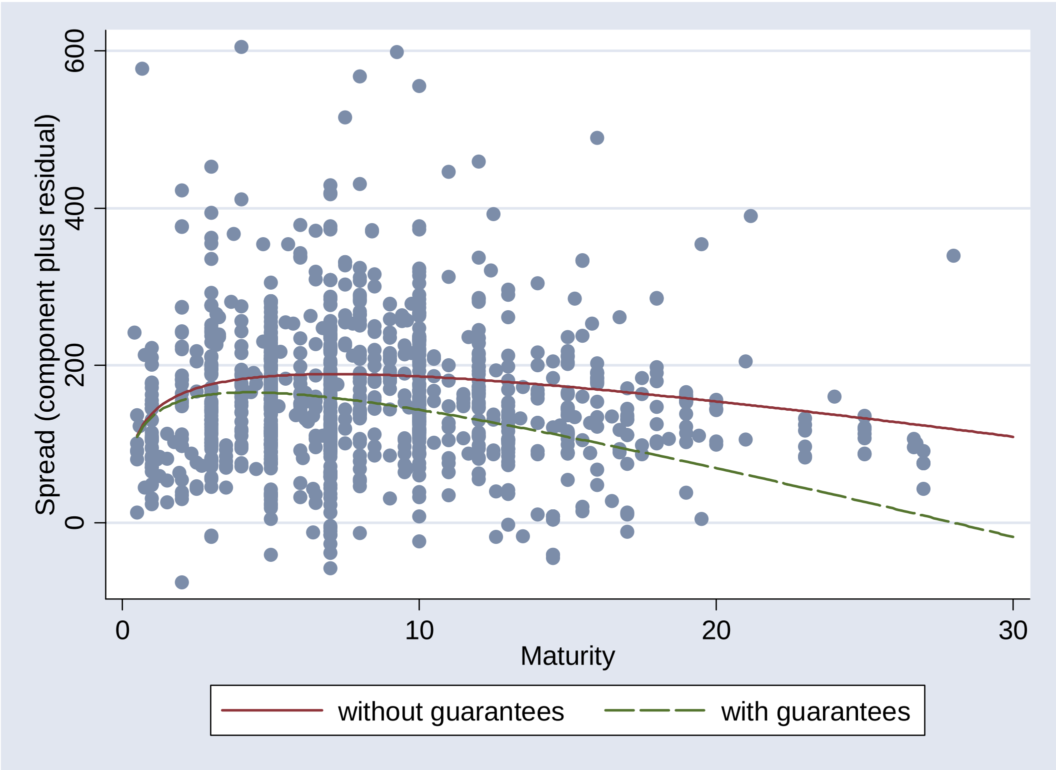
Graph 5a - The Term structure of credit spreads in project finance



Graph 5b -Term structure of credit spreads in project finance
(fitting maturities up to 20 yrs)



Graph 6a – Term structure of credit spreads for project finance loans with and without agency guarantees



Graph 6b – Ex ante term structure of capital requirements

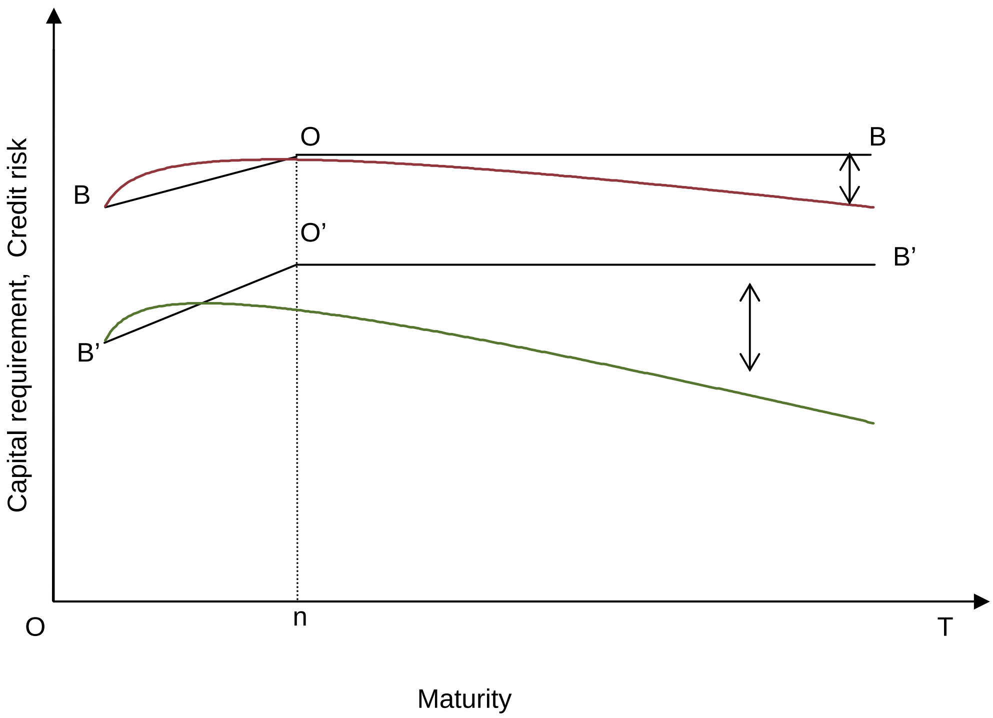


Table 1 - Average yield spreads on US corporate bonds by sector, rating and maturity
[Source: Duffie and Singleton (2001).]

		Short maturity	Medium maturity	Long maturity
All	AA	0.69	0.73	0.90
	A	0.95	1.03	1.17
	BAA	1.42	1.49	1.82
Financial	AA	0.75	0.83	1.06
	A	0.58	1.19	1.28
	BAA	1.51	1.58	1.45
Industrial	AA	0.56	0.71	0.87
	A	0.73	0.96	1.16
	BAA	1.53	1.49	1.86
Utility	AA	0.55	0.58	0.55
	A	0.76	0.80	1.01
	BAA	1.12	1.30	1.57

Table 2 - Leverage ratios in project finance

[Source: World Bank]

Sector	Mean (in percent)
Transport	77.86
Waste/water	75.00
Power	73.07
Roads	63.07
Telecoms	61.25

Table 3 - Results: linear regressions

Dependent variable: spread	Bonds (1a)	Other loans (2a)	Project finance loans (3a)
Maturity	3.232	6.853	-0.365
	(13.63)	(20.07)	(-0.63)
Log size	-12.596	-26.085	-4.896
	(-10.27)	(-39.98)	(-2.06)
Agency guarantee	101.992	-47.942	-48.228
	(2.40)	(-3.29)	(-4.45)
Other guarantee	-5.205	-23.102	-39.416
	(-1.54)	(-6.68)	(-5.15)
Subsidiary	20.043		
	(6.45)		
Secured		50.657	35.137
		(25.93)	(5.24)
Bilateral deal		-30.503	27.846
		(-9.28)	(2.15)
Traditional industry	-56.544	29.629	
	(-6.66)	(10.91)	
Transport	-88.076	-11.736	24.994
	(-7.32)	(-2.71)	(1.72)
Utilities	-83.136		-18.048
	(-8.27)		(-2.92)
High-tech industry	62.907	33.781	
	(7.23)	(11.83)	
Construction and property	-39.324	35.657	
	(-3.10)	(8.96)	
Financial services (banks)	-123.003	-13.875	-64.311
	(-16.26)	(-3.44)	(-3.53)
Financial services (non-banks)	-121.050		
	(-15.56)		
State	-93.410		-43.311
	(-11.51)		(-2.83)
Population-related services		41.671	
		(14.66)	
Investment/GDP	-6.313	-6.088	-3.650
	(-16.24)	(-22.53)	(-6.86)
Bank credit/GDP	0.001	0.0004	
	(5.41)	(3.67)	
Real GDP growth		-3.103	1.264
		(-5.82)	(1.13)
Inflation	0.338		0.494
	(6.09)		(3.57)
Current account/GDP	-3.681	-5.273	-2.564
	(-8.94)	(-14.87)	(-3.37)
Corruption index	45.451	13.344	14.426
	(45.46)	(16.36)	(7.95)
Slope of US Treasury yield curve	-8.625	-9.890	
	(-6.49)	(-11.01)	
Constant	694.887	434.239	326.494
	(43.78)	(43.98)	(14.18)
Number of observations	8595	12393	1025
Adjusted R^2	0.378	0.329	0.216

Table 4 - Results: Non-linear regressions

Dependent variable: spread	Bonds (4a)	Other loans (5a)	Project finance loans (6a)
Maturity	0.622	7.066	-6.405
	(1.10)	(9.78)	(-5.12)
Log maturity	24.855	-0.761	47.015
	(5.10)	(-0.34)	(5.43)
Log size	-13.538	-26.094	-6.513
	(-10.93)	(-39.96)	(-2.72)
Agency guarantee	109.163	-48.147	-49.361
	(2.57)	(-3.30)	(-4.61)
Other guarantee	-5.066	-23.123	-38.983
	(-1.50)	(-6.68)	(-5.14)
Subsidiary	20.120		
	(6.49)		
Secured		50.664	35.886
		(25.93)	(5.36)
Bilateral deal		-30.584	25.554
		(-9.28)	(2.00)
Traditional industry	-118.641	29.701	
	(-18.32)	(10.90)	
Transport	-150.496	-11.866	27.197
	(-14.08)	(-2.73)	(1.89)
Utilities	-144.845		-16.346
	(-17.30)		(-2.67)
High-tech industry		33.832	
		(11.83)	
Infrastructure	-151.322		
	(-5.32)		
Construction and property	-101.653	35.738	
	(-8.91)	(8.96)	
Financial services (banks)	-183.859	-13.905	-52.595
	(-35.64)	(-3.44)	(-3.48)
Financial services (non-banks)	-181.898		
	(-32.75)		
State	-153.719		-44.576
	(-25.87)		(-2.94)
Population-related services	-61.288	41.723	
	(-6.77)	(14.65)	
Investment/GDP	-6.425	-6.091	-3.890
	(-16.51)	(-22.52)	(-7.31)
Bank credit/GDP	0.001	0.000	0.000
	(5.39)	(3.67)	(1.69)
Real GDP growth		-3.102	1.405
		(-5.81)	(1.27)
Inflation	0.335		0.484
	(6.04)		(3.54)
Current account/GDP	-3.906	-5.273	-2.837
	(-9.47)	(-14.87)	(-3.71)
Corruption index	45.263	13.339	13.312
	(45.41)	(16.35)	(7.35)
Slope of US Treasury yield curve	-8.676	-9.892	
	(-6.54)	(-11.00)	
Constant	735.827	434.262	292.268
	(46.59)	(43.98)	(12.19)
Number of observations	8595	12393	1018
Adjusted R^2	0.381	0.329	0.238

Table 5 - Results: project finance in industrialised vs emerging countries

Dependent variable: spread	Project finance loans		
	Emerging (6b)	Industrialised (6c)	All countries (6d)
Maturity	-5.039 (-2.45)	-5.258 (-2.97)	-6.312 (-5.01)
Log maturity	33.184 (2.80)	52.426 (3.88)	45.133 (5.19)
Log size	-7.118 (-2.19)	-9.815 (-2.88)	-6.507 (-2.75)
Agency guarantee	-58.324 (-5.45)	11.872 (0.14)	
Maturity x agency guarantee			-4.246 (-4.80)
Other guarantee	-47.551 (-5.80)	-4.275 (-0.23)	-39.186 (-5.09)
Subsidiary	21.612 (1.88)	-18.028 (-1.17)	
Secured	32.235 (4.24)	74.413 (5.21)	38.587 (5.55)
Bilateral deal	34.289 (2.45)	-37.543 (-1.28)	26.377 (2.06)
Transport	46.125 (2.40)	3.798 (0.17)	33.709 (2.37)
High-tech industry	-31.078 (-3.12)	33.281 (2.30)	0.967 (0.13)
Financial services (banks)	-64.193 (-3.49)	-104.604 (-1.23)	-54.544 (-3.04)
Financial services (non-banks)	-33.111 (-2.30)	90.135 (2.80)	-4.765 (-0.37)
Utilities	-6.969 (-0.79)	-57.258 (-4.95)	
State	-44.105 (-2.81)	-164.736 (-1.43)	-30.207 (-1.99)
Investment/GDP	-3.377 (-7.34)	-3.890 (-1.44)	-3.123 (-7.45)
Bank credit/GDP	0.000 (1.64)	-0.913 (-3.59)	
Current account/GDP	-1.944 (-2.38)	-4.140 (-1.78)	-2.505 (-3.28)
Inflation	0.419 (3.28)	8.267 (1.28)	0.422 (3.20)
Corruption index	19.340 (5.27)	-0.792 (-0.13)	12.330 (6.92)
EMBI index	0.056 (4.71)		
Constant	96.937 (2.71)	227.527 (3.25)	145.365 (7.93)
Number of observations	687	331	1023
Adjusted R^2	0.3369	0.259	0.228

Table 6 - Robustness checks: sample selection

Dependent variable: spread	Project finance loans			
	(3b)	(3c)	(6e)	(6f)
Maturity	0.689	1.341	-4.301	-2.773
	(0.67)	(1.44)	(-1.92)	(-1.46)
Log maturity			32.599	27.440
			(2.37)	(2.61)
Log size	-7.266	-6.026	-7.421	-6910
	(-2.01)	(-2.02)	(-2.08)	(-2.41).
Agency guarantee	-60.029	-52.875	-60.355	-47.588
	(-4.69)	(-4.74)	(-5.03)	(-4.30)
Other guarantee	-48.979	-36.128	-46.809	-34.472
	(-6.75)	(-4.93)	(-6.83)	(-4.59)
Bilateral deal	28.149	17.870	25.289	14.045
	(1.61)	(1.13)	(1.44)	(0.89)
Utility	8.768	13.592	10.776	11.637
	(1.20)	(2.05)	(1.53)	(1.73)
Transport	52.677	36.917	50.649	33.276
	(1.66)	(1.47)	(1.70)	(1.32)
Secured	28.527	35.934	27.298	46.144
	(3.59)	(4.60)	(3.49)	(5.59)
Financial services (banks)	-57.190	-38.481	-52.262	-39.186
	(-5.34)	(-3.99)	(-4.71)	(-3.97)
Inflation	0.389	0.317	0.351	0.325
	(2.23)	(1.95)	(2.03)	(2.11)
Real GDP growth	-0.539	-0.887	-0.497	-0.740
	(-0.40)	(-0.81)	(-0.39)	(-0.73)
Current account/GDP	-1.422	-0.486	-1.526	-0.327
	(-1.74)	(-0.67)	(-2.03)	(-0.44)
Investment/GDP	-3.017	-1.993	-3.007	-2.409
	(-5.02)	(-3.23)	(-4.99)	(-3.58)
Bank credit/GDP			0.000	0.000
			(1.46)	(0.69)
State	-32.561	-21.265	-29.208	-19.912
	(-2.58)	(-2.08)	(-2.38)	(-2.12)
Corruption index	14.840	13.562	15.496	10.727
	(4.14)	(4.15)	(4.47)	(2.99)
Constant	320.871	229.700	295.139	202.618
	(12.17)	(7.13)	(10.27)	(5.36)

Table 6 (continued) - Robustness checks: sample selection

Probability of observing bond or loan	Project finance loans			
	(3b)	(3c)	(6e)	(6f)
Inflation	-0.002		-0.005	
	(-5.68)		(-5.36)	
Real GDP growth	0.026			
	(3.17)			
Debt service/exports	0.013			
	(6.40)			
Investment/GDP	0.097			
	(17.17)			
Bank credit/GDP	-0.000		-0.000	
	(-2.07)		(-2.73)	
EMBI index	-0.0000		-0.001	
	-0.27		(-3.85)	
Constant	-0.862		2.264	
	(-3.97)		(24.40)	
1993		1.511		0.114
		(4.58)		(1.18)
1994		1.475		0.110
		(4.46)		(1.08)
1995		1.696		
		(4.89)		
1996		1.701		0.292
		(4.96)		(2.84)
1997		2.124		0.806
		(6.02)		(7.64)
1998		1.959		0.696
		(6.26)		(6.25)
1999		1.992		0.734
		(6.40)		(7.53)
2000		2.211		0.928
		(7.03)		(10.25)
Constant		-1.151		0.138
		(-3.64)		(2.29)
Lambda	13.569	102.183	73.144	108.621
	(14.18)	(7.66)	(7.23)	(8.46)
Wald test PI-value	0.3449	0.000	0.000	0.000
Log likelihood	-4,108.743	-4,505.12	-4,122.705	-4,530.08

Table 7 - Robustness checks: endogeneity

Dependent variable: spread	Bonds (1b)	Other loans (2b)	Project finance loans (3d)
Maturity	1.101	5.157	4.783
	(0.62)	(0.98)	(0.90)
Maturity residuals	2.192	1.704	-5.204
	(1.22)	(0.32)	(-0.97)
Log size	-13.250	-26.211	-5.437
	(-10.51)	(-34.55)	(-2.25)
Agency guarantee	93.712	-41.190	-64.062
	(2.17)	(-1.62)	(-3.12)
Other guarantee	-6.432	-22.944	-32.574
	(-1.88)	(-6.57)	(-3.26)
Subsidiary	17.049		
	(4.07)		
Secured		51.415	29.796
		(16.89)	(3.32)
Bilateral deal		-32.871	14.514
		(-4.11)	(0.73)
Traditional industry	-58.473	30.975	
	(-6.70)	(6.24)	
Transport	-86.821	-7.871	16.262
	(-7.05)	(-0.62)	(0.93)
Utilities	-80.704		-28.684
	(-7.79)		(-2.18)
High-tech industry	65.608	35.100	
	(7.35)	(7.07)	
Construction and property	-38.000	35.787	
	(-2.91)	(8.95)	
Financial services (banks)	-128.196	-15.151	-74.331
	(-15.56)	(-2.69)	(-3.59)
Financial services (non-banks)	-120.338		
	(-14.73)		
State	-95.216		-57.107
	(-11.42)		(-2.69)
Population-related services		43.526	
		(6.82)	
Investment/GDP	-6.365	-5.947	-4.069
	(-15.05)	(-11.62)	(-6.65)
Bank credit/GDP	0.001	0.000	
	(5.31)	(3.68)	
Real GDP growth		-3.136	2.947
		(-5.78)	(1.93)
Inflation	0.336		0.559
	(6.01)		(3.64)
Current account/GDP	-3.773	-5.083	-2.928
	(-8.89)	(-7.43)	(-3.70)
Corruption index	44.719	12.914	15.953
	(37.54)	(8.30)	(6.13)
Slope of US Treasury yield curve	-8.715	-9.696	
	(-6.40)	(-8.83)	
Constant	714.544	435.367	302.494
	(32.68)	(41.59)	(9.43)
Number of observations	8,403	12,393	1,016
Adjusted R^2	0.382	0.329	0.212

Table 8 - Robustness checks: endogeneity

Dependent variable: spread	Bonds (4b)	Other loans (5b)	Project finance loans (6g)
Maturity	12.520	34.965	0.770
	(1.24)	(2.08)	(0.12)
Log maturity	-103.144	-102.680	69.304
	(-1.17)	(-1.86)	(1.23)
Maturity residuals	-11.888	-27.941	-7.372
	(-1.18)	(-1.66)	(-1.13)
Log maturity residuals	128.504	102.096	-21.528
	(1.45)	(1.85)	(-0.38)
Log size	-7.594	-27.306	-8.014
	(-1.60)	(-28.45)	(-2.75)
Agency guarantee	73.217	-72.852	-81.578
	(1.56)	(-2.38)	(-3.43)
Other guarantee	-0.740	-25.968	-26.213
	(-0.14)	(-6.74)	(-2.44)
Subsidiary	14.464		
	(3.27)		
Secured		51.978	25.649
		(16.99)	(2.81)
Bilateral deal		-42.404	-2.591
		(-4.46)	(-0.11)
Traditional industry	-129.894	39.976	
	(-16.51)	(5.77)	
Transport	-156.669	-27.650	10.318
	(-13.58)	(-1.67)	(0.58)
Utilities	-153.492		-36.942
	(-14.57)		(-2.59)
Infrastructure	-175.964		
	(-5.62)		
High-tech industry		41.192	
		(6.93)	
Construction and property	-110.733	46.763	
	(-8.44)	(6.57)	
Financial services (banks)	-207.809	-18.277	-81.445
	(-17.55)	(-3.11)	(-3.83)
Financial services (non-banks)	-198.197		
	(-16.90)		
State	-173.249		-72.220
	(-14.87)		(-3.10)
Population-related services	-68.200	49.505	
	(-7.28)	(6.93)	
Investment/GDP	-5.644	-6.555	-4.668
	(-7.71)	(-10.80)	(-6.51)
Bank credit/GDP	0.001	0.000	0.000
	(5.49)	(4.08)	(1.87)
Real GDP growth		-2.933	4.098
		(-5.30)	(2.40)
Inflation	0.348		0.606
	(6.14)		(3.95)
Current account/GDP	-3.183	-5.146	-3.436
	(-4.45)	(-7.51)	(-4.04)
Corruption index	42.163	12.407	15.956
	(21.83)	(7.85)	(6.21)
Slope of US Treasury yield curve	-7.294	-8.868	
	(-4.27)	(-7.49)	
Constant	829.047	437.222	230.098
	(16.25)	(41.58)	(3.36)
Number of observations	8,403	12,393	1,016
F test PI value	0.1232	0.171	0.237
Adjusted R^2	0.385	0.329	0.235

Table 9 - Robustness checks: loan amortisation schedules

Dependent variable: spread	Project finance loans (3e)	(6h)
Maturity	-0.405	-9.281
	(-0.20)	(-1.98)
Log maturity		55.541
		(2.03)
Bullet repayment	0.792	-18.222
	(0.04)	(-0.63)
Maturity x bullet repayment	0.264	1.386
	(0.12)	(0.28)
Log maturity x bullet repayment		6.383
		(0.21)
Agency guarantee	-52.205	-55.561
	(-3.19)	(-3.43)
Other guarantee	-31.853	-27.360
	(-2.69)	(-2.33)
Log size	-2.744	-3.597
	(-0.79)	(-1.03)
Bilateral deal	32.455	26.304
	(-1.27)	(1.04)
Utility	-31.330	-27.192
	(-3.36)	(-2.94)
Transport industry	25.367	28.204
	(1.09)	(1.23)
Secured	19.760	19.335
	(1.82)	(1.78)
Financial services (banks)	-53.340	-48.525
	(-2.26)	(-2.09)
Inflation	-0.018	0.039
	(-0.07)	(0.17)
Real GDP growth	-0.163	0.205
	(-0.09)	(0.12)
Current account/GDP	-2.457	-2.696
	(-2.01)	(-2.16)
Investment/GDP	-4.096	-4.529
	(-4.77)	(-5.28)
Bank credit/GDP		0.000
		(0.75)
State	-17.200	-22.066
	(-0.81)	(-1.04)
Corruption index	16.676	15.429
	(5.97)	(5.56)
Constant	365.152	335.548
	(9.41)	(7.94)
Number of observations	461	455
Adjusted R^2	0.193	0.228

Table 10 - Robustness checks: bond ratings

Dependent variable: spread	Bonds	
	(1c)	(4c)
Maturity	3.165	0.787
	(13.19)	(1.32)
Log maturity		21.586
		(4.34)
Agency guarantee	-27.338	-21.015
	(-0.73)	(-0.57)
Other guarantee	-2.630	-2.697
	(-0.82)	(-0.84)
Log size	4.044	3.418
	(3.34)	(2.81)
Subsidiary	11.131	11.184
	(3.46)	(3.48)
Traditional industry	-9.911	-35.746
	(-1.26)	(-5.91)
Slope of US Treasury yield curve	-7.761	-7.823
	(-6.24)	(-6.30)
Inflation	1.561	1.547
	(9.17)	(9.10)
Transport	-34.234	-60.104
	(-3.14)	(-6.24)
Current account/GDP	-1.319	-1.482
	(-3.48)	(-3.89)
Investment/GDP	-3.075	-3.264
	(-8.66)	(-9.12)
Bank credit/GDP	0.001	0.001
	(9.00)	(8.99)
Corruption index	11.277	11.581
	(9.84)	(10.10)
Construction and property	-28.044	-54.802
	(-2.07)	(-4.35)
Financial services (banks)	-18.431	-43.563
	(-2.58)	(-8.70)
Financial services (non-banks)	-18.042	-43.357
	(-2.40)	(-7.75)
High-tech industry	26.171	
	(3.28)	
Utilities	-17.143	-42.482
	(-1.94)	(-5.89)
State	-8.923	-34.141
	(-1.19)	(-6.24)
Infrastructure		-28.683
		(-1.20)
Population-related services		-26.157
		(-3.19)
Dummy variable for AAA rating from S&P	-326.913	-324.200
	(-31.78)	(-31.51)
AA rating	-318.811	-317.163
	(-30.74)	(-30.62)
A	-299.217	-297.658
	(-29.25)	(-29.13)
BBB	-264.102	-262.372
	(-25.59)	(-25.44)
BB	-114.009	-113.036
	(-10.27)	(-10.20)
B	-56.943	-55.662
	(-4.94)	(-4.84)
CCC	64.367	63.388
	(3.57)	(3.52)
CC	-29.077	-31.144
	(-0.36)	(-0.38)
C	-17.755	-19.244
	(-0.22)	(-0.24)
D	34.034	33.905
	(2.42)	(2.41)
Constant	480.115	491.180
	(27.94)	(28.82)
Number of observations	5,166	5,166
Adjusted R^2	0.634	0.635

Table 11 - Robustness checks: project finance loans with maturities of up to 20 years

Dependent variable: spread	Project finance loans	
	(3f)	(6i)
Maturity	0.596	-6.246
	(0.86)	(-3.90)
Log maturity		46.171
		(4.72)
Log size	-6.101	-6.635
	(-2.45)	(-2.56)
Agency guarantee	-50.773	-49.136
	(-4.56)	(-4.53)
Other guarantee	-39.310	-39.445
	(-5.11)	(-5.16)
Secured	35.180	35.993
	(5.24)	(5.35)
Bilateral deal	25.398	26.713
	(1.93)	(2.04)
Transport	22.840	28.166
	(1.54)	(1.91)
Utilities	-19.927	-15.698
	(-3.13)	(-2.46)
Financial services (banks)	-67.230	-65.547
	(-3.62)	(-3.56)
State	-45.948	-44.411
	(-2.98)	(-2.90)
Investment/GDP	-3.695	-3.867
	(-6.91)	(-7.23)
Bank credit/GDP		0.000
		(1.67)
Real GDP growth	1.378	1.436
	(1.23)	(1.29)
Inflation	0.500	0.491
	(3.61)	(3.57)
Current account/GDP	-2.553	-2.855
	(-3.34)	(-3.71)
Corruption index	13.763	13.073
	(7.51)	(7.14)
Constant	323.440	290.826
	(13.94)	(11.90)
Number of observations	998	991
Adjusted R^2	0.220	0.237

Table 12 - Robustness checks: project finance loans with maturities of up to 20 years

Dependent variable: spread	Project finance loans	
	Emerging (6j)	Industrialised (6k)
Maturity	-4.799	-4.247
	(-2.26)	(-1.74)
Log maturity	32.926	47.980
	(2.71)	(3.04)
Log size	-7.911	-10.191
	(-2.39)	(-2.79)
Agency guarantee	-56.792	9.886
	(-5.20)	(0.12)
Other guarantee	-50.769	-4.434
	(-6.08)	(-0.24)
Subsidiary	20.992	-19.307
	(1.79)	(-1.24)
Secured	28.968	76.091
	(3.76)	(5.24)
Bilateral deal	35.067	-35.676
	(2.46)	(-1.13)
Transport	44.071	2.973
	(2.26)	(0.13)
Utilities	-2.953	-59.363
	(-0.33)	(-4.55)
High-tech industry	-28.614	33.064
	(-2.83)	(2.20)
Financial services (banks)	-73.364	-110.859
	(-3.88)	(-1.29)
Financial services (non-banks)	-36.176	89.523
	(-2.48)	(2.74)
State sector	-44.665	-171.005
	(-2.80)	(-1.47)
Investment/GDP	-3.228	-4.110
	(-6.93)	(-1.50)
Bank credit/GDP	0.000	-0.949
	(1.59)	(-3.65)
Inflation	0.428	8.575
	(3.30)	(1.31)
Current account/GDP	-1.648	-3.935
	(-1.99)	(-1.66)
Corruption index	17.556	-3.573
	(4.74)	(-0.57)
Constant	327.033	215.024
	(11.50)	(2.95)
Number of observations	686	305
Adjusted R^2	0.316	0.262

Table 13 - Robustness checks: loan covenants

Dependent variable: spread	(2c)	(3g)	(3h)	(6l)
Maturity	7.999	-0.065	-0.180	-6.345
	(19.06)	(-0.10)	(-0.27)	(-4.39)
Log maturity				46.536
				(4.83)
Presence of covenants (grid-based pricing)	2.330	31.646	-16.085	7.202
	(0.53)	(1.93)	(-0.41)	(0.18)
Maturity x presence of covenants	-1.071		7.683	3.048
	(-1.16)		(1.34)	(0.53)
Agency guarantee	-66.533	-59.857	-59.348	-61.877
	(-4.20)	(-4.76)	(-4.72)	(-4.96)
Other guarantee	-25.791	-38.109	-38.271	-37.296
	(-6.79)	(-4.47)	(-4.49)	(-4.42)
Log size	-28.079	-6.215	-6.400	-7.489
	(-39.20)	(-2.29)	(-2.35)	(-2.75)
Bilateral deal	-33.148	25.302	25.784	23.838
	(-8.04)	(1.76)	(1.79)	(1.68)
Secured	43.583	28.946	28.939	29.996
	(18.26)	(3.76)	(3.76)	(3.91)
Construction and property	31.029			
	(7.06)			
High-tech industry	31.856			
	(10.22)			
Financial services (banks)	-14.175	-76.073	-75.797	-74.464
	(-3.34)	(-3.67)	(-3.65)	(-3.63)
Utilities		-22.878	-22.366	-20.727
		(-3.23)	(-3.16)	(-2.96)
Traditional industry	26.665			
	(9.02)			
Transport industry	-18.025	27.638	27.748	31.086
	(-3.87)	(1.63)	(1.64)	(1.86)
Population-related services	37.504			
	(12.09)			
State		-45.770	-45.468	-48.609
		(-2.78)	(-2.77)	(-2.98)
Corruption index	12.745	12.496	12.335	11.214
	(14.48)	(5.88)	(5.80)	(5.27)
Real GDP growth	-3.150	1.007	1.007	1.039
	(-5.63)	(0.83)	(0.83)	(0.86)
Inflation		0.563	0.565	0.556
		(3.75)	(3.76)	(3.74)
Current account/GDP	-4.544	-2.131	-2.070	-2.348
	(-12.28)	(-2.48)	(-2.40)	(-2.71)
Investment/GDP	-6.031	-3.504	-3.514	-3.725
	(-20.91)	(-5.83)	(-5.84)	(-6.24)
Bank credit/GDP	0.000			0.000
	(3.10)			(1.58)
Slope of US Treasury yield curve	-10.551			
	(-10.71)			
Constant	438.648	318.918	319.932	285.482
	(41.38)	(11.97)	(12.01)	(10.37)
Number of observations	10,258	827	827	822
Adjusted R^2	0.333	0.209	0.209	0.231

Table 14 - Robustness checks: floating rate bonds

Dependent variable: spread	(1d)	(4d)	(1e)	(4e)
Floating rate bond	-125.240	-125.252	-66.179	-59.455
	(-5.26)	(-5.27)	(-1.80)	(-1.62)
Maturity x floating rate bond	7.849	7.725	3.333	2.230
	(3.38)	(3.33)	(0.65)	(0.43)
Maturity	3.171	0.564	3.146	0.774
	(13.36)	(1.00)	(13.11)	(1.30)
Log maturity		24.848		21.555
		(5.10)		(4.34)
Agency guarantee	100.690	107.855	-27.472	-21.144
	(2.37)	(2.54)	(-0.74)	(-0.57)
Other guarantee	-5.170	-5.022	-2.499	-2.547
	(-1.53)	(-1.49)	(-0.78)	(-0.79)
Log size	-12.616	-13.563	4.025	3.398
	(-10.29)	(-10.96)	(3.33)	(2.79)
Ownership guarantee	20.042	20.112	11.009	11.045
	(6.46)	(6.49)	(3.42)	(3.44)
Construction and property	-39.750	-102.122	-27.991	-55.119
	(-3.14)	(-8.96)	(-2.06)	(-4.38)
Financial services (banks)	-122.751	-183.634	-17.968	-43.473
	(-16.25)	(-35.65)	(-2.52)	(-8.68)
Financial services (non-banks)	-120.975	-181.843	-17.755	-43.431
	(-15.57)	(-32.79)	(-2.36)	(-7.77)
High-tech industry	62.897		26.573	
	(7.24)		(3.33)	
Utilities	-83.313	-145.059	-16.869	-42.580
	(-8.30)	(-17.35)	(-1.91)	(-5.91)
Infrastructure		-151.904		-28.882
		(-5.35)		(-1.21)
Transport industry	-88.132	-150.585	-33.676	-59.871
	(-7.33)	(-14.11)	(-3.09)	(-6.21)
Population-related services		-61.398		-26.548
		(-6.80)		(-3.24)
Traditional industry	-57.130	-119.266	-9.904	-36.113
	(-6.74)	(-18.44)	(-1.26)	(-5.97)
State	-93.832	-154.177	-8.672	-34.270
	(-11.58)	(-25.99)	(-1.16)	(-6.27)
Slope of US Treasury yield curve	-8.422	-8.47174	-7.696	-7.764
	(-6.35)	(-6.40)	(-6.19)	(-6.25)
Inflation	0.336	0.333	1.559	1.545
	(6.05)	(6.01)	(9.17)	(9.10)
Current account/GDP	-3.648	-3.873	-1.308	-1.472
	(-8.88)	(-9.41)	(-3.45)	(-3.87)
Investment/GDP	-6.340	-6.454	-3.106	-3.295
	(-16.33)	(-16.60)	(-8.75)	(-9.21)
Bank credit/GDP	0.001	0.001	0.001	0.001
	(5.60)	(5.58)	(9.03)	(9.02)
Corruption index	45.644	45.458	11.348	11.647
	(45.70)	(45.65)	(9.90)	(10.16)
AAA			-326.707	-324.005
			(-31.78)	(-31.51)
AA			-318.377	-316.746
			(-30.72)	(-30.59)
A			-298.541	-296.998
			(-29.20)	(-29.07)
BBB			-263.599	-261.891
			(-25.55)	(-25.41)
BB			-113.561	-112.603
			(-10.24)	(-10.17)
B			-56.792	-55.520
			(-4.93)	(-4.83)
CCC			64.502	63.520
			(3.58)	(3.53)
CC			-28.436	-30.531
			(-0.35)	(-0.38)
C			-17.710	-19.214
			(-0.22)	(-0.24)
D			34.146	34.020
			(2.43)	(2.42)
Constant	697.740	738.770	480.950	492.403
	(44.00)	(46.82)	(28.00)	(28.90)
Number of observations	8,595	8,595	5,166	5,166
Adjusted R^2	0.380	0.383	0.634	0.636

APPENDIX

Background to Section 2.2.1: Short-term liquidity constraints

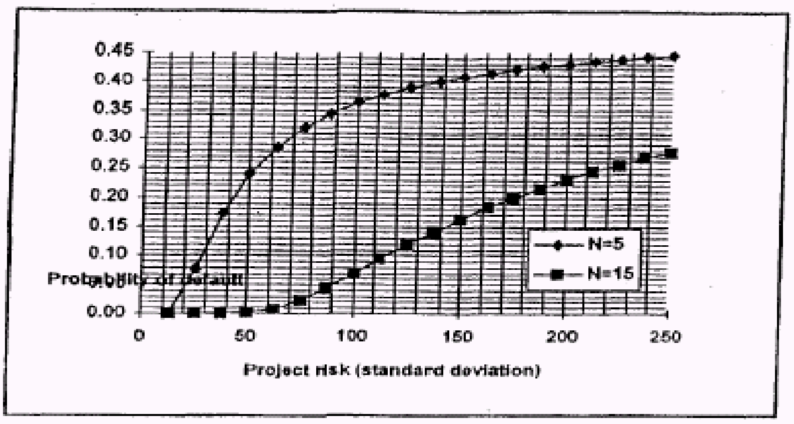
An example[37] might help to illustrate this point. Assume for simplicity[38] that project cash flows at each point in time are distributed as iid normal random variables and that loans are repaid in equal instalments out of the project cash flows only, ie with no possibility to borrow from other sources to overcome any liquidity shortages. In this stylised setup, default occurs at any point in time when random cash flows fall short of the amount needed for servicing the debt. Therefore, for a given dispersion of project cash flows, the level of the debt repayment threshold is critical for default risk.

Graph A1 plots the simulated probability of loan default against project risk (as measured by the standard deviation of cash flows) for two alternative loan maturities and terms. These hypothetical scenarios are: (i) a loan with a maturity of five years and interest rate of 7% per year; and (ii) a loan with a maturity of 15 years and interest rate of 8% per year. Both loans are for the same amount.

As expected, the probability of default increases with project risk. What is interesting to note is that the simulated probability of default is twice as high with a five-year loan maturity than with a 15-year loan maturity, even though the latter carries a higher interest rate. This is primarily because the long-term loan imposes a lower burden on the project company's liquidity as it can be repaid at a slower pace over time (a lower debt repayment is due each period). In other words, for any given standard deviation of project cash flows, the probability of default is smaller, the lower the debt repayment threshold.

Graph A1

Short-term liquidity concerns and the term structure of credit risk in project finance



Parameter assumptions are: i) Initial investment =$1000, financed with a mix of $200 equity and $800, debt; ii) Loan payment = end-of-period equal amount; iii) Rate of return on the project = 25%; iv) Distribution of project revenues, net of all non-capital production expenses, assumed to be normal with mean = 250 and with standard deviation that is assumed to vary from 12.5 to 250 with an increment of 12.5; and v) Debt service ratio = 1.1.

Source: Dailami and Leipziger (1997).

[37] Based on Dailami and Leipziger (1997).

[38] We will relax the iid assumptions and liquidity constraints in the background to Section 2.2.2.

Background to Section 2.2.2: Sequential resolution of uncertainty

In order to illustrate the importance for project finance of the sequential resolution of risks over the project advancement stages and its implications for the shape of the term structure of credit spreads, we will develop here a stylised example based on Wilson (1982) and Wilson and Kreps (1980).

Assume the uncertain cash flows from a project can be represented by the random vector $\tilde{y} = \{ \tilde{y}_1, \tilde{y}_2, \ldots, \tilde{y}_T \}$ and that at time t only the realised values of $^t\tilde{y} = \{ \tilde{y}_1, \tilde{y}_2, \ldots, \tilde{y}_t \}$ are known while uncertainty still persists about the remaining income stream $\tilde{y}^t = \{ \tilde{y}_{t+1}, \tilde{y}_{t+2}, \ldots, \tilde{y}_T \}$.

If $\tilde{y}$ has a normal distribution with mean vector m and variance matrix V, and m and the precision matrix $H = V^{-1}$ are partitioned as follows:

$$m = ({}^t m, m^t) \quad , \qquad H = \begin{bmatrix} {}^{tt}H & ({}^t H^t)' \\ {}^t H^t & H^{tt} \end{bmatrix} \tag{2}$$

then $\tilde{y}^t$ has a conditional distribution given $^t\tilde{y}$, which is normal with precision matrix H^{tt} and mean vector equal to :

$$m^t - (H^{tt})^{-1} ({}^t H^t) [{}^t y - {}^t m] \tag{3}$$

Relaxing the extreme liquidity constraints assumed in Section 2.2.1, assume now that there exists a riskless bond market that agents can use to lend or borrow in order to smooth their random income over time taking prices as given (we will indicate with β_t the price at date t-1 of a riskless bond paying $1 at date t).

The objective of the project's stakeholders is to optimally smooth the uncertain stream of cash flows over time choosing at each point in time t an amount x_t to make available for "consumption".[39] The remainder $y_t - x_t$ will be saved or borrowed in the bond market.

In other words, assume project stakeholders maximise an exponential utility function such as:

$$U(x) = \sum_{t=1}^{T} \beta^t U_t(x_t) \qquad \text{with} \quad U_t(x_t) = -r \; e^{-\frac{\alpha_t + x_t}{r}} \tag{4}$$

where $\beta^t = \prod_{\tau=1}^{t} \beta_\tau$, α_t's are intertemporal preference parameters and r is the constant risk tolerance.

Given these risk-averse preferences, project stakeholders will optimally require a positive risk premium Δ_t, i.e. the certainty equivalent will lie below the present value of the mean income stream. Risk premia at each point in time t will depend on the remaining uncertainty associated with the random cash flows $\tilde{y}^t$, given knowledge of the realised history $^t y$. In particular, it can be shown that they can be computed recursively as follows:

[39] Here "consumption" includes payment of all expenses related to the project and, in particular, servicing of the debt. Unlike in Section 2.2.1, however, default is no longer triggered by i.i.d. random cash flows falling short of a given debt repayment threshold. Risk arises here more generally from the intertemporal (co)variance of cash flows facing a representative agent who maximises a concave utility function. In particular, relaxing the iid assumptions and liquidity constraints of Section 2.2.1, we now focus instead on the implications of decreasing conditional variance of payoffs over project advancement stages.

$$\Delta_t = \frac{V(\hat{\tilde{y}}_t / {}^{t-1}y)}{2r} + \beta_{t+1}\Delta_{t+1} \qquad \text{for all } t = 1, \ldots\ldots, T-1 \tag{5}$$

$$\text{and} \quad \Delta_T = \frac{V(\tilde{y}_T / {}^{T-1}y)}{2r} \tag{6}$$

where $\hat{\tilde{y}}_t \equiv \tilde{y}_t + \beta_{t+1}\left[E\left(\hat{\tilde{y}}_{t+1} / {}^{t}\tilde{y}\right) - \Delta_{t+1}\right]$

and the conditional variances can be derived based on the distributional assumptions in (2) and (3).

Using (5) and (6) recursively proceeding backwards from t = T,T-1, ……, 1, one can back out the term structure of credit spreads associated with different maturities T.

The hypothesis of sequential resolution of uncertainty amounts to assuming a path of conditional variances in (5) and (6) decreasing over time. That will ensure the concavity of the term structure of credit spreads.

The curvature of the term structure is flatter, the higher is the serial autocorrelation in the random cash flows or, in other words, the higher is the predictive content of past realisations of ${}^{t}y$ in order to forecast y^{t}. If, conditional on past realisations of ${}^{t}y$, uncertainty is gradually resolved, then over time the optimal consumption smoothing by project stakeholders comes closer and closer to the first best utility maximisation under certainty. As a result, the additional risk premium required by project stakeholders will gradually decrease as their time horizon lengthens.

Background to Section 2.2.3: The impact of high leverage on the term structure of credit spreads in Merton's (1974) contingent claims framework

Under the assumptions of Merton's (1974) contingent claims theory, we know that the value of a firm's risky debt (D) is equal to the value of the assets (V) minus the value of a call option on the assets with strike price equal to the face value of the debt (X). In this framework, the credit spread (s) on risky debt can be expressed as follows:

$$s = \frac{1}{T} \ln [X / D(V,X,T,\sigma,r)]$$

where T is the time to maturity, σ is the asset volatility and r is the risk-free interest rate.

In order to investigate how a high level of debt relative to assets (i.e. a high leverage ratio $\frac{X}{V}$) might affect the term structure, we begin by noting in the equation above that the effect on the spread of a longer time to maturity (T) is twofold:

(1) In the contingent claims framework, an increase in the time to maturity, ceteris paribus, reduces the value of the debt (D), increasing the spread;

(2) Given the current value of the debt (D) and promised repayment (X), an increase in the life of the loan instead lowers the spread.

More precisely, these two opposite effects enter the partial derivative of the credit spread with respect to maturity as follows:

$$\frac{\partial s}{\partial T} = \left[\frac{\vartheta}{DT}\right] - \left[\frac{\ln\left(\frac{X}{D}\right)}{T^2}\right]$$

where $\ln\left(\frac{X}{D}\right)$ is positive by assumption[40] and ϑ measures the sensitivity of the option value to the time to maturity. Ceteris paribus,[41] options that have a longer time to run are usually more valuable. In fact, ϑ is typically positive and depends on the degree of the option's moneyness as shown in Graph A2.

With a low leverage ratio $\frac{X}{V}$, the first component in the equation above will prevail and the term structure will be upward-sloping. Furthermore, as X represents the option's exercise price, a low leverage ratio means that the option is more likely to be in the money and the path of ϑ will almost always be constant (see Graph A2), which implies a close-to-linear term structure of credit spreads (see Graph A3).

With a high leverage ratio $\frac{X}{V}$, on the other hand, the path of ϑ will move from that of an in-the-money option towards that of an at-the-money option, as shown in Graph A2. Furthermore, the second (negative) term in the equation of the partial derivative above will no longer be negligible. Therefore,

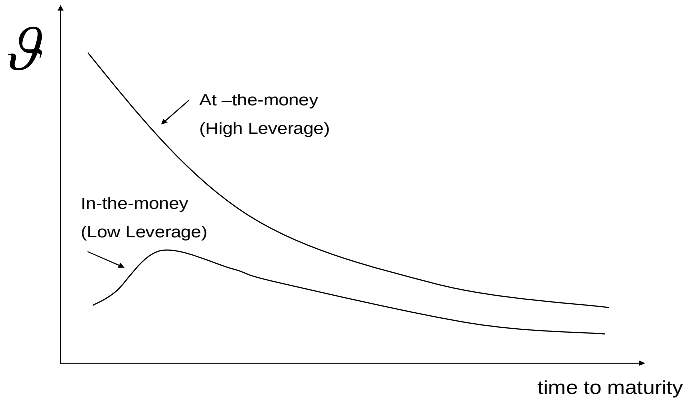
---

[40] Merton's (1974) zero coupon bond assumption suggests that the face value of the debt will exceed its price prior to maturity (i.e. X > D). His analysis, however, can be generalised to bonds that are coupon-paying, by valuing each coupon as a component of a portfolio of zero coupon bonds.

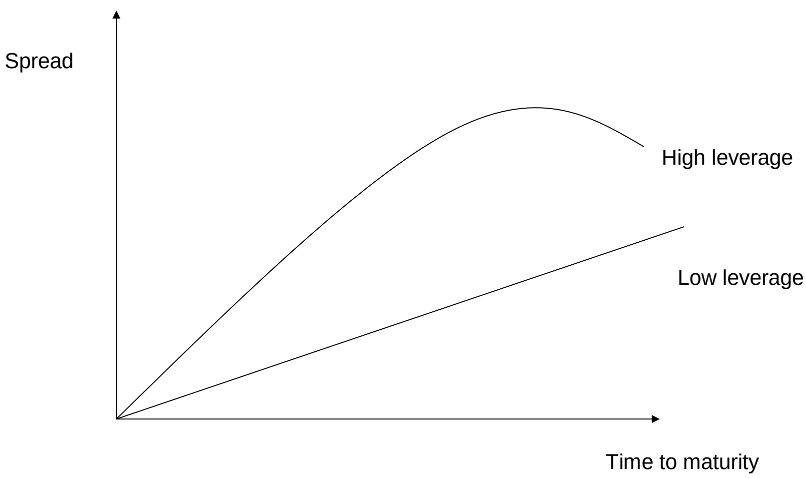
[41] Our partial derivative analysis assumes, in particular, no change in the distribution of the underlying asset value over time.

the slope of the term structure will be positive and steeper at the short end, it will then flatten out with maturity and eventually turn negative at the long end (see Graph A3).

Graph A2 – Theta option for different degrees of moneyness



Graph A3 – Term structure of credit spreads for different degrees of leverage



Background to Section 4.2: A numerical example of the potential distortions that might arise in bank lending decisions due to misalignments between credit risk and capital requirements along the maturity spectrum

The purpose of this Appendix is to show how aligning capital requirements with the actual term structure of credit risk in project finance is crucial for avoiding unintended distortions in banks' investment choices.

Assume that a bank faces the following two investment alternatives:

(LT) Committing to a long-term loan with political risk guarantee which yields a semiannual interest payment consisting of a spread s' over Libor with a maturity of T years.

(ST) Rolling over a sequence of short-term loans (with no political risk guarantees). Each of them yields a semiannual interest payment consisting of a spread s over Libor, has a maturity of one year and is rolled over T times, so that the composite maturity matches the maturity of the long-term loan T.

The bank can estimate the risk-adjusted return on capital (RAROC) at time 0 from each of these two investment alternatives as follows:

$$\text{RAROC} = \frac{\sum_{t=1}^{T} p_t \Gamma_t}{\sum_{t=1}^{T} K_t d_t} \qquad (15)$$

Where:

- p_t is the whole vector of contractual interest + principal payments over time, i.e. $p_t = (Libor_t + s)\, OLB_t + PRINCIPAL_t$,where s is the spread over Libor, $Libor_t$ is a vector of forward Libor rates and OLB_t is the outstanding loan balance at each time t.
- Assuming risk neutral pricing, Γ_t is an average of the risk-free and risky discount factors, weighted by the LGD, i.e. the loss-given-default or fraction of the value of the loan that is lost in case of default.
- K_t is the time t regulatory capital requirement based on the Basel II IRB formula.
- d_t is the risk-free discount factor.

We use our estimation results in Table 4 model (6a) to compute the spreads as a function of maturity and agency guarantees as follows:

Spread = 292.268 - 49.361 x gtragency - 6.405 * maturity + 47.015 * ln (maturity)

The spread s on the rolling one-year loan is obtained from the expression above substituting maturity = 1 and gtragency = 0 (no agency guarantee on short-term loans). The evidence suggests that banks most often obtain political risk insurance on longer-term loans. Therefore, the spread s' is computed setting maturity equal to T and the gtragency dummy equal to 1.

The spread s' is represented as a function of maturity T by the lower curve in Graph A6, panel A. The spread s is constant and is also indicated in Graph A6, panel A.

From the spreads s and s', the corresponding risk neutral default probabilities are extracted following the approach in Cline and Barnes (1997). They enter directly into our risk-adjusted discount factors Γ_t for pricing but are converted[42] into actual one-year probabilities of default in order to compute our risk-sensitive capital requirements K_t . Throughout, we use a standard assumption of LGD = 50%. Finally, we normalise the loan amounts to $1 and use a recent LIBOR curve to compute contractual cash flows and the corresponding US Treasury yield curve for discounting.

When choosing to lend long-term with the cover of political risk insurance instead of rolling over short-term loans without agency guarantees, the bank trades off the benefit associated with the political risk mitigation (the risk-adjusted discount curve shifts out as shown in Graph A4) against the cost of higher capital requirements for longer maturity lending (this cost is a function of the shaded area depicted in Graph A5).

As mentioned in Section 4.2, recognising any form of risk mitigation through a reduction in the probability of default leads to a steeper maturity adjustment within a range of PDs relevant for project finance (ceteris paribus, the shaded area in Graph A5 is larger, the steeper the upward-sloping segment O'B' in Graph 6b).

Panels B and C of Graph A6 plot the numerator and denominator of equation (15), respectively, as a function of maturity T (the dotted line represents the LT option). Panel D is obtained by taking the ratio in each of the two scenarios and plotting the difference in the risk-adjusted return on equity for the LT option minus that corresponding to the ST option as a function of maturity T.

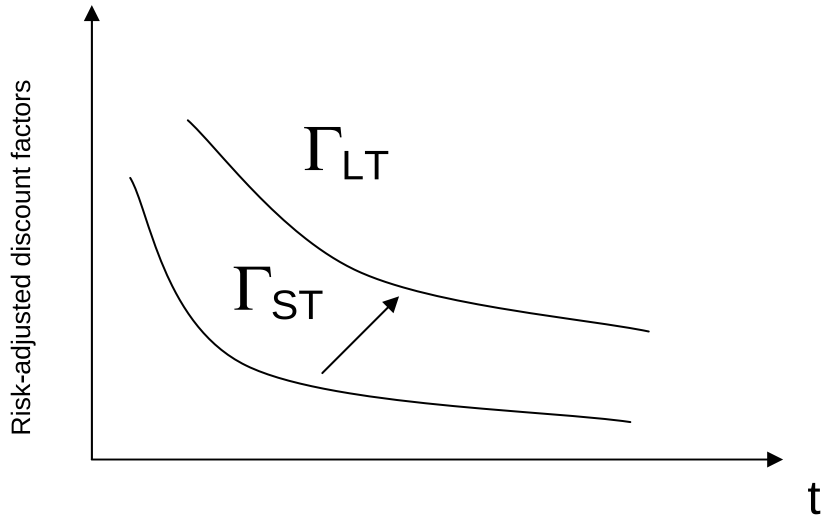
It is interesting to note that the curve in panel D always lies in negative territory, which means that the long-term option will never be preferable to a bank maximising return on equity. At low maturities, while s is constant by assumption, the spread s' follows an upward trend (see panel A) and the risk-adjusted return on capital (RAROC) from the long-term option increases with T faster than the one from the short-term alternative. That results in the upward trend observed in panel D at low maturities. However, at longer maturities, the increase in the risk-adjusted return from the long-term option slows down (see panels A and B). Capital requirements, on the other hand, go up due to the maturity adjustment (the gap between the dotted and the bold line in panel C starts to widen with maturity). In other words, the increasing capital absorption implied by the steeper maturity adjustment, without a corresponding increase in return, quickly offsets the benefit of any political risk mitigation for long-term lending and eventually brings down the RAROC for the long-term option compared to the short-term option. That explains the hump-shaped pattern of panel D.

This result suggests that a simple reduction of the default probability might not be an effective way to recognise the risk mitigation potential of political risk insurance if this leads to a steeper maturity adjustment like the segment O'B' in Graph 6b and in Graph A5. In fact, from the perspective of banks maximising risk-adjusted return on capital, a steeper term structure of capital requirements could ultimately offset the benefit of the political risk mitigation offered by multilateral development banks and export credit agencies on long-term cofinanced facilities (like B-loans). Ceteris paribus, regulatory capital arbitrage could distort banks' investment choices away from long-term project finance commitments to more short-term exposures which might not be necessarily safer.

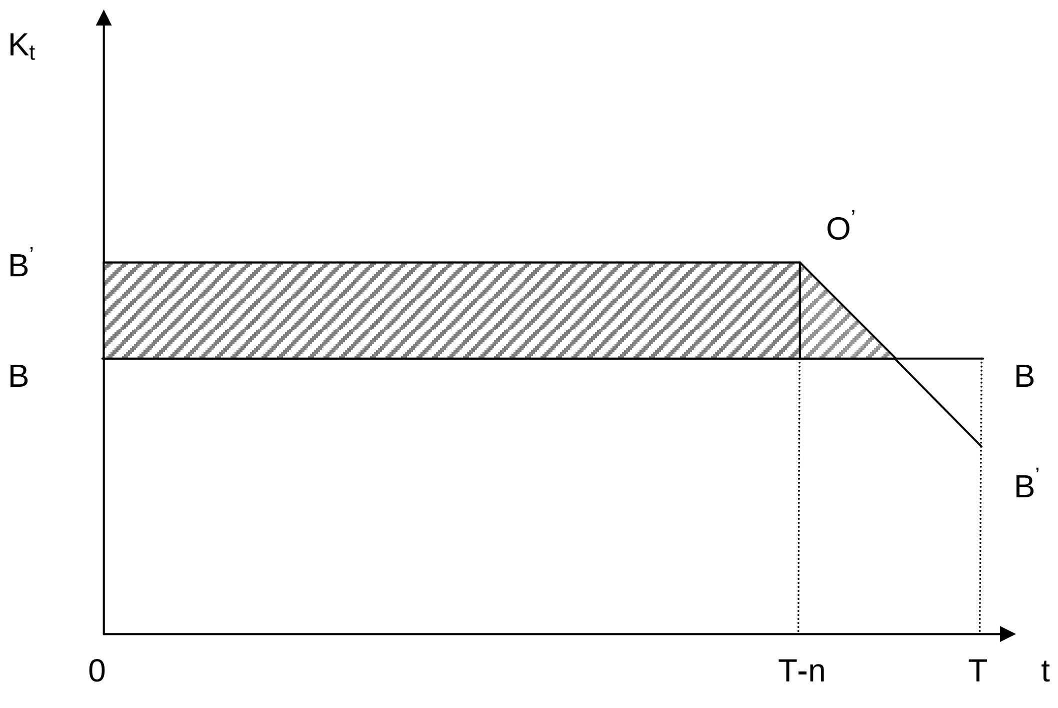
The numerical example presented above identifies offsetting effects that might need to be taken into account in the design of a comprehensive incentive scheme for long-term project finance lending as well as in the current debate on risk-sensitive capital requirements.

[42] See Crouhy et al (2000) for a simple explanation of how to derive actual one-year default probabilities (PD) from instantaneous risk neutral default probabilities, based on KMV methodology.

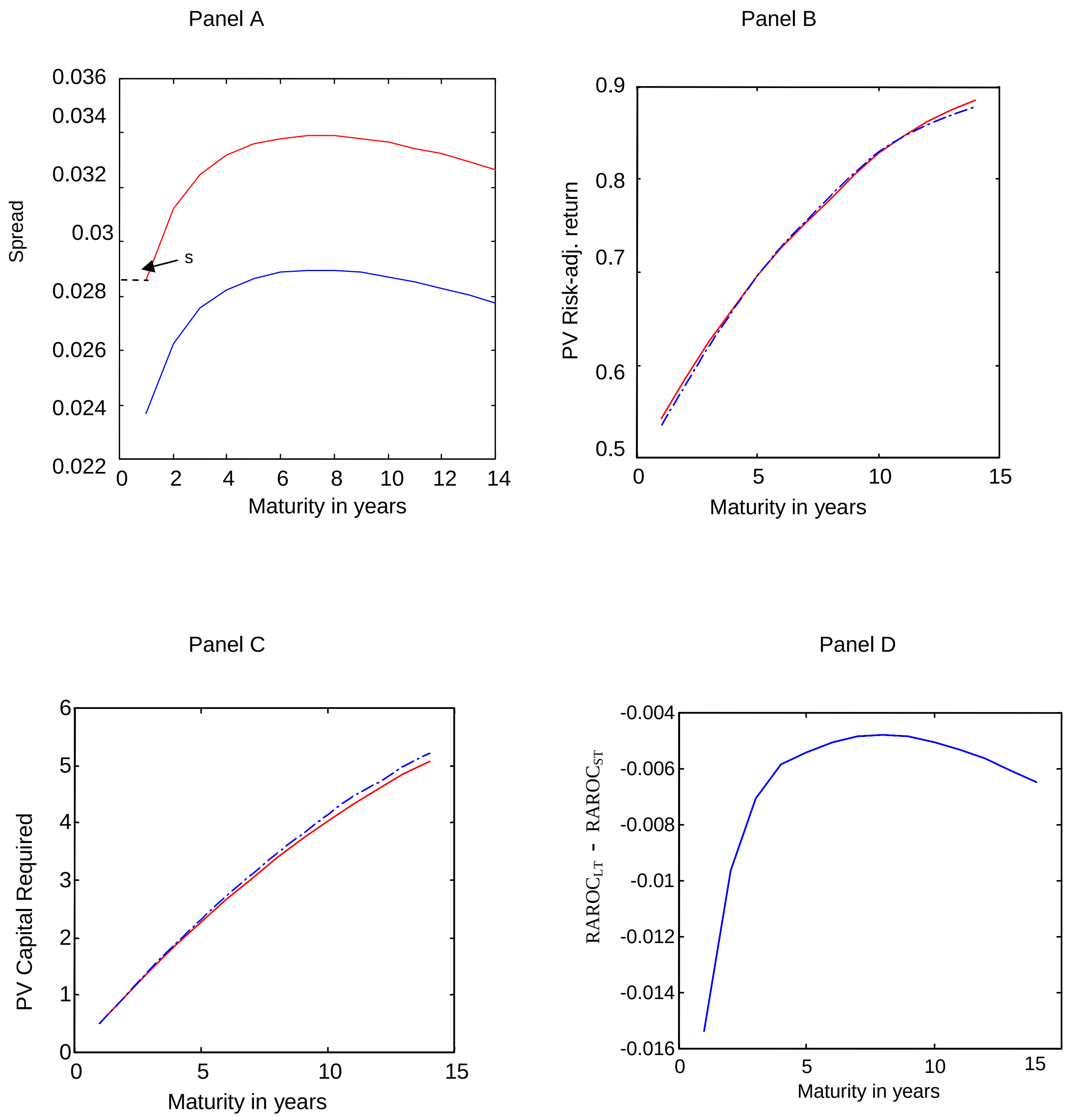
Graph A4 - Potential risk mitigation effect of long-term political risk guarantees



Graph A5 - Additional regulatory capital required on long-term vs short-term exposures



Graph A6 - Offsetting effects on banks’ choice of loan maturity: numerical example



BASELINE REGRESSION

spread = β_0 Intercept + β_1 lnsize_l + β_2 maturity + β_3 gtee_agency + β_4 gtee_other + β_5 subsidiary + β_6 secured + β_7 nbprov + β_8 bilat + β_9 constrpt + β_{10} finservb + β_{11} finservn + β_{12} hightech + β_{13} infrastr + β_{14} popserv + β_{15} state + β_{16} tradind + β_{17} transpor + β_{18} util + β_{19} tdstoxgs + β_{20} invgdp + β_{21} credgdp + β_{22} growth + β_{23} cpi + β_{24} curacGDP + β_{25} rrd + β_{26} corrupt + β_{27} trsyld + β_{28} ustrslope + β_{29} embi_svg + ε

where:

- **spread is the dependent variable.** For loans, this is the Libor spread plus difference between three-month Libor and three-month US Treasury yield at the time of the signing of the loan. For bonds, this is the spread at launch over comparable risk-free government security.

MICROECONOMIC INDEPENDENT VARIABLES

- maturity = maturity of loan or bond, in years
- lnsize_l = natural logarithm of loan or bond size, converted into millions of US dollars

Guarantees and collateral:

- gtee_agency, gtee_other, subsidiary = dummies for loans or bonds explicitly guaranteed by an agency or another third party; dummy for implicit guarantee arising from ownership (eg borrower is a developing country subsidiary of a major US concern)
- secured = dummy for secured loans or bond issues

Syndicate structure (loans only):

- nbprov; bilat = number of fund provider banks in syndicate; dummy for bilateral deal (with only one participating bank)

Sectoral dummies:

- constrpty, finservb, finservn, hightech, infrastr, popserv, state, tradind, transport, util = sectoral dummies for construction and property, financial services (banks), financial services (non-banks), high-tech industry, infrastructure, population-related services, state, traditional industry, transport, utilities. See the Appendix for the full list of sectors included in each broad grouping.

MACROECONOMIC INDEPENDENT VARIABLES

Economic growth and its sustainability:

- growth = real GDP growth in the borrower's country, for year concerned
- cpi = inflation in the borrower's country, for year concerned
- invgdp = ratio of investment to GDP for country of the borrower, for year concerned
- credgdp = ratio of bank credit to GDP for country of the borrower, for year concerned

External solvency indicators:

- curacGDP = ratio of current account to GDP for country of the borrower, for year concerned
- tdstoxgs = ratio of debt service to exports of goods and services for country of the borrower, for year concerned.

Political risk:

- corrupt = corruption index of the country of the borrower/issuer (higher value for greater corruption)
- rrd = residual obtained from regressing on all macroeconomic variables an indicator of the sovereign rating of the country of the borrower (higher values correspond to higher country risk)

Global economic factors:

- trsyld = yield on the three-year US Treasury bill, for month concerned
- ustrslope = slope of US Treasury yield curve (difference in yield between five-year and three-month Treasury security) at time of signing or issuance
- embi_svg = JPMorgan Emerging Market Sovereign Bond Index, for month concerned

Full list of borrower business sectors contained in each broad grouping

Construction and property: Construction/Building, Products-Commercial Building, Construction/Building Products-Maintenance, Construction/Building Products-Miscellaneous, Construction/Building Products-Residential Building, Construction/Building Products-Retail/Wholesale, Property/Real Estate, Property/Real Estate-Development, Property/Real Estate-Diversified, Property/Real Estate-Operations, Property/Real Estate-REIT, Construction/Building.

Financial services (bank): Finance-Commercial & Savings Banks, Finance-Student Loan, Finance-Mortgages/Building Societies, Finance-Investment Bank, Finance-Credit Cards, Finance-Development Bank.

Financial services (non-bank): Insurance, Finance-Investment Management, Insurance-Property & Casualty, Insurance-Multi-Line, Insurance-Life, Insurance-Brokers, Insurance-Accident & Health, Holding Companies-Conglomerates, Finance-Leasing Companies, Finance-Brokers & Underwriters, Finance, Holding Companies-Special Purpose Financial Vehicles, Holding Companies.

High-tech: Aerospace & Defence-Aircraft, Chemicals-Fibres, Chemicals-Diversified, Chemicals, Agribusiness-Agriculture, Aerospace & Defence-Products & Services, Aerospace & Defence, Healthcare-Genetics/Research, Chemicals-Plastic, Agribusiness, Services-Management Consulting, Telecommunications-Wireless/Mobile, Telecommunications-Telephone, Telecommunications-Services, Telecommunications-Satellite, Electronics, Telecommunications, Computers, Services-IT, Healthcare-Products, Computers-Internet, Telecommunications-Equipment, Computers-Hardware, Healthcare-Medical/Analytical Systems, Computers-Software, Electronics-Electrical Equipment, Healthcare-Drugs/Pharmaceuticals, Healthcare-Instruments/Surgical Supplies.

Infrastructure: Transportation-Airport, Transportation-Logistics/Distribution, Construction/Building Products-Infrastructure.

Population services: Dining & Lodging-Hotels & Motels, Healthcare-Nursing Homes, Automobile-Repair, Automobile-Sales, Dining & Lodging, Services-Funeral & Related, Retail-Home Furnishings, Retail-Jewellery Stores, Retail-Mail Order & Direct, Dining & Lodging-Restaurants, Retail-Pharmacy, Healthcare-Professional Services/Practices, Retail-Supermarkets, Services, Retail-Department Stores, Services-Advertising/Marketing, Retail-Miscellaneous/Diversified, Services-Legal, Services-Personnel, Services-Printing, Services-Schools/Universities, Services-Security/Protection, Services-Travel, Telecommunications-Cable Television, Telecommunications-Radio/TV Broadcasting, Services-Accounting, Healthcare-Miscellaneous Services, Healthcare, Healthcare-Hospitals/Clinics, Retail-Specialty, Healthcare-Management Systems, Retail-Convenience Stores, Healthcare-Outpatient Care/Home Care, Leisure & Recreation, Leisure & Recreation-Film, Leisure & Recreation-Gaming, Leisure & Recreation-Services, Publishing, Publishing-Books, Publishing-Diversified, Publishing-Newspapers, Publishing-Periodicals, Retail, Retail-Apparel/Shoe, Retail-Computers & Related, Leisure & Recreation-Products.

State: Finance-Export Credit Agencies, Government-Provincial Authority, Government-Local Authority, Government-Central Bank, Government-Central Authority, Finance-Multilateral Agencies, Government.

Traditional Industry: Air Conditioning and Heating, Forestry & Paper, Automobile, Automobile-Manufacturers, Automobile-Mobile Homes, Automobile-Parts, Chemicals-Fertilisers, Metal & Steel-Products, Forestry & Paper-Packaging, Forestry & Paper-Pulp & Paper, Forestry & Paper-Raw Materials, Machinery, Machinery-Electrical, Construction/Bldg Prods-Cement/Concrete, Machinery-General Industrial, Food & Beverage-Wholesale Items, Machinery-Material Handling, Machinery-Printing Trade, Food & Beverage-Miscellaneous, Metal & Steel-Distributors, Machinery-Farm Equipment, Mining, Mining-Excavation, Oil & Gas-Equipment & Services, Oil & Gas-Exploration & Development Onshore, Oil & Gas-Exploration & Development Offshore, Textile, Textile-Apparel Manufacturing, Textile-Home Furnishings, Textile-Mill Products, Textile-Miscellaneous, Metal & Steel, Consumer Products-Footwear, Construction/Bldg Prods-Engineering, Construction/Building Prods-Wood Products, Machinery-Machine Tools, Consumer Products-Cosmetics & Toiletries, Food & Beverage-Sugar & Refining, Consumer Products-Furniture, Consumer Products-Glass, Consumer Products-Home Improvement, Consumer Products-Miscellaneous, Consumer Products-Office Supplies, Consumer Products-Precious Metals/Jewellery, Consumer Products-Rubber, Consumer Products-Tobacco, Consumer Products-Tools, Food & Beverage, Food & Beverage-Alcoholic Beverages, Food & Beverage-Canned Foods, Food & Beverage-Confectionery, Food & Beverage-

Dairy Products, Food & Beverage-Flour & Grain, Food & Beverage-Meat Products, Food & Beverage-Non-Alcoholic Beverages, Consumer Products-Soap & Cleaning Preps, Consumer Products.

Transport: Transportation, Transportation-Ship, Transportation-Road, Transportation-Airline/Aircraft, Transportation-Equipment & Leasing, Transportation-Rail.

Utilities: Utility-Water Supply, Oil & Gas, Oil & Gas-Diversified, Oil & Gas-Pipeline/Distribution, Oil & Gas-Refinery/Marketing, Utility & Power, Utility-Diversified, Utility-Electric Power, Utility-Hydroelectric Power, Utility-Nuclear Power, Utility-Waste Management.

Full list of loan purposes contained in each broad grouping

Corporate control: LBO/MBO, Employee stock option plan, Acquisition, Acquisition line.

Capital structure: Refinancing, Debtor in possession financing, Recapitalisation, Receivable backed financing, Debt repayment, Securitisation, Standby/CP support.

General: General corporate, Private placement, Public finance, Trade financing, Working capital.

Project: Project financing.

Property: Mortgage lending, Property.

Transport: Shipping, Aircraft.

Other: Spin-off, Empty purpose code.

Multiple purpose code: More than one purpose for the same loan.

List of governmental or multilateral agencies providing political risk guarantees

African Development Bank
American International Group Inc (AIG)
Asian Development Bank (ADB)
Bank for Investment & Development of Vietnam
CESCE SA
China Development Bank
COFACE
Corporacion Andina de Fomento (CAF)
Credit Guarantee Insurance Corp of Africa (CGIC)
Croatian Bank for Reconstruction & Development (HBOR)
Development Bank of Singapore Ltd
Eksportfinans A/S
ERG (Swiss Export Credit Agency)
European Bank for Reconstruction & Development (EBRD)
European Investment Bank (EIB)
Export Credit Bank of Turkey (TURK EXIMBANK)
Export Credits Guarantee Department (ECGD)
Export Development Corp (EDC)
Export Finance & Insurance Corp (EFIC)
Export-Import Bank of China
Export-Import Bank of India
Export-Import Bank of Japan (JEXIM)
Export-Import Bank of Korea (KEXIM)
Export-Import Bank of the United States (US EXIMBANK)
Financial Security Assurance Holdings Ltd (FSA)
Finnerva
Finnish Export Credit plc
Finnish Guarantee Board (FGB)
FMO
Guangdong Development Bank
Hermes AG
Hungarian Development Bank (MFB Rt)
IBRD/World Bank
Industrial Credit & Investment Corp of India
Industrial Development Bank of India (IDBI)
Inter-American Development Bank (IADB)
International Development Agency of the USA

International Finance Corp (IFC)
Israel Foreign Trade Risks Insurance Corp Ltd (IFTRIC)
Japan Bank for International Cooperation (JBIC)
Korea Development Bank (KDB)
Ministry of International Trade & Industry (MITI)
Multilateral Investment Guarantee Agency (MIGA)
Nederlandsche Credietverzekering Maatschappij NV (NCM)
Nippon Export & Investment Insurance (NEXI)
Nordic Investment Bank (NIB)
Office National du Ducroire (OND)
Osterreichische Kontrollbank AG (OKB)
Overseas Development Administration (ODA)
Overseas Private Investment Corp (OPIC)
SACE
Shanghai Pudong Development Bank
Svensk Exportkredit (SEK)
Swedish Export Credits Guarantee Board (Exportkreditnamnden EKN)
Swedish International Development Agency (SIDA)
United Export Import Bank (Unexim Bank)

Table A1

Distribution of loans and bonds in data sample, by nationality of borrower/issuer and by year

Whole sample

Number of observations		**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**TOTAL**
Industrialised	**US**	684	1,312	1,143	1,579	2,643	2,950	2,771	2,750	1,557	**17,389**
	EMU	155	258	284	643	737	679	853	734	416	**4,759**
	GB	71	121	140	210	273	340	403	402	260	**2,220**
	Other W_ Europe	26	53	77	109	100	97	102	102	16	**682**
	JP	5	12	12	53	52	33	55	68	167	**457**
	Other industrialised	75	92	43	124	129	154	166	128	78	**989**
Emerging	**Africa/Middle East**	3	4	19	39	42	19	32	24		**182**
	Asia/Pacific	205	292	391	628	600	124	95	142		**2,477**
	Eastern Europe	63	41	73	137	257	183	129	123		**1,006**
	Latin America/Caribbean	24	22	46	223	360	235	213	234		**1,357**
	TOTAL	**1,311**	**2,207**	**2,228**	**3,745**	**5,193**	**4,814**	**4,819**	**4,707**	**2,494**	**31,518**

Note: Partial data for 2001.

Project finance loans

Number of observations		**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**TOTAL**
Industrialised	**US**	9	13	8	4	12	10	39	40	19	**154**
	EMU	3	2	5	4	6	15	7	13		**55**
	GB	2	9	3	3	5	15	18	24	18	**97**
	Other W_ Europe		1		1		2				**4**
	JP					1					**1**
	Other industrialised	2	2	1		2	3	3	7		**20**
Emerging	**Africa/Middle East**	2			2	2	5	9	1		**21**
	Asia/Pacific	46	56	68	84	86	22	15	14		**391**
	Eastern Europe	14	13	16	12	25	15	22	22		**139**
	Latin America/Caribbean	7	2	8	9	18	22	27	41		**134**
	TOTAL	**85**	**98**	**109**	**119**	**157**	**109**	**140**	**162**	**37**	**1,016**

Note: Partial data for 2001.

Table A2
Distribution of loans and bonds in data sample, by nationality of borrower/issuer and by year

Other loans

Number of observations		**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**TOTAL**
Industrialised	**US**	404	728	660	829	1,238	1,691	1,265	1,255	671	**8,741**
	EMU	27	40	70	53	70	79	103	90	38	**570**
	GB	32	68	102	64	78	112	115	152	71	**794**
	Other W_ Europe	3	23	36	28	27	39	23	39	5	**223**
	JP			3	1	3	13	18	9	3	**50**
	Other industrialised	18	30	13	41	36	36	43	44	21	**282**
Emerging	**Africa/Middle East**		4	7	7	16	9	11	16		**70**
	Asia/Pacific	69	106	151	201	163	60	48	91		**889**
	Eastern Europe	20	10	29	48	52	94	47	47		**347**
	Latin America/Caribbean	9	11	16	47	93	99	61	85		**421**
	TOTAL	**582**	**1,020**	**1,087**	**1,319**	**1,776**	**2,232**	**1,734**	**1,828**	**809**	**12,387**

Note: Partial data for 2001.

Bonds

Number of observations		**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**TOTAL**
Industrialised	**US**	12	32	42	201	292	284	480	331	321	**1,995**
	EMU	87	177	131	514	587	554	661	551	420	**3,682**
	GB	16	25	14	93	114	144	155	98	100	**759**
	Other W_ Europe	18	14	8	63	50	42	58	37	13	**303**
	JP	5	12	8	46	44	18	35	56	209	**433**
	Other industrialised	41	45	18	65	56	84	90	46	50	**495**
Emerging	**Africa/Middle East**				6	3	2	7	4		**22**
	Asia/Pacific	7	6	4	55	75	11	26	22		**206**
	Eastern Europe	5	4		18	46	35	32	24		**164**
	Latin America/Caribbean	2	1	1	129	167	87	81	68		**536**
	TOTAL	**193**	**316**	**226**	**1,190**	**1,434**	**1,261**	**1,625**	**1,237**	**1,113**	**8,595**

Note: Partial data for 2001.

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