Determinants of Project Bonds Yield Spreads

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Abstract

Project bonds are gaining popularity as an alternative financing tool due to the Basel regulations which restrict banks from providing loans to fund infrastructure projects. The characteristics of project bonds suggest that they are a great diversification tool due to the favourable macroeconomic conditions. Despite that, investors are unwilling to bear the risk that comes together with the project bonds, which is mirrored in the relatively low credit ratings assigned by rating agencies. The purpose of this research is to investigate the determinants of the project bonds yield spreads. First, the yield spread determinants are investigated taking into consideration the issue-specific measures including the issue size, maturity, domicile market, currency denomination, and time of issue. The results show that all variables are significantly associated with the yield spread. Second, the literature suggests that four macroeconomic variables are considered to be determinants of the yield spread. These factors include inflation, government fiscal balance, current account balance, and GDP per capita. Two regressions are performed in order to determine whether these variables provide additional effect on the yield spreads beside the credit rating. The results show that credit ratings have additional information beyond that provided by the macroeconomic variables. Finally, the investigation of the role of credit ratings show that, most notably, the relationship between the credit ratings and the government fiscal balance is significant and positive indicating that project bonds issuers with low risk of default prefer to issue bonds when the domicile market runs a fiscal surplus. To my knowledge, this is the first empirical analysis performed on project bonds and, despite its limitations, has important implications for borrowers and investors. Still, more research has to be done in order to obtain a better understanding on the characteristics of project bonds.

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1. Introduction

The introduction during the 1990s of a promising project bond market aiming to finance long-term infrastructure projects in various developing countries, such as roads, ports, electric power plants, airports, and water and waste water facilities deserves attention for several reasons. First, they emphasize the attractiveness of project bond investment opportunities that are traditionally the field of public sector for private sources of capital. Second, project bonds have the potential to become a major source of long-term private debt capital related directly to both economic growth and competitiveness. Third, project bonds offer asset diversification and new investment opportunities specifically to institutional investors (e.g., insurance companies and pension funds) whose long-term liabilities match the long-term tenor of project bonds. Fourth, they reflect the shift in the pattern of capital flows from bank loans to publicly issued bonds (Dailami and Hauswald, 2003).

On a more recent note, the global infrastructure demand has exceeded historical levels, resulting in a significant funding gap of $ 1 to 1.5 trillion annually from 2013 to 2030 (Li *et al.,* 2017). As a result, many worldwide governments embrace public-private partnerships (PPPs) with the purpose to close the infrastructure investment gap (Ke *et al.,* 2010; Zhang *et al., 2016*; Liu *et al.,* 2016). Traditionally, bank loans provided by commercial banks have been the major instrument for PPP infrastructure financing. However, the recent global financial crisis limited the banks' appetite to finance long-term infrastructure projects. Moreover, stiffer banking regulations have resulted in lending terms which are considered unfavourable and significantly influence both the bankability and value for money of PPP projects. Considering this, the need for an alternative financing instrument is pressing (Li *et al.,* 2017).

Insurance companies, pension funds, and sovereign wealth funds have expressed desire for long-term investments in infrastructure projects to match their long-term liabilities and diversify their portfolios. To illustrate empirically, the level of diversification of infrastructure related assets is a central topic of the research of Oyedele *et al.* (2012) who find that the inclusion of infrastructure assets in a mixed asset portfolio increases investment performance through risk reduction. Project bonds have gained momentum in PPP projects as an efficient debt financing instrument. For instance, bond financing consisted of 27 percent of project

finance debt issuance in 2013 in Europe, whereas bond financing in 2008 comprised of only three percent (Li *et al., 2017*).

Bond financing provides the project company with the possibility to obtain debt directly from individuals and institutions with low interest rate and long maturity. Apart from its merits, a major problem for bond financing in PPP projects is related to the low credit rating resulting in preventing a project company from raising funds with low capital costs. Institutional investors are willing to invest in bonds with a credit rating of at least "A" (Ordonez *et al., 2015*). However, PPP infrastructure projects are typically assigned a credit rating of BB+ or BBB- (EPEC, 2012), which prevents the widespread of project bonds. Considering this, Chowdhury *et al.* (2015) indicate that credit enhancement is needed in order to improve bond ratings, attract investors, and ensure sustainable cost of finance. The demise of the monoline insurers provided the opportunity of public sectors to fill the role of providing credit assistance in PPP infrastructure related projects. Through PPPs, governments can offer debt guarantees to reinforce the credit strength of project companies by assuming either full or partial obligation in the case of default. The guarantees enable a possible upgrade on the credit rating of a project to A in order to attract investments with low capital costs. This practice is widespread. For instance, several initiatives include the Transportation Infrastructure Finance and Innovation Act (TIFIA) and Railroad Rehabilitation and Improvement Financing Program in the United States, and the European 2020 Project Bond Initiative (PBI). They are all sponsored by governments to offer credit assistance in the form of debt guarantee for infrastructure financing (Li *et al., 2017*).

Basel regulations restricted significantly the ability of banks to provide loans and finance infrastructure projects. As a result, bond financing plays a significant role in bridging the financial gap for such investments. In essence, project bonds are debt instruments issued by PPP companies and usually bought by institutional investors. They are occasionally traded on secondary markets. Bond financing is unevenly used worldwide. For instance, project bonds play a major role in some PPP markets outside Europe (e.g., Canada), whereas there are still struggling to gain popularity in Europe mainly due to procuring authorities throughout the project procurement phase (EPEC, 2012).

The purpose of this paper is twofold. First, to my knowledge, this is the first empirical analysis related to project bonds. Second, examining the factors affecting the yield spread on project

bonds has an important implication in terms of what would help borrowers structure their bond issues as well as reduce their costs.

The remainder of this research is structured as follows. Following the brief introduction, the next chapter examines relevant literature related to project bonds, PPPs, and determinants of yield spread. Based on Chapter 2, Chapter 3 is devoted on developing relevant hypotheses related to the possible determinants which might affect the yield spread. Chapter 4 presents the sample used throughout the research and provides information related to the methodology that is to be undertaken in the next chapter. Chapter 5 presents the results of the empirical analysis. Finally, Chapter 6 is devoted on summarizing the main results of the study, examining existing limitations of the research, and providing possible areas for future research in order to gain better insight on project bonds.

2. Literature review

This section is divided into three main parts. First, due to the limited amount of literature on project bonds, the first sub-section is devoted on summarizing relevant papers examining project bonds and familiarize the reader with the central topic of the research. Second, several papers on PPPs are examined. Finally, the section concludes with an overview of studies examining determinants of yield spreads.

2.1   Theoretical overview of the Project Bonds

2.1.1 Defining Project Bonds

The recent global financial crisis from 2008-2009 required a major overhaul in the banking sector which can be characterized through implementing various measures aimed to improve supervision, regulation and risk management. Consequently, as mentioned in *Chapter 1*, the much stricter liquidity and capital requirements limited severely the ability of commercial banks to offer loans funding for transport, energy and information and communication technology projects. This process encouraged many scholars to highlight the importance of finding an alternative source of financing these projects in order to stimulate growth, employment, and convergence across regions (e.g., Jacobsson, R. and Jacobsson, S., 2012; Scannella, 2012; Zaharioaie, 2012; Hellowell, 2013).

A proper answer of the question "What are project bonds?" is provided by Vassallo *et al.* (2017) who define project bond as a security that is used as an alternative source of bank loans and public financing.

Project bonds are a familiar instrument in other industries, as indicated by Scannella (2012) who examines the development of project bonds in the energy industry. More specifically, he states that private or public-private project companies issue project bonds on capital markets with the intention of financing projects in the energy industry. Project bonds are private debt and being issued by project companies and not by states of the European community essentially implies that issuing bonds has the potential to expand the access to a broader capital market and long-term financing. As a result, the investor base has the possibility to be expanded from bank loans to capital market using project bonds. In particular, bond-based financing model takes the form of a traded financial instrument and targets mostly the non-banking market. In addition, the issuance of project bonds is achieved with the involvement of investment banks. Project bonds may be issued publicly (i.e., they are being placed with bonds investors by the stock exchange) or private placement (i.e., they are being placed with a restricted amount of bond investors). The growth of project bonds is benchmarked against the more traditional fixed income markets when it comes to pricing and legal structures and covenant provisions (John, T. and John, K., 1991).

An interesting point is made by Rossi and Stepic (2015) who indicate that bankers often argue that the debt capital markets are not reliable in terms of supporting a pure greenfield infrastructure project without track record due to excessive construction risks which they are unwilling to bear. In the past, project bonds have been considered only as a refinancing instrument for existing project loans rather than financing entirely greenfield projects. Nowadays, the support of certain governmental and international financial institutions in terms of, for example, credit enhancement throughout the construction period, institutional investors are willing to accept such projects if a proper credit rating is assigned.

2.1.2 Regional development of the Project Bonds

2.1.2.1   Western Europe

The book of Rossi and Stepic (2015) reveals the existence of a general decline of the global infrastructure markets resulting from the global lending crisis as well as the sovereign debt crisis. The major economic distress affected the European market, despite the fact that the

region has been historically known with the largest infrastructure project finance market. The major reasons for the infrastructure market decline are considered to be the government fiscal tightening and the progressively regulated credit markets.

Rossi and Stepic (2015) also provide an in-depth analysis for the development of project bonds in Western Europe. The region includes the leading Eurozone economies (e.g., France, Germany, Spain and Netherlands) in addition to Sweden and the UK. Analysing the spending in infrastructure assets by country in 2013, the results suggest that the three largest economies (i.e., France, Germany and UK) account for approximately 65 percent in total infrastructure spending for the region. Furthermore, an interesting result is related to the fact that Germany alone contributes with around 25 percent of total infrastructure spending in the region. Another important result from Rossi and Stepic (2015) is that infrastructure spending depends on the economy success or public deficit since governments themselves contribute significant amount of funds. For instance, the authors investigate the significant lag behind by the Italian economy from 2011 until 2015 and suggest that the economic distress of the country can explain the lag behind.

In terms of infrastructure sector distribution, Rossi and Stepic (2015) acknowledge the significant difference in the composition of spending across countries. For example, Italy is characterized with frequent investing in heavy manufacturing whereas the Netherlands invests heavily in transportation infrastructure with an emphasis on seaports and airports. The authors also recognize the substantial difference in the importance utilities investments, with Spain dominating the utilities market with approximately 40 percent spending.

2.1.2.2   The United States

Smith *et al*. (2015) examine the project bonds progress in the United States. The region emphasizes on two ways of providing transport infrastructure debt financing: bank lending and public activity bonds (PABs). In 2011 alone, the issued tax-exempt municipal PABs worth a total of nearly US$87 billion. In addition, beyond PABs, several projects are eligible for TIFIA financing. However, in order to classify, the projects need to be in high value, environmentally sound, rated as investment grade and have connected revenue source to service debt payments. Although TIFIA financing and PABs can be used together, there is an increasing trend of using all-PAB projects due to the increased timescales involved with TIFIA.

It is worth emphasizing on the initiative undertaken by the U.S. to stimulate PPP and thus help attract institutional investors towards projects related to transport infrastructure. The country recognizes the need of finding a new source of money to close the infrastructure gap. In this case, PPP have the potential to be the mechanism to fill the gap.

2.1.2.3   Africa

Smith *et al.* (2015) also investigate the development of project bonds in Africa. The African Development Bank (ADB) promotes project bonds as a solution to the continent's investment shortfall and giving priority to the implementation of a framework to assist government approach investors. By 2020, the Program for Infrastructure Development in Africa has outlined 51 vital energy, transport, water and communications projects valued approximately US$60 billion. With the urgency of securing new money being evident, project bonds are championed by the ADB as a future solution to Africa's investment shortfall.

An important remark made by the authors relates to project bond financing being new to the continent. However, several countries have already raised government Eurobonds and dollar bonds devoted solely to infrastructure projects in addition to current plans to sell international debt which takes the form of project bonds.

The ADB plays a key role in promoting project bonds in Africa. First, the bank has to ensure that a framework is put in place and it is shared with the respective governments in order to insure timely information in approaching markets. This is due to the fact that a certain amount of countries have a pressing need for new projects but have either little or no experience in structuring complex, long-term project financing which includes such non-traditional sources. Second, the ADB makes sure that sponsors are fully prepared before approaching investors. By doing so, the bank ensures that a high level of consistency is reached throughout the continent with the constant collaboration with various investment banks, law firms and other third-party sources of expertise.

2.1.2.4   Latin America

Smith *et al.* (2015) acknowledge the fact that each market has its own legal framework and its own unique set of infrastructure requirements. What is similar between the countries in Latin America is the common move towards PPP to finance existing and potential projects. The

continent is characterised with its active and liquid market led by private pensions companies, and an increasing amount of sponsors who are looking to attract cross-border investment.

With their market-friendly, ambitious PPP programs, several countries stand-out. Chile can be considered as a pioneer in Latin America PPP. During the last couple of decades, an impressive amount of the country's key infrastructure improvement projects have been partially funded with the aid of monoline-wrapped project bonds, relying on dollar financing in case of insufficient local liquidity. Currently, the country is shifting its focus from transport into energy investment as well as social infrastructure, although there are several transport deals which are negotiated – including the development of the Santiago Airport.

Another ambitious country in the Latin America region is Peru. 2005 is a turning year for the country due to the reformed PPP law which resulted in an increased degree of protection for private investors and the government effectively underwriting payments in case of project fail or overrun. The framework is designed to treat national and foreign investors alike. Apart from the interest from local investors, there are signs of interests from abroad resulting in handful of international placements of project bonds.

Colombia experienced a pressing need for new transport infrastructure in order to improve links between regions riven by mountains. The country is characterized with its increasing economic power, rapid growth, diversifying economy and investment grade rating. A crucial point in maintaining its progress is considered to be the infrastructure improvement with an ambitious US$53 billion investment program being underway. Although there is a reasonable level of liquidity in both local and neighbouring capital markets to finance various projects, there is also a government support for a proportion of dollar financing. Colombia's new PPP legislation, dating back from 2012, is designed to attract private money to infrastructure and produces improved levels of assurance to lenders and investors as well as facilitating bonds being used post-construction.

Finally, Brazil's historical association with financing for projects is based on its development bank, BNDES. More specifically, the process of covering aspects related to long-term financing of projects relied on the issuance of local currency project bonds. However, due to the fact that there is a natural limit of the locally available resources, sponsors have been keen to attract the deeper pools of foreign investment for larger and more complex financing. Nowadays, dollar-

issued project bonds issues are primarily used to refinance projects. As a consequence, their growing usage resulted in strengthening Brazil's bank balance sheets, freeing up lending for potential projects or helping towards liquidity and capital requirements.

2.1.2.5   Middle East

The geographical examination of the development of project bonds concludes with the Middle East region. The high-growth region requires infrastructure development which is addressed through the evolved financing of public projects. In the past, the region issued oil and gas related project bonds, but there is a recent trend in issuing bonds in the power sector. A potential reason for this trend, as identified by Smith *et al.* (2015), is the strong credit ratings of the gulf nations and the support offered by the respective governments. Within this framework, such strong government support provides the opportunity to tap the liquidity of the capital markets. On the other hand, the same government support is the source of the largest challenge to the development of the project bond market due to the willingness of the traditional bank lenders to lend to these projects at margins which often undercut potential bond pricing.

The region that attracts the most interest from investors' point of view is Abu Dhabi. Its investment approach distinguishes in comparison to other regions due to the fact that the region does not suffer from the lack of public money. From 1997, Abu Dhabi is slowly transforming its state-owned power and water sector assets into part-privatising – and the bond market is considered as a relevant contributor to the infrastructure financing mix. Although distribution remains fully state-owned, power generation as well as water desalination and treatment are partially owned by foreign investors.

2.1.3 The Europe 2020 Project Bonds Initiative

The idea behind the PBI is to relaunch and revitalize the project bond market in Europe (Rossi and Stepic, 2015). Developed in 2012 by the European Commission and the European Investment Bank (EIB), the initiative enables the latter to provide eligible infrastructure transactions with the Project Bond Credit Enhancement (PBCE) which takes the form of a subordinated instrument assuming the risk of the given debt facility. The PBCE program is a unique mechanism available only in the European financial market and is considered to be the only option for many complex and large European projects to access debt capital markets because of the characteristics of both private and institutional investors. Stakeholders believe that the PBCE is a good use of European Union funds as it has a considerably higher effect than structural funds or other financial instruments. The PBCE program also comes with an

improvement of credit ratings of the senior bonds. It is believed that the program will trigger the bond rating either one or two notches higher – a fundamental to bond pricing and increasing investor's appetite for such type of bonds. The eventual lower financing cost for the project indicates a saving for taxpayers and releases governmental budgets which can be used to investing in other infrastructure projects. The ultimate goal of the EIB is persuade institutional investors to participate in the funding process of infrastructure projects.

As illustrated by the EIB (2012), there are two variants of the PBCE program – funded or unfunded. Funded PBCE is close in nature to typical infrastructure mezzanine finance since it is used with other financing to fund construction or other project related costs, and then repaid during the operation phase. From senior investor point of view, funded PBCE will improve credit quality of senior bonds therefore reducing the probability of a default throughout the operation phase. On the other hand, since the mezzanine proceeds are a source of funds used to cover eligible project costs in the base case, funded mezzanine finance will, in most of the cases, not improve probability of default during the construction phase to the same level as providing additional amount of junior finance facility – the unfunded PBCE.

The unfunded version of PBCE is associated with the EIB providing a long-term, irrevocable and revolving letter of credit to the project, the benefit of which will be assigned to the trustee for the senior bonds. The main function of the letter of credit is to act as a contingent credit line which can be drawn in case of cash flows generated by the project prove to be insufficient to achieve construction completion and ensure senior bond debt service. For projects which require the usage of credit line, the EIB will inject funds under the letter of credit. The result of this process is generating a mezzanine instrument similar to the funded PBCE, as described above. However, unlike the funded PBCE, the mezzanine loan only arises when the project risk occurs and not before.

Vassallo *et al.* (2017) examine the constraints and attractiveness of the PBI through the application of SWOT methodology. The authors analyse the PBI from the point of view of both pilot case studies and responses provided by institutional investors and other stakeholders to the European Commission public consultation about the PBI. They conclude that even though the PBI may contribute substantially in facilitating infrastructure financing in Europe, there are some challenges that need to be addressed for the right implementation of the initiative. More specifically, a potential issue can be the undermining process of private firms in the expense of

the growing role of the European Commission and the EIB in achieving the goal of required credit rating of project bonds. Furthermore, the paper suggests that the PBCE needs to make sure that project bonds are suitable from a social point of view (i.e., being utilized as long as it is cheaper for the society). Finally, a third potential challenge that needs to be addressed relates to the need of adjustment of the initiative to the requirements of the institutional investors. Example of potential adjustments might include the need to structure bonds with a minimum rating of A- due to the fact that, according to the stakeholders, a credit enhancement of 20 percent of outstanding senior bonds would prove insufficient.

2.1.4 Main obstacles for the Project Bond Market progress

The literature has identified several important barriers which prevent the further development of project bonds. Vassallo *et al.* (2017) provide four main reasons which can potentially provide answer of the issue. First, capital markets are still considered as competitors of traditional commercial banks due to the fact that project finance has been historically the main source of fee business for banks. Traditionally, commercial banks are interested in capital markets to the degree that it allows them to refinance their current long term commitments and roll over their portfolios. Second, borrowers usually feel more secured with banks and fear the vulnerability related to the capital markets. In this case, vulnerability represents the existing lack of early commitments and the inflexibility of a market dictating its conditions. Third, investment bankers and advisors, not always, may exhibit interest in developing the project bond market. However, the investment in sizeable up-front costs required to arrange complex project bonds may discourage them from investing unless there is a real perspective of repeated progresses. Finally, unlike banks, bond investors prefer to assume risks only in the operational phase. Due to the dissimilarity of project bonds compared to conventional bonds and bank lending, bonds investors bear risks associated with the construction phase.

Additional obstacles for project bonds are investigated by Li *et. al.* (2017) who touch upon the ratings which are given to existent project bonds. As mentioned in Chapter 1, the typical ratings for PPP projects vary between BB+ and BBB-. The low credit ratings, in turn, prevent the issuer from the opportunity of raising funds with low capital costs. As a result, the bond ratings illustrate another reason which impedes the potential widespread usage of project bonds. For that reason, credit enhancement is required in order to improve project bond ratings, attract investors and safeguard sustainable cost of finance.

The abovementioned obstacles do not represent the full set of challenges faced by project bonds. Zaharioaie (2012) states that apart from project bonds, several other initiatives or financial instruments were introduced following the European debt crisis with the main purpose of encouraging economic growth. The initiatives include JESSICA (aiming to attract additional financing for urban development), Risk Sharing Finance Facility (a risk sharing instrument designed to provide support to PPP projects related to the research, innovation and technological area), Loan Guarantee Ten-Transport (mitigates traffic risk in the ramp-up period of large transport projects), and ELENA (providing support of public investment in energy projects). These initiatives, although not being a direct competitor due to their public nature and lack of private intervention, represent a real alternative of issuing project bonds and thus can discourage potential issuers.

2.2 Public-Private partnerships

PPPs refer to the process of bringing together both public and private sectors in long-term contracts (Rossi and Stepic, 2015; Cartlidge, 2006). Examining PPPs is important due to their vital role and key feature for project bonds development.

Tang *et al.* (2010) review current literature related to the PPP in the construction industry due to their increased popularity. The authors focus on studies covering a wide range of specific research foci, which can be grouped into three major groups – relationships, risks, and financing. The paper suggests that through conducting extra research, more effective ways can be designed to facilitate the relationship between the public sector and the private sector. Furthermore, in improving the usage of risk strategies, it is essential that potential risk areas are being identified and analysed properly. Regarding the financing of PPP, the authors, along with Norwood and Mansfield (1999), indicate that financial sources tend to be scarce despite the need for it by contractors. This results in difficulties for contractors to participate in overseas PPP projects if there is a lack of financing.

Laishram and Kalidindi (2009) examine the impact of the Desirability Rating Analytical Tool (DRAT) in enabling road project sponsors to assess the level of desirability of the project from a debt financing perspective. DRAT estimates desirability rating profile of a project by analysing how the project has performed on the criterion and precisely how important is the criterion in making the final decision using a Choquet fuzzy integral. The authors conclude that

DRAT provides valuable information for the decision making process and can aid in designing strategies in order to improve the performance of the project.

Devapriya (2006) investigates the governance issues in financing of PPP organisations in network infrastructure industries. More specifically, the paper examines the nature, form and unique governance issues in equity and debt arrangements within regulated PPP organisations. The paper finds that debt has not been an effective tool to control managers' behaviour due to the fact that subordinate financing also functions to address debt agency within the capital structure of the regulated PPP organisations. Consequently, tying performance of the managers with the financial structure of regulated PPP organisation tends to be undermined in developing and emerging market economics. The described findings illustrate the unique governance issues in financing of PPP organisations and imply the need of addressing the issues in establishing alternative benchmarks to assess efficiency level of the infrastructure companies and achieving better investment performance.

Wang (2015) investigates the process of PPP development in the infrastructure industry using a comparative case analysis of six toll projects in the United States. The author focuses on the two-phase evolution of the PPP models: from a private development model to a collaborative partnership model. As a result, the study finds that public institutions' risk management can potentially explain the PPP evolution. Moreover, empirical analysis indicates that, when project risks are due to poorly addressed critical success factors, public institutions would apply the necessary risk management measures to change the way of addressing these critical success factors in the future, ultimately leading to altering of the PPP model for future projects.

2.3 Yield spread determinants

The majority of prior researches has focused on yield spreads for corporate securities issued in domestic and international markets and for governmental securities. In particular, the literature provides a framework through which it is possible to explore factors which influence sovereign Eurobonds. More specifically, the literature identifies five factors which affect the yield spread on bonds: term to maturity, call option, issue size, credit rating, and repeated experience or frequency of borrowing.

Cox *et al.* (1981) and Fisher (1959) find a positive relationship between maturity and yields. Their reasoning is based on the liquidity preference theory of the term structure of interest rates. In addition, the studies find that as long-term fixed-rate bonds are more likely to be subject of higher price fluctuation compared to short-term notes, they offer higher yield in order to compensate for the risk involved.

Feder and Ross (1982) use data from 1979 on country-by-country risk assessments as perceived by lenders in an attempt to detect a relationship between these assessments and interest rates in the Euromarket. They show that the sign of the relationship in the regression is ambiguous. More specifically, the sign could be either negative or positive depending on the existing yield curve related to the currency of the bond.

Johnson (1967) examines the influence of term-to-maturity upon purchase prices and losses on corporate bonds. Using yearly data from 1920 until 1944, the author suggests that the difficulty of refinancing and meeting the last redemption payment throughout periods of crisis makes short maturities of low-grade issuers riskier compared to long maturities. As a consequence, this crisis-at-maturity leads to a negative relationship between yield spread and maturity.

Lamy and Thompson (1988) as well as Bradley (1991) take into account the size of a security as a proxy for both liquidity and marketability of the issue. The results from both studies show that larger outstanding bonds increase the probability that there is an active market for the issue. As a result, such bonds lower the yield spread. In addition, Booth (1992) examines bank loans between 1987 and 1989 and supports the hypothesis. In particular, he finds that loan size is negatively related to loan spreads.

Kidwell *et al.* (1985) consider an alternative argument based on the market congestion hypothesis. They examine the Eurobond market and conclude that due to its relatively small size, as well as being not deep compared to relative markets, results in inability to absorb a high volume of issues in shorter periods. The central result of their research is that large size bond issues must offer a high yield spread. Their hypothesis is supported by several other studies, most notably by Fung and Rudd (1986), Finnerty and Nun (1985), and Adedeji and McCosh (1995). However, Blackwell and Kidwell (1988) find no significant relationship between issue size and new issue yields with a sample of 293 public utility bonds issued between June 1979 and December 1983.

Contrary to the study of Blackwell and Kidwell (1988), Crabbe and Turner (1995) examine the relationship between liquidity and issue size for bonds issued between 1987 and 1992 and find that size does not influence yields. The results reveal that size may not be a good proxy for the liquidity measure of a bond issue.

Several studies have found that the call provision affects the yield spread while examining corporate bonds (e.g., Grossman *et al.,* 1993; Ferri, 1979). More specifically, the authors indicate that the existence of a call option increases the protection of the borrower against possible decreases in interest rates. As a result, the borrower should pay a higher premium in order to compensate for the protection. On the other hand, Kidwell *et al.* (1985) find no statistical significant relationship between the call provision and yield spread for Eurodollar bonds issued by various public utility companies.

Investors typically rely on bond rating agencies to analyze information related to companies, sovereigns, and bond issues and measure the uncertainty of repayment as well as to derive their conclusions by a system of ratings. In general, the capital markets tend to validate the judgement made by agencies through pricing lower rated bonds at higher average yields. Results for U.S. markets show that yields are related to credit ratings. For instance, Altman (1989) examines corporate bond yields and finds a negative relationship between yields and credit rating. In particular, the author shows an increase in the yields as the rating category is lowered. The same observation is made by Cantor and Packer (1996) for sovereign bonds denominated in U.S. dollars. In addition, several other authors also use credit ratings in analyzing the determinants of bond yields. Ederington *et al.* (1987) and Moon and Stotsky (1993) conclude that credit ratings on both corporate and municipal bonds might contain further information on default which is not available within the standard indicators of default risk. A contradictory finding is provided by Artus *et al.* (1993) who examine the French bond market and conclude that a direct relationship between yield and the ratings of the largest French bond-rating agency does not exist or is weak.

Ozler (1992) investigates the effect of the frequency of borrowing in the Eurocurrency market with the centre of attention being sovereign loans between 1968 and 1981. The two empirical measures used, namely experience or frequency of borrowing, include the cumulative number of loans provided to a specific borrower and the cumulative number of months during which the borrower receives a loan. The author shows that repeated experience influences the

evolution of spread. More specifically, she finds a negative relationship between the variables: spreads start at high values at low levels of experience or frequency of borrowing and tend to decrease with the increase of experience.

Cantor and Packer (1996) and Afonso (2002) examine the determinants of sovereign credit ratings. Using data on 35 developed and developing countries, the estimates of the OLS regression on pooled data reveal a positive relationship between credit ratings and GDP per capita. Afonso (2002) applies both linear and logistic transformation of the rating scales in order to determine the relationship between the variables for 81 developed and developing countries. The results are similar to those of Cantor and Packer (1996): there is a positive relationship between credit ratings and GDP per capita. Since both studies examine the determinants of credit ratings, the parameter estimates will, therefore, have the opposite sign when considering the determinants of the spread. For instance, since both studies show that there is positive relationship in examining determinants of the credit ratings, when examining the determinants of the spread the relationship will become negative.

Nogués and Grandes (2001) investigate the determinants of the spread of sovereign bonds in relation to comparable bonds of the US Treasury for the case of Argentina. Using monthly data between 1994 and 1998, they find that the spread is explained by growth expectations, fiscal deficits, the debt service to export ratio along with its growth rate, contagion effects, external shocks, and political noise. Given the fact that from these factors, fiscal balance is the one which will used throughout this analysis, it is useful to further investigate their results concerning the factor. The authors show that there is a negative effect of the fiscal deficit in both short and medium run. More specifically, in the short run, the authors argue that the deficit should be reduced in order to stabilize and revert the increasing external debt. Consequently, the authors suggest that the deficit should turn into a surplus, which could be partly used to diminish the debt stock. The study also indicates that the possible implementation of the law of fiscal solvency in Argentina could lead to asymptotic limit to the stock of external public debt of the National Government. The authors conclude that the achievement of equilibrium and fiscal surpluses in a credible and sustainable way is essential in the process of reducing country risk. The current account balance is also examined in their model but the variable is not statistically significant.

Amira (2004) examines the determinants of the sovereign Eurobonds yield spreads on bonds for 38 countries issued between January 1991 and October 2000. The examination of the determinants of yield spreads takes into account variables including maturity, issue size, repeated experience of borrowing, gross fees, number of managers who are responsible of syndicating the issue, and credit rating. The study also takes into account a broad amount of macroeconomic variables in searching for variables affecting the yield spreads. The author finds that yield spreads are, to some extent, explained by macroeconomic variables related to the issuing country as well as the assigned credit ratings. Another central result of the paper is the fact that credit ratings appear to provide further information about credit spread beyond that provided by the considered economic variables (e.g., inflation, government fiscal balance, current account balance, and GDP per capita). Overall, the paper indicates that maturity, issue size, and gross fees are positively related to the yield spread, both credit rating and number of managers decrease the yield spread, and repeated experience of borrowing is not found to be statistically significant in explaining the yield spread.

Spyrou (2013) examines yield spread determinants for countries in the light of the recent financial crisis. These countries include Spain, Italy, Ireland, Portugal, and Greece. The unique feature of the paper consist of the fact that, along with fundamental economic variables, it also examines the investor sentiment in the determination of yield spreads throughout the financial crisis. The author suggests that previous studies neglect behavioural biases in addition to sentiment-driven mispricings that may exist in the bond markets. Focusing on such factors, the paper finds that fundamental variables are significant for the determination of the level of the yield spreads. Moreover, investor sentiment is also a statistically significant determinant for the level and changes of the yield spreads, especially throughout the crisis period ranging from 2007 until 2011.

Espinosa and Moreno (2014) investigate and compare the yield spread determinants of U.S. and Mexican sub-sovereign government bonds. The authors find that the risk factors affecting the yield spreads of sub-sovereign bonds differ between the selected countries. On the one hand, results related to the U.S. are similar to the initially expected and are robust to different model specifications. On the other hand, the results related to Mexico reveals that the variation of the yield spreads is explained by factors mirroring the inherent characteristics of the bond, the socio-economic condition of the state which issued the bond, and the situation of the Federal District. Moreover, the statistically significant factors do not reflect the financial condition of

the state. According to the authors, a potential explanation for this might be considered the legal framework used to regulate the issuance of sub-sovereign bonds in Mexico.

Ferri (1978) examines reasons for the existence and fluctuation of yield spreads during the period from 1957 to 1975 in order to determine whether the spreads are functions of differences in call protection, creditworthiness, and supplies. Results show that differences in risk of early retirement are considered to be important to all of the yield differentials. Moreover, differences in risk of default and in supplies have a significant impact on corporate-government spreads. The nature of these relationships varies modestly during the examined period. Going further, the results indicate that capital markets and investors expect higher returns from the corporate obligors than from the U.S. government since government bonds offer a high degree of call protection and less risk of default.

Ederington (1974) examines the reasons from the yield spread and its fluctuations using data from January 1, 1964 until February 28, 1971. The reason for investigating this timeframe is due to the large fluctuations of the yield spreads from the latter half of the 1960s until late 1970s and early 1971. Furthermore, the author empirically tests three largely discussed hypotheses – the heterogeneity hypothesis, the lagging market hypothesis, and the uncertainty hypothesis. The author shows that part of the yield spread reflects the difference in call protection and potential for capital gains offered by differing coupon interest rates and call restrictions. The relation appears to be unstable. Another important result of the paper relates to the little support found in the hypothesis suggesting that the offering yield and the yield spread vary in a consistent way with syndicate uncertainty related to the demand for the issue. The paper also sheds light in confirming the hypothesis that the outstanding issue yields tend to lag behind new issue yields. Finally, the author finds that the lock-in explanation of the lagging markets in unjustified.

Gómez-Puig *et al.* (2014) investigate the EMU sovereign yield spread drives throughout times of crisis with respect to the German bund. The paper contributes to the existing literature with the high amount of variables used in studying the behaviour of the sovereign yield spreads as well as measuring the effect on these spreads of changes in market sentiment and risk aversion. Using data from the beginning of 1999 until the end of 2012, the authors find that the rise of the sovereign risk in central countries can only be partially explained by the growth of local macroeconomic variables within the countries. More interestingly, the marginal effects of the

sovereign spread drivers increased dramatically during the crisis period compared to the pre-crisis times, especially in peripheral countries. Finally, the authors conclude that the significance of the banking level of indebtedness in addition to the foreign bank's claims in the public sector along with the unfolding of the crisis indicate emphasizing on the interconnection between both public and private debt and thus between banking and sovereign crises.

Siklos (2011) explores the yield spread determinants of bonds considering 22 countries from emerging markets during 1998-2009. The period is characterized with an initial decline of the spreads followed by a temporarily sharp rise in reaction to the recent global financial crisis. The author considers the connection between bond yield spreads and volatility. Two common factors for the investigated countries are volatility and central bank transparency, whereas clear idiosyncrasies exist depending on whether emerging markets are in Latin and South America, Asia, Europe or Africa. The main result of the paper relates to the finding that the global financial crisis raised the spreads in all examined countries, except those in Asia, which indicates that bond markets in the Asian region were decoupled from those in other geographic locations.

Silvapulle *et al.* (2016) examine the contagion effects in the daily bond yield spreads, relative to Germany, of five peripheral countries – Portugal, Italy, Ireland, Greece, and Spain. Using a robust semiparametric copula method and focusing on these specific countries, the authors aim to explore the consequences of the recent euro-debt crisis. The authors provide an overwhelming evidence of financial contagion effects among the peripheral countries. The largest countries in the sample, Spain and Italy, appear to be operating independent of each other. In the same time, Ireland, Greece, and Portugal are found to be exporters of contagion. The findings of the authors have many implications for debt crisis risk management, international policy debate, and financial market participants. More specifically, the authors indicate that the phenomenon of contagion requires constant monitors and if being left unchecked it may evolve into a full blown crisis.

Beck *et al.* (2017) examine the determinants of sub-sovereign bond yield spreads using a total of 1018 annual spread observations from 96 sub-sovereign entities. In particular, the authors investigate the role of fiscal fundamentals and federal bailouts expectations. The authors find that sub-sovereign debt and deficit levels relative to GDP are major drivers of sub-sovereign spreads. Interestingly, the weight assigned by the financial markets to fundamentals in pricing

sub-sovereign bonds is decreased when institutional set-up of the federation allows for bailouts. Furthermore, the extent to which fundamental factors are priced into spreads is affected by the market's expectation of a federal bailout and the capacity of the federal government to offer support to the weaker members of the federation. The study also indicates the positive relationship between debt and risk premia which tends to break down in times of increased above certain threshold sub-sovereign government debt and is possible to reflect the market's expectation of a federal bailout as fundamentals deteriorate. Finally, another important result of the paper is related to the tendency of larger sub-sovereign entities to pay higher premia as fundamentals worsen. This could be linked to the limited capacity level of the federal government to offer support as the size of the expected bailout increases.

Maltritz and Molchanov (2013) investigate the bond yield spreads using the Bayesian Model Averaging in order to find the variables which are most likely to determine credit risk. Using 34 independent variables, the authors show that the ratio of external debt to GDP, default history, growth rate of foreign currency reserves, currency depreciation, and market sentiment proxied by S&P 500 returns are part of the most important variables in determining yield spreads. Surprisingly, a significant portion of economic variables which were traditionally considered in the literature as well as political and governance variables exhibit low to medium probability of being included in the regression model. As a result, the authors emphasize on the importance of accounting for possibility of alternative model specifications. In essence, accounting for model uncertainty is essential when a significant amount of the independent variables measure few broad concepts (e.g., solvency, liquidity, and macroeconomic conditions).

Eichler (2014) investigates the political determinants of sovereign bond yield spreads using data for 27 emerging markets between 1996 and 2009. The author finds that countries with parliamentary systems and a low quality of governance are faced with higher sovereign yield spreads. On the other hand, the degree of democracy and elections plays no significant role. Furthermore, a higher level of political stability and the power to implement austerity measures results in reducing sovereign yield spreads, especially in autocratic regimes. For democratic countries, no significant effect is detected.

Costantini *et al.* (2014) explore the determinants of sovereign bond yield spreads in the EMU. Using a panel cointegration approach which allows for structural breaks to the analysis of the

determinants, the authors find evidence for a level break in the cointegrating relationship. More specifically, results indicate that fiscal imbalances (expected government debt-to-GDP differentials) are the leading long-run drivers of sovereign spreads whereas liquidity risks and cumulated inflation differentials possess non-negligible weights. The results ultimately depend upon whether or not the sample of countries consists of members of an Optimal Currency Area (OCA). More specifically, results are driven by the set of countries not passing the OCA test. Finally, the authors show that investors carefully monitor and severely punish the deterioration of expected debt positions of those economies which exhibit major gaps in competitiveness.

Several studies focus their attention on cross-country analyses. In particular, the literature has documented important cross-country contagion/spill-over effects between various euro countries both in the market for sovereign EMU bonds as well as credit default swaps, especially in the case of sovereigns which are less well-rated (e.g., Caceres *et al.,* 2010; Arghyrou and Kontonikas, 2012; De Santis, 2012; Favero and Missale, 2011). In addition, Hui and Chung (2011) argue that the European sovereign debt crisis is the reason for spill-over effects to the exchange rate of the euro against the U.S. dollar. On the other hand, in line with the pre-crisis period, studies indicate a rather limited role of the country-specific liquidity risk (e.g., Arghyrou and Kontonikas, 2012; Attinasi *et al*., 2009; Barrios *et al*., 2009; De Santis, 2012; Favero and Missale, 2011; Haugh *et al*., 2009; Sgherri and Zoli, 2009).

The impact of currency denomination on credit spreads is not thoroughly examined in the literature. One of the few studies focusing their attention on the issue is the work of Kamin and von Kleist (1999). More specifically, the authors find that credit spreads of emerging market sovereign debt denominated in USD during the 1990s were systematically higher. The authors attribute this finding to the comparable higher U.S. treasure yields.

3. Hypothesis development

The previous sections have introduced the concepts, theories, and measurements for examining the determinants of yield spreads on sovereign, sub-sovereign, and corporate bonds. Building on the examined literature, the goal of this section is to provide rational reasoning in order to develop the hypotheses of this research. It is worth mentioning that, to my knowledge, there are no empirical studies on project bonds. As a result, the process of establishing the hypotheses is

based on the related previous literature, the characteristics of project bonds, and rational expectation of the expected relationship between the specific variables.

3.1   Bond-specific determinants

This sub-section is devoted to examining the bond-specific determinants which might influence the yield spread: issue size, term to maturity, credit rating, domicile market, currency, and time of issue.

3.1.1 Issue size

In general, studies are divided in terms of opinions on how issue size affects bond yield spreads. Several studies show that there is a negative relationship between issue size and the bond yield spreads (e.g. Lamy and Thompson, 1988; Bradley, 1991; Booth, 1992). Opposed to them, Kidwell *et al.* (1985), Fung and Rudd (1986), Finnerty and Nunn (1985), Adedeji and McCosh (1995), and Amira (2004) find a positive relationship between the variables. In addition, Crabbe and Turner (1995) find no statistical significant relationship between issue size and new issue yields.

To some extent, these studies provide a general direction from which one can build upon developing the appropriate hypothesis. The paper of Kidwell *et al.* (1985) is a good starting point. Applying the market congestion hypothesis within the project bond framework, we can conclude that although the Global Project Bond Market is experiencing an expansion (e.g., Rossi and Stepic (2015) report that in 2012, the project bond volume issuance in Europe amounted to USD 1.8 billion, whereas in 2013 it increased to USD 8.7 bn. The upward trend suggests the increasing usage of the project bonds), it is still relatively small compared to similar markets. As a consequence, the authors show that the inability to absorb a high volume of issues would ultimately lead to a positive relationship between the issue size and the yield spreads. Using more recent data, Amira (2004) shows similar results in examining sovereign Eurobonds yield spread.

Considering the abovementioned line of reasoning, the first hypothesis of the research is:

H1: The issue size variable is positively related to the yield spread.

3.1.2 Term to maturity

The examined literature can be divided into two parts. First, based on the liquidity preference theory, studies typically find a positive relationship between the maturity and yields (e.g. Cox *et al.,* 1981; Fisher, 1959; Amira, 2004). Opposing studies include Feder and Ross (1982), who find an ambiguous sign between the relationship in the regression and Johnson (1967) who finds inverse relationship between the variables during crisis times.

Project bonds are characterized with a higher term to maturity compared to other bonds. Based on the liquidity preference theory, the longer-term fixed-rated bonds might experience larger price fluctuations and in order to compensate for the risk involved, they offer higher yields. Building on this framework, the second hypothesis states:

H2: The term to maturity is positively related to the project bond yields.

3.1.3 Credit ratings

Apart from Artus *et al.* (1993), the literature, again, finds positive relationship between the considered variables: credit rating and the yield spread. It is worth mentioning that the credit ratings of the project bonds will be further enhanced after the implementation of the 2020 PBI. Currently, however, one of the major drawbacks of the project bonds is related to the low credit ratings assigned by rating agencies (Rossi and Stepic, 2015).

Taking into account the characteristics of the project bonds in terms of assigned credit ratings, the third hypothesis states:

H3: Credit ratings are negatively related to the project bond yields.

3.1.4 Domicile market

In general, studies examining periods with normal economic times show that there is a limited role for country-specific liquidity risk. Based on the fact that the sample of project bonds used throughout the research consists of issuance from the beginning of 2015 until the end of 2017, one might expect that the domicile market of the project bonds will have no effect on the yield spreads. As a result, the fourth hypothesis indicates:

H4: The domicile market is not significantly associated with the project bond yields.

3.1.5 Currency

The limited empirical literature in examining the relationship between the currency denomination and bond yield spreads requires a logical reasoning in order to come up with an appropriate hypothesis. The project bonds sample consists of 11 currencies denominations, four out of which are used as denominator for only four project bonds. For further information on the definition and statistics of the currencies considered in the dataset, see tables C, D, and E in the Appendix. Rossi and Stepic (2015) indicate that equity investors are unwilling to accept currency risks and target low-risk profile. Based on that, a reasonable expectation might be such that there is a positive relationship between the variables.

Therefore, the fifth hypothesis indicates:

H5: There is a positive relationship between the currency denomination and the yield spread.

3.1.6 Time

Most studies examine the relationship between time the bond yield spread in order to determine whether there is a relationship between the variables in a period of economic distress (e.g., the recent financial crisis or the sovereign debt crisis). Examining such relationship is beyond the scope of this research. Given the timeframe of the project bonds issuance in the sample, it is reasonable to expect no significant relationship between the variables.

Consequently, the sixth hypothesis states:

H6: There is no significant relationship between the time of issuance of the project bonds and project bonds yield spread.

3.2   Macroeconomic variables

The sub-section is devoted to examining the possible effect of the macroeconomic variables considered in the following sections: inflation, GDP per capita, government fiscal balance, and current account balance.

3.2.1 Inflation

Inflation is relatively limited considered in the literature. Bohn (1990) presents a framework through which he attempts to explain the use of foreign currency debt by a government. In

particular, he finds that time inconsistency problem may result in employing foreign currency debt. More specifically, the author argues that this might happen if there is a fear in the financial markets that the real value of nominal debt which is denominated in the government's own currency will be eroded due to inflation. On a more relevant note, Amira (2004) finds a negative relationship between inflation and credit ratings. While examining the yield spread on the sovereign Eurobonds, the author finds positive relationship. Based on the latter results, the seventh hypothesis states:

H7: Inflation is positively related to the yield spread of project bonds.

3.2.2 GDP per capita
Studies using GDP per capita are usually accompanied in examining the determinants of credit ratings. Cantor and Packer (1996), Afonso (2002), and Amira (2004) find positive relationship for between the credit ratings and GDP per capita. Taking into account their results, the next hypothesis indicates:

H8: GDP per capita is negatively related to the yield spread of project bonds.

3.2.3 Government fiscal balance
The government fiscal balance in considered in several papers, most notably in Nogués and Grandes (2001) and Amira (2004). Both studies conclude that there is a negative relationship between the spreads and the country's fiscal balance. Based on these studies, the following hypothesis is made:

H9: Government fiscal balance is negatively related to project bonds yield spread.

3.2.4 Current account balance
The final macroeconomic variable considered in the analysis is the current account balance. Similar to the government fiscal balance, Nogués and Grandes (2001) and Amira (2004) report results in examining the variable as a potential yield spread determinant. More specifically, the former study finds no statistical significance of the current account balance. However, Amira (2004) finds positive relationship between current account balance and yield spread when

considering only a selected set of economic variables and excluding credit ratings. In addition, the author finds that the variable is significant in explaining the credit ratings and current account balance increases with credit ratings.

Considering this, the final hypothesis states:

H10: Current account balance is positively related to project bonds yield spreads.

4. Methodology

This chapter is divided into two sections. The first part provides information related to the data used throughout the analysis. More specifically, it includes the data collection process, databases used, sample size, and variables description. The second section presents the yield spread determinants approach that is to be undertaken. In particular, this part of the section is devoted to examining the steps undertaken in analysing the determinants of yield spreads, yield spread and macroeconomic factors as well as the determinants of yield spread by rating agencies.

4.1   Data description

4.1.1 Data collection

The database consists of 177 project bonds issued from 01-01-2015 until 31-12-2017. In order to determine which bonds can be identified as project bonds, several online newsletters were investigated[1]. The newsletters provide information related to the bonds (e.g., coupon rate, maturity, issue size etc.) as well as in-depth information of the majority of the bonds and the use of their proceedings. In order to ensure further credibility, each project bond was further verified via the Internet. For the majority of the project bonds, the contract declaring the issuance of the bonds from the issuer is available online. However, for the rest of bonds, the only available information was related to articles from various news agencies.

The data on project bonds is obtained from two sources: Datastream and Thomson One. Obtaining data from two different sources could be a challenging issue due to different information provided from each source. In this case, both databases provide information related to the issuer name, date of issue, coupon rate, domicile market, maturity year and currency. In addition to these variables, Thomson One also displays the industry of the issuer and both the

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[1] The newsletters were published by Crédit Agricole.

proceeds amounts in the target market as well as the sum of proceeds in all markets. Datastream provides a datatype search using the bond's Datastream symbol which makes it possible to obtain information about the borrower SIC code and determine the issuer industry, and obtain the amount issued.

The dataset consists of semi-annually paid bonds, floaters, quarterly paid bonds and index-linked bonds, all derived from Datastream. To ensure consistency throughout the entire dataset, the annual percentage rate payable is obtained from Datastream's datatype search[2] in order to annualize the coupon payable as this is the case with the rest of the bonds.

4.1.2 Variable measures

Two types of variables are used throughout the analysis: variables related to the issue-specific measures and country-of-issue specific variables. Issue-specific variables consist of the yield spread, issue size, maturity, currency, and time. Country-of-issue specific variables include credit rating and economic indicators of the domicile market of the specific project bond. Table 1 provides a brief overview of the variable definitions and the way they are denoted throughout the empirical analysis. The variables are further examined below.

Considering the fact that the majority of the issue size of the projects bonds is reported in U.S. dollars, the variable for the rest of the sample is denominated in the specified currency. The U.S. dollar is the preferred currency as it requires less denomination and, as a result, the end values are as close as possible to the real issue size. The denomination process is performed through finding a suitable exchange rate between the U.S. dollar and the specified currency of the date, month, and year of issue of the project bond.

Project bonds ratings are given by credit rating agencies such as Moody's, Standard & Poor's and Fitch Ratings. 13 bonds were either not rated or the information related to them is private.

Since the rating scale varies between the agencies, all project bonds are given the Moody's bond rating equivalent. For instance, if a project bonds is rated only by Fitch Ratings, it is assigned the rating which is equivalent based on the Moody's rating scale. Apart from these three agencies, several bonds were rated by other agencies (e.g., DBRS, Axesor, RAM and ICRA). The methodology in terms of obtaining the final rating is similar to the abovementioned

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[2] The Datastream datatype search provided and used by the financial database is the current coupon.

Table 1 - Variable definitions

Variables	Symbol	Definition/Measured
Yield Spread	Yspread	Yield to maturity on the issue minus the yield to maturity on a comparable 10-year government benchmark bond of the country of issue.
Natural log of the issue Size	Size	Natural log of the issue size. The issue size is measured In US million dollars.
Term to maturity	Term	Represents number of years until maturity.
Credit ratings	Rating	Credit ratings are measured using the Moody's credit rating scale in which B3 rated project bonds are assigned a value of 1 and Aaa rated project bonds are assigned a value of 16.
Inflation	Inf	Measured using the Consumer Price Index of the country of issue during the quarter of the issue.
Government Fiscal Balance	Govfisbal	Government fiscal balance is measured using the government budget balance during the quarter of issue. divided by the GDP.
Current Account Balance	Curracc	Measured using the current account balance of the country of issue during the quarter of issue divided by the GDP.
GDP per capita	GDPc	The GDP per capita is measured using the GDP of the country of issue during the quarter of issue divided by the population of the country during the quarter of issue in US dollars.
Domicile market	Domrkt	The country of issue measured through a dummy variable taking the value of 1 when a certain country issues the bond and zero otherwise.
Currency of issue	Curr	Currency of issue measured through a dummy variable that takes the value of 1 when the bond is issued in a certain currency and zero otherwise. There are 11 currencies in the sample. The top 5 currencies in number of issues are the Indian rupee, the US dollar, the euro, the Canadian dollar and the Malaysian ringgit.
Time of issue	Time	The time of issue is the month and year during which the bond is issued. It is measured through a dummy variable which takes the value of 1 when a bond is issued in a certain month and year and zero otherwise.

Table 2 - Bond Rating Numerical Conversion

Conversion Number	Moody's Rating	Standard and Poor's Rating	Fitch Rating
16	Aaa	AAA	AAA
15	Aa1	AA+	AA+
14	Aa2	AA	AA
13	Aa3	AA-	AA-
12	A1	A+	A+
11	A2	A	A
10	A3	A-	A-
9	Baa1	BBB+	BBB+
8	Baa2	BBB	BBB
7	Baa3	BBB-	BBB-
6	Ba1	BB+	BB+
5	Ba2	BB	BB
4	Ba3	BB-	BB-
3	B1	B+	B+
2	B2	B	B
1	B3	B-	B-

Note:
The table provides bond-rating conversion codes for the three major rating agencies: Moody, Standard and Poor and Fitch ratings used throughout the analysis.

process. However, it is worth mentioning that RAM and ICRA rated a total of 77 bonds in the sample (for more information, see tables C, D, and E in the Appendix). The assigned ratings correspond to the highest rating level in their respective rating scales. Once the ratings were obtained, a dummy variable is generated and is assigned a value of 1 if the project bond is assigned a rating of B3 and 16 if it is assigned a rating of Aaa. Table 2 provides the conversion numbers for Moody's, Standard and Poor, and Fitch project bonds ratings used throughout the analysis.

The analysis also includes four macroeconomic variables – inflation[3], government fiscal balance[4], GDP per capita[5] and current account balance[6]. The process of measuring the variables is described in Table 1. For internationally traded bonds with euro currency, data is derived based on the target market of the project bond. For internationally traded bonds with U.S. dollar currencies, data is derived for the U.S. This is due to the fact that, for the most of the cases, the issuer is from a relatively small country and the project bond is issued in U.S. dollars in order to attract larger investor base.

4.2   Yield spread determinants

Examining the determinants of yield spread on project bonds is done using the following specification:

$$\text{Yspread}_{i,t} = \beta_0 + \beta_1(\text{Size}_{i,t}) + \beta_2(\text{Term}_{i,t}) + \beta_3(\text{Rating}_{i,t})$$
$$+ \beta_4(\text{Domrkt}) + \beta_5(\text{Curr}) + \beta_6(\text{Time}) + \varepsilon_{i,t}. \qquad (1)$$

Where i indicates the ith issuer at time t. The dependent variable is the yield spread, which represents the spread over the yield on a comparable 10-year government benchmark bond of the country of issue. To illustrate, if a project bond is issued in euros for a target market in France the yield spread will be the difference between the coupon rate of the bond and the French 10-year government benchmark bond during the quarter of issue of the project bond. The independent variables in equation (1) are: natural log of the issue size (Size), term to maturity (Term), credit rating (Rating), and dummy variables for domicile market (Domrkt), currency of issue (Curr) and month and year of issue (Time).

4.3   Yield spread and macroeconomic variables

This sub-section shows the approach through which the relative effect of four macroeconomic variables that are considered in the literature to be determinants of sovereign credit rating are examined. These variables include inflation, government fiscal balance, current account balance, and GDP per capita.

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[3] Inflation is derived from the Federal Reserve Bank of St. Louis which reports the inflation directly from the Consumer Price Index from the target country.
[4] Government fiscal balance is derived from the respective entity responsible for issuing the data. For instance, Canadian government fiscal balance is derived from the Canadian Department of Finance.
[5] Data on GDP per capita is derived from the World Bank.
[6] Current account balance is derived from the respective entity responsible for issuing the data. For example, US current account balance is derived from the US Bureau of Economic Analysis.

First, the abovementioned variables are tested in order to detect whether they have additional effect on the yield spread besides the credit rating. Second, the regression on the same model is tested without credit ratings.

More specifically, the model specifications are as follows:

$$Yspread_{i,t} = \beta_0 + \beta_1(Size_{i,t}) + \beta_2(Term_{i,t}) + \beta_3(Rating_{i,t})$$
$$+ \beta_4(Inf_{i,t}) + \beta_5(Govfisbal_{i,t}) + \beta_6(Curracc_{i,t})$$
$$+ \beta_7(GDPc_{i,t}) + \beta_8(Domrkt) + \beta_9(Curr)$$
$$+ \beta_{10}(Time) + \varepsilon_{i,t}. \tag{2}$$

$$Yspread_{i,t} = \beta_0 + \beta_1(Size_{i,t}) + \beta_2(Term_{i,t}) + \beta_3(Inf_{i,t})$$
$$+ \beta_4(Govfisbal_{i,t}) + \beta_5(Curracc_{i,t}) + \beta_6(GDPc_{i,t})$$
$$+ \beta_7(Domrkt) + \beta_8(Curr) + \beta_9(Time) + \varepsilon_{i,t}. \tag{3}$$

The reason to undertake this approach is based on the fact that through specifications (2) and (3) it is possible to directly test the hypothesis of Cantor and Packer (1996). More specifically, the results from the specifications might indicate whether credit ratings provide further information beyond that given by the macroeconomic variables.

To further investigate the role of credit ratings, a separate regression is performed of the credit rating on the set of the macroeconomics factors. The model specification has the following expression:

$$Rating_{i,t} = \beta_0 + \beta_1(Inf_{i,t}) + \beta_2(Govfisbal_{i,t}) + \beta_3(Curracc_{i,t}) + \beta_4(GDPc_{i,t})$$
$$+ \beta_5(Domrkt) + \beta_6(Curr) + \beta_7(Time) + \varepsilon_{i,t}. \tag{4}$$

5. Empirical results and analysis

5.1   Descriptive statistics

Tables 3, 4 and 5 present the descriptive statistics of the sample. Table 3 presents project bonds based on their domicile market, whereas table 4 divides the sample based on industry of operation. For both tables, the averages of their term to maturity, issue size, yield spread, and credit ratings are reported. Table 5 provides descriptive statistics for the yield spread, issue size, term to maturity, coupon rate, and credit rating. Included characteristics are the mean, median, standard deviation, maximum and minimum values.

Table 3 provides information related to the domicile markets of the project bonds in the sample. The major domicile markets include India, Canada, Malaysia, and the U.S. In addition, internationally traded bonds also represent a significant amount of the whole sample. This is due to the fact that many project bonds are issued by companies in relatively small markets. In order to reach a larger investor base, the companies generally issue international bonds. More specifically, out of the 45 international bonds, 23 or 51 percent are denominated in U.S. dollars, whereas 15 are denominated in euros. This is in accordance with the statement of Fabozzi (2013) that the Eurodollar bond market is the largest sector within the Eurobond market. Other currencies of internationally traded bonds include the Colombian Peso and the Great British Pound.

A potential limitation of the research can be observed from table 3. This is related to the credit ratings assigned to the issuers with domicile markets from India and Malaysia. As described in Section 4.1.2, the sub-sample consist of a combined amount of 77 project bonds or 44 percent of the whole sample. The project bonds were issued by two companies, West Coast Expressway Sdn Bhd. which engages in designing and developing expressways in Malaysia, and SP Jammu Udhampur Highway Limited which is a special vehicle purpose entity focusing on the expansion of the approximately 65 km. of Jammu-Udhampur section in India.

Table 3 - Sample description by Domicile Market of the Issuer

Domicile Market	Issues	Percent	Term	Size	Spread	Rating
Australia	1	0.5600	7.0000	234.0000	1.7500	8.0000
Canada	20	11.3000	24.8500	295.9234	2.3925	9.5000
Chile	1	0.5600	31.0000	215.0000	-0.9500	8.0000
France	8	4.5200	10.3750	584.5250	1.1944	8.5714
India	57	32.2000	8.3684	6.8153	1.3368	16.0000
International	45	25.4200	15.4667	522.1822	2.6825	7.3077
Italy	4	2.2600	10.0000	638.2500	1.7188	9.3333
Malaysia	20	11.3000	16.5000	11.7482	0.9660	16.0000
New Zealand	1	0.5600	6.0000	56.3000	1.5970	9.0000
Spain	2	1.1300	19.5000	77.6500	2.6460	6.5000
Switzerland	1	0.5600	7.0000	204.0000	1.2850	8.0000
United Kingdom	1	0.5600	5.0000	187.0000	3.3600	3.0000
United States	16	9.0400	18.3125	647.6563	2.7825	7.1538

Notes:

This table provides sample statistics for project bond issues. The data set is comprised of 177 13-country observations from January 2015 to December 2017. The descriptive statistics are presented by domicile market of issue: the domicile market of issue (Domicile Market), number of times issuers from the same industry issued project bonds (Issues), the percentage value of the industry number of issues relative to the whole sample (Percent), average term to maturity of the issues (Term), the average amount of project bond issue in millions of US dollars (Size), the average yield spread on the issue (Spread), and the average credit rating (Rating).

Table 4 - Sample description by Industry of Operation of the Issuer

Industry	Issues	Percent	Term	Size	Spread	Rating
Building/Construction & Engineering	3	1.6900	33.3333	285.3333	2.9805	
Business credit institutions	2	1.1300	20.0000	247.5000	1.1955	8.0000
Electric services	14	7.9100	18.2857	300.9286	2.5780	8.0769
Engineering & management services	1	0.5600	33.0000	136.0000	2.8020	10.000
Gas production and distribution	1	0.5600	5.0000	680.0000	6.6200	2.0000
General building contractors	1	0.5600	18.0000	173.0000	2.0370	10.000
Heavy construction, except highway	4	2.2600	12.2500	396.0000	2.0433	7.7500
Highway and street construction	7	3.9500	12.8571	402.4571	1.4176	8.4286
Holding/investment offices	30	16.9500	19.6667	581.3189	2.6362	8.0000
Oil and gas extraction	4	2.2600	10.0000	1282.5000	3.3688	5.7500
Pipelines, except natural gas	3	1.6900	10.6667	772.6667	1.3933	10.000
Security and commodity brokers	5	2.8200	18.0000	360.1600	2.2810	7.8000
Renewable energy	5	2.8200	19.8000	329.8600	2.2266	7.7500
Transportation & Infrastructure	87	49.1500	10.8161	51.3016	1.4012	15.093
Transportation by air	5	2.8200	14.4000	540.2000	2.2150	7.2000
Trucking and warehousing	2	1.1300	10.0000	610.5000	1.0150	8.5000
Water transportation services	3	1.6900	12.0000	335.4333	2.0323	9.0000

Notes:

This table provides sample statistics for project bonds issues. The data set is comprised of 177 17-industry observations from January 2015 to December 2017. The descriptive statistics are presented by industry of operation of the issuer: the industry of the issuer (Industry), number of times issuers from the same industry issued project bonds (Issues), the percentage value of the industry number of issues relative to the whole sample (Percent), average term to maturity of the issues (Term), the average amount of project bond issue in millions of U.S. dollars (Size), the average yield spread on the issue (Spread), and the average credit rating (Rating). The Building/Construction & Engineering sub-sample is not rated.

Table 5 – Sample description

Variables	Mean	Median	Standard Deviation	Maximum	Minimum
Panel A: Total Sample Including 177 Observations					
Spread (%)	1.9060	1.3900	1.3362	7.6000	-1.7000
Size	275.0475	117.0000	397.9459	3000.0000	3.6100
Term	14.1864	12.000	8.6854	52.0000	1.0000
Coupon (%)	5.9196	5.2400	2.5860	10.0000	0.6250
Rating	11.6951	11.0000	4.3742	16.0000	1.0000
Panel B: All 164 rated Observations					
Spread (%)	1.8382	1.3500	1.3295	7.6000	-1.7000
Size	276.2324	114.0000	406.2151	3000.0000	3.6100
Term	13.8171	12.0000	8.5115	52.0000	1.0000
Coupon (%)	6.0419	5.2900	2.6205	10.0000	0.6250
Rating	11.6951	11.0000	4.3742	16.0000	1.0000
Panel C: High-quality Issue Sample Including 99 Observations					
Spread (%)	1.3349	1.3500	0.5128	3.2550	-0.2900
Size	101.7772	8.868	224.6776	1100.0000	3.6100
Term	13.1515	12.000	8.7474	52.0000	1.0000
Coupon (%)	7.0214	9.1000	2.6102	9.2500	1.0000
Rating	14.7575	16.000	2.3737	16.0000	10.0000
Panel D: Low-quality Issue Sample Including 65 Observations					
Spread (%)	2.6047	2.6500	1.7637	7.6000	-1.7000
Size	541.9410	446.00	473.4780	3000.0000	56.3000
Term	14.8301	12.000	8.1001	36.0000	5.0000
Coupon (%)	4.5501	4.5000	1.8200	0.6250	10.0000
Rating	7.0308	8.0000	1.8706	9.0000	1.0000

Notes:

This table provides summary statistics related to the employed data. The data set consists of 177 observations from January 2015 to December 2017. Descriptive statistics is available for the following variables: the yield spread (Spread), issue size (Size), term to maturity (Term), coupon rate (Coupon), and credit rating (Rating).

Due to limitations in data, credit rating is available for 164 observations. Panel A includes the descriptive statistics of the whole sample and credit ratings for 164 observations. Panel B presents the descriptive statistics for all 164 rated observations. Panel C includes the descriptive statistics of the high-quality issues, containing issues having a credit rating of 10 or (A3, A-) and higher. Due to limitations in data, credit rating is available for 99 observations. Panel D includes the descriptive statistics of the low-quality issues, containing issues having a credit rating of 9 or (Baa1, BBB+) and lower. Credit rating is available for all 65 observations.

Table 4 divides the sample based on the industry of operation of the issuer. It can be observed that out of the 17 industries, the top three industries include transportation and infrastructure, holding and investment offices, and electric services. The transportation and infrastructure industry includes all project bonds from India and Malaysia. It can be seen from table 3 that the average issue size for project bonds with domicile market is significantly lower compared to the rest of the sample, which ultimately leads to lower issue size for project bonds from the abovementioned industry. Similarly, the assigned credit ratings also influence the average credit rating given to issues from the industry, which is slightly above 15, corresponding to Aa1 or AA+.

Finally, Table 5 presents the descriptive statistics for the variables used in the sample. Included characteristics are the mean, median, standard deviation, maximum and minimum values for yield spread, issue size, term to maturity, coupon rate, and credit rating. Panel A of the table shows the descriptive summary of the total sample, which includes 177 observations. Project bonds are issued with an average yield spread of 1.91% above comparable 10 year government benchmark yields of the countries of the   currency of issue, a standard deviation of 1.32%, a maximum of 7.6% for an internationally traded bond issued by Stoneway Capital Corporation in 2017, and a minimum of -1.7% for an internationally traded bond issued by Fideicomiso PA Pacifico Tres in 2016. The mean size of a project bond is US $275.05 million; Mexico City Airport Trust issued bonds equal to US $3,000 million in 2017 while SP Jammu Udhampu Highway tapped the market for only US $3.61 in 2015, which represents only one of the 57 bonds issued by the company in order to refinance a highway project in India. The issued project bonds during the period 2015-2017 can be characterized with a term as long as 52 years by PSS Generating Staition LP in 2015, a company based in Canada, and as short as one year by, again, Jammu Udhampu Highway. The mean maturity is 14.19 years. Moreover, the average credit rating of a project bond issue is 12 (A1), with highest rating grade reaching 16 (Aaa), with the lowest grade assigned is one (B3). Panel B of the table consist of all rated project bonds, or 164 observations. Due to the fact that only 13 observations are missing from Panel A, the summary statistics are extremely similar.

Panel C and D of table 5 present summary statistics of the high-quality issues having a rating of A3 (A-) or higher and low-quality issues with rating Baa1 (BBB+) or lower. Panel C includes a total of 99 project bonds, 56 percent of the total sample, whereas panel D issues amounted to 65, 37 percent of the sample.

The summary statistics show that low-quality issuers have higher average yield spreads, higher maturity, significantly higher issue size and lower coupon rate.

5.2   Determinants of yield spread

Amira (2004) indicates that a concern with time series cross-sectional data is the possibility of existence of multicollinearity and non-spherical disturbances. Due to the fact that throughout the analysis the OLS estimation technique is applied, the occurrence of multicollinearity and non-spherical disturbances violates the classical assumptions, which may ultimately lead to limiting the usefulness of the model in terms of inference and prediction.

The multicollinearity problem is tested using the variance inflation factors technique as collinearity diagnosis. Chaterjee and Price (2006, p.236) indicate that "values of variance inflation factors greater than 10 is often taken as a signal that the data have collinearity problems." The performed test showed that all estimated values are below 10 thus indicating there is no severe multicollinearity in any of the equations. In addition, a Durbin-Watson test is performed in order to check for existence for autocorrelation. The results show that there is both positive   and   first-order   autocorrelation[7].   Moreover,   the   Breuch-Pagan   test   for heteroskedasticity suggests existence of heteroskedasticity in the error distribution. In order to correct for the existence of these problems, the procedure of estimating the models as well as reporting heteroskedasticity and autocorrelation-consistent t-statistics includes following the approach suggested by Newey and West (1987). Finally, the coefficient of stability is checked through performing the Chow's analysis of variance test by splitting the sample arbitrarily in two halves. The results of the test show that the null hypothesis of coefficient stability is rejected.

Table 6 provides the regression results specified in equation (1). The results in column (1) indicate that all factors, except time, appear to be significantly associated with the yield spread on the project bonds. The positive coefficient between yield spread and maturity supports the liquidity preference hypothesis of the term structure of interest rates. Bonds with longer maturity exhibit more price volatility (i.e., are characterized with a higher duration) than bonds with shorter maturity.

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[7] The Durbin-Watson test is performed using 5 percent level of significance.

The negative coefficient between the yield spread and issue size contradicts the market congestion hypothesis. More specifically, because the project bonds issues are generally larger in terms of size compared to other types of bonds, the markets can absorb a large amount of project bonds issues in the short term without affecting interest rates. As a result, PPP companies do not need to offer a yield premium to persuade investors to purchase a large bond within a single issue.

The estimates also indicate that there is a negative relationship between the yield spread and credit ratings. The results are in accordance with the theory stating that the lower the default risk (i.e., bonds with higher credit ratings), the lower the yield spread paid by the issuer. Furthermore, the table shows that both domicile market and currency denomination factors are significantly associated with the yield spread. The relationship between the independent variables through which they are associated with the yield spread is, however, inverse. More specifically, the domicile markets of Canada and India have a positive effect on the yield spread, while Malaysia decreases the yield spread. U.S. and internationally traded bonds do not have a significant relationship with the yield spread. Focusing on currencies, the U.S. dollar and the Indian rupee are found to have a significant positive association with the yield spread, whereas the Canadian dollar does not affect the yield spread. On the other hand, both the euro and the Malaysian ringgit have a significant negative effect on the yield spread. Finally, in terms of time of issuance of the project bond, a significant relationship is detected only for project bonds issued during 2017. In particular, the first half of the year is characterized with highly significant negative effects on yield spreads, whereas the second half of the year has a significant positive effect on yield spreads.

Table 6 - Regression Results for Project Bonds Yield Spread

Variable	Predicted signs (1)	Primary Specification (2)	High-quality issuers (3)	Low-quality issuers (4)
Intercept		0.0658	0.0403	0.0558
		(5.84)*	(2.48)**	(4.27)*
Issue Size	+	-0.0044	-0.0026	-0.0011
		(-4.29)*	(-2.15)**	(-0.57)
Term to Maturity	+	0.0004	0.0004	0.0005
		(4.23)*	(4.66)*	(2.35)**
Credit Ratings	-	-0.0037	-0.0015	-0.0056
		(-6.27)*	(-1.21)	(-6.45)*
Domicile market		-0.0017	-0.0015	-0.0015
		(-3.61)*	(-2.07)**	(-2.87)
Currency	+	0.0028	0.0008	0.0029
		(5.06)*	(0.67)*	(3.63)*
Time		-0.0001	0.000008	-0.0002
		(-0.82)	(0.07)	(-0.87)
Adj. R Square		0.5498	0.6088	0.4683
D-W statistic		1.73	1.23	2.00
Sample size		164	99	65

Notes:

The table provides the estimated coefficients from the regression using the following specification:

$$Yspread = \beta_0 + \beta_1(Size) + \beta_2(Term) + \beta_3(Rating) + \beta_4(Domrkt) + \beta_5(Curr) + \beta_6(Time) + \varepsilon.$$

Where the dependent variable is the yield spread and the independent variables are natural log of the issue size (Size), term to maturity (Term), and dummy variables for credit rating (Rating), currency (Curr), domicile market (Domrkt), and time of issue (Time). Column (1) provides the predicted signs for the independent variables. Column (2) reports the OLS regression results for the whole sample or primary specification. Column (3) provides the OLS regression results for the sub-sample consisting of the high-quality issues. Column (4) provides OLS regression results for the sub-sample consisting of low-quality issues. The *t*-values are given in parenthesis below each estimate. The *t*-values are estimated using standard errors with Newey-West correction for autocorrelation and heteroskedasticity with lag one.
*,**,*** indicate significance at the 1%, 5% and 10% levels, respectively.

5.3   Yield spread and macroeconomic factors

The results from specifications (2) and (3) are provided in columns (2) and (3) of table 7. The regression coefficients reported in column (2) indicate that the macroeconomic variables contribute to the yield spread determination when included with credit rating. In particular, the significant variables are the government fiscal balance and the GDP per capita. Column (3) shows that when credit ratings are excluded the results are essentially the same with the only difference being the fact that the term to maturity becomes not significant in explaining yield spreads.

The results strongly support the statement of Cantor and Packer (1996) that credit ratings appear to provide further information beyond that provided by the macroeconomic variables.

Table A in the Appendix shows regression estimates for specifications (2) and (3) excluding project bonds with domicile markets from India and Malaysia. The issue size variable becomes significant at the 10 percent level for specifications, whereas the inflation variable in column (2) becomes statistically significant at the 5 percent level. On the other hand, the exclusion of these bonds exacerbates the relationship between the yield spread and the government fiscal balance reported in column (2). Similarly, the hypothesis of Cantor and Packer (1996) is confirmed.

To further investigate the role of the credit ratings, another regression is performed of this variable on the set of macroeconomics variables through equation (4).

The estimates of this regression are reported in table 8. The results indicate that both government fiscal balance and GDP per capita are significant in explaining the credit ratings. More specifically, the government fiscal balance increases with credit ratings, whereas the GDP per capita declines with credit rating. The examined relationship between the credit ratings and the government fiscal balance contradicts the findings of Cantor and Packer (1996). They claim that countries that want to ameliorate the credit standings are eventually required to follow more conservative fiscal policies, whereas countries with adequate credit standings can afford to run on fiscal deficits since they are still able to attract a large base of investors. This ultimately leads to reducing the significance of the variable as a factor affecting credit ratings. The results from table 8 show that the government fiscal balance increases with credit ratings indicating

Table 7 - Regression Results for Alternative Specifications

Variable	Predicted signs (1)	Estimated Coefficient (2)	Estimated Coefficient (3)
Intercept		0.0543	0.0022
		(4.54)*	(0.23)
Issue size	+	-0.0072	-0.0039
		(-5.20)*	(-2.96)*
Term to maturity	+	0.0004	0.00009
		(3.18)*	(0.86)
Credit rating	-	-0.0029	
		(-4.52)*	
Inflation	+	0.0005	0.0007
		(0.37)	(0.54)
Government Fiscal Balance	-	-0.135	-0.1695
		(-2.14)**	(-1.93)***
Current Account Balance	+	0.0144	0.0126
		(0.23)	(0.16)
GDP Per Capita	-	0.0005	0.0007
		(3.63)*	(4.01)*
Domicile market		-0.0015	-0.0011
		(-3.69)*	(-2.15)**
Currency	+	0.0020	0.0015
		(4.86)*	(2.54)**
Time		-0.0002	0.000008
		(-1.10)	(0.05)
Adj. R Square		0.6308	0.4920
D-W statistic		1.69	2.02
Sample Size		164	164

Notes:

The table provides estimated coefficients from the regression using the following specification for column (2):

$$Yspread = \beta_0 + \beta_1 Size + \beta_2 Term + \beta_3 Rating + \beta_4 Inf + \beta_5 Govfisbal + \beta_6 Curracc + \beta_7 GDPc + \beta_8 Domrkt + \beta_9 Curr + \beta_{10} Time + \varepsilon.$$

For column (3):

$$Yspread = \beta_0 + \beta_1 Size + \beta_2 Term + \beta_3 Inf + \beta_4 Govfisbal + \beta_5 Curracc + \beta_6 GDPc + \beta_7 Domrkt + \beta_8 Curr + \beta_9 Time + \varepsilon.$$

Where the dependent variable is the yield spread. Independent variables are: natural log of the issue size (Size), term to maturity (Term), credit ratings (Rating), Inflation (Inf), government fiscal balance (Govfisbal), current account balance (Curracc), GDP per capita (GDP$_c$), and dummy variables for domicile market (Domrkt), currency (Curr), and time of issue in terms of month and year (Time). Column (1) provides the predicted signs for the independent variables. Column (2) provides regression coefficients including credit rating. Column (3) provides regression coefficients excluding credit rating. The *t*-values are included in parenthesis below each estimate. The *t*-values are estimated using standard errors with Newey-West correction for autocorrelation and heteroskedasticity with lag one.

*,**,*** Indicate significance at the 1%, 5% and 10% levels, respectively. Macroeconomic data is available for 177 issues, but due to data limitations related to the credit ratings, macroeconomic data is presented for 164 issues.

Table 8 - Regression Results for Credit Rating and Economic Variables

Variable	Predicted signs	Estimated Coefficient
	(1)	*(2)*
Intercept		16.4600
		(8.55)*
Inflation	-	0.1395
		(0.46)
Government fiscal balance	+	47.6494
		(1.91)***
Current account balance	-	3.4257
		(0.29)
GDP per capita	+	-0.1341
		(-3.23)*
Domicile market		-0.1569
		(-1.08)
Currency	-	0.2601
		(1.48)
Time		-0.0946
		(-2.26)**
Adj. R Square		0.7898
D-W statistic		1.29
Sample Size		164

Notes:
The table presents the estimated coefficients from the regression using the following specification:

$$\text{Rating} = \beta_0 + \beta_1 \text{Inf} + \beta_2 \text{Govfisbal} + \beta_3 \text{Curracc} + \beta_4 \text{GDP}c + \beta_5 \text{Domrkt} + \beta_6 \text{Curr} + \beta_7 \text{Time} + \varepsilon.$$

Where the dependent variable is the credit rating. Independent variables include: Inflation (Inf), government fiscal balance (Govfisbal), current account balance (Curracc), GDP per capita (GDPc), and dummy variables for domicile market (Domrkt), currency of issue (Curr), and time of issue in terms of month and year (Time). The table provides results from the OLS regression. The t-values are generated using standard errors with Newey-West correction for autocorrelation and heteroskedasticity with lag two.
*, **, *** Indicate significance at the 1%, 5% and 10% levels, respectively. Credit ratings are available for 164 issues.

that project bonds issuers with relatively low risk of default choose to issue bonds when the country of origin of the company, or the target market of the project, runs a fiscal surplus. In addition, the coefficient estimates for both inflation and the current account balance are statistically insignificant. Table B in the Appendix reports coefficient estimates from testing specification (4) without project bonds from India and Malaysia. The results are significantly different from those reported in table 8. To begin with, the inflation coefficient becomes negative and significant, whereas the government fiscal balance becomes statistically insignificant. The

latter relationship is in accordance with the statement of Cantor and Packer (1996). Furthermore, the current account balance becomes negative and significant at the 10 percent level of significance. The other coefficient estimates remain similar, with the only remaining difference being the time variable which loses its statistical significance.

5.4   Determinants of yield spread by rating categories

The approach followed in this sub-section is done through dividing the sample into two groups: one group consists of high-quality issuers whereas the other contains low-quality issuers. The high quality issuers category includes all issuers with ratings A3 or higher. The low- quality category consists of issues with Baa1 rating or lower. The determinants of the yield spread are explored by running two separate regressions. The descriptive statistics are presented in Panels C and D of table 5 whereas the results of the regressions are reported in columns (3) and (4) of table 6.

Table 5 shows that high quality rated project bonds on average issue bonds with lower yield spread, issue size and term to maturity than low-quality issuers. The sub-sample in panel B contains all rated observations which amount to 164.

Column (3) of table 6 reports estimates of the high-quality sub-sample. The results suggest that maturity increases with the yield spread. This result is accordance with the liquidity preference theory. Moreover, the larger the size of the issue, the lower the spread. This negative relationship is supported by many authors, including Fisher (1959), Lamy and Thompson (1988), Bradley (1991) and Booth (1992). More specifically, the issue size is a proxy for both the liquidity and marketability of the issue meaning that the larger the outstanding bond's value, the higher the probability that there is an active market in the issue. As a result, high-quality borrowers would benefit when issuing bonds in larger amounts.

Column (4) of table 6 provides the estimate results of the regression related to the low-quality issues. The results indicate that maturity increases with the yield spread. The findings are similar to those in the primary specification, with the only exceptions being the issue size and the country variables both losing their statistical significant values. One notable result is that issuers whose domicile market is U.S. have a significant negative effect on the yield spread, whereas issuers from Canada have a positive impact. Furthermore, the coefficient of the euro is negative and

significant while the U.S. dollar coefficient is positive and significant. The coefficient for low-quality issues issued throughout the first six months of 2017 is negative and significant. The sub-sample does not consist of project bonds issued during the final six months of 2017.

5.5   Summary of findings and comparison with hypotheses

The results show partial support of the hypotheses made in *Chapter 3*. More specifically, the term to maturity, credit rating, currency of denomination, time of issue, GDP per capita, and the government fiscal balance behave in the predicted way. Therefore, the following hypotheses are *accepted*:

H2: The term to maturity is positively related to the project bond yields.

H3: Credit ratings are negatively related to the project bond yields.

H5: There is a positive relationship between the currency denomination and the yield spread.

H6: There is no significant relationship between the time of issuance of the project bonds and project bonds yield spread.

H9: Government fiscal balance is negatively related to project bonds yield spread.

On the other hand, the issue size, domicile market, inflation, and current account balance did not provide support of the hypotheses. As a result, the following hypotheses are *rejected*:

H1: The issue size variable is positively related to the yield spread.

H4: The domicile market is not significantly associated with the project bond yields.

H7: Inflation is positively related to the yield spread of project bonds.

H8: GDP per capita is negatively related to the yield spread of project bonds.

H10: Current account balance is positively related to project bonds yield spreads.

Given the fact that the hypotheses are derived based on empirical work on either corporate, sovereign, and sub-sovereign bonds the general conclusion is that although there are signs of similarities between project bonds and other types of bonds, but the unique characteristics of the project bonds result in important differences between them and other debt instruments. Also, empirical work related to examining the variables which are included in the rejected hypotheses, excluding the issue size, is somewhat limited. Although the results of previous researches appear similar and conclusive, they seem to be contradicted while examining project bonds.

6. Conclusion, Limitations, and future research

6.1 Conclusion

Since their introduction during the 1990s, the interest in project bonds has steadily increased throughout the years, especially since the recent global economic crisis. The bank lending restriction caused by the Basel regulations showed that project bonds can be the solution to the issue. Although project bonds can be considered as a diversifying portfolio tool, bond investors are generally reluctant to invest mainly due to the assigned low credit ratings.

This research examines the determinants of project bonds with 13 domicile markets based on macroeconomic and security specific variables categorized by issue size, maturity, credit rating, domicile market, currency of denomination, and time of issue.

Using a sample of 177 observations for the period January 2015 through December 2017, the results indicate that all bond-specific factors are significantly associated with the yield spread on project bonds. In addition, the relationship between the yield spread and maturity is in accordance with the liquidity preference hypothesis. Furthermore, the credit rating estimates support the theory for the relation between the default risk of the issuer and the yield spread paid by the issuer. On the other hand, the issue size coefficient does not confirm the market congestion hypothesis. Additional testing shows that credit ratings appear to provide additional information about credit spread beyond that offered by the considered variables. These variables include inflation, government fiscal balance, current account balance, and GDP per capita. Further investigation on the role of credit ratings reveals that the claim of Cantor & Packer (1996) associated with the relationship between the credit ratings and the government fiscal balance is not supported. This result has an important implication for project bond issuers since it indicates that project bond issuers issue the debt instruments when the domicile market runs a fiscal surplus.

In aggregate the results show that both maturity and currency denomination are positively associated with the yield spread. On the other hand, issue size, credit rating, and domicile market are negatively associated with the yield spread. The results also indicate that the time of issue has no significant relationship with the yield spread.

Finally, factors influencing the yield spread were examined after controlling for the credit ratings. The issue is tackled by splitting the sample into two parts, one including all high-quality issues, project bonds rated A3, A- or higher, and the other part consisting of low-quality issues with credit ratings of Baa1, BBB+ or below. The results indicate that, in the case of low-quality issues, the issue size and domicile market variables do not conform to the total sample regression. In the case of high-quality issues, credit ratings do follow the total sample regression.

6.2 Limitations

Several notable limitations of the study have to be pointed out. First and most obvious, the project bonds with domicile markets India and Malaysia have a significant impact on the results presented in the study and those reported in the appendix. Project bonds from each of the two domicile markets have very similar characteristics in terms of coupon rate, yield spread, issue size, issue dates, and terms to maturity. More worrying is the fact that they are all assigned the highest credit rating from the respective agencies, which significantly influences the credit rating variable.

Second, the project bond sample is comprised of 177 project bonds from January 2015 to December 2017. The newsletters used to identify the project bonds revealed a larger amount of project bonds issued in this period, but they were not found in neither Datastream nor Thomson One. However, it is possible that other sources, such as Bloomberg, provide access to a larger project bond sample. Additionally, using a broader timeframe will allow for finding a larger and more diverse project bond sample.

Third, the calculation of the project bonds yield spread is done using the 10-year government benchmark bond of the domicile market of the project bond during the quarter of issue of the specific project bond. This is done in order to ensure consistency throughout the dataset and the 10-year government benchmark was considered to be the most appropriate one given the characteristics of the data. Other studies, such as Amira (2004), measure the yield spread using a comparable government or Treasury bond of the country of the currency of issue with similar maturity.

Fourth, a potential limitation concerns the process of dividing the sample between high-quality and low-quality issues. High-quality issues throughout the study are considered those which have a rating of A3, A- or higher, whereas low-quality issues are those with credit rating below Baa1, BBB+. The reasoning is based on the statement of Rossi & Stepic (2015) who state that rating agencies structure transactions in a way to achieve a certain minimum acceptable rating of A- in order to meet the regulation requirements and match the investors' risk appetite profiles. Opposed to that statement is made by Ordonez *et al.* (2015) who focus on the profile of institutional investors and claiming that they are unwilling to invest in bonds with credit rating below A.

Fifth, the treatment of internationally traded project bonds poses a serious limitation. Macroeconomic variables for such bonds are derived based on numerous factors, including the target market of the project as well as the currency denomination of the bond. Despite that, it is possible that factors beyond these affect the yield spread.

Lastly, the final limitation is related to the usage of the yield to maturity in the relative project bonds valuation. Caks (1977) argues that that there are several notable limitations in using the specific variable. The assumption behind the measure is such that investors are able to reach a return on bond which is equal to the yield to maturity only if the bond is held until maturity and the respective coupon payments are being reinvested at the same rate as the yield. In practice, bond investors, similar to stock investors, do not hold the specific instrument until maturity, which in turns means that the measure is characterized with lack of economic significance. Additionally, potential change in credit quality of the issuer results in yield change through time. In particular, the majority of the investors will reinvest coupons at rates which are similar to an appropriate swap rate, the realized return will be lower compared to the yield to maturity. Finally, due to the fact that the measure assumes constant reinvestment rate until maturity of the specified bond, the variable, contrary to the most developed countries, assumes a flat yield curve. As a result, the measure does not provide realistic return estimate since one can expect various reinvestment rates for different maturities consistent with the shape and slope of the yield curve.

6.3 Future research
Project bonds are fruitful area of research due to the limited empirical interest in the literature. A potential technique to apply on project bonds is the limited dependent variable model proposed

by Lesmond *et al.* (1999). The essence of this technique is the fact that, while the true value of the bond is driven by numerous stochastic factors, measured prices will mirror new information only if the information value of the marginal trader surpass the entire amount of the liquidity costs. This suggests that a liquidity cost threshold exists for every bond, which is identical to the minimum information value for a trade. The probability of observing a zero return is higher in the liquidity cost threshold compared to outside the liquidity cost threshold (Chen *et al.,* 2007). As a result, this technique can be used to test the relations between liquidity and yield spread levels of project bonds and between the liquidity changes and yield spread changes.

Another interesting area of research for the project bonds is the mean-variance spanning technique developed by Huberman and Kandel (1987). The technique would potentially answer the question of what will be the effect of project bond inclusion in a portfolio. More specifically, there will on mean-variance utility function for which there will be no benefit from adding project bonds in a portfolio if the mean-variance frontier of the benchmark assets and the frontier of the benchmark plus the project bonds have exactly one point in common. However, if the mean-variance frontier of the benchmark assets plus project bonds coincides with the frontier of the benchmark assets only essentially implies that no mean-variance investor can benefit from the inclusion of project bonds to his optimal portfolio of the benchmark assets only (DeRoon and Nijman, 2001). Oyedele *et al.* (2012) perform such analysis, but their research is limited to only infrastructure assets, meaning that it will be interesting to apply it to project bonds issued in different industries.

The launch of the PBI will most likely result in an increased interest in project bonds. As a result, this might alleviate the process of collecting data related to project bonds and perform the abovementioned techniques and, as a result, acquire a deeper understanding of the project bond phenomenon.

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Appendix

Table A - Regression Results for Alternative Specifications
excluding Indian and Malaysian project bonds

Variable	Predicted signs (1)	Estimated Coefficient (2)	Estimated Coefficient (3)
Intercept		0.0379	0.0022
		(3.21)*	(0.15)
Issue size	+	-0.0027	-0.0038
		(-1.87)***	(-1.82)***
Term to maturity	+	0.0005	0.0001
		(4.62)*	(0.90)
Credit rating	-	-0.0048	
		(-7.72)*	
Inflation	+	-0.0021	-0.0006
		(-2.49)**	(-0.54)
Government Fiscal Balance	-	-0.0794	-0.1510
		(-1.26)	(-1.70)***
Current Account Balance	+	-0.0347	0.0192
		(-0.70)	(0.23)
GDP Per Capita	-	0.0007	0.0007
		(5.39)*	(3.60)*
Domicile market		-0.00095	-0.0008
		(-2.23)**	(-1.55)**
Currency	+	0.0006	0.0012
		(1.13)*	(1.84)***
Time		-0.00007	0.00005
		(-0.53)	(0.31)
Adj. R Square		0.6295	0.3755
D-W statistic		1.79	2.04
Sample Size		87	87

Notes:

The table provides estimated coefficients from the regression using the following specification for column (2):

$Yspread = \beta_0 + \beta_1 Size + \beta_2 Term + \beta_3 Rating + \beta_4 Inf + \beta_5 Govfisbal + \beta_6 Curracc + \beta_7 GDPc + \beta_8 Domrkt + \beta_9 Curr + \beta_{10} Time + \varepsilon.$

For column (3):

$Yspread = \beta_0 + \beta_1 Size + \beta_2 Term + \beta_3 Inf + \beta_4 Govfisbal + \beta_5 Curracc + \beta_6 GDPc + \beta_7 Domrkt + \beta_8 Curr + \beta_9 Time + \varepsilon.$

Where the dependent variable is the yield spread. Independent variables are: natural log of the issue size (Size), term to maturity (Term), credit ratings (Rating), Inflation (Inf), government fiscal balance (Govfisbal), current account balance (Curracc), GDP per capita (GDPc), and dummy variables for domicile market (Domrkt), currency (Curr), and time of issue in terms of month and year (Time). Column (1) provides the predicted signs for the independent variables. Column (2) provides regression coefficients including credit rating. Column (3) provides regression coefficients excluding credit rating. The *t*-values are included in parenthesis below each estimate. The *t*-values are estimated using standard errors with Newey-West correction for autocorrelation and heteroskedasticity with lag one.

*,**,** Indicate significance at the 1%, 5% and 10% levels, respectively. Macroeconomic data is available for 87 issues.

Table B - Regression Results for Credit Rating and Economic Variables
excluding Indian and Malaysian project bonds

Variable	Predicted signs (1)	Estimated Coefficient (2)
Intercept		10.1084
		(7.79)*
Inflation	-	-0.2841
		(-1.72)***
Government fiscal balance	+	18.0777
		(1.25)
Current account balance	-	-17.6797
		(-1.90)***
GDP per capita	+	-0.0031
		(-0.10)*
Domicile market		-0.0513
		(-0.53)
Currency	-	-0.1730
		(-1.45)
Time		-0.0145
		(-0.48)
Adj. R Square		0.1497
D-W statistic		1.48
Sample Size		87

Notes:

The table presents the estimated coefficients from the regression using the following specification:

$$Rating = \beta_0 + \beta_1 Inf + \beta_2 Govfisbal + \beta_3 Curracc + \beta_4 GDPc + \beta_5 Domrkt + \beta_6 Curr + \beta_7 Time + \varepsilon.$$

Where the dependent variable is the credit rating. Independent variables include: Inflation (Inflation), government fiscal balance (Govfisbal), current account balance (Curracc), GDP per capita (GDPc), and dummy variables for domicile market (Domrkt), currency of issue (Curr), and time of issue in terms of month and year (Time). The table provides results from the OLS regression. The *t*-values are included in parenthesis below each estimate. The *t*-values are estimated using standard errors with Newey-West correction for autocorrelation and heteroskedasticity with lag two.

*, **, *** Indicate significance at the 1%, 5% and 10% levels, respectively. Credit ratings are available for 87 issues.

Table C - Currencies description

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ID	Currency
AUD	Australian Dollar
CAD	Canadian Dollar
CHF	Swiss Franc
COP	Colombian Peso
EUR	Euro
GBP	Great British Pound
INR	Indian rupee
NZD	New Zealand Dollar
RM	Malaysian ringgit
UF	Chilean Unidad de Fomento
USD	United States Dollar

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Notes:

This table provides the acronyms and the description of the currencies in the data sample of 177 project bonds.

Table D - Descriptive statistics per currency denomination

Currency	Number of Issues	Mean	Median	Standard Deviation	Maximum	Minimum
AUD	1	234.0000	234.0000		234.0000	234.0000
CAD	20	288.7984	196.7500	237.9896	1100.0000	85.0000
CHF	1	204.0000	204.0000		204.0000	204.0000
COP	2	255.5000	255.5000	204.3539	400.0000	111.0000
EUR	29	429.1138	462.0000	277.5040	942.0000	30.0000
GBP	6	352.4833	362.9500	112.3158	524.0000	187.0000
INR	57	6.8153	6.2000	2.2616	10.9870	3.6100
NZD	1	56.3000	56.3000		56.3000	56.3000
RM	20	11.7482	11.1555	5.4356	22.3840	4.6970
UF	1	215.0000	215.0000		215.0000	215.0000
USD	39	679.6026	500.0000	559.0376	3000.0000	150.8000

Notes:

This table presents summary statistics for all currency denominations of the project bond dataset. It contains data on the mean, median, standard deviation, maximum, and minimum amount of the total amount issued measured in millions of US Dollars per currency denomination.

Table E - List of project bonds included in the dataset

N	Sym	Domicile Market	Curr	Issue Date	Maturity Year	Maturity at issue	Amnt (USD mn)	Cpn (%)	Cpn Freq.	Rating
1		USA	USD	11/30/2017	2047	30	154.00	5.15		
2		USA	USD	11/30/2017	2052	35	154.00	5.50		
3	859W3U	Italy	EUR	11/08/2017	2027	10	406.00	8.00	2	
4	849Y58	France	EUR	05/31/2017	2032	15	567.00	1.63	1	A3
5	849QPN	Inter'l	USD	05/24/2017	2030	13	300.00	7.38	2	Ba2
6	845TA0	UK	GBP	03/14/2017	2022	5	187.00	4.50	4	B1
7	828KX9	Italy	EUR	04/05/2016	2030	14	942.00	2.12	2	A3
8		Spain	EUR	04/19/2016	2025	9	61.30	4.75		Ba1
9	829ULV	France	EUR	05/04/2016	2026	10	574.00	1.00	1	A3
10		USA	USD	05/14/2015	2050	35	548.00	5.30		
11	819U2W	France	EUR	10/28/2015	2024	9	547.00	1.50	1	Baa1
12	819XFT	Italy	EUR	10/30/2015	2021	6	656.00	1.13	1	Baa1
13	819XFU	Italy	EUR	10/30/2015	2025	10	549.00	1.88	1	Baa1
14	805F5D	Inter'l	GBP	02/05/2015	2020	5	286.00	6.75	2	Ba2
15	805NTT	Inter'l	EUR	02/11/2015	2030	15	885.00	1.50	1	A3
16	804P3U	New Zealand	NZD	01/29/2015	2021	6	56.30	4.79	2	Baa1
17	807H72	USA	USD	03/15/2015	2035	20	325.00	3.95	2	Baa3
18	807CEK	USA	USD	03/03/2015	2025	10	2000.00	5.63	2	Ba3
19	805R65	Inter'l	EUR	02/13/2015	2020	5	680.00	7.50	2	B2
20	806CW1	Inter'l	GBP	02/17/2015	2034	19	524.00	2.78	2	A3
21	806NYA	Australia	AUD	02/25/2015	2022	7	234.00	4.25	2	Baa2
22	808ARF	Canada	CAD	03/13/2015	2021	6	209.00	1.71	2	A3
23	808ARG	Canada	CAD	03/13/2015	2047	32	85.00	3.76	2	A3
24	808TJ5	Canada	CAD	03/27/2015	2019	4	88.00	3.72	4	
25	857UCW	Inter'l	USD	04/07/2015	2031	16	274.00	5.88	2	Baa1
26	807ZWG	Inter'l	EUR	03/20/2015	2020	5	654.00	2.38	1	Baa3
27	810HUM	USA	USD	04/30/2015	2025	10	500.00	4.56	2	Baa3
28	810HTR	USA	USD	04/30/2015	2025	10	500.00	3.38	2	Baa2
29	813EG8	Inter'l	USD	06/17/2015	2034	19	1154.90	5.88	4	Baa1
30	815MRF	France	EUR	08/05/2015	2025	10	599.00	2.20	1	Baa2
31	814TNU	Inter'l	USD	07/14/2015	2025	10	425.00	5.00	2	Baa3
32	813P0T	Inter'l	USD	06/25/2015	2022	7	300.00	6.00	2	Ba3
33	815PEE	Canada	CAD	07/24/2015	2051	36	128.31	4.56	2	Baa2
34	815R6J	Canada	CAD	07/24/2015	2046	31	434.16	4.65	2	Baa2
35	815NZR	USA	USD	07/23/2015	2025	10	300.00	4.20	2	Baa2
36	815NZT	USA	USD	07/23/2015	2035	20	500.00	5.18	2	Baa2
37	815NZU	USA	USD	07/23/2015	2040	25	250.00	5.28	2	Baa2
38	813VLU	Canada	CAD	06/26/2015	2047	32	117.00	4.14	2	A3
39	819M3H	Canada	CAD	10/23/2015	2067	52	186.00	4.80	2	A3
40	821XC1	Canada	CAD	10/22/2015	2033	18	150.00	4.32	2	Baa2
41	818H4X	Canada	CAD	10/01/2015	2028	13	333.00	3.83	2	Baa2
42	818NWC	Inter'l	EUR	09/30/2015	2034	19	320.00	3.76	2	Baa2
43	816PGZ	Inter'l	GBP	08/25/2015	2034	19	392.00	3.45	2	A3
44	819AZC	France	EUR	10/19/2015	2022	7	659.00	2.88	1	Baa3
45	819V0L	Canada	CAD	10/23/2015	2033	18	173.00	3.58	2	A3
46	816Z9U	Canada	CAD	09/01/2015	2048	33	136.00	4.23	2	A3
47	818J5Z	Inter'l	USD	10/01/2015	2035	20	450.00	4.95	2	A2
48	833G38	Inter'l	COP	02/22/2016	2035	19	400.00	7.00	2	Baa3
49	825VL2	Inter'l	USD	02/22/2016	2035	19	260.00	8.25	2	Baa3
50	824R90	Inter'l	EUR	02/02/2016	2042	26	162.50	2.68	4	Baa1
51	829DH9	Inter'l	USD	04/28/2016	2026	10	900.00	3.63	2	Baa2
52	828FX1	France	EUR	04/07/2016	2026	10	908.00	2.50	1	Baa3
53	829EQM	Inter'l	EUR	05/06/2016	2029	13	30.00	2.26	1	
54	830JH7	Inter'l	EUR	06/01/2016	2026	10	447.00	2.88	1	Baa3
55	830ANC	USA	USD	05/18/2016	2024	8	1250.00	7.00	2	Ba3
56	829Q73	USA	USD	05/18/2016	2036	20	575.00	5.63	2	Baa2
57	831H39	Inter'l	USD	06/17/2016	2031	15	530.80	6.63	4	Baa3
58	830WCM	Canada	CAD	06/09/2016	2035	19	479.00	3.93	2	Baa2
59	831T1Q	Inter'l	EUR	06/22/2016	2036	20	446.00	3.20	2	Baa2

Table E – continued

N	Sym	Domicile Market	Curr	Issue Date	Maturity Year	Maturity at issue	Amnt (USD mn)	Cpn (%)	Cpn Freq.	Rating
60	831EWZ	Switzerland	CHF	06/24/2016	2023	7	204.00	0.63	1	Baa2
61	833WVZ	USA	USD	07/20/2016	2038	22	1250.00	4.13	2	Baa2
62	832PDG	Inter'l	USD	07/08/2016	2034	18	150.80	6.75	2	Baa3
63	832PDF	Inter'l	COP	07/08/2016	2034	18	111.00	6.25	2	Baa3
64	832TTJ	Inter'l	EUR	07/29/2016	2032	16	45.00	4.20	2	
65	837CDW	Canada	CAD	10/14/2016	2035	19	481.00	3.57	2	Baa2
66	836CUJ	USA	USD	09/23/2016	2027	11	1500.00	5.00	2	Ba2
67	836V2Y	Inter'l	GBP	10/07/2016	2046	30	368.90	2.63	2	Baa1
68	837THE	Canada	CAD	10/21/2016	2050	34	297.50	3.86	12	A3
69	837FZW	France	Euro	10/19/2016	2028	12	328.20	0.95	1	Baa1
70	836DKF	Canada	CAD	09/16/2016	2051	35	1100.00	3.97	2	A3
71	836GV5	Inter'l	USD	09/29/2016	2046	30	1000.00	5.50	2	Baa1
72	836KWQ	Inter'l	USD	09/29/2016	2026	10	1000.00	4.25	2	Baa1
73	845VZE	Inter'l	USD	03/23/2017	2027	10	850.00	4.25	2	Baa2
74	843VCJ	Inter'l	USD	02/15/2017	2027	10	500.00	10.00	2	B3
75	841GA2	Inter'l	EUR	12/21/2016	2038	22	44.30	3.95	2	
76	205XFW	Chile	UF	12/22/2016	2047	31	215.00	3.35	2	Baa2
77	847WTM	Inter'l	USD	04/28/2017	2027	10	550.00	5.63	2	Ba2
78	848GQY	Inter'l	USD	05/15/2017	2039	22	814.00	5.95	2	Baa3
79	843KPX	Inter'l	USD	02/13/2017	2022	5	475.00	6.00	2	B1
80	848MX4	Inter'l	USD	05/11/2017	2047	30	379.00	5.20	2	Baa2
81	851NG5	Inter'l	EUR	07/12/2017	2032	15	567.00	1.88	1	A3
82	849QLP	Inter'l	GBP	06/07/2017	2027	10	357.00	3.88	2	Ba3
83	854HKJ	Spain	EUR	06/30/2017	2047	30	94.00	3.66	12	Baa3
84	851H7Y	Inter'l	USD	06/30/2017	2027	10	500.00	4.00	2	Baa3
85	856JXF	Canada	USD	10/02/2017	2033	16	260.00	4.45	2	
86	853FUQ	Inter'l	EUR	08/03/2017	2040	23	109.00	3.88	2	
87	857YEM	Inter'l	USD	11/02/2017	2029	12	869.00	3.65	2	Aa2
88	852M33	Inter'l	EUR	07/24/2017	2037	20	49.00	3.80	2	
89	856MQ7	USA	CAD	10/02/2017	2032	15	117.50	3.34	2	A2
90	856ND8	Canada	CAD	10/02/2017	2032	15	117.50	3.34	2	A2
91	856KF3	Canada	CAD	10/02/2017	2054	37	427.00	4.07	2	A2
92	856KF1	Canada	CAD	10/02/2017	2053	36	427.00	4.07	2	A2
93	860MAQ	France	EUR	11/30/2017	2027	10	494.00	2.82	2	
94	815GMU	Canada	CAD	07/21/2015	2026	11	380.00	3.20	2	A3
95	842C7K	Inter'l	USD	01/20/2017	2029	12	317.00	6.75	4	Ba3
96	823GYH	Inter'l	EUR	12/17/2015	2021	6	462.00	2.13	2	Baa3
97	841U04	USA	USD	12/16/2015	2027	12	439.00	5.02	2	Baa3
98	860XR1	Inter'l	EUR	12/17/2015	2027	12	159.00	3.59	2	Baa3
99	855MF3	Inter'l	USD	09/20/2017	2028	11	1000.00	3.88	2	
100	855MF5	Inter'l	USD	09/20/2017	2047	30	3000.00	5.50	2	Baa1
101		Malaysia	RM	08/26/2015	2035	20	22.38	5.29		Aaa
102		Malaysia	RM	08/26/2015	2028	13	11.78	5.00		Aaa
103		Malaysia	RM	08/24/2015	2029	14	10.57	5.04		Aaa
104		Malaysia	RM	08/24/2015	2030	15	10.57	5.08		Aaa
105		Malaysia	RM	08/24/2015	2036	21	22.31	5.33		Aaa
106		Malaysia	RM	08/24/2015	2028	13	4.70	5.05		Aaa
107		Malaysia	RM	08/24/2015	2030	15	7.05	5.13		Aaa
108		Malaysia	RM	08/24/2015	2032	17	7.05	5.21		Aaa
109		Malaysia	RM	08/24/2015	2027	12	9.39	4.95		Aaa
110		Malaysia	RM	08/24/2015	2036	21	11.74	5.38		Aaa
111		Malaysia	RM	08/24/2015	2035	20	11.74	5.34		Aaa
112		Malaysia	RM	08/24/2015	2034	19	11.74	5.29		Aaa
113		Malaysia	RM	08/24/2015	2033	18	9.39	5.25		Aaa
114		Malaysia	RM	08/24/2015	2031	16	7.05	5.17		Aaa
115		Malaysia	RM	08/24/2015	2029	14	5.87	5.09		Aaa
116		Malaysia	RM	08/24/2015	2027	12	5.87	5.00		Aaa
117		Malaysia	RM	08/24/2015	2034	19	22.31	5.24		Aaa
118		Malaysia	RM	08/24/2015	2033	18	15.27	5.20		Aaa
119		Malaysia	RM	08/24/2015	2032	17	15.27	5.16		Aaa
120		Malaysia	RM	08/24/2015	2031	16	12.92	5.12		Aaa
121		India	INR	08/06/2015	2017	2	3.92	8.90		Aaa

Table E – continued

N	Sym	Domicile Market	Curr	Issue Date	Maturity Year	Maturity at issue	Amnt (USD mn)	Cpn (%)	Cpn Freq.	Rating
122		India	INR	08/06/2015	2017	2	3.92	8.90		Aaa
123		India	INR	08/06/2015	2022	7	5.96	9.25		Aaa
124		India	INR	08/06/2015	2021	6	5.57	9.25		Aaa
125		India	INR	08/06/2015	2021	6	5.49	9.25		Aaa
126		India	INR	08/06/2015	2020	5	4.79	9.25		Aaa
127		India	INR	08/06/2015	2020	5	4.71	9.10		Aaa
128		India	INR	08/06/2015	2019	4	4.40	9.10		Aaa
129		India	INR	08/06/2015	2019	4	4.32	9.10		Aaa
130		India	INR	08/06/2015	2018	3	4.08	9.10		Aaa
131		India	INR	08/06/2015	2018	3	4.08	9.10		Aaa
132		India	INR	08/06/2015	2030	15	9.81	9.15		Aaa
133		India	INR	08/06/2015	2030	15	10.99	9.15		Aaa
134		India	INR	08/06/2015	2029	14	9.81	9.15		Aaa
135		India	INR	08/06/2015	2029	14	10.52	9.15		Aaa
136		India	INR	08/06/2015	2028	13	10.12	9.15		Aaa
137		India	INR	08/06/2015	2028	13	9.81	9.15		Aaa
138		India	INR	08/06/2015	2027	12	8.87	9.15		Aaa
139		India	INR	08/06/2015	2027	12	8.63	9.15		Aaa
140		India	INR	08/06/2015	2026	11	8.24	9.15		Aaa
141		India	INR	08/06/2015	2026	11	8.01	9.15		Aaa
142		India	INR	08/06/2015	2025	10	7.30	9.15		Aaa
143		India	INR	08/06/2015	2025	10	7.14	9.15		Aaa
144		India	INR	08/06/2015	2024	9	6.91	9.15		Aaa
145		India	INR	08/06/2015	2024	9	6.67	9.15		Aaa
146		India	INR	08/06/2015	2023	8	6.20	9.15		Aaa
147		India	INR	08/06/2015	2023	8	6.12	9.15		Aaa
148		India	INR	08/06/2015	2022	7	6.04	9.25		Aaa
149		India	INR	08/06/2015	2023	8	6.12	9.15		Aaa
150		India	INR	08/06/2015	2024	9	6.91	9.15		Aaa
151		India	INR	08/06/2015	2028	13	10.12	9.15		Aaa
152		India	INR	08/06/2015	2027	12	8.63	9.15		Aaa
153		India	INR	08/06/2015	2026	11	8.24	9.15		Aaa
154		India	INR	08/06/2015	2026	11	8.01	9.15		Aaa
155		India	INR	08/06/2015	2028	13	9.81	9.15		Aaa
156		India	INR	08/06/2015	2027	12	8.87	9.15		Aaa
157		India	INR	08/06/2015	2016	1	3.61	8.90		Aaa
158		India	INR	08/06/2015	2025	10	7.30	9.15		Aaa
159		India	INR	08/06/2015	2025	10	7.14	9.15		Aaa
160		India	INR	08/06/2015	2022	7	5.96	9.25		Aaa
161		India	INR	08/06/2015	2021	6	5.57	9.25		Aaa
162		India	INR	08/06/2015	2021	6	5.49	9.25		Aaa
163		India	INR	08/06/2015	2020	5	4.79	9.25		Aaa
164		India	INR	08/06/2015	2020	5	4.71	9.10		Aaa
165		India	INR	08/06/2015	2019	4	4.40	9.10		Aaa
166		India	INR	08/06/2015	2019	4	4.32	9.10		Aaa
167		India	INR	08/06/2015	2018	3	4.08	9.10		Aaa
168		India	INR	08/06/2015	2018	3	4.08	9.10		Aaa
169		India	INR	08/06/2015	2017	2	3.92	8.90		Aaa
170		India	INR	08/06/2015	2017	2	3.92	8.90		Aaa
171		India	INR	08/06/2015	2030	15	9.81	9.15		Aaa
172		India	INR	08/06/2015	2030	15	10.99	9.15		Aaa
173		India	INR	08/06/2015	2029	14	9.81	9.15		Aaa
174		India	INR	08/06/2015	2029	14	10.52	9.15		Aaa
175		India	INR	08/06/2015	2024	9	6.67	9.15		Aaa
176		India	INR	08/06/2015	2023	8	6.20	9.15		Aaa
177		India	INR	08/06/2015	2022	7	6.04	9.25		Aaa

Notes:

This table consists of 177 project bonds considered in the data sample used throughout the analysis. The following characteristics for each project bonds are provided: Datastream Symbol (Sym), country of issue (Issuer Country), currency of issue (Curr), issue date and maturity year, term to maturity at issue (Maturity at issue), amount issued in millions of United States Dollars (Amnt (USD mn)), coupon rate (Cpn %), coupon frequency (Cpn Freq.) and credit rating of the bond (Rating). Bonds from Thomson One lack the following characteristics: Datastream symbol and coupon frequency. 13 project bonds lack information on their credit rating due to information being private or not published at all.