



UNIVERSIDADE CATÓLICA PORTUGUESA

The Pricing of Project Finance Bonds

An Empirical Analysis of Credit Spread
Determinants

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Católica Porto Business School
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by

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Resumo

Esta dissertação analisa os fatores que influenciam o pricing de obrigações de Project Finance (PF), com base numa amostra de 28.016 obrigações emitidas globalmente por instituições não financeiras, no período 1995-2019. Apresenta uma comparação detalhada dos spreads de crédito e os processos de pricing entre obrigações de PF e obrigações comparáveis do tipo Corporate Finance (CF). A análise não fornece evidência que apoie o PF como um mecanismo para reduzir o custo da dívida dos sponsors dos projetos, tendo-se obtido evidência que as obrigações emitidas através de operações de PF apresentam spreads semelhantes ou superiores aos das obrigações tradicionais emitidas diretamente pelos sponsors. No entanto, este trabalho apresenta evidências empíricas de que, embora os ratings sejam os fatores de pricing mais importantes para estes títulos na data da sua emissão, outros fatores contratuais e macroeconómicos, para além dos ratings, explicam significativamente tais spreads. Adicionalmente, identificamos um claro impacto económico sobre os spreads e seus determinantes quando comparado o período de pré-crise financeira 2007/08 com o período subsequente. Este impacto não se reflete apenas no aumento significativo do spread para as duas tipologias de obrigações, mas também na alteração dos fatores que influenciam esses mesmos spreads; i.e., os processos de pricing alteraram-se significativamente com a crise financeira internacional.

Palavras-chave: obrigações de project finance; spread de crédito; pricing da dívida; structured finance; crise

Abstract

This dissertation examines the factors that influence the pricing of Project Finance (PF) bonds, using a cross-section of 28,016 global bonds issued by non-financial institutions in the 1995-2019 period. In addition, it provides a comprehensive comparison between credit spreads and the pricing processes of PF bonds vis-à-vis comparable Corporate Finance (CF) bonds. Our analysis does not provide evidence supporting project finance as a mechanism to reduce sponsors' cost of borrowing: we find that PF bond credit spreads are higher or equal to those of CF bonds. We provide empirical evidence that while ratings are the most important pricing determinant for both PF and CF bonds at issuance, investors rely on other contractual and macroeconomic factors beyond these ratings. Furthermore, we recognize a clear economic impact on pricing determinants when comparing the pre-crisis and crisis periods. These impacts are not reflected only in a significant increase of the overall credit spreads for both securities, but also in a significant change in the economic factors that explain the pricing of both bond instruments.

Keywords: project finance bonds; credit spread; debt pricing; structured finance; crisis

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1. Introduction

When firms have to choose how to finance productive investments using debt financing, various factors should be considered when selecting a specific type of financial instrument. Within the class of debt securities, companies can choose between private and public debt. Additionally, firms can choose between bank loans and public bonds. Finally, they also have the choice to borrow on-balance-sheet or off-balance-sheet through, e.g., a structured finance (SF) transaction. According to Fabozzi et al. (2006), a Project Finance (PF) deal is a type of a SF transaction.¹ Extant SF literature addresses the roles of funding costs, financial flexibility, risk management, agency costs, information asymmetries, and interest tax shields in determining the use of off-balance-sheet debt arrangements (Marques and Pinto, 2020). While the common preference seems to be predicated on an on-balance sheet approach through the use of corporate financing (CF), more and more companies choose to borrow off-balance sheet through the creation of Special Purpose Vehicles (SPV) (Caselli and Gatti, 2005; Leland, 2007).

PF involves the creation of a legally independent project company financed with nonrecourse debt for the purpose of investing in a capital asset, generally with a single purpose and a limited life (Esty, 2003; Caselli and Gatti, 2005). PF helps the financing of new capital-intensive projects by structuring the transaction around the project's own operating cash flows and assets. For that reason, in PF the project credit risk largely depends on the assets and cash flows generated by the project and not on the reliability and creditworthiness of the sponsors. The capability to redirect investor focus solely to the project's ability to repay the debt contracted and allowing for the remuneration of the capital

¹ Fabozzi et al. (2006) and Caselli and Gatti (2005) present project finance, asset securitization, structured leases, and leveraged acquisitions, as common examples of SF transactions.

invested to be coherent with the level of risk that surrounds the project, seems to be the main differentiator between PF and CF transactions (Esty, 2003; Fabozzi et al., 2006; Leland, 2007). In addition, PF debt financing is granted on a no-recourse or limited-recourse basis, meaning that the financiers don't have recourse to the assets of the agents involved in the creation of the project in the event of an unsuccessful venture (increasing the sponsors' financial flexibility).

Prior theoretical literature has essentially addressed the rationale for sponsors using PF as opposed to using CF. Extant studies hypothesize that PF contracting is designed aiming at the reduction of costly agency costs (Kensinger and Martin; 1988; Brealey, Cooper, and Habib; 1996; Esty; 2003; Bonetti, Caselli, and Gatti; 2010), reducing debt-overhang and distress costs (John and John, 1991; Esty, 2003; Caselli and Gatti, 2005; Fabozzi et al., 2006; Leland, 2007), reducing asymmetric information (Shah and Thakor, 1987; Kensinger and Martin, 1988; Esty, 2003; Corielli et al., 2010) and increasing interest tax shields (Shah and Thakor, 1987; John and John, 1991).

Typically used for funding public and private capital-intensive projects, especially in industries as construction, utilities, manufacturing, mining and transportation, PF is an economically significant growing financial market segment, but still largely understudied (Pinto, 2017). Nonetheless, the rise of PF, especially in the last decade, provides strong *prima facie* to prove that such financing structures do, indeed, matter. Total project-financed investment has grown by a factor of 10 times from \$41.3 billion in 1994 to \$415.0 billion in 2013 (Esty, Chavich and Sesia, 2014). These PF projects are usually funded with larger amounts of nonrecourse syndicated loans, which are the favored external capital-market financing method (Gatti, Kleimeier, Megginson and Steffanoni, 2013).

However, this landscape has been changing since the global financial crisis. Due to the crisis, that displayed that the capital bases of financial institutions were too low, Basel Committee presented significant changes to bank loans'

capital consumption with the Third Basel Agreement (Brenk, 2012). The new regulatory framework aimed to raise the quality and quantity of banks' regulatory capital base to improve the risk coverage of the banking sector (Bridges et al., 2014; Bezoen, 2015; Ma, 2016). These changes had a significant impact on PF syndicated bank loan market, as the pressure on banks' balance-sheets constrained long-term lending. From this situation, PF bonds have emerged as a substitute for bank loans to finance long-term projects. This change is supported by Esty, Chavich and Sesia (2014), which report that from 2009 to 2013 the use of PF bonds increased 500 basis points (from 8% of total PF debt to 13%). These types of bonds seem to potentially be a major source of long-term private debt capital linked directly to economic growth and competitiveness (Hauswald and Dailami, 2003). Today, the market encompasses a broad range of project types, issue sizes, seniorities, and maturities.

However, despite the growing importance of PF bonds as a funding instrument adapted to a new structural economic environment, there has been very little empirical academic research on PF bonds. Kleimeier and Megginson (2000) find that PF loans have lower credit spreads than comparable syndicated non-PF loans. Hainz and Kleimeier (2012) find that political risk and creditor rights correlate positively with the use of PF. Pinto and Alves (2016a) find, using a sample of syndicated loans closed between 2000 and 2014, that PF and non-PF loans are influenced differently by common pricing characteristics. Having this in mind, virtually no empirical study focuses on the determinants of the pricing of PF bonds, despite the literature regarding the pricing of traditional CF bonds being vast.

In this dissertation, we intend to contribute to the extant literature by providing empirical evidence on the factors that influence the pricing of PF bonds. In addition, it is also our objective to compare the credit spreads and the pricing process of PF bonds to that of CF bonds. Overall, this work will extend

current financial literature by providing an overview of the differences in pricing between these two debt instruments. Finally, it is also our objective to understand how these pricing mechanics are affected by the 2007/08 financial crisis, and how market agents' priorities and evaluations change in different economic circumstances.

Our findings do not support extant theoretical literature suggesting that PF deals reduce the cost of borrowing *vis-à-vis* comparable CF deals. However, as PF bond credit spreads are equal or higher than comparable CF bonds, we validate our hypothesis that due to higher transaction costs related to PF deals, the cost of borrowing would be higher. We identify that both PF and CF bonds are priced differently by common pricing determinants and that investors indeed rely on other factors besides credit ratings when pricing PF bonds. We find that factors important in the pricing of CF bonds, such as maturity, transaction size, currency risk, country risk, and creditor rights are also important for determining credit spreads on PF bonds. Finally, we identify a clear economic impact on pricing determinants when comparing the periods before and after the 2007/2008 financial crisis. These impacts are not only reflected in an increase of the overall credit spreads for both securities, but also into the factors that explain both PF and CF bond credit spreads.

This dissertation is organized as follows. In section 2, it is discussed the theoretical and empirical background of PF. Section 3 presents the research gap that this paper intends to fill and describes the research hypotheses. Section 4 introduces the sample used in this study and describes the methodology and variables used. Section 5 presents univariate analysis, while section 6 examines if PF reduces issuer firms' cost of funding and examines the determinants of credit spreads for PF and CF tranches. It also analyzes the impact of the 2007/08 financial crisis on the pricing structures. Finally, Section 7 presents the main conclusions of the study.

2. Literature Review

2.1. What is Project Finance?

Project finance (PF) is the process of financing a particular economic unit that is created by the project “sponsors”, financed through non-recourse (or limited recourse) debt, with the intent of investing in capital assets characterized by a pre-determined limited life. PF helps the financing of new capital-intensive projects by structuring the transaction around the project's operating cash flow and assets, without additional sponsor’s guarantees. Pinto (2017) stresses that the success of a PF transaction is highly associated with obtaining “little recourse as possible to the sponsor, while at the same time providing sufficient credit support through guarantees or undertakings of a sponsor or third party so that lenders will be satisfied with the credit risk”.

This type of transaction clearly presents different characteristics when compared with a traditional corporate finance operation. From a structural standpoint, PF usually involves the creation of a legally independent project company. Special Purpose Vehicles (SPV's) are thus created to facilitate the transaction and are used to segregate the credit risk of the project from that of its sponsors so that lenders, investors, and other parties will appraise the project focusing only on its predicted cash flows. In cases where there is only a single sponsor, project financing can be arranged simply by negotiating non-recourse loans through special-purpose subsidiaries or trusts.

For that reason, PF is a form of financing belonging to a broad category called structured finance, which also includes other non-conventional operations like leveraged buyouts, structured leases, and asset securitization. Structured Finance refers to off-balance-sheet contractual arrangements designed to fund a specified

asset, or a segregated pool of assets, by setting up bankruptcy-remote corporations to operationalize the transaction. These transactions are financed through the tranching of liabilities that are backed by an asset pool (Pinto and Alves, 2016b; Fabozzi, Davis and Choudhry, 2006; Leland, 2007). Caselli and Gatti (2005) identify three necessary conditions so that a transaction can be included in the business area of structured finance: (i) separation between the recipient of the funds raised (typically, an SPV) from the parties that sponsor the transaction; (ii) financiers grant exclusively financing in this operation to the independent legal entity and not to the parties who founded the company; and (iii) due to the legal separation from the assets instrumental to manage the project and the remaining assets of the parties that created the vehicle, along with the cash flow from the initiative, only the SPV's assets become collateral for creditors.

It is important to notice that in an economy *à la* Modigliani and Miller (1958), SF transactions would be irrelevant. Therefore, in such a scenario, encapsulating a pool of assets in an *ad hoc* entity, could not result in the creation of value. Thus, the existence of market imperfections, including asymmetric information, agency conflicts, market incompleteness, or market segmentation, can be helpful in explaining tranching, off-balance-sheet financing, and the benefits of SF transactions. This logic is supported by the fact that PF is mainly used in inherently complex projects with large risks and substantial informational asymmetries (Shah and Thakor, 1987). Yet, opposing to traditional capital structure logic, these projects are funded with small amounts of private equity contributions and much larger amounts of nonrecourse syndicated loans, which are the preferential external capital-market financing method in such deals (Gatti, Kleimeier, Megginson and Steffanoni, 2013).

The presence of the separate vehicle company that is created with the purpose of obtaining financing for the realization of a specific initiative disjoined from other projects, implies that the loans granted to the project find repayment

primarily in the ability of the initiative to generate cash flows. The net worth of the sponsors should, in theory, be irrelevant in assessing the financial sustainability of the loans. This is due to the fact that creditors are dealing with no recourse financing or limited recourse financing, in very specific cases, on the assets of parties that set up the vehicle company (Esty, 2003; Caselli and Gatti, 2005); Buscaino, Caselli, Corielli, and Gatti, 2012).

2.2. The Historic Evolution of Project Finance

Despite being a non-conventional operation and included in a relatively recent growing financial market segment, the PF way of organizing an economic venture is not recent and, instead, dates back to old-fashion merchant trading expeditions were “projects” where financed in a voyage-by-voyage basis (Kensinger and Martin, 1988). One of the earliest examples of project finance dates back to the year 1299 when the English Crown enlisted a Florentine to help in the development of the Devon Silver Mines (Esty, Chavich and Sesia, 2014). There are clear similarities in terms of finite life-span of the project and an independent approach of financing when compared with modern times PF.

During the early 1970s, PF became an established vehicle for companies seeking new ways to finance large natural resource discoveries and operations: mainly oil and gas production, refining, gas transmission, chemicals, food processing and textiles (John and John, 1991). Over the last 35 years, PF has been an important source of funding for public and private economic ventures. Pinto (2017) reports the concentration of PF lending in five strategic key industries: utilities, construction, manufacturing, mining and transportation that account for 77.3% of all PF lending. Despite this clustering, it is possible to identify the continuous expansion and adaptability of the use of PF in a wide variety of

industries, like tourism and hospitality, entertainment, telecommunication, agriculture, medical, and research and development (Kensinger and Martin, 1988).

In the last two decades, it is evident the growth of PF investment in global markets. Esty (2004) justifies this increase with the fact that the “long-term demand for capital and infrastructure investment remains large given the globalization of product markets, deregulation of key business sectors such as power, telecommunications, and transportation, and privatization of government-owned entities in both developed and developing countries”. Esty, Chavich and Sesia (2014) report that “total project-financed investment grew by a factor of 10 times from \$41.3 billion in 1994 to \$415.0 billion in 2013”. In the year of 2009, a steep drop in total value invested occurred in response to a depressed global economy and the total PF market dropped to the total value of \$249.3 billion. This amount quickly recovered in the following years, especially driven by the project finance investment in developing economies. According to Refinitiv, \$354.3 billion were arranged worldwide in 2019 through PF operations. This represents an increase of approximately 6% when compared with the total value in 2018. From this total value, 296.6 billion derive from project finance loans (861 issues) while the other 57.7 billion were issue through project finance bonds (138 issues). The three main sectors associated with PF operations during this period were Power, Oil and Gas, and Transportation.

Kleimeier and Versteeg (2010) explore the extensive use of PF in economies such as Taiwan, China, and Malaysia, and identify empirically the importance of this type of financing as a driving force of strong economic growth in low-income countries, where transaction costs are particularly high. One of the main advantages of this type of financing process is that it promotes the allocation of specific project risks to the parties that are best able to manage them through the use of a set of contractual arrangements aimed at improving risk management

(Brealey, Cooper, and Habib, 1996; Corielli, Gatti and Steffanoni, 2010; Bonetti, Caselli and Gatti, 2010; Pinto, 2017). These characteristics of PF enables it to “substitute underdeveloped financial markets and emulate, in part, the desirable features of a well-developed market” (Kleimeier and Versteeg, 2010), which supports the increased use of PF in emerging economies. Having this into account, it is important to note that like in any other type of financing mechanism, project finance is most successful in a transparent environment where contracts are respected. This happens because adjusting the structure of PF to deal with market failures will be costly and imperfect (Ahmed, 1999).

2.3. Project Finance Characteristics

As Esty (2004) points out, “project finance involves the creation of a legally independent project company financed with equity from one or more sponsoring firms and non-recourse debt for the purpose of investing in a capital asset”. This definition highlights two key features of PF: (i) limited or nonrecourse debt and (ii) the legal independence of the project entity.

When compared with a traditional corporate financing transaction, it is possible to identify that these key features are the central difference between the two methods of financing, because in PF the project credit risk largely depends on the assets and cash flows generated by the project and not on the reliability and creditworthiness of the sponsors. In other words, it redirects the focus solely to the project’s ability to repay the debt contracted and allows for the remuneration of the capital invested that is coherent with the level of risk that surrounds the project (Esty, 2003; Fabozzi et al., 2006; Leland, 2007). As Caselli and Gatti (2005) describe, “corporate financing is based on being able to count on a much broader asset base than assets relating specifically to the individual

initiative (if the latter fails, the financier can always count on the company's other assets)". In the case of PF, the financing is granted on a no-recourse or limited-recourse basis meaning that the financiers don't have recourse to the assets of the agents involved in the creation of the project in the event of an unsuccessful venture. Even in the existence of limited recourse instead of no recourse, the situation doesn't change. While it is true no absolute division exists between sponsors and project, in any event, full enforcement of the guarantees would not allow for the full recovery of the sums loaned by debt holders. Consequently, it is important to notice that these factors have different impacts on the financial flexibility of the company. While from a corporate financing standpoint, the process of financing reduces the financial flexibility of the company, in PF the effects are non-existent or very reduced as regards the sponsor's flexibility.

Focusing on the capital structure of an SPV, project companies have highly concentrated debt and equity ownership structures. In terms of equity ownership, the typical project company has from one to three sponsors, and the equity is almost always privately held (Esty, 2003). Usually, it appears as an off-balance sheet item in the corresponding sponsor's financial statements (John and John, 1991). The common legal structures used by project companies are a corporation, a limited liability company, a subsidiary, a partnership, an unincorporated joint venture and a trust (Alam, 2010). Projects are heavily debt-financed. According to Esty (2003), a project company has a book value debt-to-total capitalization ratio of 70.0%, compared to 33.1% for similar-sized public firms. As pointed out by Esty and Megginson (2003), syndicated bank debt is the predominant mode of financing.

Another alternative method of financing is through the use of PF bonds, an increasing debt market segment due to the increasing restrictions on long-term syndicated lending. Of the total debt raised by project companies in 2013, bank loans represent 81% of total debt while PF bonds represent 19%. PF bonds market

has recovered since 2009, from \$8.3 billion to \$49.3 billion in 2013, the highest amount so far. Even though the issuance of this type of instrument has been predominantly concentrated in the United States (US), the United Kingdom (UK), and Canada, it is apparent that PF bond usage has been increasing in every country (Esty, Chavich and Sesia, 2014).

PF is also known as “contract finance”, as the number of contracts for larger projects can range from several hundred to several thousand and can involve as many as 15 parties united in a vertical chain from input suppliers to output buyers (John and John, 1991; Esty, 2003; Esty and Megginson, 2003). Pinto (2017) stresses that of all the types of contracts four are particularly important: (i) construction contracts and engineering, procurement, and construction (EPC); (ii) purchasing agreements to guarantee raw materials to the SPV at predefined quantities, quality, and prices; (iii) selling agreements that allow the SPV to sell part or all of its output to a third party at predefined prices and for a given period of time; and (iv) operation and maintenance agreements. Corielli et al. (2010) support the idea and argue that this key characteristic of PF is essential in the risk management and risk allocation of the project. Through a network of non-financial contracts, organized between the SPV and third parties, a system for distributing risk among the parties involved in a venture is created. With the effective identification and allocation of risks, it is possible to minimize cash flows’ volatility generated by the project.

Many of these structural features appear counter-intuitive, especially when compared to the option of using corporate financing. For that reason, it is important to understand the economic motivations behind the use of PF. Depending on the context, these individual structural components can combine resulting in a form of financing that can reduce the net financing costs associated with capital-intensive investments when compared with traditional on-balance sheet funding.

2.4. Economic Motivations for The Use of Project Finance

To comprehend the reasons behind the use of PF, a complete understanding is needed of why the combination of a firm plus a project might be worth more when financed separately with nonrecourse debt than when they are financed jointly with corporate funds. The prior theoretical literature on structured finance and more specifically on PF has addressed the role of funding costs, financial flexibility, risk management, agency costs, information asymmetries, interest tax shields, and financial synergies in determining the use of off-balance-sheet debt arrangements. To understand how certain characteristics create value it is important to notice that that firms bear “deadweight costs” when they invest in and finance new assets. These deadweight costs range from transaction costs, agency costs, distress costs, information costs, and taxes resulting from capital market imperfections or frictions (Shah and Thakor, 1987; John and John, 1991; Esty, 2003; Leland, 2007). The value of a new capital investment equals the present value of the project expected cash flows minus the deadweight costs associated with the project and the sponsoring firm. Financing decisions play a central role in the valuation because they affect the existence and the impact of these deadweight costs. Following this line of thought, sponsors should base their decision on whether the total deadweight costs under project financing are lower than the total costs under corporate financing (Esty, 2003). In order to grasp how PF can reduce the overall funding cost of a transaction, it is important to expose how PF can reduce the effect of these costs.

2.4.1. Agency Costs

Costly agency costs can arise from different sources and are more predominant in the presence of assets that generate high operating margins and significant amounts of free cash flow (Jensen and Meckling, 1976). These conditions can lead to inefficient investment and value destruction. For that reason, it is optimal to reduce the amount of free cash flow available to reinvestment and instead return it to the capital holders (Jensen, 1986).

The first agency conflict arises when managers that control investment decisions have different incentives from capital providers. According to Esty (2003), PF can be used to mitigate costly agency conflicts inside project companies and among capital providers (agency cost motivation). Kensinger and Martin (1988) discuss the ability that sponsors have in reducing manager discretion over cash flows when structuring a separated legal entity. This is possible through the use of contractual arrangements in order to control the “dividend policy” of the project, which guarantees that investors rather than managers are the ones that can make decisions about the reinvestment of cash flows. More specifically, every project company includes “cash flow waterfall” contracts that prioritize claims over cash flows and proper allocation. Through the use of these *ex-ante* contracts, all parties involved agree to virtually all capital expenditures, maintenance costs, debt service, reserve accounts, and shareholder distributions (Esty, 2003).

Beyond the use of contracts that in some cases can be incomplete and cannot predict every outcome in a normally long project life (“All complex contracts are unavoidably incomplete” (Williamson, 2002)), sponsors use concentrated equity ownership, separate legal incorporation and high leverage to limit manager discretion. Concentrated equity gives incentives to sponsors to monitor managerial actions, easing this process and improving the quick response in decision making. The use of a separate legal entity also reduces the

cost and complexity of monitoring manager's decisions and actions. This happens because it is much more simple to analyze cash flows correspondent to a single project than trying to evaluate the performance of a single project (and hence the associated performance/skill of the manager) from a pool of cash flows where there is always an incremental effect and synergies from different ventures on a corporate context (Jensen, 1986; Stulz, 1990; Esty and Megginson, 2003). For that reason, a corporate balance provides a “safety net” when the debt is allocated internally, which in the end will result in a reduced incentive to generate cash flow from the point of view of the manager. In PF, due to the fact that the repayment of project debt is totally dependent upon project cash flows, project managers have more incentive in promoting efficiency in the allocation of cash flows. Finally, by using bank debt instead of public bonds (syndicate loans are the primary financing method) sponsors gain the benefits of credit monitoring (Diamond, 1984).

Another agency conflict may arise between the owner and parties/involved in the project. Potential for these costs is associated with the possibility of opportunistic behavior between bilateral monopolists (common in large capital-intensive projects). More commonly known as the “hold up” problem, normal conflict situations tend to result from opportunistic behavior from parties that supply or buy key inputs/outputs or host nations that supply legal system and contractual enforcement (Esty, 2003). Facing the possibility of opportunistic behavior, sponsors should protect themselves before incurring large, durable capital investment, especially in industries with a high percentage of fixed costs.

Sponsors can use long-term contracts and joint ownership structures to avoid the “fundamental transformation” that takes place following investment in transaction-specific assets (Williamson, 2002). Bonetti, Caselli, and Gatti (2010) explore how Quezon Power Ltd Co relied extensively on long-term contracts to control the prices of inputs and to guarantee *à priori* the sale of a percentage of

output production, which ensured Quezon a stable and predictable flow of revenues. Another possible solution is vertical integration (downstream or upstream). This option is more probable the higher is the asset specificity of the project. But vertical integration is not always possible or desirable as companies may prefer not to hold large risky assets (Joskow, 1985). Sponsors in a project company also use high leverage to enforce the contracts, because, in the presence of high leverage, even small attempts to appropriate value will result in costly default and, possibly, a change in control. Knowing this, other parties will have less incentive to display opportunistic behavior.

Finally, another agency conflict could arise between equity holders and debt holders. This conflict is usually related to the allocation and distribution of the cash flows of the project. In standard contexts, lenders benefit from project structures that limit managerial discretion over the cash flows. Although high leverage can lead to risk shifting and underinvestment in many corporate settings, these distortions impact on the context of PF is diminished. Brealey, Cooper, and Habib (1996) and Esty (1999) argue that PF helps to reduce the debt-overhang problem by assigning project returns to new investors rather than existing capital providers. Because normally there are few valuable growth options, the opportunity cost of underinvestment due to leverage is essentially negligible in project companies (Jensen and Meckling, 1976; Esty, 2003; Acharya, Mehran and Thakor, 2010). Also, to complement that, prior to project implantation there are extensive discussions focusing on the structure of cash flow waterfall in order to protect the interest of the banks. Pinto and Alves (2016b) argue that “there is a role for contracting as a disciplinary device to curtail the potential inefficient effects of agency problems in corporate borrowing”. Using contract arrangements banks impose strict cash flow allocation restrictions, in order to protect their investment from managerial discretion. On

the other hand, sponsors agree to those conditions to reduce the project's borrowing cost (Corielli et al., 2010).

The general idea is that through the use of PF, sponsors tailor the governance structures in order to reduce the costs associated with agency conflicts. This process results in an increase in the expected cash flows from the project, which will increase the expected return for the sponsors and allow access to lower credit spreads on the debt markets.

2.4.2. Debt-Overhang and Distress Costs

As it is known from Myers (1977), the presence of outstanding (risky) debt leads to underinvestment, that is, a situation in which some positive net present value (NPV) projects are foregone (debt-overhang problem). In comparison with firms that generate significant amounts of free cash flow, which can finance investment opportunities internally, highly leveraged firms have more trouble financing attractive investment opportunities (Esty, 2004).

PF helps high leveraged firms to avoid the opportunity cost of underinvestment or in other cases can allow firms with moderate debt structure to fund themselves without becoming unbearable high leveraged. While using corporate debt companies could be exposed to situations of underinvestment, with project debt it is possible to preserve debt capacity. This debt capacity would allow companies to have the flexibility to invest in attractive opportunities, and also to finance themselves cheaply than they otherwise could. John and John (1991) support the premise that PF reduces leverage-induced underinvestment through separate incorporation and nonrecourse debt.

Beyond allowing for extra-debt capacity, PF helps to reduce the potential distress costs that a project can impose on the sponsoring firm. This idea is

presented by Caselli and Gatti (2005), who assert that the use of PF may enable sponsors to obtain “insurance” against any potential negative impact of the project. While in corporate-financed investments, an increase in leverage increases the sponsors expected distress costs due to contamination risk, the off-balance-sheet treatment of the funding raised through an SPV avoids such risk, and allows for the preservation of financial ratios, with a limited impact on sponsors’ creditworthiness (J. Pinto and Alves, 2016b; Esty, 2004). This means that especially for investments with high expected distress costs, PF could reduce the incremental distress costs to the point where the NPV of the project becomes positive. Through the project structure, sponsors are able to share project risk with other sponsors, debt holders and other stakeholders on the project diluting potential costs.

PF investment exposes firms to losses only as large as its equity commitment (Caselli and Gatti, 2005; Fabozzi et al., 2006; Leland, 2007). Given the high leverage ratios used in PF transactions, the equity commitments are a small fraction of the project’s total cost, which supports the potential reduction of contamination risk using an SPV. The limited liability effect can be seen as a valuable option that sponsors have of walking away from a potentially unprofitable project, without considerable costs. For that reason, the use of PF can be seen as a decision to buy a “walkaway” put option on project assets (Esty, 2003).

2.4.3 Asymmetric Information

In the presence of information asymmetry between borrowers and lenders, adverse selection problems affect borrowing decisions. Leland and Pyle (1977) assert that for “projects of good quality” to be financed, information transfer must occur (reduction of information asymmetries). Myers and Majluf (1984) show that firms with high deadweight costs of asymmetric information are more prone to underinvestment, which occurs when the value of both assets-in-place and investment opportunities is uncertain. The authors provide an intuition that the underinvestment problem can be solved by using a project company as a financial vehicle.

Shah and Thakor (1987) point out that PF is optimal especially in situations where there are large costs of information asymmetry (benefits from information production are high) because the cost of screening a separately incorporated project is much lower than the analysis necessary in a corporate financing context. Following this line of reasoning Kensinger and Martin (1988) argue that this type of off-balance-sheet treatment reduces signaling costs. In addition, Esty (2003) and Corielli et al. (2010) justify that PF can help reduce the asymmetric information problem because the separation of projects from the sponsoring firm facilitates initial credit decisions and simplifies the process of conveying internal information.

Miglo (2011) develops on this reasoning and shows that when asymmetric information regarding firms' total value is small enough, the issuance of non-recourse debt through a project company is beneficial because it allows for “good type” projects to signal its quality. Also, Diamond (1993) discusses how short term maturity can reduce adverse selection costs of new debt issues because the frequent and systematic repricing allows for more rapid incorporation of new information. This premise supports the use of PF when comparing with

corporate financing and can also partially explain why PF companies mainly choose syndicated loans instead of project bonds as the main source of financing.

Finally, through the use of multiple and extensive contractual arrangements, which are disclosed to other parties, it is possible to lower general information asymmetries with PF (John and John, 1991).

2.4.4 Tax Benefits

As mentioned before, PF companies have highly leveraged capital structures (the average project company has a debt-to-total capitalization ratio of 70% compared to 35% for public companies) when compared to companies under corporate financing (Esty, 2004). As Nevitt and Fabozzi (2001) point out, “Project financing can sometimes be used to improve the return on the capital invested in a project by leveraging the investment to a greater extent than would be possible in straight commercial financing of the project.”. Shah and Thakor (1987) analyze optimal financing under corporate taxation and argue that PF can provide greater tax benefits (or interest tax shields) due to increased levels of leverage. This happens because under corporate financing the level of leverage is sub-optimal. John and John (1991) also argue that the optimal allocation of debt in project financing allows for the increase of the value of tax shields when compared to the case of straight debt financing. This optimal allocation involves assigning to the sponsor firm and the new venture debt levels equal to their individual optimal capital structure.

On the other hand, Esty (2003) contends that “the desire to generate interest tax shields is a reason to use high leverage”, but not a direct motivation to use PF. This emerges because corporate and project debt generate the same interest tax shields, with a “few exceptions” that don’t have a significant impact on the decision. For that reason, firms use PF to achieve high leverage at the project level

while avoiding the debt overhang problem at the sponsor level, which denotes a motivation to reduce costs of underinvestment, and not specifically to increase the value of the tax shields.

Having analyzed these four economic motivations, we can realize how they combine in a very coherent form to reduce the funding cost for sponsoring firms while using PF.

2.4.5. Disadvantages

Despite the abovementioned advantages, PF also presents some disadvantages that can in some contexts result in value destruction. For example, considering the fact that structuring a PF transaction is much more costlier than a traditional corporate financing alternative, it is expected that small PF deals would not be cost-effective (Caselli and Gatti, 2005). Setting up a project involves various transaction costs such as fees to financial and legal advisors, payment to consultants who assess the feasibility of the projects, cost of tax advice and loan documentation (Esty and Megginson, 2003; Alam, 2010). Creating a stand-alone project company can take from six to eighteen months and requires significantly greater transaction costs than financing an asset on an existing balance sheet. Klein, So and Shin (1996) report that costs for infrastructure projects average 3% to 5% of the amount invested, but can be as high as 10% for “pioneering projects”.

Also, the process of arranging the financial agreement is often of uttermost complexity, involving many participants with diverse interests. There is a risk for tensions arising regarding risk allocation between lenders, project sponsors, and other stakeholders. Finally, in some cases, project risks cannot be effectively allocated or the resulting credit risk enhanced. This results in higher rates and fees charged by lenders for the transaction than are charged in traditional corporate finance.

Another negative effect of using off-balance-sheet financing is the fact that decision-makers may use this structure to “hide” liabilities, avoid reporting assets and to defer losses. For that reason, PF can reduce transparency between the company and outside market agents (Powers, 2002).

Finally, PF can increase the risk of current on-balance sheet creditors. Since the PF transaction is structured through the transfer of a subdivision of firms’ assets into a bankruptcy-remote corporation, the sponsors’ current creditors have no access to the project’s resulting cash flows. This effect may increase the default risk of existing creditors if sponsors choose to implement through PF, from the prevailing investment opportunities’ portfolio, those projects with the highest NPV.

2.5. Bank Regulation and Project Finance Bonds

Focusing on strategic financial decisions, managers of PF companies normally choose between contract bank syndicated loans and issue PF bonds. It is clear that currently, most project companies rely mainly on bank debt rather than bonds (concentrated debt ownership). Even though long-term bonds provide a better match with the duration of project cash flows, companies tend to use shorter/medium-term bank debt with maturities ranging from 5 to 15 years (Esty, 2003).

But this framework has been changing: the regulatory landscape for debt has been evolving since the 2008 crisis, which displayed that the bank supervision quality was not good enough. The capital bases of financial institutions were too low, their leverage was too high and they did not have enough liquid assets (Brenk, 2012). For that reason, the Basel Committee presented significant changes to bank loans’ capital consumption with the Third Basel Agreement (Basel III Capital Accord). The new regulatory framework aims to raise the quality and

quantity of banks' regulatory capital base and to improve the risk coverage of the banking sector, thus improving the endurance of this sector to systemic shocks (Bridges et al., 2014; Bezoen, 2015; Ma, 2016).

The evolution of the sector in response to these restrictions has been notorious, and since 2015 the capital requirement demands became effective. Cosimano and Hakura (2011) empirically study how higher capital requirements, by raising banks' marginal cost of funding, lead to higher lending rates. More specifically, Slovik and Cournede (2015) estimate that to meet capital requirements banks are projected to have to increase their lending spreads on average by about 15 basis points. This estimate increases when analyzing the capital requirements effective as of 2019 (7% for the common equity ratio, 8.5% for the Tier 1 capital ratio) to 50 basis points.

In this situation, where the pressure on banks' balance-sheets constrains long-term lending, banks are worst positioned for long-term PF lending. This impact has been apparent in the ways PF deals are being structured. Project bonds have emerged as a substitute for bank loans to finance long-term projects. Project bonds are not a new instrument, but their advantages over traditional bank loans became more salient after the 2008 crisis. With minimum refinancing risk, competitive pricing, and improved credit ratings thanks to the help of government support programs, it is predictable that institutional investors will gradually increase their interest in project bonds, making them a major instrument for funding long-term projects (Ma, 2016). This change of preferences is supported by Esty, Chavich and Sesia (2014) that report the rapid change in relation to the choice of financing instrument, due to the fact that from 2009 to 2013 the use of project bonds increased 500 basis points (from 8% of total debt to 13%).

Project bonds are interesting because they can match long term liabilities to long-term cash flows from projects (maturities may extend 20 years or more).

This type of bond can allow borrowers to access a capital markets investor base, attract another pool of liquidity that could complement existing loans. The bonds themselves often offer stable returns at higher rates than similarly structured sovereign debt. They usually have low volatility and little correlation with other asset classes. They have flexible financing structures and can be adapted to include multiple assets and projects.

3. Research Gap and Hypotheses

Although the growth of the PF market and, more recently, the investors' increase interest in the PF bonds' market, there has been very little empirical academic research on this specific segment of the bond market. The issuance of this type of bond is recent, but increasingly important as the financing of projects via bank syndicates, with the 2007-2008 crisis and the subsequent sovereign debt crisis in Europe has been progressively more difficult. In addition, PF has become increasingly important in financing large-scale projects around the world. Finally, with the structural changes associated with long-term syndicate lending, the usage of PF bonds instead of PF loans increased in the last decade.

For that reason, it is essential and imperative to examine PF bonds. While the empirical study of the pricing of standard corporate bonds (Collin-Dufresne, Goldstein, and Martin 2001; Elton, Gruber, Agrawal and Mann, 2001; Longstaff, Mithal and Neis, 2005; Gabbi and Sironi, 2005; Flannery, Nikolova and Öztekin, 2012; Cornaggia, Cornaggia and Hund, 2017) extensively created a base for the understanding of what factors can affect bond credit spreads in general, the distinctive characteristics associated with a Project Finance operation merit their own separate study and analysis. Moreover, notwithstanding research developed in the area of syndicated loans (Maskara, 2010; Lim, Minton and

Weisbach, 2014; Prilmeier, 2017) and PF loans (Esty and Megginson, 2003; Hainz and Kleimeier, 2012; Corielli et al., 2010; Gatti et al., 2013; Pinto and Alves, 2016b), it is important to identify how different factors can impact PF bonds' credit spreads and how they compare with those of standard corporate finance (CF) bonds. Having this in mind, a question arises: Do PF bonds have higher credit spreads than CF bonds?

According to Esty (2003), PF syndicated debt structures, arguably, reduce funding costs by mitigating deadweight costs of market imperfections as agency and asymmetric information problems. Also, Corielli et al. (2010) argue that PF can reduce the cost of debt by reducing the number of assets subject to costs related to financial distress and bankruptcy by separating some assets from their balance sheet (increasing financial flexibility and reducing contamination risk). Empirically, Kleimeier and Megginson (2000) find that PF loans have lower credit spreads than do comparable syndicated non-PF loans, with the exception of fixed-asset based loans. This leads to a first hypothesis:

Hypothesis 1 (H1): PF bonds are issued with lower credit spreads than similarly rated CF bonds.

On the other hand, it is important to consider that structuring a PF transaction is much more costlier than a traditional corporate financing alternate (Caselli and Gatti, 2005). Creating a stand-alone project company can take from six to eighteen months and requires significantly greater transaction costs than financing an asset on an existing balance sheet (Esty and Megginson, 2003). Besides, the process of arranging the financial agreement is very complex, involving many different stakeholders. These factors can result in higher rates and fees charged by lenders for the transaction vis-à-vis traditional corporate financing.

Recently Pinto and Alves (2016a) find that PF deal's weighted average spread is not lower than that of CF deals, by using a sample of 15,191 syndicated deals closed between 2000 and 2016. This leads to the opposite hypothesis:

Hypothesis 2 (H2): PF bonds are issued with higher credit spreads than similarly rated CF bonds.

Beyond comparing the spread values for these two types of operation it is important to understand how different pricing mechanics impact these bonds. This raises a second research question: are PF and CF bonds priced differently by common pricing determinants? Cuchra (2005) stresses that the rating process is different for these two types of bonds: whereas securities and issuers are evaluated according to certain conditions upon which a given rating is assigned on CF bonds, in structured finance the process is inverted: the issue is structured in order to achieve a specified credit rating. This means that CF bonds are rated ex-post while structured finance operations are rated ex-ante. Therefore, contrary to the traditional corporate bonds, where the credit spread depends fundamentally on the issuing firm's characteristics, the credit spread of any SF tranche depends, instead, on the assets and cash flows pledged as collateral and on the credit improvement mechanisms used (Liu, Mao and Nini, 2018; Marques and Pinto, 2020). Due to the difference in underlying risks, the relevant pricing characteristics for these two types of debt instruments should also differ. Pinto and Alves (2016a), using a sample of syndicated loans closed between 2000 and 2014, find that PF and non-PF loans are influenced differently by common pricing characteristics. Under this framework, we develop the following hypothesis.

Hypothesis 3 (H2): PF and CF bond issues are priced differently by common pricing factors and, as for CF bonds, investors rely on other factors besides credit ratings when pricing PF bonds.

Finally, it is imperative to understand how these different economical and structural conditions can impact the pricing of these instruments. More specifically, the study of the impact that the 2007-2008 financial crisis and the subsequent European sovereign debt crisis had on PF and CF bonds could help to clarify the economic efficiency gains of project financing vis-à-vis corporate financing in different contexts. This leads to the following question: Are the credit spreads and pricing determinants of PF and CF bonds significantly affected by the financial crises?

During the financial crisis, increased illiquidity combined with risk aversion was verified. Dick-Nielsen, Feldhütter and Lando (2012) explore the effect of illiquidity during the sub-prime crisis on corporate bonds. Their study displays that spread contribution from illiquidity increases dramatically with the onset of the subprime crisis. Liao, Chen and Pei-ling (2009) deepened this analysis and corroborate that liquidity volatility significantly impacts bond yield spreads when controlling for well-known variables.

Furthermore, Pinto and Alves (2016a) show that the 2007-2008 financial crisis and the subsequent European sovereign debt crisis impacted significantly both PF loan spreads and borrower's choices in Western Europe. This leads to a final hypothesis:

Hypothesis (H4): PF and CF bond credit spreads and pricing processes are significantly affected by the 2007/2008 financial crisis and the subsequent European sovereign debt crisis.

This empirical study follows the same line of thought as Marques and Pinto (2020), that examine the pricing of 3 types of structured finance operations (asset-backed securities, mortgage-backed securities and collateralized debt obligations) and compare it with the pricing of corporate bonds at issuance.

There has been practically no empirical research that has investigated the factors that affect the pricing of PF bonds. This work aims to contribute to filling that gap in the literature.

The main objective of this thesis is to study the pricing of PF bonds, identifying the factors that determine the overall spread, and to make a comparison with the main factors that influence CF bonds. This work will extend current financial literature by providing an overview of the differences in pricing between these two debt instruments. Overall, it helps shed some light on the characteristics of PF projects and how they compare to other types of financing. These aspects are of extreme importance to policymakers, as it provides them with a better knowledge of these instruments, allowing for more precise and efficient regulatory interventions. At the same time, it will help market agents to understand and evaluate in more complete form PF operations, namely in terms of financing mechanisms.

4. Data, Methodology and Variable Definition

4.1 Sample selection

The sample used in this study consists of individual bond offers extracted from DCM Analytics and covers the 1995-2019 period. This database contains comprehensive information on bond securities issued on the debt capital markets. Despite the available information on various types of bonds, it is only included in this sample bonds categorized as “corporate bond investment-grade” and “corporate bond high yield”. These criteria were applied in order to guarantee maximum comparability between the two bond classes and to avoid the impact of specific instrument characteristics to impact the spreads. In terms of the geographical distribution of these bonds, it was chosen a full global sample to maximize the size of the PF bonds sample. In order to obtain the PF bond sample deals, we selected those with a use of proceeds equal to “project financing”. Appendix A displays the evolution of the full sample of PF and CF bonds by year. Additionally, being the main objective of this study to analyze the factors that influence PF bond pricing and to guarantee maximum comparability with CF bonds, we excluded issues from the financial sector (classified as general industry group “Finance” or “Insurance”). Some of the PF operations were classified in the “Finance” industry group, not necessarily because of the purpose of the loan but because they used an SPV classified as a “Financial Vehicle”. For that reason, and to maximize the survival rate, each PF operation classified in the “Finance” industry group, was manually evaluated and reclassified having into account the purpose of the transaction.

Since the primary purpose of this analysis is to evaluate how credit spreads and pricing processes on PF bonds compare with those of similarly rated CF

bonds, it was required that each transaction contained information about the credit spread. It was only included bond tranches classified as either fixed-rate bonds or variable rate bonds with yield to maturity information. Finally, to increase comparability, from the full sample of CF bonds a sub-sample was selected. The main criteria in this selection was obtaining only the transactions that were classified within the same industries as PF ones (industry comparability).

These screens yield a sample of 28,687 tranches (22,356 transactions) worth \$23,553.3 billion, of which 405 tranches (308 transactions) worth €253.6 billion are classified as PF bonds and 28,282 tranches (22,048 transactions) worth €23,299.6 billion as CF bonds. Panel A of Table 1 presents the industrial distribution of the full sample of tranches divided by deal type, while Panel B details the tranche allocation to issuers in a particular area/geography.

Panel A shows that PF bonds, as expected, are issued in four main industries: Utilities (35.08%), Oil and Gas (21.17%), Transportation (17.41%), Construction/Heavy Engineering (7.14%). On the other hand, CF bonds reveal a more fragmented industrial pattern, with Utilities (15.92%), Oil and Gas (11.61%), Communications (11.53%) and Services (10.28%) receiving the highest shares of all CF bond issuance.

Panel B reveals clearly that the majority of both PF (51.29%) and CF (50.83%) bonds are issued in North America. After that, it is possible to see a second similar concentration of issues for both PF (28.45%) and CF (31.50%) tranches in Europe. Important to notice the relative difference in both South America and Africa areas. These geographies represent a higher share in PF tranches (5.32% and 1.87%, respectively) when compared with CF ones (2.63% and 0.23%). This disparity can help support the extensive use of PF in developing economies.

Table 1: Industrial and geographic distribution, and top issuers

Panel A: Industrial distribution

Industrial category of originator/issuer	Project Finance Bonds			Corporate Bonds		
	Number of tranches	Total value	Percent of total value	Number of tranches	Total value	Percent of total value
		[\$ Million]			[\$ Million]	
<i>Commercial and Industrial</i>						
Agriculture, Forestry and Fishing	2	525	0,30	469	120 255	1,02
Communications	5	1 342	0,77	1 929	1 364 209	11,53
Construction/Heavy Engineering	46	12 384	7,14	3 326	1 116 814	9,44
Manufacturing						
Chemicals, Plastic and Rubber	2	2 035	1,17	901	332 916	2,81
Food and Beverages	1	1 000	0,58	1 166	548 629	4,64
Machinery and Equipment	6	6 264	3,61	1 778	1 066 871	9,02
Steel, Aluminum and other Meta	-	-	-	-	-	-
Other	2	73	0,04	843	379 120	3,20
Mining and Natural Resources	11	2 368	1,36	544	300 137	2,54
Oil and Gas	50	36 724	21,17	2 318	1 374 381	11,61
Real Estate	34	10 978	6,33	3 308	890 167	7,52
Retail Trade	5	738	0,43	901	399 149	3,37
Services	26	6 532	3,76	2 696	1 215 926	10,28
Utilities	153	60 860	35,08	5 781	1 884 082	15,92
<i>Financial Institutions</i>	-	-	-	-	-	-
<i>Transportation</i>	59	30 204	17,41	2 247	806 119	6,81
<i>Public Administration/Government</i>	3	1 481	0,85	75	34 162	0,29
<i>Other</i>	-	-	-	-	-	-
Total	405	173 510	100,00	28 282	11 832 938	100,00

Panel B: Geographic distribution

Geographic location of originator/issuer	Project Finance Bonds			Corporate Bonds		
	Number of tranches	Total value	Percent of total value	Number of tranches	Total value	Percent of total value
		[\$ Million]			[\$ Million]	
Europe	90	49 362	28,45	6 990	3 726 840	31,50
Africa	3	3 250	1,87	88	27 013	0,23
Asia	47	18 042	10,40	5 512	1 548 838	13,09
South America	64	9 223	5,32	1 443	310 637	2,63
North America	192	88 988	51,29	13 645	6 014 274	50,83
Caribbean	1	619	0,36	31	11 520	0,10
Australia & Pacific	8	4 027	2,32	573	193 817	1,64
Total	405	173 510	100,00	28 282	11 832 938	100,00

(Continued)

Panel C provides information concerning the top issuers and their relative importance in PF and CF bond markets. It is important to notice a higher concentration of the value of the deals around the top 10 issuers in PF bonds when compared with the distribution of issuers for CF tranches. The top 10 PF issuers were involved in 24,65% of the deals while the top 10 CF issuers were involved in only 7,05% of all deals. This difference is even more glaring when comparing the top 3 PF issuers (Sabine Pass Liquefaction LLC, Mexico City Airport Trust and North West Redwater Partnership) that represent 13,44% of the market to the top 3 CF issuers (China Railway Corp, BP Capital Markets and Apple Inc) that equate to 2,70% of the total market. Appendix B presents information about the Top 13 biggest PF transactions in our database.

Table 1: Industrial and geographic distribution, and top issuers

(continued)

Panel C: Top originators/issuers					
Project Finance Bonds			Corporate Bonds		
	By value of deals	By number of deals		By value of deals	By number of deals
Sabine Pass Liquefaction LLC	7,12%	2,22%	China Railway Corp	1,08%	0,29%
Mexico City Airport Trust	3,46%	0,99%	BP Capital Markets plc	0,85%	0,39%
North West Redwater Partnership	2,87%	3,21%	Apple Inc	0,77%	0,24%
VMware Inc	2,31%	0,74%	Shell International Finance BV	0,74%	0,25%
Iberdrola International BV	1,70%	0,74%	AT&T Inc	0,69%	0,21%
Electricite de France SA	1,62%	0,49%	Petroleos Mexicanos	0,61%	0,22%
Cheniere Corpus Christi Holdings LLC	1,58%	0,49%	IBM	0,61%	0,26%
MidAmerican Energy Co	1,35%	0,99%	Telefonica Emisiones SAU	0,58%	0,20%
Entergy Louisiana LLC	1,34%	0,99%	John Deere Capital Corp	0,57%	0,57%
Sasol Financing USA LLC	1,30%	0,49%	Deutsche Telekom International Finance BV	0,54%	0,19%

Panel A describes the industrial distribution of tranches, whereas Panel B details the tranche allocation to issuers in a particular region. Panel C provides information on the biggest players and their relative importance in PF and CF bond markets. Data are for tranches with credit spread and tranche amount available, closed by issuers during the 1995-2019 period.

According to our database, the project that leads to the first PF bond issuance is ‘Ras Laffan Liquefied Natural Gas Co Ltd – Rasgas’, in December 1996. The Ras Laffan Liquefied Natural Gas (Ras Gas) project involved a \$1.2 billion bond offering that had been the largest for any international project at the time. The main purpose of the Ras Gas project was to extract, process, and sell liquefied natural gas from a field off the shore of Qatar. The principal off-taker was the Korea Gas Corporation, which resold most of the LNG to the Korea Electric Power Corporation for electricity generation.

4.2. Methodology

To examine the common pricing determinants of individual PF and CF tranches, and how PF credit spreads compare with similarly rated CF bonds, it was used the model described in equation (1). The dependent variable is the credit spread, in basis points. It was employed OLS regression techniques and the respective adjustment for heteroskedasticity. Due to time-varying risk premia and cross-country differences, it was estimated standard errors clustered by year and country.

$$(1) \quad \begin{aligned} Credit\ Spread_{i,t} = & \alpha_0 + \beta_1 Rated_{i,t} + \sum_{n=2}^{21} B_n Rating\ Dummy_{n,i,t} + \\ & \beta_{22} Rating\ Discordence_{i,t} + \gamma Contractual\ Characteristics_{i,t} + \\ & \varphi Macroeconomic\ Factors_t + \varepsilon_{i,t} \end{aligned}$$

Besides the rating, the independent variables used in the empirical analysis can be grouped in *Contractual characteristics* and *Macroeconomic Factors*. These variables are reported in Appendix C, which provides the definitions and sources

for all the variables used, as well as the expected impact of the independent variables on credit spreads. Appendix D provides summary descriptive statistics.

4.3. Variables

4.3.1. Credit Spread

Credit Spread represents the price for the risk, in basis points (bps) associated with the bond at closing, defined as the difference between the yield to maturity at issue and the yield to maturity of a corresponding currency treasury bond with a comparable maturity.

This study is based on primary market spreads. The use of secondary market spreads is avoided not only because of the relatively poor liquidity of some minor issues but also because ratings of new issues reflect more clearly the raters' assessment near the time of issuance.

4.3.2 Credit Rating

This variable *rating* evaluates the capacity of the borrower to repay interest and principal on time or, in other words, evaluates the issuer's probability of default. For that reason, the lower the credit rating the higher the default probability, so it is expected an increase in the *credit spread* as rating decreases.

Credit ratings in structured finance probably carry more explanatory power on credit spreads than in traditional CF bonds. Cuchra (2005) argues that this happens because the process of rating each issue is different: securities and issuers are assessed according to certain conditions upon which a given rating is

assigned, in the case of corporate bonds. On the other hand, in structured finance the process is inverted: the issue is structured in order to achieve a given credit rating.

In the present study, all tranches are characterized by credit ratings from Moody's and Standard & Poor's rating agencies. It is used a rating classification scheme based on 21 rating scales. The rating assigned by S&P or Moody's is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=21 (Gabbi and Sironi, 2005; Cornaggia, Cornaggia and Hund, 2017; Marques and Pinto, 2020). If a tranche has two different credit ratings, the average was calculated.

The dummy variable *rated* is included in this analysis, as some bonds are not rated – it is equal to 1 if the bond has a credit rating from S&P and/or Moody's and 0, otherwise. Besides, the variable *rating discordance* is used to evaluate whether rating agencies' discordance has any statistically significant impact on the *credit spread* (Gabbi and Sironi, 2005). Different numeric equivalent values assigned by rating agencies reflect a higher level of uncertainty regarding default risk, so it is expected that *rating discordance* has a positive impact on the *bond spread*. This is a dummy variable which equals 1 if there is a discordance in the rating assigned by S&P and Moody's and 0, otherwise.

4.3.3. Contractual Characteristics

Various empirical studies indicate that numerous contractual factors beyond rating categories impact the pricing of CF bonds (Elton, Gruber, Agrawal, and Mann, 2001; Campbell and Taksler, 2003; Longstaff, Mithal and Neis, 2005; Gabbi and Sironi, 2005) and SF tranches, namely asset securitization bonds (Vink and Thibeault, 2008; Sorge and Gadanecz 2008; Fabozzi and Vink, 2012; Marques and Pinto, 2020). Some of these factors include maturity, deal size, number of banks

in the issuing syndicate, bank reputation, subordination level, collateral-type, currency risk, and type of interest rate. For that reason, it is important to test how these factors can affect the pricing of PF bonds.

4.3.3.1 Maturity

This variable represents the maturity of bonds, in years. Usually, bonds with shorter maturities are usually less risky than bonds with longer maturities. For that reason, higher premiums for long-term securities are generally demanded by investors (Marques and Pinto, 2020).

However, results presented by Sorge and Gadanecz (2008) regarding PF suggest that the impact of maturity on spreads is non-linear, while Vink and Thibeault (2008) find that this relationship can be negative in structured finance operations. For that reason, in addition to controlling for maturity, it is specified the logarithm of maturity (*log maturity*) in the baseline multiple regression, as a surrogate for any non-linear relationships between credit spread and maturity.

4.3.3.2. Transaction Size

A higher issue amount is usually thought to improve, *ceteris paribus*, the secondary market liquidity. This happens because larger issues are likely to be associated with less uncertainty and to have more public information available about them than smaller offerings. Despite this, Cuchra (2005) finds little evidence of the importance of this variable in explaining bond liquidity. Likewise, Gabbi and Sironi (2005) find that the association between *transaction size* and *credit spread* is not statistically significant. The same authors suggest that

this occurs since investors do not expect the liquidity of a bond's secondary market to be affected by the size of the issue. However, Marques and Pinto (2020) find a negative and significant impact of *transaction size* on the *spread* for SF tranches but an insignificant one for Corporate Bond issues, which is in agreement with the remnant literature. Being PF a Structured Finance operation, it is expected that as the *transaction size* increases, the PF *credit spread* will decrease. This variable is expressed as the natural log of the transaction size.

4.3.3.3. Number of tranches

The variable number of tranches per transaction is included in this analysis to observe the influence of tranching on credit spread (Cumming and Schwienbacher, 2019). Each transaction is divided into one or more tranches and the number of tranches for each transaction was documented. A negative relationship between the number of tranches and bond spread is expected, as tranching can allow the issuer to benefit from market factors such as "greater investor sophistication and heterogeneous screening skills related to asymmetric information" (Vink and Thibeault, 2008). Marques and Pinto (2020) suggest that this might be explained by the fact that a tranche belonging to a CF issue with a relatively higher number of tranches is usually seen as less risky, as it allows for risk distribution.

Similarly, regarding securitizations, Cuchra and Jenkinson (2006) find a significant negative association between the number of tranches and the spread after controlling for credit rating. In addition, it is concluded that a considerably higher number of tranches per transaction is issued in an SF transaction in comparison to a CF transaction and that SF transactions benefit from tranching to a larger extent than straight debt finance transactions.

Additionally, there can be both fixed-rate and floating-rate tranches in the same deal. For that reason, it is included in the model a *fixed rate* dummy variable to control for this effect on credit spread.

4.3.3.4. Number of Banks and Bank Reputation

The variable *number of banks* tries to measure the bank involvement of each transaction. It is expected a negative relationship for both PF and CF bonds credit spreads. To capture additional differences in bank syndicates, it is also controlled for bank reputation, computed according to the 2018 Thomson Reuters EMEA bookrunners ranks (Marques and Pinto, 2020). It is expected that the higher the *bank reputation*, the lower the *credit spread* for PF and CF bonds, which might be explained by the reduction of information asymmetries and higher investor confidence when banks with a higher reputation are involved (Kara, Marques-Ibanez and Ongena, 2015).

4.3.3.5. Currency risk

Currency risk is defined as the risk that is run if there is a mismatch in the currency of the deal's nationality and the currency of the bond issue. According to Vink and Thibault (2008), it should be expected an increase in the *spreads* of issues exposed to currency risk than issues not exposed to currency risk. The same authors find a significant, positive relationship between *currency risk* and *spread* for ABS, MBS, and CDOs after controlling for credit rating. Similarly, Marques and Pinto (2020) found a positive and significant influence of currency risk on spreads for CDO, but a positive and insignificant influence on spreads for

ABS, MBS, and Corporate Bonds (CB). In line with these findings, it is expected currency risk to have a positive impact on the *spread* of PF bonds. The dummy variable takes the value of 1 if a bond is exposed to currency risk and zero otherwise.

4.3.3.6. Callable, Subordinated and Collateralized Tranches

To search for differences in risk existing among different tranches of a deal, the dummy variables *subordinated*, *callable* and *collateralized* were included in the model. It is expected subordinated bonds to have higher credit spreads than senior bonds (Marques and Pinto, 2020). In addition, because a callable option in a bond allows the issuer to redeem it earlier than the maturity date (increases risk for the investor), it is expected that the *callable* dummy variable to have a positive relationship with the *credit spread*. Finally, it is anticipated that a bond with a collateral attached is less risky because the collateral serves as an additional guarantee to the investor. Interestingly, Kleimeier and Megginson (2000) empirically display a negative relationship with the spread for General Corporate Purpose loans but found a positive relationship with PF loan spreads. They raise the hypothesis that by the fact that normally PF loans are concentrated upon funding tangible-asset-rich projects, industries chosen as “collateralizable” may be riskier than the average. Thus, it is expected a positive relationship between the dummy variable *collateralized* and *credit spread* for PF bonds, but a possible negative relationship for CF bonds.

4.3.4. Macroeconomic Factors

4.3.4.1. Yield Curve Slope and Market Volatility

In order to study the effect of macroeconomic factors on *credit spread*, the variable *yield curve slope* is included and it is estimated as the difference between the five-year US Treasury Bond and the 3-month US Treasury Bill (USA5y-USA3M). Collin-Dufresne, Goldstein and Martin (2001) claim that the slope of the term structure provides a measure of uncertainty in the economy. Having that in mind, a negative slope should indicate expectations of cuts in interest rates in the future. This drop in interest rates could be associated with a deteriorating economic climate and higher credit risk premiums. According to Marques and Pinto (2020), it is expected, for both AS and CF bonds, that increases in the *yield curve slope* should have a negative influence on *spreads*.

The variable *market volatility*, measured by the Chicago Board Options Exchange Volatility Index, which reflects a market estimate of future volatility, is also included. It is predicted that as *market volatility* increases, *credit spreads* will also increase (Cremers, Driessen, Maenhout and Weinbaum, 2004). Additionally, Campbell and Taksler (2003) argue that volatility can explain the variation in yields as much as ratings do and its explanatory power persists even in the presence of credit ratings.

4.3.4.2. Country Risk and Creditor Rights

Moody's country credit rating was used to measure the *country risk*. This variable measures from 1 for the countries with the lowest risk (Aaa=1) to 21 for the countries of highest risk (C=21). An increase in spread is expected as *country risk* gets higher.

Strong evidence that investors charge higher yields on CF bonds to firms from countries with poor creditors' rights protection is reported by Boubakri and Ghouma (2010). According to the same authors, higher protection of rights usually decreases *credit spread* and increases bond ratings. Therefore, the impact of *creditor rights* on *credit spread* is analyzed using La Porta, Lopez-de-Silanes, Shleifer and Vishny's (1998) indexes. La Porta et al. (1998) display that the level of investor protection affects external financing and governance of operations, impacting the firm market value in equity markets.

4.3.4.3. Crisis

Finally, dummy variables *financial crisis* and *sovereign crisis* are included in the present analysis to study the impact of the crisis period on *credit spread*. Marques and Pinto (2020) confirmed in their analysis that the average credit spread is significantly higher for ABS, MBS, CDO, and CB issues during the *financial crisis* and the subsequent European *sovereign crisis*.

As in Riachi and Schvienbacher (2015) and Marques and Pinto (2020), it is also used year and industry dummy variables to control for unobserved macroeconomic trends and possible industry-specific variations.

5. Univariate analysis

5.1. Descriptive Statistics

The sample is described by asset class, in Table 2. This table presents the descriptive statistics of each variable per bond instrument. Table 2 also presents the results of using the Wilcoxon z-tests for continuous variables and Fisher's exact tests for discrete ones, comparing the distribution for the values of each variable in the PF and CF bond samples.

Starting with the relative pricing of PF versus CF bonds, we show that average credit spreads are economically and statistically higher for PF bonds (254.0 bps) than they are for CF bonds (208.1 bps), at a 1% significance level. We compare also the evolution of credit spreads for PF and CF securities, by analyzing a pre-crisis period from January 1, 1995, through to September 14, 2008, and a crisis period from September 15, 2008 (the first trading day after Lehman Brothers' bankruptcy filing the day before) through to December 31, 2019 (see Table 5). As expected, the evidence supports the assumption that the average credit spread is significantly higher for PF bonds (258.8 bps versus 169.7 bps) and CF bonds (211.0 bps versus 199.5 bps) during the crisis period.

A PF tranche of average size matures in 14.5 years, a considerably longer period when compared to the average maturity of CF tranches of 10.0 years. This difference supports the idea that project financing is used mainly in long-term arrangements.

Average credit ratings for PF bonds (8|BBB+), are not statistically different from those of CF issues (8|BBB+). This preliminary analysis suggests similar risk profiles between the two instruments. The average country risk for PF (3.8) borrowers is significantly higher than the corresponding value for CF (2.7). This

result follows the general theory that a considerable percentage of firms that are involved in PF operations are located in riskier countries (driven by developing economies). Concerning the number of banks in the issuing syndicate, both PF (5.9) and CF (5.8) bond issuance have a similar number of financial institutions supporting the transaction. These results differ from those obtained from Kleimeier and Megginson (2000) regarding PF loans. This may suggest a different approach by the banks regarding the two types of instruments, even though they can be used in a project with the same risk profile. In fact, while in PF loans, arranging banks stay with the loans on its balance sheet, PF bonds are issued in capital markets, which means that the risk is spread out for a large number of investors. In addition, Table 2 shows that the average bank reputation of banks involved in CF transactions is significantly better than that of those involved in PF transactions. Regarding creditor rights in each country, we can see that there is no difference between the two types of bonds, with both PF and CF presenting a mean of 1.5.

PF bonds exhibit an average tranche size of €428.0 million, which does not differ significantly from the €418.0 million average tranche size exhibited by CF bonds. Similarly, the average transaction size does not differ significantly between the two bond types. In a typical CF transaction, the average number of tranches per transaction is 1.7, which does not differ significantly from the average of 1.8 for a PF transaction.

Regarding dummy variables, results show that a significantly larger fraction of CF bonds is fixed-rate (85.0%) when compared to the sample of PF bonds (78.3%). Also, a significantly higher fraction of CF bonds is closed in the pre-crisis period (25.3%) compared to the sub-sample of PF bonds (5.4%). These numbers support the idea that the issuing of PF bonds, especially on a larger scale, is very recent but at the same time extremely important to overcome bank restrictions on long-term lending (significant growth after 2008). PF and CF tranches do not

differ significantly in terms of rating discordance (different ratings from Moody's and S&P) and currency risk. Finally, examining specific bond characteristics we can identify that a higher percentage of CF tranches (2.2%) are subordinated when compared with PF ones (0.5%), but the opposite is verified when evaluating the percentage of tranches that are callable (50.3% and 54.6%, respectively). Additionally, comparing the percentage of tranches there are collateralized for each type of instrument, it is clear that PF bonds, with 43.0%, have a much higher proportion of bonds collateralized *vis-à-vis* CF bonds (8.2%). These numbers corroborate the assumption that a substantial percentage of PF deals (especially capital-intensive ones), SPV's assets and cash flows are pledged as collateral to improve credit quality and ultimately reduce the overall funding costs.

The results indicate that some of the common pricing characteristics differ significantly in value between PF and CF tranches. Therefore, it is expected the impact on pricing to be bond-specific.

Table 2: Univariate statistics - pricing features associated with bonds compared

Variable of interest	Project Finance Bonds	Corporate bonds	Variable of interest	PF Bonds	Corporate bonds
<i>Univariate analysis - continuous variables</i>					
Credit spread (bps)			Transaction size (\$ Million)		
Number	405	28 282	Number	405	28 282
Mean	254,0	208,1 ***	Mean	626,0	824,0
Median	195,0	155,0	Median	462,0	389,0
Rating [1-21 weak]			Tranche size (\$ Million)		
Number	286	21 086	Number	405	28 282
Mean	7,9	8,4	Mean	428,0	418,0
Median	8	8	Median	325,0	300,0
Number of tranches			Number of banks		
Number	405	28 282	Number	405	28 282
Mean	1,8	1,7	Mean	5,9	5,8
Median	1	1	Median	4	4
Maturity (years)			Country risk [1-21 weak]		
Number	405	28 248	Number	2 520	28 282
Mean	14,5	10,0 ***	Mean	3,8	2,7 ***
Median	10,0	7,0	Median	1	1
Bank Reputation [1-26 worst]			Creditor rights		
Number	405	28 282	Number	398	27 652
Mean	9,9	7,0 ***	Mean	1,5	1,5
Median	5,0	2,0	Median	1	1

(Continued)

Table 2: Univariate statistics - pricing features associated with bonds compared
(continued)

<i>Univariate analysis - dummy variables</i>					
Fixed rate			Currency risk		
Nr. of tranches	405	28 282	Nr. of tranches	405	28 282
Nr. of tranches with d=1	317	24 031 [#]	Nr. of tranches with d=	81	6 700
% of total	78,3%	85,0%	% of total	20,0%	23,7%
Rating Discordance			Collateral		
Nr. of tranches	405	28 282	Nr. of tranches	405	28 282
Nr. of tranches with d=1	127	8 057	Nr. of tranches with d=	174	2 309 [#]
% of total	31,4%	28,5%	% of total	43,0%	8,2%
Rated			Subordinated		
Nr. of tranches	405	28 282	Nr. of tranches	405	28 282
Nr. of tranches with d=1	286	21 086	Nr. of tranches with d=	2	627 [#]
% of total	70,6%	74,6%	% of total	0,5%	2,2%
Callable			Pre-crisis period		
Nr. of tranches	405	28 282	Nr. of tranches	405	28 282
Nr. of tranches with d=1	221	14 236	Nr. of tranches with d=	22	7 144 [#]
% of total	54,6%	50,3%	% of total	5,4%	25,3%

This table reports summary statistics for a sample of PF bonds and CF bonds issued during the 1995-2019 period. Information on the characteristics of bond issuances was obtained from DCM Analytics. We test for similar distributions in contractual characteristics using the Wilcoxon rank-sum test for continuous variables and the Fisher's exact test for discrete ones. *** indicates significant difference at the 1% level between PF and CF tranches. ** indicates significant difference at the 5% level. * indicates significant difference at the 10% level. Bond rating is based on the S&P and Moody's rating at the time of bond issuance. For Discrete Variables # indicates significant difference at the 5% level. The rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=21. For a definition of the variables, see Appendix C.

6. The Pricing of PF bonds vs CF bonds

Table 3 presents the results of estimating regression (1) using the two samples discussed in section 4.1. Model [1] presents the pricing results for a joint sample of PF and CF bonds and includes the dummy variable *Deal Type PF* (1 if the bond is a PF bond and 0 if it is a CF bond). Models [2] and [3] present the pricing results for PF bond and CF bond samples, respectively. Models [4], [5], [6] present the results of re-estimating models [1] to [3] for the pre-crisis period, and models [7], [8], [9] for the crisis period. It is important to note that, due to the fact that the PF bonds sample has a low number of observations for the pre-crisis period, which resulted in biased coefficients, the results were not presented.

Table 3: Regression analyses of the determinants of credit spreads

Dependent variable: Credit spread (bps)	[1] PF and CB	[2] PF	[3] CB	[4] PF and CB Pre-Crisis	[5] PF Pre-Crisis	[6] CB Pre-Crisis	[7] PF and CB Crisis	[8] PF Crisis	[9] CB Crisis
Independent variables:									
Intercept	96,697 (1.23)	1013,09 *** (5.52)	94,33 (1.20)	108,80 * (-1.80)		-111,65 * (-1.88)	415,58 *** (3.97)	942,69 *** (4.86)	412,25 *** (3.97)
Rated	-118,55 *** (-11.29)	-71,03 * (-1.82)	-117,08 *** (-10.97)	-160,05 *** (-6.47)		-156,91 *** (-6.34)	-107,71 *** (-8.04)	-116,45 *** (-3.06)	-107,842 *** (-7.83)
AA+	-19,14 * (-1.94)	-18,01 (-0.30)	-20,94 ** (-2.09)	-7,14 (-0.69)		-8,13 (-0.77)	-24,16 * (-1.91)	20,17 (0.31)	-25,30 ** (-1.96)
AA	-21,51 (-1.39)	60,65 (0.95)	-24,08 (-1.55)	-14,47 (-0.98)		-16,41 (-1.12)	-40,16 ** (-2.03)	134,07 ** (2.17)	-42,15 ** (-2.09)
AA-	-2,52 (-0.26)	86,06 (1.35)	-4,72 (-0.49)	1,83 (0.17)		-0,41 (-0.04)	-13,80 (-1.10)	151,35 ** (2.47)	-14,98 (-1.15)
A+	15,43 (1.55)	-34,87 (-0.53)	13,41 (1.32)	12,98 (1.65)		11,08 (1.44)	2,42 (0.19)	9,68 (0.16)	1,55 (0.12)
A	31,12 *** (3.11)	-21,86 (-0.42)	29,09 *** (2.86)	31,49 *** (3.27)		29,54 *** (3.23)	17,83 (1.42)	28,59 (0.57)	16,89 (1.30)
A-	45,62 *** (4.76)	34,97 (0.68)	44,13 *** (4.49)	44,81 *** (5.39)		42,60 *** (5.36)	32,58 ** (2.53)	90,20 * (1.90)	32,35 ** (2.43)
BBB+	80,07 *** (7.97)	60,36 (1.16)	77,64 *** (7.58)	61,11 *** (7.95)		59,31 *** (7.82)	72,03 *** (5.389)	110,35 ** (2.22)	70,63 *** (5.10)
BBB	98,41 *** (9.69)	59,99 (1.19)	96,77 *** (9.24)	80,73 *** (9.21)		78,82 *** (8.99)	87,90 *** (6.279)	110,97 ** (2.40)	87,68 *** (6.05)
BBB-	144,99 *** (12.25)	119,75 ** (2.37)	142,86 *** (11.79)	108,94 *** (11.33)		106,97 *** (10.81)	141,58 *** (8.94)	169,25 *** (3.08)	140,71 *** (8.67)
BB+	211,06 *** (14.81)	123,28 (0.66)	209,35 *** (14.05)	170,94 *** (10.94)		168,94 *** (10.65)	212,93 *** (10.83)	170,70 (0.97)	212,96 *** (10.47)
BB	216,62 *** (11.53)	280,76 *** (3.47)	212,36 *** (11.08)	180,77 *** (9.78)		178,70 *** (9.55)	239,44 *** (11.78)	368,95 *** (5.05)	235,62 *** (11.20)
BB-	288,73 *** (12.98)	246,67 *** (3.27)	286,65 *** (12.65)	217,22 *** (9.34)		215,14 *** (9.09)	322,91 *** (14.47)	301,73 *** (5.19)	322,63 *** (14.24)
B+	357,18 *** (19.55)	271,99 *** (3.08)	355,38 *** (19.01)	320,64 *** (12.88)		318,30 *** (12.57)	365,00 *** (16.27)	329,14 *** (3.47)	364,87 *** (15.91)
B	413,61 *** (21.34)	250,00 ** (2.60)	411,91 *** (20.84)	371,91 *** (15.67)		369,87 *** (15.32)	425,89 *** (16.48)	305,36 *** (3.35)	426,14 *** (16.18)
B-	474,50 *** (28.28)	835,96 *** (7.05)	470,89 *** (27.68)	447,16 *** (23.08)		444,20 *** (22.40)	474,30 *** (20.44)	917,93 *** (6.47)	470,36 *** (20.17)
CCC+	551,99 *** (16.32)		549,39 *** (16.20)	467,28 *** (10.03)		465,06 *** (9.99)	595,31 *** (20.04)		593,43 *** (19.88)
CCC	631,02 *** (16.90)	1066,24 *** (13.27)	622,15 *** (16.95)	551,97 *** (8.93)		550,38 *** (8.95)	659,85 *** (16.65)	1123,96 *** (14.75)	650,19 *** (16.29)
CCC-	526,21 *** (4.23)		524,06 *** (4.21)	469,46 *** (2.98)		466,34 *** (2.96)	667,78 *** (8.94)		665,82 *** (8.82)
CC									
D	345,57 *** (2.88)		346,61 *** (2.89)	462,30 *** (8.10)		459,07 *** (8.02)	283,90 * (1.69)		289,06 * (1.72)
Rating discordance	17,00 *** (5.96)	2,95 (0.21)	17,42 *** (6.02)	16,22 *** (3.59)		16,14 *** (3.55)	18,56 *** (5.53)	-1,58 (-0.11)	18,98 *** (5.51)
Maturity	0,04 (0.11)	-7,41 *** (-2.90)	0,17 (0.46)	0,72 *** (2.58)		0,74 *** (2.64)	-0,71 (-1.41)	-8,68 *** (-3.48)	-0,54 (-1.13)
Log maturity	19,20 *** (2.99)	126,88 *** (3.08)	17,42 *** (2.80)	7,58 (1.33)		7,61 (1.34)	26,15 *** (3.20)	146,49 *** (3.59)	23,69 *** (3.00)
Log transaction size	-4,15 (-0.84)	-52,78 *** (-4.60)	-3,97 (-0.81)	9,36 *** (3.06)		9,26 *** (3.04)	-14,91 *** (-2.79)	-50,82 *** (-4.44)	-14,61 *** (-2.72)
Number of Tranches	2,55 (0.44)	15,01 (1.58)	2,28 (0.39)	-2,31 (-0.74)		-2,37 (-0.76)	5,83 (1.00)	15,11 (1.62)	5,53 (0.92)
Subordinated	-53,85 *** (-5.19)	209,05 *** (3.80)	-54,38 *** (-5.23)	-59,26 *** (-5.22)		-58,83 *** (-5.17)	68,77 *** (3.18)	221,50 *** (3.74)	66,95 *** (3.08)
Currency risk	27,25 *** (6.25)	71,60 *** (3.15)	27,34 *** (6.22)	-1,48 (-0.18)		-1,33 (-0.16)	37,90 *** (7.81)	67,04 *** (2.87)	37,92 *** (7.74)
Fixed rate	-18,91 ** (-2.05)	-130,40 *** (-3.26)	-16,33 * (-1.79)	54,63 *** (3.75)		54,22 *** (3.70)	-26,46 *** (-2.67)	-126,20 *** (-3.30)	-23,78 ** (-2.40)
Number of banks	-1,90 *** (-4.37)	0,12 (0.05)	-1,90 *** (-4.38)	-2,45 *** (-3.92)		-2,42 *** (-3.86)	-1,40 *** (-3.38)	0,06 (0.02)	-1,42 *** (-3.38)
Bank reputation	2,08 *** (5.59)	-0,40 (-0.24)	2,10 *** (5.53)	1,85 (0.81)		4,25 (1.45)	1,77 *** (4.87)	0,38 (0.22)	1,78 *** (4.84)
Country risk	6,01 *** (5.34)	6,38 ** (2.18)	5,83 *** (5.20)	6,65 *** (3.31)		6,78 *** (3.41)	5,81 *** (4.94)	7,74 *** (2.84)	5,60 *** (4.75)
Creditor rights	-6,65 *** (-3.59)	-18,84 ** (-2.40)	-6,52 *** (-3.51)	-7,57 ** (-2.23)		-7,56 ** (-2.20)	-5,16 *** (-2.59)	-20,24 *** (-2.64)	-4,96 ** (-2.49)
Collateral	55,15 *** (7.97)	55,94 ** (2.06)	55,43 *** (7.80)	20,67 ** (2.48)		20,77 ** (2.47)	53,36 *** (7.44)	54,78 ** (2.10)	53,55 *** (7.20)
Callable	44,00 *** (7.54)	22,77 (1.11)	44,51 *** (7.55)	16,13 ** (2.28)		15,93 ** (2.26)	56,82 *** (8.58)	25,07 (1.20)	57,78 *** (8.57)

(Continued)

Table 3: Regression analyses of the determinants of credit spreads
(continued)

Financial crisis	50,97 (1.00)	-139,69 (-1.30)	50,66 (1.00)					
Sovereign crisis	25,07 (0.47)	-0,87 (-1.30)	24,75 (0.46)					
Volatility	3,40 *** (5.20)	-0,56 (-0.26)	3,43 *** (5.23)	2,82 *** (4.16)	2,81 *** (4.09)	3,66 *** (4.55)	-1,27 (-0.67)	3,70 *** (4.58)
USA5y-USA3M	-0,000628 (-0.01)	0,8969 *** (2.73)	-0,0038 (-0.07)	0,0425 (0.55)	0,0421 (0.55)	-0,0098 (-0.15)	0,6855 *** (2.21)	-0,0179 (-0.27)
Deal Type PF	26,01 * (1.86)			9,14 (0.29)		24,95 * (1.79)		
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations:	28016			6 946		21 070	378	
PF bonds	398	398		20		378		
Corporate bonds	27618		27 618	6 926	6 926	20 692		20 692
Adjusted R ²	0,55	0,62	0,55	0,62	0,62	0,55	0,63	0,55
Rated and rating dummies as independent variables only								
Adjusted R ²	0,40	0,39	0,40	0,46	0,46	0,42	0,37	0,42
Differences in adjusted R ²	0,15	0,23	0,15	0,16	0,16	0,13	0,26	0,13

Table 3 presents the results of an OLS regression analysis of the determinants of bond credit spreads. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors. Due to time varying risk premia and cross-country differences, we estimate standard errors clustered by year and country.

Regarding the impact of credit risk on the credit spread, Table 4 presents the distribution of PF and CF bonds issued by credit rating scale for investment-grade bonds. It is interesting to notice that both PF and CF bonds display a similar distribution in terms of credit rating. We can see a clear concentration of the majority of ratings for both types of bonds concentrated around A- to BBB area. This seems to indicate a similar distribution in terms of default risk for the two types of bonds. However, comparing the median credit spread for each rating, we can observe that for the full sample, the median rating for each credit rating is superior in PF bonds when compared with similar CF bonds - e.g.: AAA PF (75 bps) is higher than CF issue median credit spread (68.8 bps). This simple sample analyses, however, do not allow us to control for other micro and macro pricing factors. Thus, to further test if PF bonds have higher spreads than comparable CF bonds, we proceed with regression analyses taking those pricing characteristics directly into account.

Table 4: PF and CF bonds mean and median credit spreads by credit rating

1995-2020 Period								
Credit rating (S&P / Moody's)	Project Bond				Corporate Bond			
	Number	Credit spread		% of Total Value	Number	Credit spread		% of Total Value
		Mean	Median			Mean	Median	
AAA / Aaa	11	81,2	75,0	4,51	324	88,5	68,8	1,96
AA+ / Aa1	7	88,0	80,0	2,87	330	92,4	76,0	1,99
AA / Aa2	7	131,0	122,5	2,87	665	74,5	62,1	4,02
AA- / Aa3	6	153,6	118,5	2,46	1 118	88,8	81,5	6,75
A+ / A1	13	101,3	92,0	5,33	1 588	101,0	90,0	9,59
A / A2	19	110,1	112,0	7,79	2 502	116,0	105,0	15,11
A- / A3	67	159,2	157,0	27,46	2 671	131,0	117,0	16,14
BBB+ / Baa1	43	227,6	187,0	17,62	3 026	164,8	148,0	18,28
BBB / Baa2	52	202,9	205,4	21,31	2 795	184,8	170,0	16,88
BBB- / Baa3	19	279,7	295,0	7,79	1 535	227,1	210,0	9,27
Pre-Crisis (1995-2008)								
Credit rating (S&P / Moody's)	Project Bond				Corporate Bond			
	Number	Credit spread		% of Total Value	Number	Credit spread		% of Total Value
		Mean	Median			Mean	Median	
AAA / Aaa	6	83,2	84,1	35,3	149	74,1	53,0	3,24
AA+ / Aa1	1	79,0	79,0	5,9	63	64,9	53,9	1,37
AA / Aa2	1	10,0	10,0	5,9	193	59,2	44,0	4,20
AA- / Aa3				0,0	259	73,4	67,0	5,63
A+ / A1	1	12,5	12,5	5,9	429	88,7	83,0	9,33
A / A2				0,0	711	99,6	93,0	15,46
A- / A3	5	118,3	109,8	29,4	648	120,8	112,3	14,09
BBB+ / Baa1	2	144,5	144,5	11,8	867	144,5	135,0	18,86
BBB / Baa2				0,0	816	160,5	141,8	17,75
BBB- / Baa3	1	225,0	225,0	5,9	463	183,4	165,0	10,07
Crisis (2008-2019)								
Credit rating (S&P / Moody's)	Project Bond				Corporate Bond			
	Number	Credit spread		% of Total Value	Number	Credit spread		% of Total Value
		Mean	Median			Mean	Median	
AAA / Aaa	5	78,8	69,0	2,2	175	100,8	77,0	1,5
AA+ / Aa1	6	89,5	53,2	2,6	267	98,8	80,0	2,2
AA / Aa2	6	151,2	138,8	2,6	472	80,7	69,4	3,9
AA- / Aa3	6	153,6	118,5	2,6	859	93,5	85,0	7,2
A+ / A1	12	108,7	94,5	5,3	1 159	105,6	95,0	9,7
A / A2	19	110,1	112,0	8,4	1 791	122,5	108,4	15,0
A- / A3	62	162,5	161,5	27,3	2 023	134,3	118,0	16,9
BBB+ / Baa1	41	231,7	195,0	18,1	2 159	172,9	150,0	18,1
BBB / Baa2	52	202,9	205,4	22,9	1 979	194,8	175,0	16,6
BBB- / Baa3	18	282,8	295,3	7,9	1 072	246,0	225,0	9,0

Table 4 displays number, mean and median credit spread for project finance (PF) bonds and corporate finance (CF) bonds issues by initial S&P and / or Moody's credit rating. Only investment grade bonds were included.

6.1. Do PF bonds have higher spreads than CF bonds?

Starting by comparing the variable *Deal Type PF* for the three periods – models [1], [4], and [7] - results show that when analyzing the 1995-2019 period, PF bonds have, on average, a 26 bps higher credit spread than comparable CF bonds. When considering the crisis period, we show that the credit spread is 24.95 bps higher for PF bonds than for CF bonds. The coefficient for the dummy variable *Deal Type PF*, despite being positive, it is not statistically significant in the pre-crisis period. For that reason, we can conclude that credit spreads do not differ significantly between PF and CF bonds in the pre-crisis period. This means that the significant difference between credit spreads only arises during the crisis period. These results seem to suggest a higher impact of the crisis in the overall risk of PF bonds, which are not fully captured by the credit ratings. We suggest that this can be explained by the increased costs that banks have when arranging these operations in a post-Basel III context conjugated with the increased inherent risks associated with long-term PF operations in a more volatile environment. Thus, we reject H1 and accept H2.

6.2. Baseline Results

Table 3 shows, as expected, that bonds that are rated have a lower credit spread. Moreover, there is a negative relationship between credit rating and credit spread: as credit rating decreases, the credit spread increases. Having this in mind, it should be noted that this relationship is not linear. Especially for PF coefficients, there is a non-linear relationship between credit ratings and spreads,

which can be explained by the smaller sample, where some rating categories display few observations.

It is also estimated for all models, a regression considering only rated and credit rating dummies as independent variables. Considering models [2] and [3], we show that they yield adjusted R² values of 0.39 and 0.40, respectively. This confirms credit ratings as the most important determinant of credit spreads in both PF and CF issues. However, our results do not corroborate the idea that credit ratings, in structured finance transactions, carry more explanatory power on credit spreads than in operations using corporate bonds (Cuchra, 2005). Additionally, the adjusted R² value increases, on average, 0.23 for PF bonds and 0.15 for CF bonds with the inclusion of additional contractual and macroeconomic variables. This shows that credit rating is not the only determinant of the credit spread. In fact, investors seem to not rely exclusively on ratings: they consider other factors when pricing PF and CF bonds, and for that reason do rely on other factors besides credit ratings, which corroborates H3.

Additionally analyzing model [3], we find that credit rating discordance between S&P and Moody's has a substantial positive impact (17.42 bps) on the credit spread for CF issues only, which is line with the results obtained by Marques and Pinto (2020). This result shows that rating agencies' discordance is incorporated by investors in the pricing of CF bonds, requiring a supplementary risk premium to compensate for a higher degree of uncertainty concerning the issuer's default risk. On the other hand, rating discordance seems to have no impact on PF tranches. These results remain the same when comparing both pre-crisis (16.14 bps; Model [6]) and crisis (18.98 bps; Model [9]) periods for CF bonds. Even during the crisis period, PF bonds does not seem to be influenced by rating discordance.

6.2.1. Contractual Characteristics

Analyzing the impact of the contractual characteristics, a hump-shaped relationship between credit spread and maturity appears strongly significant for PF bonds – model [2]. This follows the same rationale presented by Sorge and Gadanecz (2008), justifying this relation with the specific characteristics of PF operations such as “high leverage decreasing over time, long-term political risk guarantees and the sequential resolution of uncertainty along project advancement stages”. Interestingly, we find a positive relationship between credit spreads and maturity for CF tranches.

The impact of transaction size on credit spread is negative and significant for PF tranches, but insignificant for CF tranches for the entire sample period (Model [3]). These results may indicate a liquidity premium (positive price liquidity effect) on PF issues that are not present on the CF bonds market. These findings are in line with the results of Marques and Pinto (2020) that find a negative and significant impact of the transaction size on the spread for SF tranches but an insignificant one for Corporate Bond issues, and with Gabbi and Sironi (2005) that suggest that this occurs since investors do not expect the liquidity of a bond’s secondary market to be affected by the size of the issue on CF bonds.

Against expectations, we found that the number of tranches per transaction doesn’t impact the credit spread of both PF and CF bonds. This seems to contradict the findings of Vink and Thibeault (2008) and Cuchra and Jenkinson (2006), that found a negative relationship between the number of tranches and bond. This may suggest that investors don’t significantly see issues with a relatively higher number of tranches as less risky (no perception of risk distribution). Additionally, we found that PF and CF fixed-rate tranches tend to have lower credit spreads than floating-rate ones. This relation is specifically

strong for PF tranches, where this characteristic reduces the credit spread in 130.40 basis points.

The influence of currency risk on a credit spread is significant for both PF and CF bonds. As expected, such a mismatch in the currency of the deal's nationality and the currency of the bond issue significantly increases the rate charged, which is in line with the findings of Vink and Thibeault (2008). While credit spread and the number of banks have an insignificant relationship for PF tranches, it has a negative impact on the credit spread of CF tranches. This seems to indicate that increasing the number of banks involved in CF operations can reduce the perceived risk for investors. Also, we verify the same pattern when analyzing bank reputation. While PF bonds seem to not be influenced by this variable, the better the reputation of the banks involved, the lower the credit spread for CF bonds.

As expected, PF tranches have higher credit spreads when they are subordinated. Surprisingly, we observe the opposite significant relationship for CF tranches, where subordination has a negative impact on credit spreads.

Due to the fact that a callable option in a bond allows the issuer to redeem it earlier than the maturity date (increases risk for the investor), it was expected that the callable dummy variable to have a positive relationship with bonds spread. This relation was only observed for CF bonds where the existence of a call option increases the credit spread by 44.51 bps. Regarding PF bonds we did not find a significant relationship despite the positive coefficient.

Finally, it was anticipated that a CF bond with collateral attached is less risky because the collateral serves as an additional guarantee to the investors. Unexpectedly, we found that the existence of a collateral in a bond increases the credit spread for both CF and PF bonds. These results are in line with the one obtained by Kleimeier and Megginson (2000) which empirically display a positive relationship with PF loan spreads. The explanation for these results may

reside in the fact that normally PF loans are concentrated upon funding tangible-asset-rich projects, industries chosen as “collateralizable” may be riskier than the average.

6.2.2. Macroeconomic Factors

As expected, country risk is significantly positively related to credit spread for PF and CF issues, indicating that lending to a borrower located in a country with a rating of BB+ (BB+=11) versus one with a rating of AAA (AAA=1) will increase the credit spread by 63.8 bps and 58.3 bps for PF and CF bonds. This reflects the global risk perception of lenders concerning the borrowers’ country.

The impact of the creditor rights index is significant and negative, as expected, for both types of instruments. This evidence supports the premise defended by Boubakri and Ghouma (2010) and La Porta et al. (1998) that investors charge higher yields to firms from countries with poor creditors’ rights protection. It is also important to point out that this effect is stronger for PF transactions, which seems to indicate that since normally project finance operations are long-term oriented and with high fixed costs associated (pre-defined purposes), investors give more importance to the location of the project, and by consequence the creditor rights associated with the country.

Regarding the yield curve slope, we did not find evidence in line with the results presented by Sorge and Gadanecz (2008) and Marques and Pinto (2020), as credit spread and the yield curve slope, USA5y-USA3M, are not significantly related for CF bonds. Instead, we found this relationship to be significant and positive for PF bonds, meaning a steeper Euro swap curve is associated with higher credit spreads. Concerning credit spread and market volatility, we verify the opposite. CF bonds seem to display a positive relationship between volatility

and credit spread as expected (in line with Cremers, Driessen, Maenhout and Weinbaum (2004)), but PF bonds don't seem to be affected by fluctuations in volatility.

Finally, the financial crisis and sovereign crisis dummies were used to try to capture the impact of tranches issued between the starting date of each crisis and the end of that year. The results reveal no apparent impact of these periods on both PF and CF bonds.

Clearly, the overall results reinforce that both PF and CF bonds are priced differently by common pricing factors and that investors rely on factors other than credit ratings when pricing PF tranches, which validates H3.

6.3. The impact of the financial crisis in the pricing of PF and CF bonds

In order to provide a more in-depth analysis of the impact of the crisis on the pricing of both PF and CF bonds, we start by providing a descriptive analysis for each variable comparing pre-crisis and crisis periods (see Table 5). The Table also presents the results of Fisher's exact tests and Wilcoxon z-tests, which compare the distribution for the values of the variables in different periods: pre-crisis, from January 1, 1993, through to September 14, 2008; and a crisis period, from September 15, 2008, through to December 31, 2019.

Table 5: The impact of the financial crisis on pricing characteristics on PF and CF tranches

Panel A: The impact of the financial crisis on pricing characteristics - continuous variables

Variable of interest	Project Bond				Corporate Bonds			
	Number	Mean	Median	Wilcoxon z-test	Number	Mean	Median	Wilcoxon z-test
Credit spread (bps)								
pre-crisis	22	169,7	101,9	-3,38 ***	7 144	199,5	140,0	-13,40 ***
crisis	383	258,8	200,0		21 138	211,0	158,0	
Rating [1-22 weak]								
pre-crisis	20	5,9	7,0	-2,66 ***	6 788	9,2	9,0	21,01 ***
crisis	266	8,1	8,0		14 298	8,0	8,0	
Maturity (years)								
pre-crisis	22	16,6	9,9	0,02	7 110	11,2	10,0	20,05 ***
crisis	383	14,4	10,0		21 138	9,6	7,0	
Transaction size (\$ million)								
pre-crisis	22	536,0	342,0	-0,34	7 144	598,0	300,0	-17,07 ***
crisis	383	631,0	472,0		21 138	900,0	415,0	
Number of tranches								
pre-crisis	22	1,4	1	-0,83	7 144	1,5	1,0	-16,12 ***
crisis	383	1,8	1,0		21 138	1,8	1,0	
Number of banks								
pre-crisis	22	2,6	2,0	-3,66 ***	7 144	4,6	4,0	-17,90 ***
crisis	383	6,1	5,0		21 138	6,2	4,0	
Country risk [1-22 weak]								
pre-crisis	22	3,2	1,0	-0,80	7 144	1,7	1,0	-43,09 ***
crisis	383	3,9	1,0		21 138	3,0	1,0	

Panel B: The impact of the financial crisis on pricing characteristics - dummy variables

Variable of interest	Project Bond				Corporate Bonds			
	Number	Number (d=1)	% of total	Fisher's exact test	Number	Number (d=1)	% of total	Fisher's exact test
Fixed rate								
pre-crisis	22	15	68,2%	0,285	7 144	6 496	90,9%	0,000 #
crisis	383	302	78,9%		21 138	17 535	83,0%	
Currency risk								
pre-crisis	22	7	31,8%	0,171	7 144	1 595	22,3%	0,002 #
crisis	283	74	26,1%		21 138	5 105	24,2%	
Collateralized								
pre-crisis	22	9	40,9%	1,000	7 144	439	6,1%	0,000 #
crisis	283	165	58,3%		21 138	1 870	8,8%	
Subordinated								
pre-crisis	22	0	0,0%	1,000	7 144	527	7,4%	0,000 #
crisis	383	2	0,5%		21 138	100	0,5%	
Callable								
pre-crisis	22	4	18,2%	0,001 #	7 144	4 332	60,6%	0,000 #
crisis	383	217	56,7%		21 196	9 904	46,7%	

This table reports statistics for PF and CF tranches separated into two sub-samples: pre-crisis period (from January 1, 1995 through to September 14, 2008) and crisis period (from September 15, 2008 through to December 31, 2019). We test for similar distributions using the Wilcoxon rank-sum test for continuous variables (Panel A) and the Fisher's exact test for discrete ones (Panel B). In Panel A, ***, **, and * indicate significant difference at the 1%, 5%, and 10% levels, respectively. In Panel B, # indicates that there is a statistically significant difference in the dummy variable between the two periods at 5% significance level.

As expected, we observe a significant increase in the average credit spread of both PF bonds (from 169.7 bps to 258.8 bps) and CF bonds (from 199.5 bps to 211.0 bps) from the pre-crisis to the crisis period. It is important to notice that this impact is stronger in PF bonds, which supports the significant increase in systemic risk during this period. These results are in concordance with previous literature (Dick-Nielsen, Feldhütter and Lando, 2012; Liao, Chen and Pei-ling 2009; Pinto and Alves, 2016a; Marques and Pinto, 2020) that also document this impact. While we verify the same movement regarding the decrease of credit ratings for PF bonds, the opposite is found for CF bonds, where we find an increase in the average credit rating during the crisis period. These statistics contrast with the results obtained in models [2] and [3], where the periods of the Financial Crisis and Sovereign crisis seem do not impact the credit spreads of PF and CF bonds.

In addition, the average maturity for both PF and CF tranches decreased significantly. This can be explained by limitations in long-term lending from financial markets and, simultaneously, a higher degree of uncertainty that results in investors favoring short to medium-term securities. Regarding the average transaction size and number of tranches, we verify that there is also an increase for both PF and CF bonds.

In the previous chapter, it was hypothesized that investors seem to require a higher number of banks involved to invest in riskier bonds or, in other words, increasing the number of banks involved in CF operations can reduce the perceived risk for investors. We can see that this theory is supported by the average number of banks involved in the transaction in the crisis period (increased perceived risk). The results show that for both PF and CF bonds there is a clear and significant increase in the number of banks involved per transaction. This may reflect an approach to mitigate additional systematic risk investors had to support during this period.

Results also show clearly an increase in the average country risk for both PF and CF bonds. This may be justified by the fact that during the financial crisis, solvability issues and other political risks are more impactful and present due to the slowdown of global and regional economies. In consequence, this can increase the relative likelihood that a sovereign government will default on its obligations, and for that reason can lead to a worsening in credit ratings.

When analyzing the econometric results, it is important to point out some differences when comparing the two periods for CF tranches (models [6] and [9]). In the first place, as mentioned before while in the pre-crisis the transaction size has an unexpected positive impact on the credit spread, during the crisis period this relation is negative (the higher the transaction size, the lower the credit spread). This represents a change when compared with the full data period. These results may seem to indicate that during the crisis period, investors of PF and CF bonds weight the size of the transaction as a measure of the secondary market liquidity, and for that reason require a premium to invest in less liquid bonds (the effect is stronger for PF bonds). Besides, we verify that during both pre-crisis and crisis periods CF bonds credit spreads are positively impacted by maturity.

We show that in the crisis period a subordinated CF tranche has, on average, 66.95 bps higher credit spread, all other factors remaining constant. This follows our expectation, and contrast with the results obtained for the full sample and the pre-crisis period. In addition, we notice that during the pre-crisis period bank reputation seems to not affect the credit spread. This may indicate that during the crisis, investors gave more importance to the credibility of the involved banks, which is reflected in the spread. The same is verifiable for the currency risk impact on the credit spread of CF bonds. Finally, while for the pre-crisis period the fixed-rate tranches seem to increase the overall cost of funding, during the crisis period we verify the opposite, as having a fixed rate reduces on average

the credit spread in 23.78 bps. This may indicate that during a period of more volatility and uncertainty, investors seem to pay a premium for bonds with a fixed rate.

Having this in mind and to conclude, despite not finding a direct relationship between the two specific periods of crisis (financial and sovereign crisis) on our regression analysis, it is evident that both PF and CF bonds display different credit spreads and pricing processes when comparing pre-crisis and crisis periods. These results display the impact of two completely different economic environments on the pricing of two different securities, displaying different thought processes from market agents in dissimilar conditions. For that reason, we validate H4.

6.4. Additional sensitivity tests

The equation (1) used in the base model, was re-estimated to control for additional variables that reduce significantly our sample. The results are presented in Table 6. The following regressions were tested for each bond type: (i) models [1.B] and [2.B] test the inclusion of gross spread as an explanatory variable; (ii) models [3.B] and [4.B] test the impact of the number of bookrunners on spread; (iii) models [5.B] and [6.B] include legal enforcement dummy variable; (iv) models [7.B] and [8.B] include management fees; (v) and models [9.B] and [10.B] add the variable collateral type. Note that some PF regressions do not present information since the number of observations for those specific variables was insufficient in order to obtain unbiased coefficients.

Models [1.A] and [1.B] presents the results of estimating the base model with the inclusion of the variable gross spread. We find that a bond's gross spread has

a strong positive impact on CF bonds credit spreads, but seems to not have an impact on PF bond the spreads.

In the second place, we re-estimate our models controlling for the number of bookrunners involved in the operation (Models [2.A] and [2.B]). It was expected that an increase in the number of bookrunners in the operation would result in a decrease of the credit spread, by increasing issuer bargaining power and increasing investor confidence. Surprisingly, we verify the opposite: as the number of bookrunners increases for both PF and CF bonds, the higher is the spread. One hypothesis that can justify this, is the fact that a higher number of underwriters are needed to validate and issue a riskier instrument, and for that reason, capture the effect of an increase in credit spreads. On the other hand, the inclusion of the variable legal enforcement (Models [3.A] and [3.B]) didn't affect both PF and CF bonds' credit spread.

In the third place, it was included the variable management fees to test the impact of these market inefficiencies on the overall credit spread (Model [4.B]). We discover a strong positive relationship, as an increase in 1 bps in the management fees of the operation would result in an increase of 121.27 bps of the credit spread for CF bonds.

Finally, we tested the impact of different collateral types on the spread of CF bonds (Model [5.B]) and found that this variable didn't seem to have explanatory power on the credit spread.

Table 6: Sensitivity Tests for the Base Model

Dependent variable: Credit spread (bps)	[1.B] PF Gross Spread	[2.B] CB Gross Spread	[3.B] PF N° of Bookrunners	[4.B] CB N° of Bookrunners	[5.B] PF Legal Enforcement	[6.B] CB Legal Enforcement	[7] PF Management Fees	[8] CB Management Fees	[9] PF Collateral Type	[10] CB Collateral Type
Independent variables:										
Intercept	1006.53 * (1.91)	-354.41 *** (-7.68)	1111.48 *** (5.33)	111.59 (1.38)	1174.359 *** (3.69)	-6.09 (-0.07)		-340.83 *** (-4.30)		105.479 (0.40)
Rated	-209.32 *** (-2.72)	-29.85 ** (-2.32)	-62.92 (-1.65)	-119.18 *** (-11.27)	-84.89 ** (-2.14)	-127.64 *** (-11.28)		-43.65 *** (-3.59)		-192.00 *** (-3.71)
AA+	-130.90 (-1.10)	-20.09 (-1.61)	-26.85 (-0.47)	-19.73 ** (-1.96)	-25.95 (-0.30)	-21.57 ** (-2.16)		2.95 (0.20)		32.92 (0.77)
AA	24.47 (0.37)	-33.29 ** (-2.52)	53.15 (0.86)	-23.92 (-1.53)	31.71 (0.33)	-26.94 * (-1.72)		7.83 (0.71)		26.95 (0.58)
AA-	101.56 (1.62)	-8.98 (-1.30)	76.44 (1.26)	-5.15 (-0.53)	21.17 (0.28)	-10.21 (-1.02)		15.58 (1.38)		43.25 (1.30)
A+	19.81 (0.30)	8.27 (1.26)	-40.43 (-0.63)	13.09 (1.29)	-70.75 (-0.90)	9.63 (0.93)		23.47 ** (2.04)		61.25 (1.58)
A	-4.24 (-0.05)	24.12 *** (3.93)	-27.76 (-0.55)	29.67 *** (2.92)	-61.45 (-0.91)	27.47 *** (2.59)		27.07 ** (2.47)		44.67 (1.19)
A-	88.64 (1.10)	41.83 *** (6.31)	27.38 (0.55)	44.41 *** (4.52)	30.47 (0.47)	43.41 *** (4.33)		48.83 *** (4.30)		109.79 *** (2.73)
BBB+	102.18 * (1.89)	68.15 *** (9.32)	50.91 (1.03)	77.53 *** (7.55)	41.66 (0.64)	76.47 *** (7.16)		69.25 *** (5.85)		85.32 * (1.95)
BBB	79.37 (1.18)	90.23 *** (10.94)	49.59 (1.00)	96.67 *** (9.20)	29.43 (0.46)	94.87 *** (8.76)		81.75 *** (5.62)		54.68 (1.11)
BBB-	292.91 *** (3.55)	129.83 *** (12.06)	109.14 ** (2.20)	141.67 *** (11.72)	70.36 (1.06)	141.22 *** (10.97)		101.60 *** (6.21)		209.80 *** (4.70)
BB+		173.28 *** (9.86)	82.49 (0.48)	209.36 *** (14.00)	48.06 (0.27)	210.96 *** (13.72)		155.52 *** (5.76)		91.91 *** (3.94)
BB	-229.49 (-1.36)	194.34 *** (10.94)	259.27 *** (3.22)	210.59 *** (10.94)	153.39 * (1.84)	211.51 *** (11.23)		174.12 *** (5.73)		43.19 (0.71)
BB-		225.11 *** (7.61)	228.62 *** (3.44)	286.22 *** (12.62)	186.81 ** (2.04)	281.91 *** (12.05)		200.84 *** (4.41)		632.17 *** (7.63)
B+	429.28 *** (3.03)	279.59 *** (11.92)	263.58 *** (2.98)	355.02 *** (18.98)	193.06 (1.66)	349.71 *** (17.25)		300.86 *** (7.16)		126.24 ** (2.57)
B	437.19 *** (3.02)	271.78 *** (9.06)	234.95 ** (2.48)	411.93 *** (20.79)	264.47 *** (3.71)	411.42 *** (19.78)		264.65 *** (5.59)		554.43 *** (5.97)
B-	935.53 *** (6.84)	344.92 *** (11.18)	826.03 *** (6.97)	470.10 *** (27.64)	773.18 *** (6.14)	474.58 *** (27.58)		305.27 *** (4.82)		
CCC+		388.00 *** (4.87)		549.05 *** (16.23)		549.21 *** (15.48)		373.41 *** (5.57)		
CCC		560.67 *** (11.44)	1048.95 *** (13.49)	621.68 *** (17.02)	1080.00 (11.66)	624.76 *** (16.19)		500.15 *** (20.92)		
CCC-		403.49 *** (19.24)		524.34 *** (4.20)		531.53 *** (4.24)				
CC										
C		266.11 *** (9.62)		350.14 *** (2.93)		351.30 *** (3.09)				
Rating discordance	-20.51 (-0.93)	13.60 *** (4.63)	-2.10 (-0.16)	17.18 *** (5.90)	-1.33 (-0.08)	18.65 *** (6.18)		12.62 *** (2.77)		-11.17 (-0.53)
Number of Tranches	-7.93 (-0.52)	-6.13 ** (-2.30)	16.39 * (1.71)	2.21 (0.37)	1.73 (0.16)	1.11 (0.17)		-7.37 ** (-2.34)		-2.77 (-0.75)
Maturity	-5.03 *** (-3.02)	0.30 (1.10)	-7.30 *** (-2.85)	0.20 (0.55)	-9.54 ** (-2.49)	-0.02 (-0.06)		0.09 (0.25)		1.05 (0.38)
Log maturity	121.01 *** (4.56)	8.43 * (1.66)	126.57 *** (3.04)	17.43 *** (2.80)	135.91 ** (2.41)	21.64 *** (3.21)		7.71 (1.13)		-19.98 (-0.43)
Log transaction size	-40.52 * (-1.70)	14.86 *** (6.79)	-57.62 *** (-4.39)	-4.82 (-0.96)	-45.38 *** (-3.43)	-0.39 (-0.07)		15.82 *** (4.07)		2.71 (0.22)
Bank reputation	-2.82 (-0.86)	1.58 ** (2.26)	-0.35 (-0.21)	2.20 *** (5.90)	-2.22 (-0.95)	2.58 *** (6.34)		0.26 (0.81)		0.69 (0.40)
Number of banks	-0.07 (-0.02)	-0.67 *** (-2.84)	-1.61211 (-0.63)	-2.43 *** (-5.11)	1.45 (0.58)	-1.14 *** (-2.86)		-0.76 (-0.86)		1.53 (0.36)
Country risk	3.35 (0.70)	5.57 *** (3.98)	5.51 * (1.86)	5.63 *** (4.99)	-4.10 (-0.58)	6.76 *** (2.82)		8.34 *** (3.80)		-17.65 ** (-2.54)
Currency risk	22.92 (0.25)	15.53 *** (3.19)	72.51 *** (3.11)	26.88 *** (6.20)	26.21 (0.99)	19.14 *** (4.48)		-6.54 (-0.77)		-36.75 (-1.53)
Volatility	-4.39 (-1.15)	2.95 *** (3.29)	-0.64 (-0.31)	3,425616 *** (5.19)	2.59 (0.98)	3.75 *** (5.46)		1.18 * (1.74)		1.08 (0.67)
Fixed rate	4.91 (0.09)	28.54 *** (3.51)	-129.96 *** (-3.29)	-15.63 * (-1.72)	-205.98 *** (-4.23)	-16.40 (-1.61)		50.14 ** (2.00)		-22.89 (-0.87)
Creditor rights	-7.23 (-0.33)	-0.01 (-0.28)	-20.29 ** (-2.60)	-6.79 *** (-3.68)	-7.46 (-0.75)	-6.00 *** (-3.04)		-5.81 (-1.26)		7.10 (0.56)
USA5y-USA3M	-0.62809 ** (-2.59)	-0.01 (-0.28)	0.93 *** (2.82)	-0.00533 (-0.09)	0.88 ** (2.42)	0.00 (0.01)		0.01 (0.09)		0.40 (1.98)
Subordinated		-62.73 *** (-3.48)	209.32 *** (3.83)	-54.90 *** (-5.31)	217.81 * (1.79)	-55.79 *** (-5.12)		-77.43 *** (-2.91)		89.59 (1.63)
Collateral	71.48 ** (2.41)	34.58 *** (5.07)	53.88 ** (2.01)	55.76 *** (7.80)	93.34 *** (3.04)	60.62 *** (7.64)		32.89 ** (2.43)		
Callable	-21.60 (-0.45)	13.96 *** (2.38)	22.80 (1.11)	44.04 *** (7.59)	32.38 (1.33)	44.88 *** (6.81)		0.80 (0.13)		7.18 (0.40)

(Continued)

Table 6: Sensitivity Tests for the Base Model*(continued)*

Financial crisis	46,88 (0.58)	76,53 (1.06)	-152,01 (-1.41)	49,25 (0.97)	-234,52 * (-1.74)	48,44 (0.99)	68,58 (0.72)	-55,96 (-0.81)
Sovereign crisis	-70,24 (-0.98)	44,95 (0.59)	-8,91 (-0.22)	23,08 (0.43)	43,50 (0.60)	18,57 (0.36)	27,55 (0.28)	-79,72 (-1.66)
Gross Spread	-90,02 (-1.17)	51,74 *** (4.92)						
Number of Bookrunners			5,26 * (1.68)	2,76 *** (3.19)				
Legal Enforcement					-5,98 (-1.47)	0,89 (0.70)		
Management Fees bps							121,27 *** (7.16)	
Collateral Type								1,62 (0.18)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	93	10 360	398	27 618	288	22 824	2 518	295
Adjusted R ²	0,97	0,63	0,62	0,55	0,68	0,57	0,67	0,72
Rated and rating dummies as independent variables only								
Adjusted R ²	0,39	0,40	0,39	0,40	0,39	0,40	0,39	0,40
Differences in adjusted R ²	0,58	0,23	0,23	0,15	0,29	0,17	0,29	0,32

Table 6 presents the results of an OLS regression analysis of the determinants of bond credit spreads with additional variables to the base model. ***, ** and * indicate that the reported coefficients are significantly different from zero at the 1%, 5% and 10% levels, respectively. The t-statistics reported in parentheses are based on heteroskedasticity-consistent standard errors. Due to time varying risk premia and cross-country differences, we estimate standard errors

7. Conclusions

This work provides empirical evidence on the factors that determine the pricing of Project Finance (PF) bonds. In addition, we compare credit spreads and pricing processes of PF bonds (off-balance-sheet financing) to that of Corporate Finance (CF) bonds (on-balance-sheet financing), using a cross-section of global bonds closed in the 1995-2019 period. We also study whether credit spreads convey information beyond credit ratings across PF and CF. To the best of our knowledge, there has been no previous empirical research on PF bonds. We intend to fill this void in the literature.

Evidence provided does not support extant theoretical literature suggesting that PF deals reduce the cost of borrowing vis-à-vis comparable CF deals. The results show that PF bonds' average spread is significantly higher than that of similarly rated CF bonds. Most importantly, we show that both PF and CF bonds are priced differently by common pricing determinants and that investors indeed rely on other factors besides credit ratings when pricing PF bonds. We identify that due to the different underlying characteristics, contractual specific features and off-balance sheet treatment, PF bonds are influenced by factors such as maturity, transaction size, currency risk, country risk and creditor rights.

Finally, we identify a clear economic impact on the pricing determinants when comparing the periods before and during the 2007/08 financial crisis and the subsequent European sovereign crisis. These impacts are not only reflected in an increase of the overall credit spreads for both securities, but also in the change in the variables that market agents' use when pricing such bonds.

This work extends current financial literature by providing an in-depth overview of the factors that influence the pricing of PF bonds and how they

compare with the ones that influence CF bonds. Hence, it sheds some light on previous theoretical structured finance literature arguments.

Considering an increasing role of PF in a post-Basel III scenario, where syndicated long-term lending is more and more strangled by capital requirements, we believe that this study is of extreme importance not only to investors but also to policymakers. Considering the important role of PF in promoting public investment and as a driver of economic growth in low-income countries, by “substitute underdeveloped financial markets and emulate, in part, the desirable features of a well-developed market” (Kleimeier and Versteeg, 2010), we believe that policymakers should have a better knowledge of these instruments, allowing for more precise and efficient regulatory interventions.

Finally, with this work, we hope to motivate future research not only in PF markets but also to develop more empirical knowledge of PF bonds. The main limitation of our study is related to the size of the PF bonds sample. We believe that, with the significant increase of PF bond issuances in recent years, and utilizing a large database with more complete information, it would be possible to obtain even more complete and clear results. In addition, the potential for additional studies with more specific samples would allow for a deep understanding of PF bonds usage in different contexts, namely in different regions and/or countries. For example, it would be interesting to develop this analysis using deals that take place in emerging economies only. We believe that those results would be even more impactful and provide a more in-depth analysis about the benefits of PF vis-à-vis CF debt choices.

8. References

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9. Appendix

Appendix A: Distribution of tranches by firm type and year

Year	Project Finance Bonds			Corporate Bonds		
	Number of tranches	Total value [\$ Million]	Percent of total value	Number of tranches	Total value [\$ Million]	Percent of total value
1995				330	54 435,33	0,31
1996	2	1 200,00	0,30	387	55 200,80	0,31
1997				560	70 618,55	0,40
1998				550	99 315,65	0,56
1999	1	255,00	0,06	550	122 036,80	0,69
2000				691	200 771,74	1,13
2001				980	346 249,75	1,96
2002				718	221 390,38	1,25
2003	2	1 000,23	0,25	1 142	293 889,46	1,66
2004	2	1 318,89	0,33	1 130	290 253,05	1,64
2005	4	1 936,44	0,49	858	254 405,21	1,44
2006	7	2 490,92	0,63	1 085	355 010,45	2,00
2007	38	10 419,93	2,62	2 073	603 073,89	3,41
2008	11	2 320,09	0,58	2 171	721 541,67	4,07
2009	217	58 601,67	14,74	2 876	997 746,03	5,63
2010	192	44 486,46	11,19	2 740	797 752,46	4,51
2011	206	44 684,82	11,24	3 047	891 848,28	5,04
2012	50	10 274,20	2,58	4 702	1 387 973,80	7,84
2013	79	35 447,29	8,92	4 887	1 469 332,05	8,30
2014	106	22 946,90	5,77	5 349	1 475 595,19	8,33
2015	168	25 611,64	6,44	4 525	1 272 958,60	7,19
2016	135	38 106,91	9,58	5 398	1 552 293,23	8,77
2017	98	48 880,94	12,29	5 523	1 567 949,53	8,85
2018	80	17 387,69	4,37	4 496	1 177 277,86	6,65
2019	162	30 219,71	7,60	4 619	1 428 426,40	8,07
Total	1 560	397 589,74	100,00	61 387	17 707 346,14	100,00

This table presents the distribution of the full sample of tranches by firm type and year. Data are for tranches reported in DCM Analytics with amount available, issued by global nonfinancial firms during the 1995-2019 period.

Appendix B: Financial details of the thirteen largest Project Finance deals

Issuer Name	Project Location	Transaction Size (\$ Million)	Issue Date	Industry	Tranche Size (\$ Million)	Maturity	Spread above benchmark (bps)	Collateral
State Grid Corp of China	China	4394,4	04/02/2010	Utilities	2929,6	10	N/A	N
					1464,8	15	N/A	
Company Purpose: Operation of electric power grid for power transmission, transformation and distribution.								
VMware Inc	United States	4000,0	16/08/2017	Machinery and Equipment	1250,0	3	85,00	N
					1500,0	5	120,00	
					1250,0	10	170,00	
Company Purpose: Development of virtual infrastructure software for software-defined data centers, also for supporting operating systems as well as networking and storage infrastructure.								
Mexico City Airport Trust	Mexico	4000,0	13/09/2017	Transportation	1000,0	10,61	175,00	Y
					3000,0	29,86	275,00	
Company Purpose: Purpose of purchasing and holding the rights to collect passenger charges from the existing Benito Juarez International Airport and the new Mexico City International Airport								
National Iranian Oil Co	Iran	3862,4	21/03/2011	Oil and Gas	3862,4	4,03	N/A	N
Company Purpose: Responsible for the exploration, drilling, production, distribution and export of crude oil, as well as exploration, extraction and sales of natural gas and liquefied natural gas.								
Abu Dhabi Crude Oil Pipeline	United Arab Emirates	3037,0	26/10/2017	Oil and Gas	837,0	12	N/A	Y
					2200,0	30	N/A	
Company Purpose: Responsible for the transportation of oil, gas, and petroleum products.								
China National Petroleum Corp	China	2948,1	13/08/2010	Oil and Gas	1474,1	10	N/A	N
					1474,1	15	N/A	
Company Purpose: The Company explores, refines, and markets gasoline, kerosene, diesel, lube oils, chemical light oils, fuel oils, solvent oils. Also offers refueling, oilfield, petroleum equipment supply, and other services.								
State Grid Corp of China	China	2929,1	24/12/2009	Utilities	1464,6	7	N/A	N
					1464,6	10	N/A	
Company Purpose: Operation of electric power grid for power transmission, transformation and distribution.								
State Grid Corp of China	China	2928,1	09/09/2009	Utilities	2196,1	7	N/A	N
					732,0	10	N/A	
Company Purpose: Operation of electric power grid for power transmission, transformation and distribution.								
Shenhua Group Corp Ltd	China	2927,2	03/07/2009	Mining and Natural Resources	2927,2	5	N/A	N
Company Purpose: Responsible for the overall development and operation of the Shenhua Dongsheng coalfield as well as the related railway, power station, coal terminal and shipping fleet.								
Electricite de France SA	France	2803,2	06/10/2016	Utilities	1962,2	10	101,90	N
					840,9	20	171,90	
Company Purpose: Using nuclear power, coal and gas, produces, transmits electricity for French energy consumers.								
State Grid Corp of China	China	2364,2	07/12/2011	Utilities	1576,1	10	N/A	N
					788,1	15	N/A	
Company Purpose: Operation of electric power grid for power transmission, transformation and distribution.								
Sasol Financing USA LLC	South Africa	2250,0	20/09/2018	Oil and Gas	1500,0	5,5	295,00	N
					750,0	10	345,00	
Company Purpose: Financial issuer for the international integrated company that produces and market chemical and energy products.								
Apple Inc	United States	2215,2	07/11/2019	Machinery and Equipment	1107,6	6	53,20	N
					1107,6	12	81,80	
Company Purpose: Designs, manufactures, and markets personal computers and related personal computing and mobile communication devices along with a variety of related software, services and peripherals.								

This table presents the financial information for the 13 biggest Project Finance deals in the full sample. Deals are ordered by the Transaction Size, in millions of Dollars.

Appendix C: Definition of variables, sources, and the expected impact on credit spread

Variable name	Variable definition	Source	Expected impact on credit	
			PF Bonds	CF Bonds
Dependent variable:				
Credit spread	Margin yielded by the security at issue above a corresponding currency treasury benchmark with a comparable maturity.	DCM Analytics		
Independent variables:				
Contractual characteristics				
Rated	Dummy equal to 1 if the bond has a credit rating from S&P or Moody's, and 0 otherwise.	DCM Analytics	-	-
Rating	Bond rating based on the S&P and Moody's rating at the time of bond issuance. The rating is converted as follows: AAA=Aaa=1, AA+=Aa1=2, and so on until D=21.	DCM Analytics	+	+
Rating discordance	Dummy equal to 1 if S&P and Moody's assign a different credit rating for the same tranche, and 0 otherwise.	DCM Analytics	+	+
Number of tranches	The number of tranches per transaction.	DCM Analytics	-	-
Maturity	Maturity of bonds, in years.	DCM Analytics	NL / -	+
Transaction size	Bond transaction size. Transaction size is converted into Dollar millions.	DCM Analytics	-	-
Bank reputation	EMEA bookrunners rank according to Thomson Reuters League Tables. Ranks range from 1 (best) to 26 (worst).	Thomson Reuters DMI	+	+
Number of banks	The number of banks participating in bond issuance as underwriters or servicers.	DCM Analytics	-	-
Currency risk	Dummy equal to 1 for bonds that are denominated in a currency different from the currency in the deal's nationality, and 0 otherwise.	DCM Analytics	+	+
Fixed rate	Dummy equal to 1 if a bond is fixed price, and 0 otherwise.	DCM Analytics	+	+
Subordinated	Dummy equal to 1 for tranches that are subordinated, and 0 otherwise.	DCM Analytics	+	+
Collateralized	Dummy equal to 1 if a bond has a collateral, and 0 otherwise.	DCM Analytics	+	-
Callable	Dummy equal to 1 if the bond has a call option, and 0 otherwise.	DCM Analytics	+	+
Gross spread	The difference between the underwriting price received by the bond issuer and the actual price offered to the investing public, divided by the tranche size.	DCM Analytics	+	+
Number of Bookrunners	The number of bookrunners participating in bond issuance.	DCM Analytics	-	-
Management fee	Fees (in bps) that are periodically paid to the bank syndicates.	DCM Analytics	+	+
Collateral type	Type of Collateral used in the operation (ordinal value for each type).	DCM Analytics	NA	NA
Macroeconomic factors				
Volatility	The Chicago Board Options Exchange Volatility Index (VIX). VIX reflects a market estimate of future volatility.	Datastream	+	+
USA5y-USA3M	Yield curve slope, obtained as the difference between the five-year USA Treasury bond yield and the 3-month USA Treasury Bill yield.	Datastream	-	-
Country risk	Moody's country credit rating at close. The rating is converted as follows: AAA=1, AA+=2, and so on until C=21.	Moody's Global Ratings	+	+
Financial crisis	Dummy equal to 1 if the issue date belongs to the 2007-2008 financial crisis period (from September 15, 2008 - Lehman Brothers' bankruptcy filing date - through to April 23, 2010), and 0 otherwise as in Marques and Pinto (2020).	Marques and Pinto (2020)	+	+
Sovereign crisis	Dummy equal to 1 if the issue date belongs to the European sovereign debt crisis (from April 24, 2010 through to December 31, 2016), and 0 otherwise as in Maruques and Pinto (2020).	Marques and Pinto (2020)	+	+
Creditor rights	Measured using La Porta, Lopez-de-Silanes, Shleifer and Vishny's (1998) indices, using four creditor rights variables (no automatic stay on assets; secured creditors first paid; restrictions for going into reorganization; management does not stay in reorganization).	LLSV (1998)	-	-
Legal Enforcement	Measured using La Porta, Lopez-de-Silanes, Shleifer and Vishny's (1998) indices. We use five enforcement variables (efficiency of judicial system; rule of law; corruption; risk of expropriation; risk of contract repudiation) and added up the scores to create an index.	LLSV (1998)	-	-

The following characters mean: - = negative impact on the credit spread | + = positive impact on the credit spread | NL = Not linear | NA = information about this variable is not available

Appendix D: Descriptive statistics for PF and CF samples

Panel A: Continuous variables

Variable of interest	Project Bonds						Corporate bonds					
	Number	Mean	Median	Std. Dev.	Min	Max	Number	Mean	Median	Std. Dev.	Min	Max
<i>Contractual characteristics</i>												
Credit spread (bps)	405	254,0	195,0	197,1	3,5	1 106,0	28 282	208,1	155,0	181,4	-300,0	1 568,0
Rating [1-22 weak]	286	7,9	8,0	3,0	1,0	18,0	21 086	8,4	8,0	3,5	1,0	21,0
Maturity (years)	405	14,5	10,0	10,4	1,0	60,0	28 248	10,0	7,0	8,9	0,3	100,4
Transaction size (\$ Million)	405	626,0	462,0	626,0	3,2	4 000,0	28 282	824,0	389,0	1 350,0	0,02	17 000,0
Tranche size (\$ Million)	405	428,0	325,0	412,0	3,2	3 000,0	28 282	418,0	300,0	426,0	0,0	5 670,0
Number of tranches	405	1,8	1,0	1,2	1,0	7,0	28 282	1,7	1,0	1,4	1,0	20,0
Number of banks	405	5,9	4,0	4,9	1	23,0	28 282	5,8	4,0	5,0	0,0	40,0
Bank reputation [1-26 worst]	405	9,9	5,0	9,7	1	26,0	28 282	7,0	2,0	9,4	1,0	26,0
Number of Bookrunners	405	3,7	3,0	3,4	1,0	23,0	28 282	3,1	2,0	2,4	0,0	26,0
Management fee	6	0,1	0,1	0,2	0,1	0,5	2 539	0,2	0,1	0,3	0,0	4,0
Gross spread (bps)	93	62,1	62,5	37,8	0,0	250,0	10 546	64,9	60,0	50,1	0,0	750,0
<i>Macroeconomic factors</i>												
Country risk [1-21 weak]	405	3,8	1,0	3,9	1,0	17,0	28 282	2,7	1	3,0	1,0	21
Risk Free	405	73,7	19,0	107,3	-0,3	503,0	28 282	131,1	33,7	167,9	-1,3	639,0
Volatility	405	16,4	14,5	6,1	9,4	45,8	28 282	17,9	15,9	7,3	9,1	80,9
USA5y-USA3M (bps)	405	108,9	99,7	57,9	-59,9	264,4	28 282	107,6	104,8	70,0	-86,7	303,5
Creditor rights	398	1,5	1,0	1,0	0,0	4,0	27 652	1,5	1,0	0,9	0,0	4,0
Enforcement	289	42,1	47,0	7,4	20,4	49,3	23 345	45,2	47,6	5,5	20,4	50,0

Panel B: Dummy variables

Variable of interest	Project Bonds			Corporate bonds		
	Number	% of total	Std. Dev.	Number	% of total	Std. Dev.
Rated	405	70,6%	0,46	28 282	74,6%	0,44
Subordinated	405	0,5%	0,07	28 282	2,2%	0,15
Collateralized	405	43,0%	0,50	28 282	8,2%	0,27
Currency risk	405	20,0%	0,40	28 282	23,7%	0,43
Fixed rate	405	78,3%	0,41	28 282	85,0%	0,36
Rating discordance	405	31,4%	0,46	28 282	25,4%	0,45
Callable	405	54,6%	0,50	28 282	50,3%	0,50

This table presents the descriptive statistics of PF and CF samples issued during the 1995-2019 period. Information on the characteristics of bond issuances was obtained from DCM Analytics. For a definition of the variables, see Appendix C.