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Risk Management in Project Finance by Focusing on Perceived Risk and Payoff Risk

An application in Aerospace Industries

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1.1 History, background, and Growth of Project Finance

Since the early 1970s, when British Petroleum collected $945 million to develop the "Forties Field" in the North Sea and Freeport Minerals obtained $120 million for the Ertsberg copper mine in Indonesia, project finance has been used as a financing method for significant natural resource discoveries (Esty, 2002). However, the passage of the Public Utility Regulatory Policy Act (PURPA) in 1978 marked the beginning of modern project finance, as the U.S. Congress aimed to encourage investment in alternative energy generators during soaring energy prices (Esty, 2002). Approximately 10-15% of total capital investment in the United States is financed on a project basis, with over half of the capital assets costing more than $500 million financed in this manner (Esty, 2004). Despite a 40% fall in project finance in 2002, the market rebounded in 2003 to $165 billion, representing a 30% increase over 2002 (Esty, 2004).

Project finance has become a multi-billion-dollar business over the years, with the value of deals closed between January 1980 and March 2003 amounting to around $960 billion (Hainz and Kleimeier, 2003), a figure that grew at a compound annual rate of almost 20% during the 1990s (Esty, 2004). Developing countries have increasingly turned to project finance as a viable and efficient solution for limited infrastructure investments. The financing mechanism has also been widely used to fund oil, gas, power, and telecom projects (Gadanecz and Sorge, 2004; Gatti et al., 2007).

Project Finance has reached a remarkable growth, with a significant increase from a $217B in 2001 to a peak of $328 in 2006. (Esty and Sesia,2007), yet the ongoing figures show a decrease of $195 billion in 2012. But again, it shows a growth between 2012-2021, Figure 3. Between 1991 and 2012, Project Finance successfully has supported nearly 6000 projects, generating more than $2.5 trillion. (Subramanian & Tung, 2016).

According to Thomson One Banker, the market for global project finance loans reached a record peak in USD of $251 billion in 2008, even as the severe financial turmoil reduced the global lending volume of syndicated loans by 44% as compared to 2007 data (Bonetti et al., 2009). In 2009, project finance accounts for almost 10% of all syndicated loans worldwide, indicating that the financing mechanism remains a promising segment of global lending activity (Bonetti et al., 2009).

Data reported by Esty and Sesia (2007) indicate that in the United States, the project finance

market is smaller than the total value of corporate bond issues but more significant than the total value of funds raised through initial public offerings or venture capital funds. Project finance bank loans and bonds have recorded compound annual growth rates of 23% and 15%, respectively, across all global markets (CORIELLI et al., 2010).

In 2021 and 2022, 1444 and 1396 project finance deals worth $545,431 million and $648,923 million, respectively, were closed, as per IJGlobal Transaction database (Figure 1), 2.5 time more than 2008.

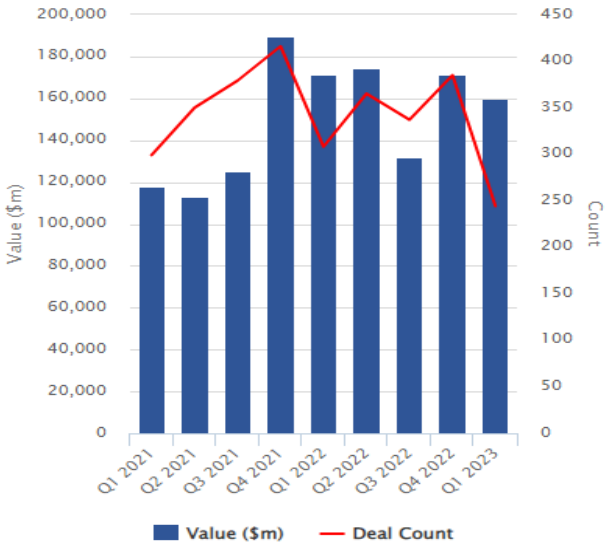


Figure 1: Quarterly Closed Project Finance Deals2021-2022, Source: IJGlobal Transaction Data

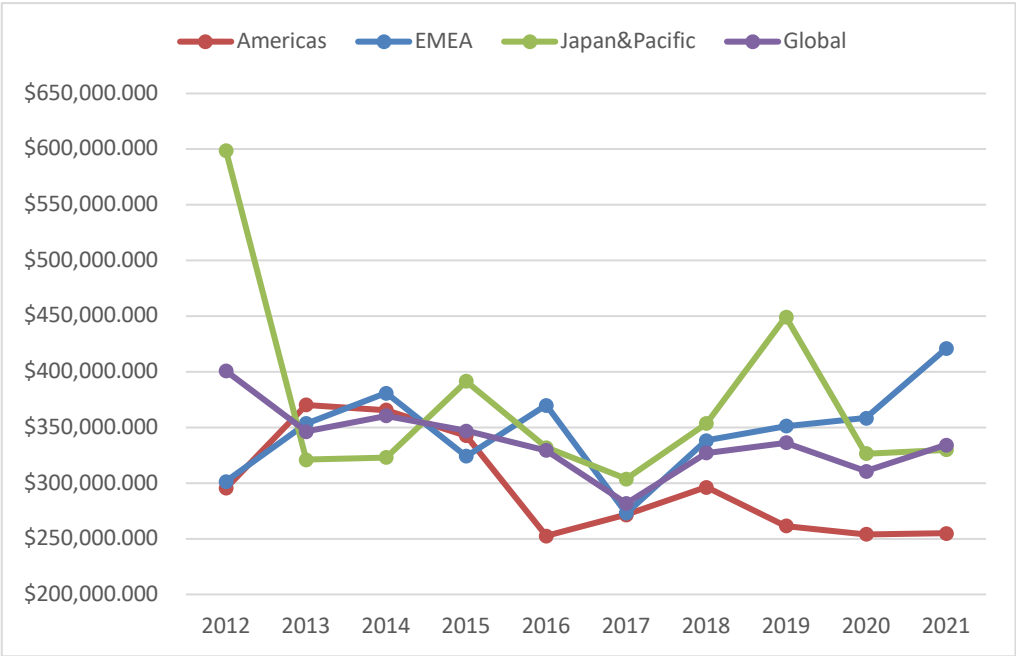


Figure 2: $ per Closed Project Finance Deals for different Geography,

Source: IJGlobal Transaction Data

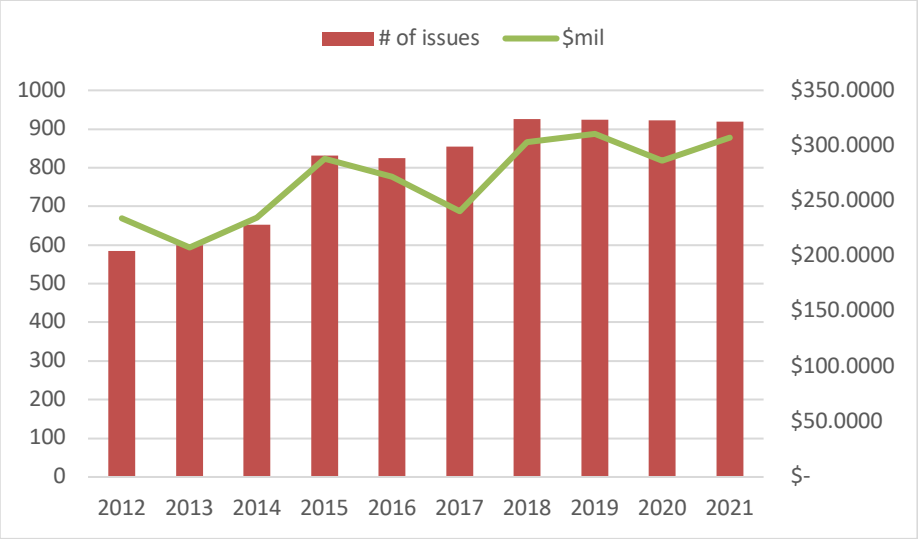


Figure 3: Global Fiance loan, Source: IJGlobal Transaction Data

According to Figure 3, There is a growing trend for both the value of deal and the number of issued deals, between 2012-2021. However, considering the average value of deal per number of issues, the trend become declining. Looking in different region graphs, we find that in contrast with global trend, the average value per issue for EMAE is increasing significantly. Let's investigate the EMEA more.

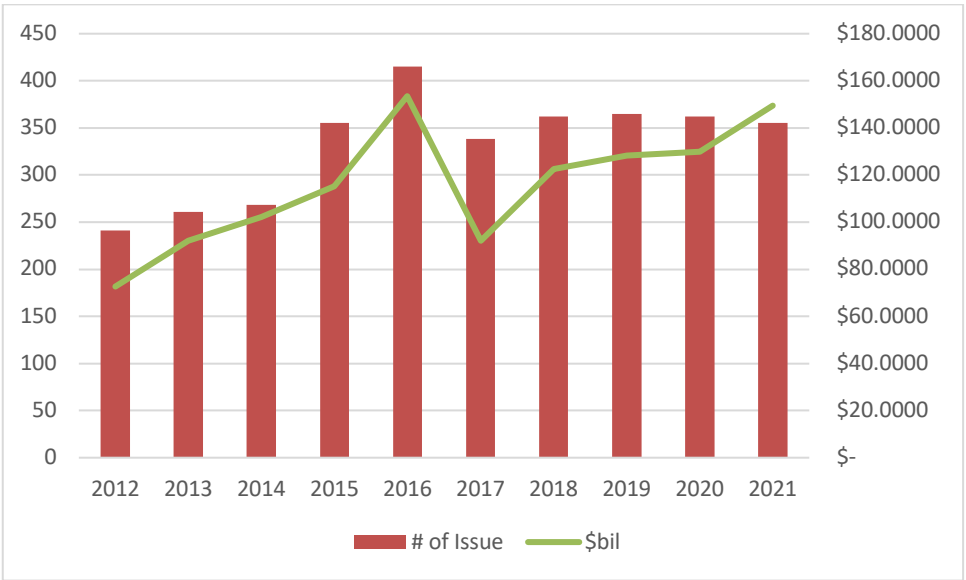


Figure 4: EMEA Fiance loan, Source: IJGlobal Transaction Data

In EMEA region (Figure 4), there is rapid growth between 2012-2016, with summit in 2016. Then there is fall in 2017, which it's happened for all the regions, with different magnitude. The reason is not clear for me, and maybe worth to be a topic for research.

There are pieces of evidence that suggest a bullish trend for Project Finance. Due to budgetary

constraints, developed governments have become increasingly dependent on private sector funding, while developing countries are eager to close the infrastructure gap (Esty et al., 2014). The re-emergence of expropriation concerns has provided a strong incentive for private companies to use project finance to address political risk. Despite some volatilities regarding global or domestic financial and economic crises, the growth of project finance is progressive and promising. In the long term, demand for capital and infrastructure investment remains large, making it imperative for officials to understand project finance, its value creation potential, and how to structure transactions with a high probability of succeeding operationally and financially (Esty, 2004).

1.2 Definition

From a practitioner's perspective, possibly, the most important definition is given by Basel Committee on Banking Supervision (BASEL III), which primarily addressed the banks as loan providers (Müllner, 2017). In BASEL III, Project Finance is defined as "30.10 PF is a method of funding in which the lender looks primarily to the revenues generated by a single project, both as the source of repayment and as security for the exposure. This type of financing is usually for large, complex, and expensive installations [...]. 30.11 In such transactions, the lender is usually paid solely or almost exclusively out of the money generated by the contracts for the facility's output, […]. The borrower is usually an SPE (Special Purpose Entity) that is not permitted to perform any function [...] (CRE30 - IRB Approach: Overview and Asset Class Definitions. The Bank for International Settlements [090])".

From the development agency's view, in OECD documents, Project finance is defined as "the financing of long-term infrastructure, industrial, extractive, environmental and other projects / public services [...] based upon a limited recourse financial structure where project debt and equity used to finance the project are paid back from the cash flow generated by the project (typically, a special purpose entity (SPE) or vehicle (SPV)) " (INFRASTRUCTURE FINANCING INSTRUMENTS AND INCENTIVES © OECD 2015).

As a pioneer Shah and Thakor (1987) defines Project finance as "an arrangement whereby a sponsor or group of sponsors incorporates a project as a legally separate entity, with project cash flows kept segregated for financing purposes from its sponsors, thereby permitting an appraisal independent of any direct support from the participants themselves. Project financing usually involves the sponsors providing equity and management for the project and issuing debt that is non-recourse to the sponsors. That means creditors must rely exclusively on the project's ability to repay project-related debt obligations." Gatti (2007) updated the definition

as "Project finance is a special form of off-balance sheet financing based on the segregation of the project into a Special Purpose Vehicle (SPV) with limited or no recourse towards its shareholders (called sponsors)." Academic scholar addressing more fully incorporate the equity providers' view by highlighting the pivotal risk management role and high transaction cost (Müllner, 2017). Based on the definition provided by Gatti (2007), we introduce the main characteristics of Project Finance deal here and will discuss details in following chapter.

Sponsors: Sponsors are simply the shareholders who provide equity for the project company and aim to run the specific project through the project company. Sponsors can be one or a group of private investors, or in case of Public-Private partnership a public authority who invest in the initiative (Gatti, 2013 CH.1).

Lenders: Lenders are debt providers, usually as a syndication (Esty, 2002; Buscaino et al., 2010).

Special Purpose Vehicle (SPV): special purpose vehicle is a new established entity separated legally and financially from a sponsor company for sole purpose of specific project in limited time (Esty, 2002; Buscaino et al., 2010).

Non-recourse or Limited-recourse: The non-recourse nature of project finance deal means in the event of default lenders have no right to sponsors' assets. Therefore, it reduces the potential for collateral damage from a failing investment. The interest and principal will pay solely by future generated cash flow by project. (Esty, 2002; Buscaino et al., 2010). A project-finance loan can either be a limited-recourse loan that allows lenders some recourse to the sponsors, in the form of, for example, additional equity or the reduction of dividend or royalty payments (Hainz & Kleimeier, 2008).

High-Leverage: Project finance deals are mainly highly leveraged (Esty, 2002; Buscaino et al., 2010). In a sample of 38742 deals the average debt to equity ratio is %74 to %26 (IJGlobal Transaction Data, https://www.ijglobal.com/).

Capital Intensive: Project Finance deals mostly are billion dollars deals, using to finance infrastructures, energy project and mega projects. In a sample of 38742 deals the average deal is $647.87 Million (IJGlobal Transaction Data, https://www.ijglobal.com/).

Project Finance characteristic is discussed in more details in CHAPTER 2.

1.3 Strategic site for research

Project Finance has significant advantages for academic scholarship it is surprising that PF has been largely underestimated in academic research (Shah & Thakor, 1987; Esty, 2004; DAILAMI & HAUSWALD, 2007; Sawant, 2009; Müllner, 2017). The lack of academic

research is surprising given that project companies (SPVs) provide unique research setting, as described by Esty (2004) as "*strategic research sites"*, for research, investigates existing theories, and possibly develops new ones.

The newly established project company (SPV) with independent organizational and financial structure from its sponsors provides a unique control environment (Byoun and Xu, 2014) to investigate the management incentives, decisions, and its outcomes in a clear window (Esty, 2004). The "*clarity benefit of Project Finance*" reduces the risk of excluding relevant variables and false findings in research (Müllner, 2017). In a corporate portfolio, multiple projects exist with different risks (Subramanian and Tung, 2016), making it unclear which project's risk a managerial decision is associated with. Similarly, the portfolio is changing over time, and it is not always possible to trace back the line of decisions and their causes (Esty, 2004; Byoun and Xu, 2014; Müllner, 2017). Besides, PF is influenced quite less by pre-existing corporate structures and history (Marquis and Tilcsik, 2013; Müllner, 2017).

Moreover, PF is important financing tool for large investment projects or megaprojects (Subramanian & Tung, 2016). In 2001, 25% of projects worth each more than $500 million and more received 75% of the value of investments (Esty, 2002, 2004). This type of projects provides an opportunity to study topics that are not applicable in routine corporate decision making and can be observed just in extreme contexts, e.g., highly leveraged (Esty, 2004). As a result, PFI provides a cleaner and more transparent environment for observing the determinants and impacts of different structural changes than a corporate context (Byoun et al., 2013**;** Byoun & Xu, 2014). PF offers a desirable controlled environment free of various influences found in corporate finance for the analysis of governance-related issues (Byoun & Xu, 2014). This complexity benefits makes it possible to study conscious and value-enhanced investments and financing decision making because it needs longer time to structure it, ability, and there is significant more money on table, economic incentive, in term of personal wealth, professional reputation, and investors' substantial capital (Müllner, 2017).

In sum, Project Finance provides an excellent setting to examine the effect of structural features such as high leverage, separate legal entity, and concentrated equity ownership on managerial inducement and asset values (Esty, 2004). Project finance provides research setting that is not affected by portfolio effects, historic firm decisions and strategies, or institutional overlap, due to its single-purpose structure. (In a project company, the decisions clearly just follow one guideline, increasing value and/or managing risk.). Scholars can ask and study questions that are not applicable in daily corporate finance and investments (Müllner, 2017; Esty, 2004;

Byoun and Xu, 2014).

Despite the significant and ongoing growth of project finance and its unique setting for academic studies, academic research has lagged behind and is underrepresented in addressing the needs of practitioners, developing existing related theories, and creating new ones. There is a dearth of empirical research. Though current Project Finance practice is far more advanced than academic research, and there are still many topics and fields to investigate. The under presented of Project Finance in academic literature is an existing situation from early vast practice of PF till nowadays, addressed in Shah & Thakor (1987), Esty (2004), DAILAMI & HAUSWALD (2007), Sawant (2009), Müllner (2017) and Gatti et al. (2007) argue that as a result of this lack of empirical data, many of the banks and project lenders are not able to base their decisions on the academic studies.

1.4 Project Finance and Capital Structure theories

There are various literature streams related to project finance. Shah and Thakor (1987) were the pioneers in project finance research, providing both an economic rationale and a theory to explain the characteristics of project finance. To develop a theory of project finance that can explain the significant leverage differences between conventional financing and project financing, as well as why project financing has proliferated and many investments using project financing that appears to be highly risky, they have developed an alternative model of optimal capital structure based on corporate taxes and asymmetric information. Their theory links the risk and value of a firm, which is especially relevant to large companies (Shah and Thakor, 1987). In contrast with a strand of literature that focused on the trade-off between the tax advantages and exogenous bankruptcy costs of leverage, which results in an interior optimal capital structure, Shah and Thakor (1987) assumed asymmetric information between managers and investors and show that a firm's capital structure may be important because it acts as a signal of an a priori unknown parameter of the probability distribution of its future cash flows (Shah and Thakor, 1987; Esty, 2002). They demonstrate that contrary to conventional wisdom, riskier firms acquire more debt, and have a higher value in equilibrium (Shah and Thakor, 1987). The method of incorporation of the project affects both its leverage and economic value (Esty, 2002); project financing enhances the values of some of these projects by permitting higher optimal leverage than with conventional financing (Shah and Thakor, 1987; Esty, 2002). it follows that the values of the riskiest projects will be maximized with project financing (Shah and Thakor, 1987).

Modigliani and Miller's Capital structure theory's 'irrelevance' proposition is challenged by

the growing use of the PF (Esty, 2004). From this perspective, Modigliani and Miller (1958) argue that the financing and investment decisions are independent; However, as the research on PF indicates, this proposition appears not to be applicable to large infrastructure investments in high-risk countries due to significant costs of financial distress and tax benefits from debt (Esty, 2004; Müllner, 2017). In other words, financing and investment are not separable and independent activities, indeed, financing structure matters and is value relevant. (Esty, 2004; Müllner, 2017).

Müllner (2017) explains that the pecking-order theory of capital structure proposes that information asymmetries between firms and lenders lead to a preference for debt in risky investments. In PF, sponsoring firms aim to maximize the benefit of debt while simultaneously reducing information asymmetry between sponsors and borrowers by isolating the project. Addressing the risks of the project ex-ante allows them to maintain the cost of debt at a sustainable level (Brealey et al. 1996).

In addition, as argued by the trade-off theory (Kraus and Litzenberger, 1973), sponsors can isolate project risks, reduce costs of financial distress, conserve debt capacity, and maximize tax benefits, by two of the characteristics of PF: the non-recourse negotiations of the lenders and the establishment of SPV.

Furthermore, PF has provided substantial empirical support for recent theoretical approaches such as real options theory. The non-recourse characteristics of PF align with the nature of the 'walkaway put option because both provide a value of managerial flexibility. (Müllner, 2017).

1.5 Project Finance Advantages in Literature

Another focus in the literature highlights various advantages of using Project Finance for both sponsors and lenders, primarily through the incorporation of a legally and financially separate Special Purpose Vehicle for new projects. Shah and Thakor (1987) present an economic rationale for PF that involves the legal separation of a new project from a firm's existing assets, based on asymmetric information rather than risk aversion or bankruptcy costs. This separation results in a systematic leverage difference between PF projects and conventionally financed ones.

Lenders benefit from Project Finance as it facilitates distinguishing project performance from firm performance, monitoring project behavior, and determining cash flow availability for interest and principal repayment (Shah and Thakor, 1987; Gatti, 2012). Monitoring is enhanced through detailed debt covenants that force lenders to commit to continuous control of the behavior of management (Ahn & Choi, 2009; Sawant, 2009), and the separate incorporation of

a new venture allows for better collateral assessment (Esty, 2003; Gatti, 2012). Habib and Johnsen (1999) emphasize the importance of revenue valuation from the asset's current use due to the low redeployment/resale value of most project-financed assets (Gatti et al., 2007).

Project finance is a popular choice for sponsors to leverage their investments while avoiding the contamination effect of a project default on their other asset portfolios (Gatti, 2012; Chemmanur and John, 1996). The higher the correlation between the cash flows of the project and the existing flows of the firm's assets in place, the riskier the new venture, and the higher the size of the new venture compared to the size of the firm's assets, the more likely the contamination effect is to appear (Gatti, 2012; Leland, 2007).

The use of a special purpose vehicle to separate a new project legally and financially from a sponsor company can help mitigate under-investments. This is because risk-averse managers may be hesitant to invest in a new venture with positive net present value (NPV) due to the possibility of the sponsor firm failing because of default from the new project, and the existence of asymmetric information. Financing assets in a newly established entity is a solution to avoid underinvestment (Megginson, 2010; Gatti et al., 2012; Subramanian & Tung, 2016).

A manager may be unwilling to undertake a high-risk investment even if it has a positive NPV due to the distress costs associated with investment in a risky asset (Esty, 2002). By investing through a project company instead of using its own balance sheet, a company can reduce the collateral damage caused by a failing investment (Esty, 2002). Furthermore, project finance allows sponsors to allocate debt to the existing firms and the new venture according to their expected performance, thereby solving the debt-overhang problem (Myers, 1977; Shah and Thakor, 1987; Esty, 1999, 2002, 2004; Gendron et al., 2007; Sawant., 2009; Hainzand Kleimeier, 2012).

Legal separation of the project company segregates project cash flows from the sponsor's other assets, preventing inefficient investment or cross-subsidization of other divisions (Scharfstein and Stein, 2000). On-balance sheet financing can have a considerable impact on project sponsors and can prove hard to sustain (Esty, 2003, 2004; Brealey et al., 1996). By segregating risky assets in a project company, managers can prevent a failing project from dragging the parent firm into default (Esty, 2004).

Asset size is an important determinant in utilizing project finance, as it affects a manager's willingness to bear risk and ability to finance a particular investment (Esty, 2004; Kong et al., 2008). Using project finance as a risk hedging tool to prevent sub-optimal investment strategies has been re-examined recently (Parrino et al., 2002). Chemmanur and John (1996) advocate utilizing project finance for bankruptcy protection of a low-risk project from high-risk projects.

Brealey et al. (1996) believe that the risk management motivation can lead to an agency conflict between ownership and control.

Large projects not only affect key decision makers and the companies in which they work, they also affect the communities and nations where they are located (Esty, 2004). Therefore, project finance can be an effective tool to mitigate risks associated with large projects and prevent under-investment due to asymmetric information, managerial risk aversion or debt overhang (Esty, 2004; Subramanian, & Tung, 2016; Berkovitch and Kim, 1990; Dailami, & Hauswald, 1999).

Another justification for financing assets separately comes from the option pricing theory, which states that the value of a portfolio of options, e.g., project finance, is greater than the value of an option on a portfolio, e.g., corporate finance (Esty, 2004).

1.6 Agency Cost

How Project Finance helps to mitigate the agency cost and conflicts between agents is addressed in many literatures. Project Finance provides strong empirical support for agency-based theories of capital structure in the presence of incomplete contracts (Jensen, 1986; Stulz, 1990; Hart, 1995; Esty, 2002, 2003). According to Jensen (1996), pay-outs to shareholders can reduce the resources under managers' control, leading to a decrease in managers' power and an increased likelihood of monitoring from capital markets during new capital acquisition. This monitoring can occur due to the reduction of managers' ability to control resources within the firm. To increase their power, managers may have incentives to grow the firm beyond its optimal size, as growth can increase resources under their control and lead to higher compensation. Additionally, firms may promote middle managers based on growth rather than providing year-to-year bonuses, which creates an organizational bias towards growth to supply new positions required for such promotion-based reward systems. Esty (2002, 2003, 2004) highlights that project finance offers a solution to various agency problems as it reduces costly incentive conflicts among capital providers, managers, and deal participants. He argues that project leverage has a stronger discipline on a project manager compared to corporate leverage on a divisional manager, and project-specific compensation provides stronger incentives than compensation linked to corporate performance. Corporate leverage can affect future investment decisions, making high leverage at the corporate level undesirable. Project Finance can increase the verifiability of cash flows from the project, as noted by Subramanian et al. (2008) and Byoun & Xu (2014). The financing structure can establish a link between financing and asset values, thereby increasing expected cash flows available to capital providers. Overall, utilizing

project finance can reduce agency conflicts, improve verifiability of cash flows, and strengthen managerial discipline, ultimately leading to better project outcomes. Corielli et al. (2010) and Dailami and Hauswald (2003) suggest that Non-Financial Contracts (NFC) can align the interests of shareholders with those of lenders, resulting in a reduction of agency costs. Byoun and Xu (2014) add to these theories by suggesting that bundling financial, organizational, and operational structures can serve as an important governance mechanism. Such bundling can help address agency conflicts of stakeholders and mitigate the adverse effects of external risks. These new insights provide a deeper understanding of how corporate governance and risk management can work together to achieve optimal project outcomes. By considering the bundling of various structures, managers can more effectively address the complex agency conflicts that arise in project finance.

1.7 Risk Management

Project Finance was originally designed to provide large capital for implementing large projects (Subramanian & Tung, 2016; Esty, 2002, 2004). However, the initial structures were not designed to handle large amounts of asset risk other than sovereign risk (Esty, 2002). Moving into riskier assets has created new motivations for using project finance, and it has become a tool for risk management, rather than a tool to mitigate free cash flow problems or debt-overhang problem (Brealey et al., 1996; Esty, 2002). To support this, analysis shows that project loans have lower default rates and higher recovery rates than corporate loans (Esty, 2002, 2004). risk mitigation characteristic of Project Finance became the corner stone of this financial tool and one of the main motives of hiring it. Risk shifting is a corner stone of Project Finance, and some scholars investigate it mainly based on contract theories. To the best of our knowledge, Hoffman (1989) and Beidleman et al (1990) are the pioneers that investigated risk management in Project Finance. Beidleman et al (1990) provide a base for Risk management and risk allocation to partners as the most important success factor in Project Finance.

More recent, stream of literature addresses the relationship between the use of nonfinancial contracts, risk management, and financial decision making. HF Moore (1986) provided a risk identification method, and his work followed by Dikmen & Birgonul (2006), Gatti et al. (2007) and finally Gatti (2013).

In the realm of project finance, managing risk is a crucial aspect that requires the utilization of contractual instruments such as offtake agreements, supply agreements, equipment procurement contracts, export credit guarantees, and operation and maintenance contracts (Müllner, 2017). Large projects demand the careful allocation of risks to parties that are best

able to control or bear that specific type of risk, as opposed to an overall risk allocation (Brealey et al., 1996). When a project use bond to provide debt, despite covenants designed to specifically isolate bondholders from operational uncertainty, residual risks are shared between bondholders and shareholders, primarily due to contractual incompleteness, the non-recourse feature of PF, and the lack of appropriate hedging opportunities (Dailami & Hauswald, 2007). This risk bearing is not a result of deliberate actions by management to pursue high-risk, low-value activities to increase shareholder gains at the expense of debtholders (DAILAMI & HAUSWALD, 2007).

Project Finance as the so-called "nexus of contracts" (Esty and Megginson, 2003; Esty, 2004; Dailami and Hauswald, 2007; Gatti et al., 2007; Corielli et al., 2010; Müllner, 2017) has been addressed in a vast number of works of literature. The contracts are the primary mechanism for risk management in Project Finance deals. Indeed, along with the rising popularity of financial contracting theory, the majority of later Finance research extended its focus from capital structure-related benefits to contractual risk management (Byoun et al., 2013; Byoun and Xu, 2014; Corielli et al., 2010). The research highlighted the pivotal role of contractual agreements between parties in PF. It also recognized the risk-mitigating role of specific project partners, such as international development banks (Hainz and Kleimeier, 2012) and reputable lead arranging banks (Gatti et al., 2013). The contracts among multiple parties to project finance also shift a variety of project risks to those who can best appraise and manage them (Byoun & Xu, 2014; Brealey et al., 1996; Byoun et al., 2013). To the best of our knowledge, Corielli et al. (2010) is the only paper that explicitly addressing the effects of intensive risk management policies by utilizing networks of nonfinancial contracts and the effects on the cost of funding and capital structure of project finance deals and found that the absence of certain nonfinancial contracts increases loan costs by 19 basis points (bps) and reduce the debt-to-equity ratio by 0.8 points. Indeed, the nature of project finance is to be a nexus of nonfinancial and financial contracts. However, the effect that nonfinancial contracts can exert on financial contracts has not been completely analyzed by the literature, particularly empirically (Gatti, 2012).

Byoun et al. (2013) suggest that Project companies use more leverage in high project risk scenarios but less when offtake agreements reduce risk, and leverage and contract structures in project companies serve as important hedging mechanisms. Bonetti et al. (2009) highlight the significance of offtake agreements as a risk transfer mechanism in project finance. However, they also point out the trade-off between lower market risks and higher counterparty risks. Their empirical study reveals a positive correlation between the spread of a project.

Empirical research shows that markets do not price risks that are effectively managed through

a firm's contractual structure (Dailami & Hauswald, 2007). In project finance, there is often a trade-off between the ability to control risk and the ability to bear risk. To explain the allocation of downside risks, such as construction risk, commercial banks are often allocated the risk through bank debt, even though risk control considerations would dictate that the risk be allocated to contractors and risk-bearing considerations would dictate that it be shared among many investors through bond financing (Brealey et al., 1996). Studies have examined the determinants of risk management practices in project finance deals, including the management of country-specific risks to reduce default risk, as well as the determinants of corporate hedging decisions (Esty and Megginson, 2003; Corielli et al., 2010; Hainz and Kleimeier, 2012). In addition to market risk, political risk is also an important aspect of project finance that has received significant attention in the literature.

Empirical evidence suggests that projects with greater exposure to sovereign or market risk have lower leverage ratios (Esty, 2002) and are important for spread loan (Corielli et al., 2010). For example, Dailami and Leipziger (1998) found that the market imposes a high-risk premium on loans to countries with high inflation. Esty (2002) found that sponsors use less leverage in the presence of sovereign risks and suggest that project finance can effectively manage sovereign risks. Hainz and Kleimeier (2008) developed a model that shows that the use of project finance increases with both the political risk of the country in which the project is located and the influence of the lender over this political risk exposure, and banks grant relatively more project finance loans to borrowers in riskier countries. Multilateral development banks act as "political umbrellas" in project finance deals (Ramamurti and Doh, 2004; Vaaler et al., 2007; Hainz and Kleimeier, 2008, 2012). Additionally, Fotak et al. (2019) found that stronger property rights lead to a lower cost of debt, larger loans, larger syndicates, less collateral, and fewer covenants in project finance.

The next step in project finance is measuring risk and determining the spread and premium. While there are only a few studies on this topic, sponsors and lenders mainly rely on internally developed instruments. Gatti et al. (2007) propose using Monte Carlo simulations to derive a Value-at-Risk estimate for project finance deals, discussing critical issues to consider when developing such a model and providing a holistic model to evaluate the probability of default using Value at Risk. Chiara & Garvin (2008) suggest a financial risk assessment method for a BOT project, by combining Monte Carlo simulation with discounted cash flow analysis. Meanwhile, Cooper & Nyborg (2017) acknowledge that existing formulas yield incorrect valuations as they are inconsistent with the basic assumptions of this method and provide a formula that captures the effects of a fixed debt plan, potentially expensive debt, and costs of

financial distress, solving the critical issue of what to use as the cost of debt. Chapter 4 of this thesis is dedicated to risk management feature of PF.

1.8 Perceived / Payoff Risk

Although there are different ways to estimate project risk or so-called payoff risk, investors' and lenders' risk perception determines the capital price. Nguyen et al. (2017) show a lack of a comprehensive risk perception measure in Project Finance. Dailami & Hauswald (1999) found that the risk factors affecting the sales and purchase agreements drive perceptions of market risk for Ras Gas project bonds. Dailami & Hauswald (1999, 2007) and Bonetti et al. (2009) provide empirical results that show the relationship between companies' project risk and the risk perceived by investors by investigating the relationship between volatility of stocks/bonds' of off-taker counterparty and project company. They show that the market is not pricing the risk, which is ex-ante managed mainly through a bundle of well-drafted contracts. Previously mentioned studies focused on market risk and off-taker agreements. Choi & Kim (2018) provides another window by focusing on the sponsor side of the project to understand how project companies' decisions to hedge the risk of future prices (in this case of oil and gas) respond to the changes in the price volatility of oil and gas, especially the role of the exposure of the sponsor company's stock returns to the risk of oil and gas prices. (Kong et al., 2008) provides a model for lenders to evaluate their exposure to default risk by monitoring the project company's credit quality changes. In another study, Buscaino et al. (2010) find that the Primary market spread for CDOs backed by Project Finance is significantly higher when the underlying PF loans bear a higher level of market risk and when the proportion of projects still under construction in the securitized portfolio is larger.

1.9 Syndicate loan

This stream of literature examines project finance as one subset of the broader syndicated loan market. Studies have focused on the differences between project finance loans and other syndicated credits (Kleimeier and Megginson, 2000), on the pricing of syndicated loans, and the use of syndicates to solve agency problems (Esty & Megginson, 2003; Esty, 2004; Sorge and Gadanecz, 2007; valler, 2007; Gatti, 2013; Cortés et al., 2020), and the role of certification of borrower quality played by the arranger bank (Casolaro et al., 2003; Gatti et al., 2011; Ahiabor & James, 2018). Syndication loan is discussed in details in section 2.5.

1.10 Project Finance and Law

Project Finance provides a contractual and organizational substitute for investor protection

laws, and it is more likely in countries with weaker laws against insider stealing and fewer rights for creditors under bankruptcy (Subramanian & Tung, 2016). In order to deter strategic default, lenders create larger and more diffuse syndicates when they cannot rely on legal enforcement mechanisms to protect their claims (Esty & Megginson, 2003; Vaaler et al., 2007; Subramanian & Tung, 2016; Fotak et al., 2019). In contrast, Byoun et al. (2013) perceived that there was no remarkable correlation between the leverage of project companies and their legal origins. a Moreover, Esty & Megginson (2003) suggests that common law systems provide stronger investor protection than civil law systems. Therefore, the type of jurisdiction system matters. This will discuss in detail in Chapter 3.

1.11 Public-Private Partnership (PPP)

Prior to the epiphany of the public sectors, project finance was utilized by the private sectors as a technique where its root can be found in the oil extraction and power production sectors. As time passed, this financing approach has experienced the public and government involvement. (Gatti, 2013 CH.2). In developing nations, governments embarked on instigating the private entities to participate actively in the public projects. (Cited).

According to Byoun & Xu (2014), Yescombe (2007) and Engel et al. (2010) argue that the growth of the public–private partnership is tightly linked to the development of project finance. PPP is widely using Project Finance as a financing tool and a branch of literature is focused on it but it is not the focus of this study. While PPPs are commonly viewed as beneficial contractual mechanisms for the public sector which are capable of creating value for money through risk sharing, private asset ownership, and contractual bundling, the theory also acknowledges that these advantages come with associated costs; high transaction costs and potential impacts on service quality may offset cost efficiency gains (Vaaler et al., 2007; Valila, 2005; Dewatripont and Legros, 2005). Project Finance enables the optimization of risk allocation, and concession grants and offtake agreements can benefit both public and private sponsors, particularly in the presence of political risk. Contract choice and government involvement depend on institutional context, particularly political risk (Byoun and Xu, 2014; Müllner, 2017). Blanc-Brude and Strange (2007) have argued that the cost of debt for PPPs is solely determined by systematic risks, as all project-specific risks are addressed through contractual means. However, this argument has been challenged by several researchers who point out the incomplete nature of contracts (Dailami & Hauswald, 1999; Esty, 2002; Dailami & Hauswald, 2007; Byoun & Xu, 2014). Even in the best-case scenario, contracts may be incomplete, as they cannot account for all possible actions by all parties in every situation

(Esty, 2002).

1.12 Project Finance and Aerospace Industry

Using Project Finance in Aeronautical industries is more advanced than in space and space-related industries. In space industries, Project Finance has already been utilized in satellite communication projects, both downstream and upstream. Financing satellites using project finance is relatively new, and we can see its growth after the 2008 financial crisis. However, in an academic setting, it has yet to be studied. Most studies are about financing space infrastructure, such as Quiat (1997). the law aspects of project finance have more work on it by such as dos Santos (2003), Johnson (2010), Nayoung (2022). Another noticeable work is Cahan et al. (2016), who suggested establishing a space bank to specialize in these sectors. In chapter 5 we discuss briefly about space economy and investigate a satellite Project Finance deal.

Chapter 2 Project finance Structure and Characteristics

Literature generally agrees with the definition of Project Finance as the structured financing of a Special Purpose Vehicle, a project company which is created by sponsors. Project Finance does not rely on the creditworthiness and soundness of investors and the project company itself, but on the future cash flow generated by the project to repay the principal and interest and remunerate capital invested consistent with the level of risk inherent in the project (Byoun et al., 2013).

A project finance deal is characterized by the certain characteristics as follow (Shah and Thakor, 1987; Esty, 2004; Hainz & Kleimeier, 2008, 2012; Byoun et al., 2013; Gatti, 2013; YESCOMBE, 2017; Choi & Kim, 2018; Alonso-Conde & Rojo-Suárez, 2020):

Special Purpose Vehicle (SPV) or project company set ad hoc legally and financially independent from the sponsor and acts as debtor toward lenders. It is a new establishment serving for sole purpose of realizing project and operating it.

Project Finance deal is a non-recourse (or in some cases limited recourse). The lenders have no rights over sponsors' assets and pre-existing cash flow of parent firms. In case of limited recourse, the sponsors' involvement is limited in terms of time, amount, and quality[1]. This characteristic implies that risk assessments cannot be perform in conventional approach based current sponsors' firms cash flow or sponsors' assets and need a different approach.

The future cash flow generated by the project company is the only source for debt service. Therefore, the project must be able generated sufficient cash to cover operating cost, maintenance, service the debt. Dividends can only pay by residual after mentioned payments.

Project Finance consist of extensive contractual bundle, both financial and non-financial contracts.

Risk Management is a corner stone of Project Finance, by allocating the risk to the party through contracts which is the in best position to control and manage the risk. Figure 5 indicates a typical Project Finance deal.

[1] "It is limited in terms of time (generally during the setup to start-up period), amount (they can be called on for equity injections if certain economic-financial tests prove unsatisfactory), and quality (managing the system efficiently and ensuring certain performance levels)" (Gatti, 2013).

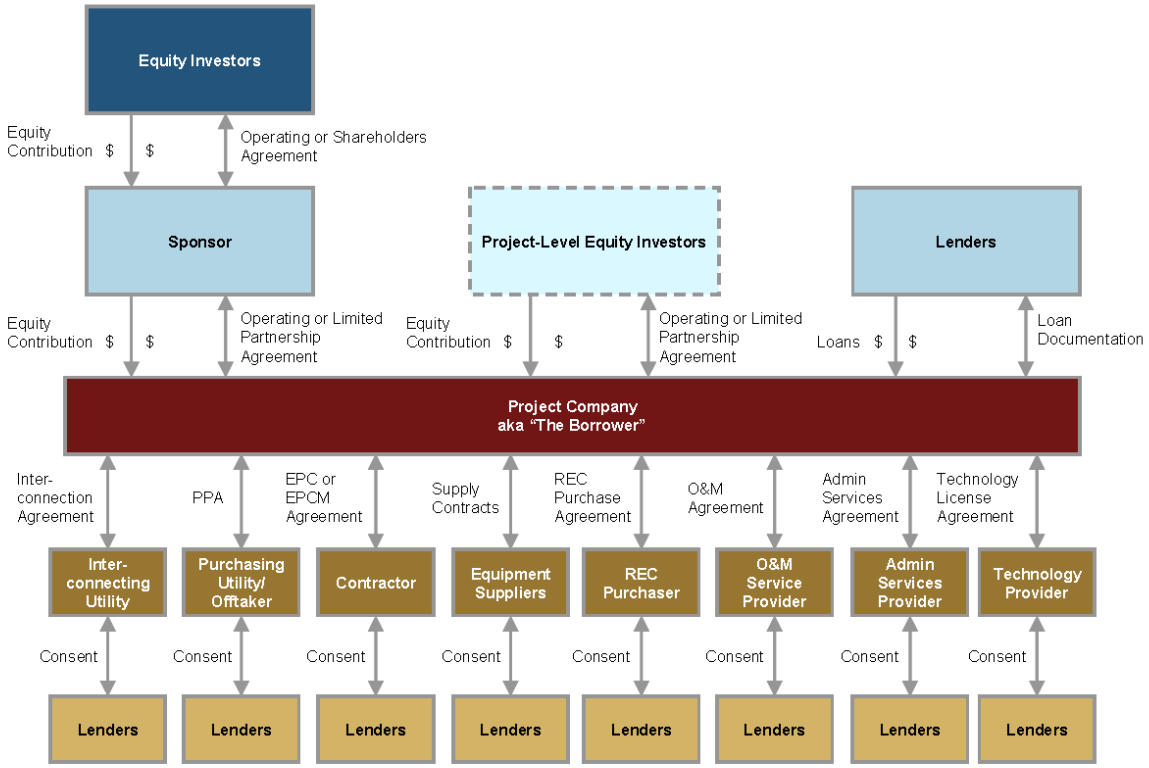


Figure 5: A Typical Project Finance Deal, Groobey et al. (2010).

A stand-alone company relies on debt provided by banks and other specialized lenders. However, the project company functions in a way that separates it from the assets of its parent firm, making it immune to bankruptcy. In case of project failure, the creditors can solely make a claim on the project assets. Sponsoring parent firms would not guarantee the financial stability of the project company. Instead, it serves as sponsors with their risk limited to their equity investments. (Buljevich & Park, 1999; Esty, 2002, 2003, 2004; Finnerty, 1996; Lang, 1998; Vaaler et al., 2007). The project company can be considered as a distinct business entity, offering transparency in terms of the capital structure, which comprises creditor debt and sponsor equity (Vaaler et al., 2007). There are some essential roles in each project finance deal such as sponsors, SPV, and lenders and some others that do not appear in all deals, e.g., public authority. Sponsors are simply the shareholders who provide equity for the project company and aim to run the specific project through the SPV (Gatt et al., 2007, 2012). Sponsor can be one firm or a group of sponsors who invest in the initiative (Shah & Thakor, 1987). Sponsors can be private or public investors. Private sponsors usually invest in the project by integrating it as upstream or downstream or, in some cases, as linked to their core business. Another sponsorship category is the public sector, such as Central or local government and municipal. When the investor is a public administration, it is referred to the project finance deal by Public-Private Partnership (Gatti, 2013). At the same level of importance of providing equity by

sponsors for SPV, they are fundamental in the development of the field of the project by bringing the know-how that the SPV requires to develop the project in its lifetime. Therefore, they usually perform one of the critical roles in developing the project (Gatti, 2013).

In addition, as Crook et al. (2013) shows *transaction cost* matters and *transaction cost economics* explains firms' decisions and resulting performance, including decision about capital structure of the existing firm or the new project, but other conditions and perspectives define the size of its impact.

Structuring a Project Finance deal are costly and transaction cost is higher rather than corporate finance (Hoffman, 1989; Esty, 1999, 2004; An & Cheung, 2010; Steffen, 2018; Verweij & van Meerkerk, 2020). High transaction cost is considered the most significant disadvantage of Project Finance (Esty, 1999). The small amount of evidence available show that transaction costs is around 5–10% of the Project Finance deal value (Esty, 2003, 2004).

For example, Conoco and Maraven project, studied by Esty (1999), took more than five years to negotiate the deal and paid more than $15 million in advisory fees (structuring expenses), representing 60 basis points of the $2.43 billion deal value, plus additional approximately $17 million for financing and issuance, which total $32 million. This cost does not comprise the professional spent time and expenses for their own employees working on the deal.

The higher transaction costs in Project Finance primarily arise from the negotiation of the deal structure, encompassing financial, construction, and operational contracts. This process involves the participation of legal, technical, and insurance advisors from both the sponsors and the loan arranger, resulting in a time-consuming and expensive evaluation of the project and the negotiation of contract terms documented (Esty, 1999; Verweij & van Meerkerk, 2020). Second, the very high cost of extensive monitoring the project and contracts increase the transaction costs (Gatti, 2013; la Cour and Müller, 2014; Cortés et al., 2020; Verweij & van Meerkerk, 2020). In contrast, Project Finance reduces the asymmetric information between sponsors and lenders, which is consequently reduce the Transaction cost (Shah and Thakor, 1987).

On the other hand, Project Finance helps mitigate the problem of asymmetric information between sponsors and lenders which can be eventuated in reducing transaction costs (Shah and Thakor, 1987).

In project finance deals, other structural features affect real investment and decisions and therefore, high transaction costs are offset by its advantages (Esty, 1999, 2003, 2004; An & Cheung, 2010; Gatti, 2013). Mega projects require extensive capital, which is difficult for a company or group of sponsors to finance internally or on-balance sheet (Esty, 2004; Kong et

al., 2008).

The size of assets plays a crucial role in the use of project finance and impacts a manager's capacity to finance a specific investment (Esty, 2004; Kong et al., 2008). Large-scale projects not only have implications for key decision-makers and their respective and relevant companies but also have significant effects on the communities where they are placed. (Esty, 2004).

2.1 Contamination risk

When a company takes a significantly large project, it has an enormous impact on the total assets reflected on the balance sheet. The size of the project directly relates to the increase in assets, which includes both existing assets and those associated with the project (Esty, 2002, 2003; Gatti, 2012; Leland, 2007; Gatti, 2013). If the failure emerges in the new project, its sheer size will threaten the continuation of the company's other business operations and the value of its remaining assets (Esty, 2002, 2003; Gatti, 2012; Leland, 2007). This risk is commonly referred to as contamination risk (Gatti, 2013). The higher the risk associated with the new project, the more likely the contamination effect will occur (Leland, 2007; Gatti, 2012). To mitigate this risk, managers can establish a separate project company to put aside the risky assets, thereby preventing a failed project from causing a default of the parent firm (Esty, 2004). Project finance serves as a popular choice for sponsors to leverage their investments while avoiding the contamination effect that a project default could have on their other asset portfolios (Gatti, 2012; Chemmanur and John, 1996)

If management opts to finance a new project on the company's balance sheet, combined with the parent firm, the increased risk perception should be considered both by financiers and shareholders (Leland, 2007; Gatti, 2012, 2013). Gatti (2013) argues that financiers would be willing to provide funding for the new venture, but at a higher cost to compensate for the greater ex ante risk associated with the company incorporating the new project. However, if the increase in the weighted average cost of capital exceeds the increase in the company's expected return, financing the new venture on the balance sheet would lead to a decrease rather than an increase in the company's value. This is why sponsors isolate large and risky projects in a separate off-balance sheet vehicle company. This separation mitigates the risk of the new project affecting the parent firm, which would subsequently increase the weighted average cost of capital for both entities. Project finance, being an off-balance sheet solution, achieves this important outcome.

2.2 Debt Overhang and Underinvestment

By using corporate finance, projects are financed through equity and debt on the sponsor's

balance sheet which can have a considerable impact on project sponsors and can prove hard to sustain (Brealey et al., 1996; Esty, 2002, 2003, 2004; Steffan, 2018). The ability to finance new projects hence depends on the strength of that balance sheet and can be limited if its debt ratio is already high, especially if many new projects are planned in a row, e.g., fast-growing project developers, or when the size of the new project is massive in compare with the sponsors' current assets (Steffan, 2018).

Project finance provides sponsors with the ability to allocate a fixed amount of debt to both existing firms and the new venture based on their expected performance (Gatti, 2012). This allocation helps resolve the debt-overhang issue for sponsors (Sawant, 2009; la Cour and Müller, 2014; Esty, 1999, 2002, 2004; Agrawal, 2012; Myers, 1977; Gendron et al., 2007; Hainz and Kleimeier, 2012). In this case, the sponsors are allowed to use higher leverage and benefit from tax advantages on interest payments. (Shah and Thakor; 1987; Esty, 2002; Gatti, 2012; Kong et al., 2008).

Stulz and Johnson (1985) argue that the addition of extra security beyond the general recourse on the balance sheet can make profitable projects feasible that might otherwise not have been pursued (steffan, 2018). Project finance provides an effective means of financing such projects since it fully separates the project from the sponsor's balance sheet, as Esty (2003) argues. Through project finance, it becomes possible to establish a separate project company that is financed with non-recourse debt, thereby reducing the opportunity cost of underinvestment resulting from managerial risk aversion or debt overhang (Esty, 2004). Project finance can also help mitigate the agency cost of underinvestment caused by risky debt while increasing the value of the tax-shield of debt (Shah and Thakor, 1987; Esty, 2002; Gatti, 2012; Kong et al., 2008; Kleimeier & Versteeg, 2010).

One reason for underinvestment is the reluctance of managers to invest in large, risky assets, even when they have positive NPVs in expectation (Esty, 2004). Such investment involves distress costs associated with a risky asset (Esty, 2002). By investing through a project company, rather than using its own balance sheet, a company can reduce the collateral damage caused by a failing investment (Esty, 2002). Separating new projects legally and financially in a special purpose vehicle (SPV) helps sponsor companies avoid underinvestment (Subramanian & Tung, 2016; Gatti et al, 2012; Megginson, 2010). Moreover, Myers and Majluf (1984) show that underinvestment occurs only when the value of both assets-in-place and investment opportunities is uncertain and propose financing assets in a newly established entity is as a solution to avoid underinvestment (Esty, 2004).

Byoun & Xu (2014) argue that the legal separation of the project company segregates project

cash flows from the sponsor's other assets, preventing inefficient investment or cross-subsidization of other divisions.

The use of an SPV to separate a new project legally and financially from a sponsor company can help mitigate underinvestment due to conflict between equity-holders and debtholders of the multinational enterprise (Megginson, 2010; Gatti et al., 2012; Subramanian & Tung, 2016). Underinvestment arises because existing debtholders capture the value of cash flows from new investments when existing debt is risky, and equity-holders prefer to pass up positive NPV projects to avoid transferring wealth to existing risky debtholders. Project finance can mitigate costs from underinvestment by ensuring that returns from new assets go only to new capital providers and not to holders of the sponsoring firm's risky debt. The Project Finance structure is beneficial when existing debt is risky and the variance of returns from the new investment is low (Flannery et al., 1993; Sawant, 2009).

The non-recourse nature of project finance allowing sponsors to allocate debt to the existing firms and the new venture according to their expected performance, thereby solving the debt-overhang problem (Shah & Thakor, 1987; Brealey et al., 1996; Esty, 1999, 2002, 2004; Gendron et al., 2007; Sawant, 2009; Hainz & Kleimeier, 2012; la Cour and Müller, 2014) and enhances the project's debt capacity (Subramanian and Tung, 2016).

Project financing aids in addressing the problem of underinvestment caused by high debt levels. When a heavily indebted company faces hardships in funding promising projects due to existing debt burdens, project financing produces a solution. By using this approach, projects can be financed separately, reducing the impact on the company's overall debt capacity. This ensures that the sponsor's ability to borrow is preserved, as project financing limits recourse to the sponsor (Esty, 2002; la Cour and Müller, 2014). This structure is especially instrumental when existing debt is risky. (Flannery et al., 1993; Sawant 2009).

Project finance enables sponsors to follow projects that may be unfeasible under traditional corporate finance approaches. It also allows sponsors to employ a higher debt ratio for the project, leading to increased tax advantages. (John and John, 1991).

Finally, project finance positively impacts investment decisions: "reduce the opportunity cost of under investments due to managerial risk aversion or debt over hanged" (Esty 2004).

2.3 Agency conflict

The pivotal reason for using project finance is to recognize agency costs, and this refers to the conflicts between the owners and managers of large tangible assets, or conflicts of interest between sponsors and lenders and wealth expropriation, that produce significant cash flows

(Esty, 2003). With the help of a project company, sponsors are able to establish a specific governance system that helps eliminating these conflicts between ownership and control (Esty, 2003).

Esty (2003) articulates the important institutional details of PF and argues that the governance structure of project companies combines with high leverage to mitigate agency conflicts. He supports his analysis with detailed case studies and field research. Corielli et al. (2010) study the effects on PF of projects' non-financial contracts. They show that use of non-financial contracts—contracts for engineering and construction, agreements for inputs and outputs, and operation and maintenance agreements—reduces loan spreads by reducing agency costs and volatility of project cash flow. Also, when sponsors are not key counterparties to those contracts, loan spreads and lenders' demands for sponsor equity contributions are lower.

Project finance involves contractual relationships with different parties, but these relationships can lead to problems like the "hold-up" issue, where parties may take advantage of the project's completion to demand better terms (Esty, 2003; Steffan, 2018). In order to alleviate such conflicts, project finance relies on well-designed long-term contracts that go beyond financial aspects (Corielli et al., 2010; Esty, 2003). Additionally, there is a potential conflict with host governments, who may attempt to gradually take control of the project after it is completed (Steffan, 2018). Project finance helps manage these risks by allowing a higher debt ratio and syndication of debt, which strengthens the project owners' bargaining position (Sawant, 2009).

In addition, in the companies with high free cash flow like capital-intensive power plants, the interest of the owners and managers may not be in alignment. To simply put, Managers choose to hold the cash rather than distributing it to the shareholders and invest it in the ways that can endanger the business. (Jensen,1986) highlights that managers keep the resources under their surveillance through value-destructing re-investments. Project finance provides a solution by establishing a focused governance structure and using a high level of debt to keep managers in check. (Esty, 2003; Jensen, 1986). This alleged "discipling" effect is particularly effective for projects that require significant upfront investment and have low operating costs. It helps ensure managers make responsible decisions that benefit the company and its owners (Sorge & Gadanecz, 2008; Steffen, 2018).

Corporate Debt Finance (CDF) allows managers more freedom in allocating cash flows and utilizing internal capital markets within the company. However, the verifiability of these cash flows is lower.

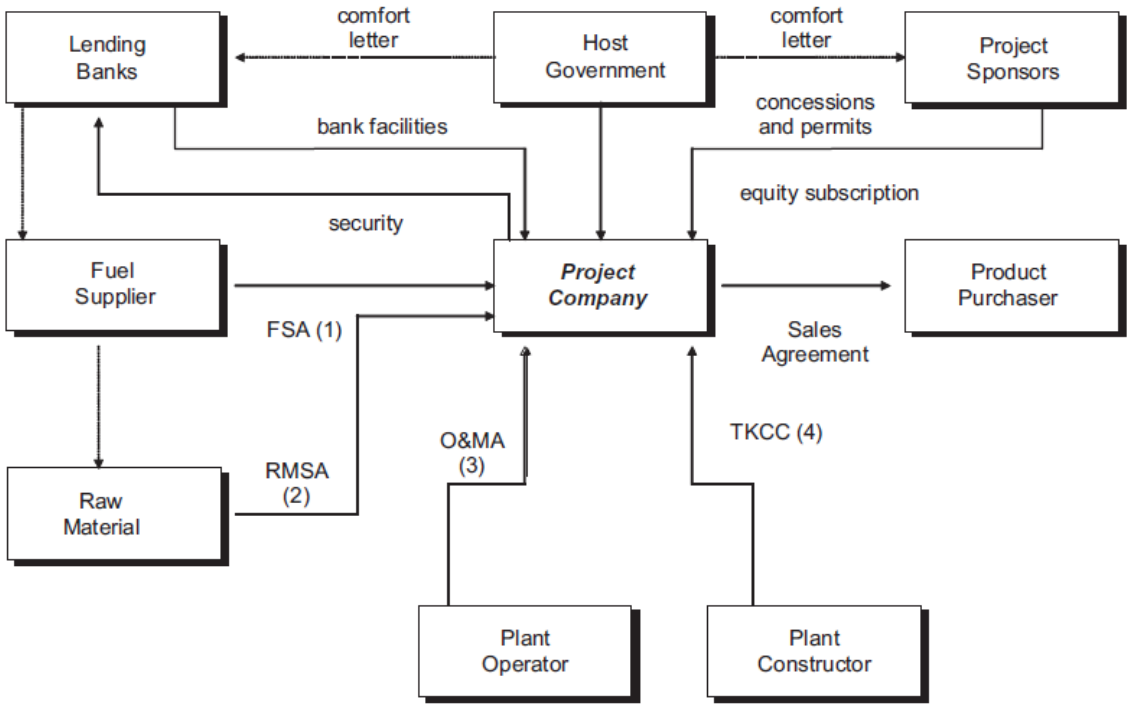
In contrast, Project Finance (PF) provides higher cash flow verifiability. However, the strict cash flow controls in PF limit managers from using internal cash flows for project-related

growth or reallocating cash flows across multiple projects. (Subramanian & Tung, 2016). Briefly, CDF produces flexibility intertwined with less verifiable cash flows, while PF ensures verifiability but restricts managerial discretion. The choice between CDF and PF depends on the company's specific needs and priorities for cash flow management and project financing. (Subramanian & Tung, 2016).

2.4 Contracts and Types of Contracts

One of the key features of Project Finance is the existence of a network of nonfinancial contracts (NFCs) (Alchian and Demsetz 1972, Jensen and Meckling 1976; Bonetti et al., 2009), a contractual network that revolves around the SPV (Gatti, 2013). NFCs is defined as contracts that generate cash inflows or outflows that affect the unlevered free cash flows of the SPV (Bonetti et al., 2009). The SPV organizes this network of contracts with third parties (often involving sponsoring firms as well). Of the numerous types of NFCs, refer to specific phases or parts of the project (Bonetti et al., 2009). Every contract can include subcontracts with third parties and the provision of collateral guarantees (Gatti, 2013). Figure 6 shows a typical contract framework used in projects Finance.

Project Finance is characterized by the presence of a network of nonfinancial contracts (NFCs). These contracts, as defined by Alchian and Demsetz (1972), Jensen and Meckling (1976), and Bonetti et al. (2009), generate cash inflows or outflows that impact the unlevered free cash flows of the Special Purpose Vehicle (SPV) involved in the project (Bonetti et al., 2009). The SPV sets up and manages this contractual network such as collaborating with sponsoring firms and other third parties NFCs can vary in their types, and they correspond to specific project phases or components (Bonetti et al., 2009). Additionally, each contract may include subcontracts with third parties and collateral guarantees (Gatti, 2013). Figure 2 illustrates a typical contractual framework utilized in Project Finance.



Typical contract structure of a project finance deal. (1) Fuel supply agreement; (2) raw material supply agreement; (3) operating and maintenance agreement; (4) turnkey construction contract.

Figure 6: Typical contract structure of a project finance deal, Gatti (2013 CH.1)

First, it should be considered that a single participant in a project finance deal can take on a number of roles. Second, not all the organizations shown in Figure 6 are necessarily involved in a project finance deal. Third, financing may also be structured through leasing plants or with a bond issue on the stock market (Gatti, 2013 CH.1).

As Bonetti et al., 2009 describe Four contracts are particularly vital to the soundness of the project.

1) Construction contracts and engineering, procurement, and construction (EPC) contracts are closed on a turnkey basis to make plant and equipment available to the SPV, usually at predefined prices, times of delivery, and standards of performance (construction risk shifting) (Gatti et al., 2007; Bonetti et al., 2009; Corielli et al., 2010).

construction contracts and engineering, procurement, and construction (EPC) contracts play a crucial role, in Project Finance. These contracts are closed on a turnkey basis, signifying they are designed to provide the Special Purpose Vehicle (SPV) with complete plant and equipment, usually at predefined prices, delivery times, and performance standards (construction risk shifting). This approach helps to shift the construction risk from the SPV to the contracting parties. Researchers such as Gatti et al. (2007), Bonetti et al. (2009), and Corielli et al. (2010)

have examined the significance of these contracts in Project Finance.

2) Purchasing agreements guarantee raw material to the SPV at predefined quantities, quality, and prices (raw material cost and availability risk shifting) (Gatti et al., 2007; Bonetti et al., 2009; Corielli et al., 2010).

3) Selling agreements, often known as take-or-pay or off-taking agreements, enable the SPV to sell part or all of its output to a third party that commits to buy unconditionally, again at predefined prices and for a given period of time (market risk shifting) (Gatti et al., 2007; Bonetti et al., 2009; Corielli et al., 2010).

In Project Finance, selling agreements, also referred to as take-or-pay or off-taking agreements, play a significant role in managing market risks. These agreements are potential to allow the Special Purpose Vehicle (SPV) to sell a portion or all its output to a third party, who commits to purchasing unconditionally. The selling agreements are established at predefined prices and for a specific duration. With the help of these agreements, the SPV can beneficially shift the market risks associated with selling its output onto the third party. The importance of these selling agreements in mitigating market risks has been examined by researchers such as Gatti et al. (2007), Bonetti et al. (2009), and Corielli et al. (2010) in the context of Project Finance.

4) Operation and maintenance (O&M) agreements are designed to provide the SPV with efficient and effective plant maintenance, agreeable with predefined service-level agreements (operational risk shifting) (Gatti et al., 2007; Bonetti et al., 2009; Corielli et al., 2010).

The entire set of contracts is managed and coordinated by the board of directors of the SPV, appointed by the sponsoring firms. Sponsors negotiate all these contracts in a vertical chain from construction and input supply to output sale (Bonetti et al., 2009). This “contractual bundle” is then presented to creditors to seek debt financing on the syndicated loan or on the bond market, serving as the basis for negotiating the quantity and cost of external resources (Yescombe 2002, ch. 5, Finnerty 2007, chs. 4 and 12; Bonetti et al., 2009). To entice lenders to back the SPV, arranger banks of the syndicated loan or bond issue work creatively on the contractual architecture of the deal with lenders' and sponsors' legal advisors (Esty, 2001; Gatti, Kleiemeier, Megginson, & Steffanoni, 2008).

An optimal mix of key project finance contracts (EPC, O&M, Offtaking and Purchase Agreements) is one that allocates the risks associated with the initiative to the counterparty, or counterparties, most able to deal with them. (Corielli et al., 2007). These counterparties must possess high creditworthiness, because they will be required to pay penalties and liquidated damages to the SPV if the risk in question comes to pass, or in the case of default (Bonetti et al., 2009).

In project financed deals, NFCs are what Esty (2003) defines as "institutional risk management" tools. In fact, contracts are both mechanisms that sponsors and lenders use to limit agency problems (Brealey, Cooper, and Habib 1996) and tools for managing corporate risk (CORIELLI et al., 2010).

The process of study and designing the project, joining different parties as a sponsor, and establishing the SPV is costly and can take long time as years (Esty, 1999). After establishing SPV, project company goes through a negotiation process with lenders to provide debt for the project. At this point, the contracts with different parties involved in the project is prepared (Esty, 1999, Gatti, 2013). Lenders are another prominent agent in a project finance deal. They are providing a significant share of capital by lending to SPV. Lenders are banks or institutional investors that usually act as syndication, providing loans (or syndicated loans) to SPV. A syndication is a group of banks with distinct roles inside the syndicate that provides the money, prepares documents and contracts, performs due diligence, monitors the project, carries out the cash flow, and executes the transactions, including paying back the principal and interest to the debtors. Banks use the syndication strategy for two reasons, 1) risk mitigation and 2) provide money (Gatti, 2013).

2.5 Syndicated Loan

The syndicated loan is provided by multiple lenders which form a "syndicate" with the purpose of providing financing to a single borrower (An & Cheung, 2010), is the most important source of external funding for corporations (Fotak et al., 2019). Cortés et al., (2020) by referring to Simon (1993) argue that the size of the loan plays an important role in the lender's decision to syndicate a loan. When lenders' lending capacity is limited, syndication is common, and also capital constraints and regulations also promote loan syndication (Cortés et al., 2020). Banks with capital-asset ratios below or close to regulatory minimums prefer to syndicate since they may not want to increase assets by adding large loans to their balance sheets. (Cortés et al., 2020).

Syndicated loans are indeed provided by multiple lenders who form a syndicate to provide financing to a single borrower. This type of loan is the most important source of external funding for corporations, as mentioned in the study by Fotak et al. (2019).

The size of the loan is an important factor in the decision of lenders to syndicate a loan, according to Cortés et al. (2020), who reference Simon (1993). When lenders have limited lending capacity, they often choose to participate in syndication. This allows them to share the risk and exposure associated with a large loan among multiple lenders, instead of solely

shouldering the burden themselves.

In addition to limited lending capacity, capital constraints and regulations also play a role in promoting loan syndication, as stated by Cortés et al. (2020). Banks that have capital-asset ratios below or close to regulatory minimums may prefer to syndicate loans. By syndicating, these banks can avoid increasing their assets by adding large loans to their balance sheets, which could potentially put them in violation of regulatory requirements.

Overall, loan syndication enables lenders to pool their resources and share the risks associated with financing large-scale projects, while also addressing their own limitations in lending capacity and regulatory constraints.

The process to organize a syndicated loan in Project Finance is following, as provided by Esty (2001). First, a prospective borrower selects a *lead arranger* to advise and manage the syndication process. In most cases, this *mandate* is awarded based on competitive bidding among the borrower's principal relationship banks or other banks with relevant expertise. The lead arranger is responsible for negotiating key terms and covenants with the borrower, in addition to analysing credit quality. After awarding the lead arranger then engages legal counsel to prepare an initial draft of the loan documentation it can be single-stage *general syndication* or a two-stage syndication with *sub-underwriting.*

According to Esty (2001), the process of organizing a syndicated loan in Project Finance typically involves the following steps:

Selection of a Lead Arranger: The prospective borrower chooses a lead arranger who will guide and manage the syndication process. This selection is often made through a competitive bidding process among the borrower's main relationship banks or other banks with relevant expertise.

Negotiation of Terms: The lead arranger takes on the responsibility of negotiating key terms and covenants with the borrower. This includes analyzing the credit quality of the borrower and working out the specifics of the loan agreement.

Engagement of Legal Counsel: Once the lead arranger is chosen, they engage legal counsel to prepare an initial draft of the loan documentation. This step ensures that the legal aspects of the syndicated loan are properly addressed.

Syndication Process: The syndication process can take one of two forms. It can either be a single-stage general syndication or a two-stage syndication with sub-underwriting.

a. Single-stage General Syndication: In this approach, the lead arranger directly distributes the loan opportunity to potential participants in the syndicate. Interested lenders can review the terms and decide whether to join the syndicate by providing a commitment to lend.

b. Two-stage Syndication with Sub-underwriting: In this approach, the lead arranger first seeks commitments from a group of sub-underwriters. These sub-underwriters commit to purchasing a portion of the loan from the lead arranger. Once a sufficient level of sub-underwriting is achieved, the loan opportunity is then presented to additional lenders for syndication.

These steps allow for the efficient organization and management of a syndicated loan in Project Finance, with the lead arranger playing a crucial role in coordinating the process and securing commitments from lenders.

In single-stage *general syndication* case, the Mandate Lead Arranger (MLA) will lead a syndicate where banks do not share the underwriting commitment on the loan with it (Gatti et al., 2012, Gatti, 2013). In a deal with sub-underwriting, the lead arranger and a small group of banks underwrite the full amount before offering shares to a broader group of banks (Gatti et al., 2012). Prior to general syndication, the lead arranger structures the syndicate in tiers according to commitment amounts, sets closing fees for each tier, and identifies which banks to invite to participate. Banks in each tier of the syndicate have titles based on their commitment amount (Gatti et al., 2012, Gatti, 2013).

In a sub-underwriting agreement, the main arranger and a select few banks fully underwrite the entire amount before extending the offer to a wider range of banks (Gatti et al., 2012). Before the general syndication process, the main arranger organizes the syndicate into tiers based on the level of commitment, establishes closing fees for each tier, and determines which banks to invite for participation. The banks in each tier of the syndicate are assigned titles based on their respective commitment amounts (Gatti et al., 2012, Gatti, 2013).

As Gatti (2013) argues that these two options are different in terms of a trade-off between risk and return. The first strategy is preferable when liquidity is abundant, the deal is very sound from the technical/industrial and financial point of view, and banks will very likely be ready to participate in the syndicate at convenient conditions for the MLA. In these cases, the MLA is in the favorable position to invite other banks and to retain most of the arranging fees for itself. The second strategy is preferable when market conditions are very uncertain or the deal features are very aggressive and/or have very specific clauses. Furthermore, the choice is sometimes a consequence of a request by the borrower. In order to safeguard good relationships with house banks (banks that provide the largest part of funds to a firm and with which the firm maintains a long term relationship), the borrower can suggest that the MLA include one or more banks in the underwriting group (Also see Ahiabor & James, 2018; Gatti et al., 2012; Esty, 1999).

According to Gatti (2013), there is a trade-off between risk and return when considering these two options. The first strategy is more suitable when there is ample liquidity, the deal is strong

from technical, industrial, and financial perspectives, and banks are likely to participate in the syndicate on favorable terms for the main arranger. In such cases, the main arranger can invite other banks and retain a significant portion of the arranging fees. On the other hand, the second strategy is preferable when market conditions are uncertain or when the deal involves aggressive features or specific clauses. Additionally, the choice of strategy can sometimes be influenced by the borrower's request. To maintain a positive relationship with their primary banks (those that provide a major portion of funds and have a long-term relationship with the borrower), the borrower may suggest including one or more banks in the underwriting group. This concept is also supported by Ahiabor and James (2018), Gatti et al. (2012), and Esty (1999).

Most large banks have a syndicated finance group that specializes in these deals, so-called club deal (Gatti, 2013). A club deal refers to a situation where several banks form a syndicate to structure the loan (INFRASTRUCTURE FINANCING INSTRUMENTS AND INCENTIVES © OECD 2015). The syndicated finance group performs two key functions: structuring, which involves designing and negotiating deals with borrowers, and distribution, which involves marketing deals to other banks. The two functions must be closely coordinated because the deal that is presented to the borrower (structuring) has to reflect terms that are acceptable to the market, distribution (Gatti, 2013). The market assigns the most importance to the Lead Arranger and Bookrunner titles Usually, one bank acts as the administrative agent for the syndicate, keeping track of borrowings and repayments as well as serving as the clearinghouse for interim cash flows (Gatti, 2013).

The syndicated finance group performs two key functions: structuring, which involves designing and negotiating deals with borrowers, and distribution, which involves marketing deals to other banks. The two functions must be closely coordinated because the deal that is presented to the borrower (structuring) has to reflect terms that are acceptable to the market, distribution (Gatti, 2013). The market assigns the most importance to the Lead Arranger and Bookrunner titles Usually, one bank acts as the administrative agent for the syndicate, keeping track of borrowings and repayments as well as serving as the clearinghouse for interim cash flows (Gatti, 2013).

As Gatti et al., 2012 argue syndicated loan lead arranging bank (also known as Mandated Lead Arranger (MLA) is arguably the most crucial. First, it must conduct due diligence on the vehicle company and the project itself. This is especially difficult as the project company has no prior operating history. The arranging bank has access to specialist engineering, legal, financial, logistical, market assessment, and risk assessment skills that allow the bank to effectively

certify a project's true potential and to ensure that relevant adverse inside information is revealed prior to loan syndication. Sponsors seek a bank that can successfully syndicate the PF loan. This requires both distribution capability and certification of the project's quality and risk.

According to Gatti et al. (2012), the syndicated loan lead arranging bank, also known as the Mandated Lead Arranger (MLA), holds a crucial role in the syndication process. One of the primary responsibilities of the MLA is to conduct thorough due diligence on both the vehicle company and the project itself. This task can be particularly challenging when the project company lacks prior operating history. The arranging bank possesses specialized expertise in engineering, law, finance, logistics, market assessment, and risk assessment, enabling them to effectively evaluate the true potential of a project and ensure that any relevant adverse inside information is disclosed before loan syndication.

Sponsors of the project look for a bank that can successfully syndicate the project finance loan. This requires the MLA to have strong distribution capabilities and the ability to certify the quality and risk associated with the project.

The most common titles are, in descending order of amount: Mandated Arranger, Lead Arranger, Arranger, Co-Arranger, Lead Manager, and Manager (Gatti et al., 2012, Gatti, 2013). Given the high debt/equity ratio used, the work of the syndicated loan lead arranging bank (also known as Mandated Lead Arranger (MLA)) is arguably the most crucial (Gatti et al., 2012). The bank selected by the project sponsors must perform three vital and difficult tasks as follow (Gatti et al., 2012). First, it must conduct due diligence on the vehicle company and the project itself. This is especially difficult as the project company has no prior operating history. The arranging bank has access to specialist engineering, legal, financial, logistical, market assessment, and risk assessment skills that allow the bank to effectively certify a project's true potential and to ensure that relevant adverse inside information is revealed prior to loan syndication. Sponsors seek a bank that can successfully syndicate the PF loan. This requires both distribution capability and certification of the project's quality and risk. Alternatively, a bank's distribution abilities are highly correlated with its size, the geographic sweep of its network, and its ability to attract local banks to the loan syndicate. This should be particularly important for PF loans since local banks bring not only local knowledge and ties, but also serve as a political bond to help ensure that a host government will not interfere in a project's evolution (Mian, 2006). On the other hand, the MLA's ability to certify the project's quality requires extensive knowledge of the industry where the project operates and an ability to coordinate the work of all the consultants (engineers, auditors, and lawyers) working

simultaneously on the project. Next, the lead arranger is responsible for the organization of the bank syndicate and must be able to attract a sufficient number and diversity of participating banks to fund the PF loan at a price that is both low enough to ensure project solvency and high enough to adequately compensate the banks for the risks they are taking by extending credit. Finally, the lead arranger develops a meticulous system of rules and covenants in cooperation with the lawyers, managed by the agent bank of the syndicate, to constantly monitor the vehicle company's actions after the loan closing and throughout the life of the loan itself. Furthermore, the lenders, legally represented by the agent bank of the syndicate, typically have little or no power to seize assets or shut down project operations in host countries, so deterrence must be expressed through some other mechanism.

Considering the substantial debt/equity ratio involved, the role of the syndicated loan lead arranging bank, also known as the Mandated Lead Arranger (MLA), is of utmost importance (Gatti et al., 2012). The selected bank must undertake three crucial and challenging tasks (Gatti et al., 2012).

Firstly, it is responsible for conducting comprehensive due diligence on both the project company and the vehicle company, which can be particularly difficult when the project lacks prior operational history. The arranging bank has access to specialized skills in engineering, law, finance, logistics, market assessment, and risk assessment. This expertise allows the bank to effectively evaluate the true potential of the project and ensure the disclosure of relevant adverse inside information before syndicating the loan. Project sponsors seek a bank capable of successfully syndicating the PF loan, requiring both distribution capabilities and certification of the project's quality and risk.

On one hand, a bank's distribution abilities are strongly linked to its size, the extent of its network coverage, and its ability to attract local banks to participate in the loan syndicate. This aspect is particularly significant for PF loans, as local banks not only contribute local knowledge and connections but also serve as political intermediaries, helping to ensure that the host government does not interfere with the project's progress (Mian, 2006).

On the other hand, the MLA's ability to certify the project's quality necessitates extensive knowledge of the industry in which the project operates, as well as the ability to coordinate the work of various consultants, including engineers, auditors, and lawyers, who are simultaneously involved in the project.

Furthermore, the lead arranger is responsible for organizing the bank syndicate and attracting a diverse and sufficient number of participating banks to provide funding for the PF loan at a price that balances project solvency and adequately compensates the banks for the risks

associated with extending credit.

Lastly, the lead arranger collaborates with lawyers and the syndicate's agent bank to establish a meticulous system of rules and covenants. This system continuously monitors the actions of the vehicle company after loan closure and throughout the loan's lifespan. Given that lenders typically have limited power to seize assets or halt project operations in host countries, deterrence must be expressed through alternative mechanisms.

Overall, the MLA plays a critical role in coordinating and executing these tasks, ensuring the success and viability of the syndicated loan for the project.

In spite of these complexities, Kleimeier and Megginson (2000) find that PF loans have lower spreads than many other types of syndicated loans, despite their being riskier nonrecourse credits with longer maturities, suggesting that the unique contractual features of PF and the underlying risk management process in fact reduce default risk.

Gatti et al., (2012) argue that certification by more prestigious lead arranging banks can reduce the cost of arranging a particular financial transaction, then projects certified by these intermediaries will have lower overall financing costs than will projects arranged by less prestigious banks. They found that certification by prestigious arrangers will create economic value in that loans can be arranged at lower spreads by more prestigious arrangers, and the top arrangers will be paid with higher fees, even if the overall cost of the loan is reduced by certification. In sum, prestigious arrangers also successfully syndicate PF loans with total fees that are no higher than loans arranged by banks with lower arranger market shares. The mandated lead arranger receives additional fees in exchange for the improved financial conditions offered to the sponsoring firms (CORIELLI, 2010). Top banks are compensated for providing certification with higher upfront arranger fees, but this is offset by the lower non-arranger fees accepted by banks participating in loan syndicates organized by these prestigious arrangers (Gatti et al., 2012), and participating banks, rather than Project sponsors, “pay” for the certification that top arrangers provide (Gatti et al., 2012). Certification is most valuable during banking crisis periods, when information asymmetry is greatest and financial stress is most extreme (Gatti et al., 2012).

According to Gatti et al. (2012), certification by prestigious lead arranging banks can result in lower costs for arranging a specific financial transaction. Projects that receive certification from these reputable intermediaries tend to have lower overall financing costs compared to projects arranged by less prestigious banks. The study found that certification by prestigious arrangers adds economic value by enabling loans to be arranged at lower spreads, and these top arrangers are compensated with higher fees, even if the overall cost of the loan is reduced due to

certification. In essence, prestigious arrangers are successful in syndicating project finance loans without incurring higher total fees compared to banks with lower arranger market shares. The mandated lead arranger receives additional fees in exchange for offering improved financial conditions to the sponsoring firms (CORIELLI, 2010).

Adding to the effect of lead arranger, Ahiabor & James (2018) argue that certification provided by domestic arrangers causes a substantial decrease in loan spreads across different geographic locations and industrial categories of projects. Their finding reveals the economic value of domestic arranger certification in project finance deals. Moreover, in the presence of information asymmetry between project sponsors and participant lenders in the syndicate, certification by domestic arrangers presents a superior mechanism to minimize search, information, and monitoring costs.

Top banks receive compensation for providing certification through higher upfront arranger fees. However, this is offset by the lower non-arranger fees accepted by banks participating in loan syndicates organized by these prestigious arrangers (Gatti et al., 2012). It is the participating banks, rather than the project sponsors, who "pay" for the certification provided by top arrangers (Gatti et al., 2012). Certification holds the most value during periods of banking crises when information asymmetry is more pronounced, and financial stress is at its highest levels (Gatti et al., 2012).

Esty (2001) discuss that banks participate in the syndicated loan market for different reasons. Arranging banks, which are typically more interested in generating fee income, seek to structure and lead transactions. Participating banks, those interested primarily in generating loan assets while staying within regulatory constraints on leverage and loan size, seek to diversify credit exposures to particular borrowers, industries, or countries as well as to make loans in markets where they lack origination capabilities. As one can see from this description, there are important differences between arranging banks and participating banks in a syndicated loan financing; this article focuses mainly on the arranging banks and their role in structuring transactions.

Esty (2001) discusses that banks engage in the syndicated loan market for various reasons. Arranging banks, primarily driven by fee income generation, are focused on structuring and leading transactions. Their main objective is to take a leading role in organizing and facilitating the loan process. On the other hand, participating banks have different motivations. They are primarily interested in generating loan assets while adhering to regulatory constraints regarding leverage and loan size. Participating banks seek to diversify their credit exposures to specific

borrowers, industries, or countries. Additionally, they may target markets where they lack origination capabilities.

This description highlights significant distinctions between arranging banks and participating banks within the syndicated loan financing context. The article primarily emphasizes the role of arranging banks and their involvement in structuring transactions.

Finally, political and Sovereign risk is the major factor that affect lenders syndication, in which lenders create smaller and more concentrated syndicates to Militate monitoring and low-cost contracting in countries with strong creditor rights and reliable legal enforcement, and they create larger and more diffuse syndicates as a way to deter strategic default when lenders cannot rely on legal enforcement mechanisms to protect their claims, (Esty & Megginson, 2003).

We close this topic by shortly address the same other benefits of a syndicated loan to banks, such as risk diversification, increased reputation, coordination, and development of a profitable relationship between banks and issues such as moral hazard due to information asymmetric, Coordination costs within loan syndicates, and Strategic collusion (An & Cheung, 2010; Cortés et al., 2020).

Risk sharing and Diversification

A key element that determines the overall risk borne by lenders is their corresponding stake in the loan (Cortés et al., 2020). The decision to syndicate will reduce the loan stakes among the lenders in a syndicate loan compared to single-lender loans, which, in turn, will reduce their individual exposure to idiosyncratic credit risk, which is known as Risk sharing and diversification (Cortés et al., 2020).

The stake that lenders have in a loan is a critical factor in determining the overall risk they bear, as highlighted by Cortés et al. (2020). When lenders choose to syndicate a loan, their individual stakes in the loan are reduced compared to single-lender loans. This reduction in loan stakes allows for risk sharing and diversification among the lenders within the syndicate. Consequently, lenders' exposure to idiosyncratic credit risk is diminished.

Through syndication, lenders are able to distribute their loan exposure across multiple participants, which lowers their individual risk and potential losses associated with a default or credit event. By diversifying their loan portfolios through syndication, lenders can mitigate the impact of adverse credit events on their overall loan portfolios. This risk sharing and diversification mechanism is a significant advantage of loan syndication and contributes to a more balanced and diversified risk profile for participating lenders.

Information asymmetries

Bharath et al. (2009) identified this situation as a syndicate moral hazard problem. This moral hazard problem implies that syndicate participants are exposed to the risk of wrongdoing by the lead bank; as a result, they will demand a higher loan spread (Angbazo et al., 1998; Bae et al., 2014). These informational problems can be reduced if the lead bank retains a larger share of the loan (Ivashina, 2009). Hence, in syndicated loans in which the stake of the lead arranger is lower than that in a single-lender loan, larger spreads are expected (Cortés et al., 2020).
Bharath et al. (2009) identified this situation as a syndicate moral hazard problem. This moral hazard problem implies that syndicate participants are exposed to the risk of wrongdoing by the lead bank; as a result, they will demand a higher loan spread (Angbazo et al., 1998; Bae et al., 2014). These informational problems can be reduced if the lead bank retains a larger share of the loan (Ivashina, 2009). Hence, in syndicated loans in which the stake of the lead arranger is lower than that in a single-lender loan, larger spreads are expected (Cortés et al., 2020).
Coordination costs within loan syndicates

In syndicated loans, coordination problems arise since lenders may have different objectives, risk profiles and incentives (Cortés et al., 2020). The co-operation required among different lenders results in additional transaction costs that do not exist in single-lender loans (Cortés et al., 2020).
Strategic collusion

Cortés et al. (2020) argue that a syndicated loan contract is a temporary agreement among a group of lenders. When a firm borrows from a syndicate, its out- side bargaining options are reduced more than that in the case of borrowing from a single lender for two reasons. 1 First, there are fewer alternative lenders outside the syndicate than with single- lender loans. Second, the connection between the lenders in a syndicate and lenders in other syndicates will very likely create a collusive network among them, which will be larger than the collusive network around a single lender. This situation improves the bargaining power of the members of the syndicate and leads them to charge higher rates than single lenders.
Cortés et al. (2020) posit that a syndicated loan contract represents a temporary agreement among a group of lenders. When a firm opts for a syndicated loan, its external options for bargaining are diminished compared to borrowing from a single lender. There are two primary reasons for this reduction in outside bargaining options.
First, the availability of alternative lenders outside the syndicate is limited in comparison to single-lender loans. With a syndicate, the borrower has access to a smaller pool of potential lenders. This narrower selection limits the borrower's ability to negotiate and obtain more

favorable terms.

Second, the interconnectedness between lenders within a syndicate and lenders in other syndicates is likely to foster a larger collusive network among them. This expanded collusive network enhances the bargaining power of syndicate members. They can coordinate their actions more effectively, leading to higher interest rates being charged compared to loans from single lenders.

The increased bargaining power of syndicate members, arising from the reduced external options and the presence of a collusive network, allows them to demand higher rates from borrowers. This situation is attributed to the improved coordination and collective power of syndicate lenders, which strengthens their ability to extract higher returns in the form of interest rates.

Monitoring

In relation to a bank's monitoring role, syndication typically not only does not relieve each participating bank from doing its own credit analysis and risk assessment, but also the monitoring role of a bank might be weakened because of a free rider problem among the participating banks and information asymmetry between the lead bank and the other participant banks (An & Cheung, 2010).

Cost

As An & Cheung, 2010 argue the costs of a syndicated lending arrangement are expected to be smaller than its benefits for large loans for the following reasons: 1) banks participating in a syndicated lending can designate a single bank to act as the main monitor and share expertise with the main monitor, thus, preventing the lead lender from reducing the level of governance, and 2) the reputation of a lead bank is very important in the loan syndication process, hence, preventing the opportunistic behavior of a lead bank.

Chapter 3 Law and Project Finance

"**Law Matters**" (Subramanian & Tung, 2016 p154).

In this chapter we will delve into the general legal issues that emerge from project financing transactions and introduce the solutions typically developed and adopted by operators. Additionally, we aim to examine how financial and economic planning for project development can manifest in the legal and contractual relationship framework that binds participants, thus making non-recourse or limited recourse financing of the project less likely to default (Esty & Megginson, 2003).

The legal framework for project financing finds its roots in the common law system (Gatti, 2013 CH.7). Perhaps one of the most critical differences in investor protection between civil law and common law jurisdictions is related to their approaches to unpredicted circumstances. As Coffee (2000) explains, since the civil legal system is restricted by existing laws; thus, the common law system is better equipped to deal with unforeseen circumstances.

Various legal and financial researchers concur that countries with common law systems like the UK and US provide more robust protection for creditors compared to those with civil law systems, such as those in mainland Europe (Vaaler et al., 2007). In the UK, common law principles mainly depend on judicial precedents for rapid and fair resolution of financial disputes resulting from company failures. This approach is preferred over strict, often inflexible regulations that are periodically clarified by legislators and enforced by executives or bureaucrats (Vaaler et al., 2007). Thus, common law enables the organic evolution and timely application of practical heuristics, upheld by politically independent decision-makers (Vaaler et al., 2007).

This notion aligns with the views of LLSV (1998), who argue that common law countries provide stronger legal protection for both shareholders and creditors. Within the project financing sphere, Hoffman (1998) suggests that common law countries offer more flexibility in terms of the types of collateral that can be seized in case of default and the types of liens that can be placed on assets (Esty & Megginson, 2003).

The same pattern has been found by Vaaler et al. (2007) for the leverage ratio of projects located in Asian common law countries, in which the usage of Project Finance has been increased by approximately 10 percentage points. This high leverage ratio implies that the overall project credit risk is low in common law countries.

However, interestingly, Subramanian and Tung (2016) discovered that Project Finance is more common in France, a civil law country, than in the UK, a common law country, with prevalence at 55% and 36% respectively. This finding suggests that investor protection laws play a significant role in deciding whether to opt for Project Finance or Corporate Debt Financing (CDF), particularly in countries with civil law. They emphasize in their findings that investor protection laws in France, a civil law country, are weaker compared to those in the UK, a common law country as result they almost compensate for the shortcomings of the civil law.
Within the framework of the codified legal system, the legal construction of project financing emerges as a valuable tool for aligning financing structures with the purposes of project financing, particularly in contexts where investor legal protection is weak (Gatti, 2013 CH.7).

3.1 Legal Analysis of Project Financing

Project financing transactions, as described by Gatti (2013), represent a complex system with interrelated elements.
The legal analysis of project financing primarily involves examining a typical project financing transaction (often found in textbooks) and understanding its formation: 1) the project company, and 2) the contracts associated with the project and their interconnections (Gatti, 2013 CH.7). In these transactions, the borrower is typically the project company, or the Special Purpose Vehicle (SPV), which is exclusively involved in developing the project (CRE30 - IRB approach: overview and asset class definitions, 2019; and other). This entity is a newly established organization, designed solely for the execution and operation of the project in question (Esty, 2004; and others). Therefore, the project company can be defined as a new company (Gatti, 2013 CH.7).

3.1.1 Article of Incorporation

The capital of the project company must be secured, often through a share pledge, to assure the lender (Gatti, 2013 CH.7). Consequently, the project company's articles of association must not contain provisions that prohibit such guarantees or impose restrictions on the grant of security interests, such as needing approval from the board of directors or other initiators (Cited).
Hence, the lender may require restrictions on the transfer of the sponsor's shares to third parties. The limitation on share transferability should ideally be a contractual agreement between the project company and the lender, and, if applicable, between the project company and the sponsor (Cited). Contrarily, restrictions on share circulation outlined in the company bylaws can negatively impact the project's finance ability, as they may obstruct the enforcement of

security interests (Cited).

3.1.2 Outsourcing the Corporate Functions of SPV

As (Gatti, 2013 CH.7) describes, in this perspective, we can consider that the project company runs by outsourcing some of its function to third parties. From this perspective, it's worth noting that the project company often operates by outsourcing certain functions to third parties. While the project company strives to integrate the project fully from both financial and legal perspectives, it typically outsources all its operational activities to third parties for reasons that are relatively straightforward:

Firstly, the internal costs are variable and difficult to control, and it's necessary to convert them into fixed costs or costs that only change within certain predetermined parameters (usually related to the performance of contracting parties that would benefit from cost increases).

Moreover, predetermined objectives can be applied to outsourcers in terms of economic results or performance goals.

If these goals are not achieved, the outsourcing contract can be terminated by the project company. Problematic outsourcers can then be replaced by service providers that are more effective and/or cheaper.

This approach seems to be the only way for the project to be financed with an extremely aggressive debt to equity ratio, resulting in a financing company with a minimalist corporate structure. In this setup, each company's role is to delegate project tasks to third parties through a network of pre-established legal relationships. This structure ensures that the nature and extent of outsourcing costs and risks are fully transparent, thereby facilitating effective supervision and guidance. Given these factors, the project company can be seen as an artificial entity, essentially serving as a vessel to accommodate the cash flow needed for financing and repayment (Cited).

3.1.3 The Contract Structure

In this section, we'll briefly review the contractual system underpinning project financing transactions. For a detailed description of its structure, content, and the key legal issues related to drafting these agreements, refer to Gatti (2013, Chapter 7).

Two documents are particularly crucial in project financing: the due diligence report and the term sheet of the credit agreement. The due diligence report is a summary of the project from a legal perspective, providing lenders with a comprehensive tool for evaluating the project (Cited). The term sheet contains a summary of key clauses in the contract documents, which serve as a guide for the legal advisor during the drafting process (Cited).

The next step involves project documents, which can be classified into finance documents, security documents, and project agreements. The finance documents comprise the agreement underpinning the project financing (Cited). Security documents create a system of security interests to aid lenders, while project agreements are the operating contracts of the project company (Cited).

Project financing transactions revolve around a complex contract system with credit agreements at its core. This document regulates all aspects of project financing transactions, controlling the entire financing transaction through which borrowers and lenders provide financial resources to the project company (Cited). In Europe, it is common for credit agreements to be governed by British law (Cited).

Financial documents usually begin by specifying how certain terms are to be interpreted (Cited). The issues of credit arrangements are then addressed, with project financing loans usually divided into different credit lines or tranches. These include base loans, standby loans (used to cover cost overruns), and value-added tax loans (Cited).

Interest on drawdown, default interest rates, repayment schedules, rights to cancel the loan, and credit agreement costs are all outlined in this document (Cited). Profit distribution is a key aspect covered in the document. Due to the unique structure of project financing transactions, cash flows generated by projects are typically allocated only when certain conditions are met (Cited). We'll discuss this more when we introduce the waterfall of cashflow concept in an upcoming section.

A security package is activated during abnormal projects or financing situations. The purpose of a security interest is to use specific assets as credit guarantees. However, it's important to note that the project company does not typically own any substantial assets at the start of the project. The proceeds of a loan are used to purchase or construct assets. Furthermore, shares representing project company capital are always included in the security package (Cited).

If a crisis arises due to poor project management, measures outlined in the Operation and Maintenance (O&M) agreement can be implemented, such as replacing operators or changing management practice standards. The borrower's defense strategy might involve tools different from the security package. For instance, if the operator performs poorly, the project company has the right to terminate the contract and, with lender's consent, appoint a potentially better operator. This is what we refer to as 'intervention rights (Cited).

The guarantee documents typically include common clauses, such as a pledge of shares in the project company. Stock guarantees and accounts receivable from the project company are major features of project financing guarantees. Another important security measure is the

assurance of the project company's bank accounts. All assets of the project company must be guaranteed. This is a fundamental requirement, with cash being the most attractive asset for lenders as it does not need to be converted into secured credit and is not affected by market risk, although it might be impacted by currency exchange risk (Cited).

Other assets of the project company, in addition to accounts receivable, bank account cash, and real estate, also serve to protect the interests of lenders. A direct agreement, which is part of the guarantee package, is a contract directly executed by the borrower and the main transaction parties of the project agreement. The purpose is twofold: to maintain the project agreement and to establish a lender's right to 'take over' these agreements (Cited).

A project company is primarily a financial tool: a corporate shell that incorporates projects for the implementation of project financing techniques. To implement and operate the project, the Special Purpose Vehicle (SPV) develops a series of contracts including construction contracts, operation and maintenance agreements, off-take agreements, supply agreements, and host country agreements (Cited).

The off-take agreement is a vital component of the project financing transaction structure. In project financing, cash is king, and the off-take agreement is an agreement by the project company to generate cash flow for the project. We'll discuss this more in the later sections (Cited).

3.1.4 Project Financing; Alternative to Investor Protection Law

Subramanian & Tung (2016) argue that the ability to verify cash flows in CDF results in higher private returns, whereas in project finance, it results in lower returns due to the nature of the contract, which can't be written as explicitly in CDF as it can be in Project Finance. This stands in contrast to Chemmanur and John (1996) who posit that a defining feature of Project Finance is the segregation of project cash flows from the sponsors' cash flows.

Stringent cash control is necessary in project finance as lenders can only rely on project cash flow for repayment. Unlike corporate financing, which provides some risk diversification due to multiple projects and growth opportunities, project financing lenders must mitigate the risk of future cash flow shortages. This requires 'cash flow waterfall' arrangements and multiple lenders monitoring cash accounts (Subramanian & Tung, 2016).

Weak investor protection laws may inversely impact companies. Given the higher cost of external financing in countries with weak investor protection, companies may prefer the flexibility of CDFs, allowing them to maintain larger internal capital markets. For such companies, this flexibility might outweigh the verifiability of cash flow provided by project

finance. The prevalence of these two effects is an empirical question we attempt to answer in this paper (Subramanian&Tung, 2016).

Contractual arrangements specify a 'cash flow waterfall' to dictate the allocation order of project cash flows. Typically, borrowers must first use project cash flow to meet operating expenses, then pay interest and loan principal. The contracts also outline the allocation of excess cash flow, exceeding what is necessary for project costs and debt repayment (Subramanian&Tung, 2016). A schematic of cashflow waterfall arrangement is shown in Figure 7.

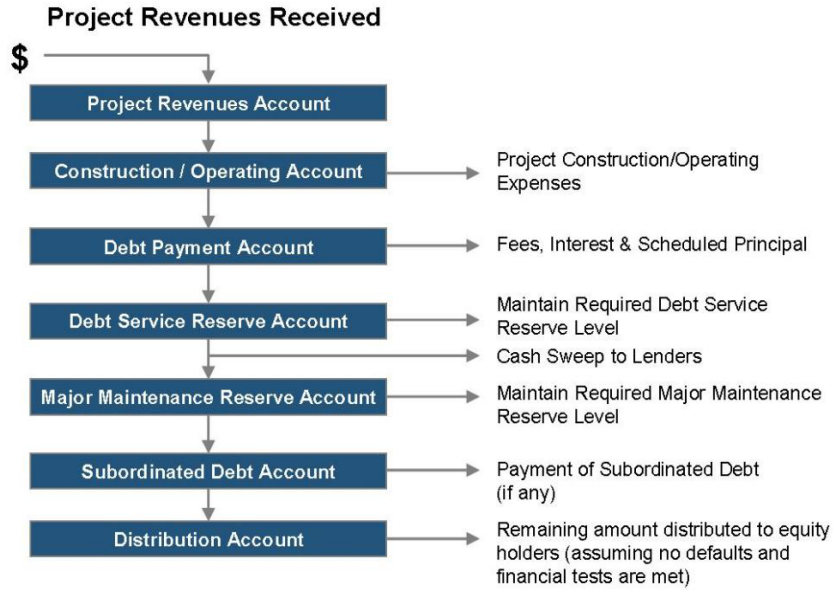


Figure 7: Typical Project Finance Cashflow Waterfall Arrangement (. Groobey et al., 2010)

This waterfall arrangement is carried out through several project accounts, typically controlled by lenders and held overseas to mitigate currency and other political risks (Subramanian&Tung, 2016). These accounts include a revenue account for storing project income, a payment account for all payments made to the lender and distributions to equity holders, and a debt service reserve account for retaining cash flow in case project income is insufficient for principal and interest payments (Subramanian&Tung, 2016).

Vaaler et al., (2007) present three significant institutional variables at the national level: common law, debt, and enforcement. These variables have a predictive value and statistical significance at a level of 10% or higher. In countries with stronger creditors' rights, lenders are more inclined to finance projects. However, if the process to exercise these rights is lengthy, lenders are less willing to finance projects in Asian countries.

3.1.5 Property Rights

Kleimeier and Megginson (2000), in their comparison of project financing loans with non-PF

loans, found that Project Finance loans are more likely to be extended to borrowers in high-risk countries, especially those with elevated political and economic risks. Esty and Megginson (2003) further support this finding, studying the impact of debt and reliable legal enforcement on debt ownership patterns. Subramanian & Tung (2016) build upon this literature by documenting the effect of country-specific risks, particularly the quality of legal protection for external investors, on the choice between project finance and Corporate Debt Financing.

Strengthening creditors and property rights can enhance the appeal of a Project Finance deal. Fotak et al., (2019) discovered that in international Project Finance deals, bilateral investment treaties (BITs) can fortify property rights. They achieve this by reducing the likelihood of government expropriation, imposing higher costs on the expropriating government, and ensuring better compensation for the affected parties in case of government expropriation. They argue that while international law provides better protection for foreign equity investors compared to foreign creditors, bilateral investment treaties specifically safeguard both equity investors and foreign creditors.

A bilateral investment treaty is an agreement between two sovereign entities designed to bolster property protection for foreign investors and shield them from the risk of government expropriation. The primary and almost exclusive purpose of these agreements is to enhance legal protection for foreign investors (Fotak et al., 2019).

Fotak et al., (2019) estimates approximately 12 basis points as the impact of a BIT on a Project Finance deal and the estimated benefits are much more in states with a high risk of expropriations, with nearly additional savings of over $22 million per loan.

Moreover, Fotak et al., (2019) point out that Qian and Strahan (2007), along with Haselmann et al., (2010), found that foreign lenders are highly sensitive to variations in legal systems.

The discussion will proceed in two parts. First, we will consider the importance of the contractual system of Project Finance in ensuring the allocation of free cash flow to lenders. Subsequently, we will briefly review the significant provisions and agreements that are necessary for a Project Finance deal. Our resources for this section will include Model Consent to Assignment for Project Finance Transactions (with Commentary), from Business Lawyer (2012), along with Gatti (2013 CH.7).

3.2 Legal aspects of Project Finance in Aerospace industry

Pursuant to the objectives of this study, subsequent sections will explore the application of Project Finance in the Aerospace industry in a legal context. A recent examination of this field by Nayoung (2022) posits that project finance offers a more effective mechanism for the space

manufacturing industry compared to the prevailing asset-based finance structure. To determine the feasibility of project finance in the space sector, the establishment of an international regulation is necessitated.

3.2.1 Current Space Treaties and Laws

The Outer Space Treaty is a seminal international treaty that governs human activities in outer space, providing a comprehensive legal framework for such activities (von der Dunk, 2018). This Treaty stipulates that a State Party is liable for its national activities carried out by both governmental and non-governmental entities. This provision implies that all private commercial entities are subject to the State's control and must comply with the State's national laws and financial regulations wherever their activities are conducted, including in outer space (Nayoung, 2022).

Cahan et al. (2016) argue that however, the fundamental space treaties did not anticipate the commercialization of space finance. The United Nations treaties on outer space, developed during the 1960s and 1970s, primarily serve as the legal framework for conducting space activities. Initially, space activities were conducted almost exclusively by a limited number of governments and international organizations, financed by superpower government budgets dedicated to space technology and exploration. This legal framework primarily addresses public international law, focusing on the relationship between nation-states and international organizations. The treaties hold states accountable for authorizing and supervising their activities in outer space, for which they are internationally responsible (Outer Space Treaty, Article VI). States are also held liable for damage caused by space objects, even those privately owned (Liability Convention, Articles II and III). According to the UN space treaties, the registration of space objects is obligatory (Registration Convention, Article II), and the registration in a national registry determines which state has jurisdiction and control over the space object (Outer Space Treaty, Article VIII).

The rapid expansion of private and commercial space activities in the early 1990s resulted in numerous financial challenges, particularly for start-up companies lacking credit history and possessing no assets except the satellite they operate (Nayoung, 2022). This intensified the need to address the issue of security rights in space equipment at the international level (Cited). A critical concern for creditors regarding space equipment is the ambiguity surrounding which state's law applies to the creditor's security interest in such equipment, given its location in outer space (Cited).

The Space Protocol introduced the concept of a 'space asset', which has a broader definition

than 'space objects' in the Corpus Iuris Spatialis and includes property on the Earth's surface. It is estimated that the Cape Town Convention and the Space Protocol could reduce the cost of financing space activities by 20-40 percent if the Space Protocol is enforced (Nayoung, 2022). These conventions provide risk reduction to lenders in secured financing transactions, lower funding costs on export credit, risk reduction through the registration system, and minimize legal fees for the space industry (Nayoung, 2022).

As of the date of this study, the Cape Town Convention and the Space Protocol serve as the only private international space law, prepared under the aegis of the International Institute for the Unification of Private Law (UNIDROIT). The Cape Town Convention marks a significant advancement in international asset-based finance law, establishing a new regime for financing assets not only in the space industry but also in aviation, rail transportation, mining, agriculture, and construction sectors, facilitated through the Space Protocol (Nayoung, 2022).

The space-service sector is one of the most rapidly expanding and profitable sectors of the global economy. In 2009, despite the financial crisis, global revenues totaled US $261.61 billion (Karski & Myszona-Kostrzewa, 2019), marking a modest yet steady growth of 1.6% compared to 2008. By 2018, the global space industry had grown by more than 8.1%, amounting to US $414.75 billion in total (Cited). Traditional actors in the space business have maintained their growth trajectory and are being accompanied by a surge of innovative new space companies (Karski & Myszona-Kostrzewa, 2019).

Until the early 1980s, the deployment of objects into space, including items owned by private entities, was exclusively undertaken by states. However, the increasing commercialization of the space industry has sparked a growing interest among private entities to own their spacecraft launch systems and gain independent, reliable, and profitable access to space (Karski & Myszona-Kostrzewa, 2019). The space sector currently encompasses the upstream sector, which includes all objects deployed in space, and the downstream sector, which includes the ground infrastructure and satellite technology-based services (Karski & Myszona-Kostrzewa, 2019).

Satellite telecommunication is the oldest and most established space sector. The revenues generated by telecommunication satellites are approximately thirty times the costs associated with their construction and deployment in orbit. The second relatively commercialized sector is applications based on satellite navigation. Currently, two Global Navigation Satellite Systems (GNSS) are operational: the American Global Positioning System (GPS) and the Russian GLONASS. The European Galileo and Chinese Compass systems are anticipated to be fully operational by 2020 (Karski & Myszona-Kostrzewa, 2019).

Only three states possessed technological capabilities in the Earth observation sector twenty-five years ago; today, that number exceeds twenty. Increased accessibility and commercialization of access to state resources and satellite data archives have fostered new sales markets and a demand for advanced geo-information products based on satellite data. The European Union's Copernicus programme is one of the leading providers of Earth observation data, though technical barriers currently prevent users from fully exploiting the data and information Copernicus delivers (Karski & Myszona-Kostrzewa, 2019).

In the 21st century, especially within the present decade, space exploration has transitioned from being the domain of state agencies to becoming another industry branch accessible even to small and medium enterprises as well as educational institutions. Two main processes were instrumental in effecting this breakthrough (Karski & Myszona-Kostrzewa, 2019).

However, it is important to note that there are no multilateral international law conventions specifically regulating numerous issues associated with satellite technologies or mineral mining on the moon and other celestial bodies. The commercialization of space activities would be accelerated if countries or companies could secure more financial support. However, due to the high-risk nature of space activities, financial institutions remain hesitant to provide credit (dos Santos, 2003).

3.2.2 Legal Issues in Asset-Based Finance of Commercial Space Activities

Commercial space activities, like any other commercial ventures, are regulated by respective states' national laws. These laws encompass contract, property, tort, creditors' rights, bankruptcy, insolvency, reorganization, among others. Given the nature of space activities, they pose issues related to cross-border jurisdiction. It is fittingly observed that space law resembles family or environmental law, in that various laws are denoted by the material they deal with rather than stemming purely from the rational development of a single legal theory. Space assets, high-value mobile equipment, present challenges for financing due to their mobile nature and the absence of global uniformity of national laws for cross-border asset-based lending. Currently, various legal regimes allow (and can complicate) a range of financing methods. The jurisdictional issues in cases of bankruptcy, insolvency, or reorganization where a borrower has provided multiple lenders security interests in functionally connected space assets as collateral can be incredibly complex, particularly when each lender has registered their interest in multiple states. This section is provided by referencing to Dula (1983), ROTOCOL TO THE CONVENTION ON INTERNATIONAL INTERESTS IN MOBILE EQUIPMENT ON MATTERS SPECIFIC TO SPACE ASSETS (BERLIN, 9 MARCH 2012),

Nayoung (2022).

3.2.3 Proposal for a New Legal Framework of Project-based Financing

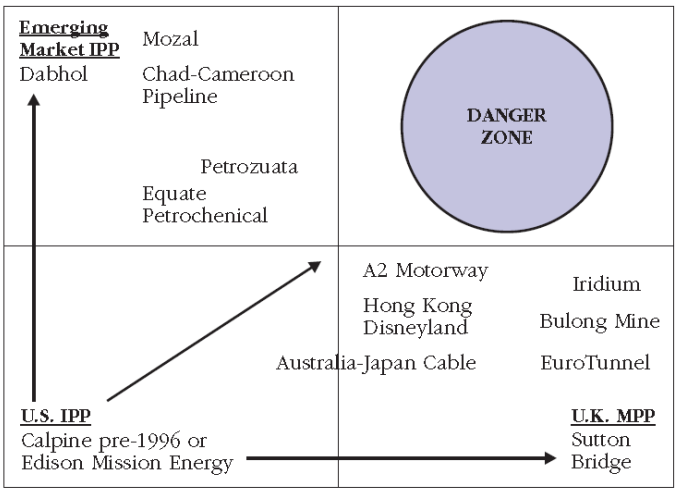
A suitable legal framework is a critical factor in reducing the risk of failure. However, the international legal regime for the space industry is largely restricted to a single convention and a protocol on space financing, which has yet to be enforced. Despite the lack of legislation specific to the space industry, project finance in space activities is increasingly popular on a global scale. The National Laboratory aboard the International Space Station (ISS) exemplifies a public-private partnership concept that is successfully functioning in space. However, there have been instances of failure where PPPs were inadequately conceived and prepared, most notably the Galileo concession project from 2004 to 2007. Despite these setbacks, project finance is becoming increasingly crucial for the EU's large satellite infrastructure projects and the satellite communication industry. This section is provided by referencing Nordon (2011), Fouad et al., (2021) and Nayoung (2022).

Chapter 4 Risk Management by Project Finance

The project finance acts as a tool in which several billion dollars of investment can be mobilized to the projects annually. These projects' success can be defined in the joint effort of several related parties and factions. (Sorge,2004). As we describe in section 1.7, the cornerstone of Project Finance is risk management with mainly a nexus of contract, which is designed for each specific project based on its idiosyncratic risk (Hoffman, 1989; and others).

Esty (2002) explains that during the 1980s, project finance was primarily conceptualized as an instrument to regulate issues associated with agencies' free cash flow, and the expansion debt capacity in low-rated firms. In the 1990s, the scope of project finance began to stretch beyond these initial motivations. Utilization of Project Finance empowered sponsors to finance a broader array of assets situated in various countries. A significant shift was their investment in Independent Power Producers (IPPs) in nations associated with high sovereign risk. Figure 8 illustrates the changing trends of sponsor firms, where the horizontal axis denotes the level technology risk and market risk, and the vertical axis signifies sovereign risk.

A2 Motorway: $900 million toll road in Poland (HBS case # 202-030).
Australia-Japan Cable: $520 million undersea communications cable (HBS case # 203-029).
Bulong Mine: $350 million nickel/cobalt mine in Australia (HBS case # 203-027).
Calpine Corporation: $1 billion financing facility to build IPP's in the US (HBS case # 201-098).
Chad-Cameroon Pipeline: $4 billion oil field development and pipeline project in Africa (HBS case # 202-010)
Dabhol: first phase was $900 million, total expenditure was $3 billion for this Indian IPP (HBS case # 596-009)



Euro Tunnel: $15 billion undersea tunnel between France and the UK.
Equate Petrochemical: $2 billion petrochemical plant in Kuwait (HBS case #200-012).
Hong Kong Disneyland: $14 billion theme park (HBS case # 201-072)
Iridium: $5.5 billion global satellite telecommunications system (HBS case # 200-039).
Mozal: $1.4 billion aluminum smelter in Mozambique (HBS case # 200-005).
Petrozuata: $2.4 billion oil field development project in Venezuela (HBS case # 299-021)
Sutton Bridge: $570 million hybrid IPP/MPP power project in the UK (HBS case # 200-051)

Figure 8: Distribution, and evolution, of Project Finance by Type of Risk, Esty (2002).

Within the upper-left quadrant of the graph, projects in high sovereign risk countries are displayed, Such as the Dabhol Power Project in India. This project was considered a high-risk initiation at the time due to India's low Institutional Investor credit rating. Conversely, the lower-right quadrant encompasses projects with elevated market and technology risks situated in countries with higher rating score. Merchant power plants (MPPs) in the U.S. and U.K. serve

as prime examples, as these plants lack long-term fixed prices and quantities contracts (off-taker contracts), leaving them more vulnerable to market fluctuations.

Centered in the graph, we observe projects exposed to retail demand and increased sovereign risks. Examples include the A2 Motorway in Poland and Hong Kong Disneyland, which, due to their large retail customer base, face heightened demand uncertainty. The upper-right quadrant, labelled as the "Danger Zone," contains projects fraught with high sovereign risk as well as considerable market or technology risk. Given their substantial uncertainty levels, these projects are typically unattractive candidates for project finance. Esty (2002) conclude that lenders have no willing to accept a deal bearing both sovereign and technological risks.

For these projects to be enticing investment opportunities for lenders, a detailed and accurate assessment of the inherent risks is imperative (Ravis, 2013). The essence of project finance lies in striking an balance between sharing the risk of sizeable investments amongst multiple investors and ensuring effective monitoring of managerial actions. It also underscores the importance of coordinated effort by all parties associated with the project (Sorge, 2004).

If risks are not anticipated and managed properly, they can affect cash flow. This can lead to a cash shortfall, and when there isn't enough cash to pay creditors, the project is technically in default. Myriad studies have highlighted this connection between risk, cash flow, and project default. (Moore & Giaccio, 1986; Gatti, 2007; Kong et al., 2008; Bonetti, 2009).

To ensure successful project financing, a thorough assessment of all potential risks is necessary. These risks can arise during the construction phase, when the project isn't generating cash, or during its operation. Construction risks include delays and unexpected challenges, while operational risks involve market changes and regulatory uncertainties. By analyzing and managing these risks effectively, project financiers can secure the project's financial stability throughout its lifespan (Moore & Giaccio, 1986; Sorge, 2004; Gatti, 2007; Kong et al., 2008; Bonetti, 2009; Ravis, 2013). Indeed, the lender's most critical concern at the outset of a proposed international project financing is the identification of all sources of risks (Moore & Giaccio 1986).

Projects go through two main phases: construction and operation, each with different risks and cash flow patterns. For example, during construction, the main risks involve technology and the environment. In the operation phase, risks include market fluctuations and political factors. Meanwhile, most of the project's expenses occur in the construction phase, while revenues start once the project is operational. (Moore & Giaccio, 1986; Esty, 1999; Gatti, 2007; Kong et al., 2008; Bonetti, 2009; Ravis, 2013).

Creditworthiness in a transaction is determined by a combination of contracts, guarantees, and

other factors. These elements work together to make the transaction acceptable to lenders for financing. It is not solely the responsibility of one party but a collaborative effort to establish a credit profile that meets the requirements of lenders. (Ravis,2013).

Valuing a project-financed initiative on a self-standing basis (not considering guarantees in the form of sponsors' assets) calls for a creative approach to the issue of quantifying and managing credit risk (Gatti, 2013 CH.3).

Before a deal is financed, a significant amount of time is typically spent on analyzing and mapping out all the potential risks that the project might face. The focus is on finding solutions to minimize or eliminate the impact of each risk. This process aims to ensure the project's success by addressing and preparing for potential challenges in advance. (Gatti, 2013 CH.3)

There are three basic strategies SPV can put in place to allay the impact of a risk (Gatti, 2013 CH.3):

1) Retain the risk: It is common in a corporate finance setting, because technically speaking, the risk is not idiosyncratic.

2)Transfer the risk by allocating it to one of the key counterparties.

In project finance, a key strategy (cornerstone) is to assign rights and obligations through contracts to the SPV (construction, supply, purchase, O&M) and its counterparties. This helps manage risks effectively, as each party takes responsibility for the risks they can handle best. This approach creates incentives for everyone to stick to the agreements and avoid negative consequences. If a risk is assigned to a third party, they bear the associated costs, protecting the SPV and its lenders. (Esty, 1999; 2002, 2003, Gatti, 2013 CH.3).

3. Transfer the risk to professional agents whose core business is risk management, insurers: as a residual mitigation policy.

The risk analysis used by lenders and investors in the project finance market can be categorized into a three-step process: (1) identifying and assessing risk, (2) allocating the risk, and (3) analyzing and mitigating the unallocated risks (Moore & Giaccio, 1986; Sorge, Esty, 1999; 2004; Gatti, 2007, Bonetti, 2009; Ravis, 2013).

4.1 Risk Identification and Assessments

Scholars nearly provide similar categorized project risks, mainly separating risk chronologically and addressing common risk applicable in whole project life in one or two different categories.

The identification of risks is essential in an analysis of a project financing because of the nonrecourse nature of the project debt and contractual undertakings of the project owner. An

exhaustive list of potential risks (Hoffman, 1989).

Hoffman (1989) comes up with nine categories of reasons for failed project. the three common causes of project failure occur during the design engineering and construction phases. These include project completion delays and subsequent cash flow delays, increased capital requirements for construction, and the insolvency or lack of experience of contractors or major suppliers.

The remaining six risks typically arise during the project's start-up and operating stages. These risks involve technological changes, legal changes, uninsured losses, shifts in resource availability, shifts in demand or output prices, and negligence.

However, it's important to note that the mere presence of these risks doesn't automatically result in project failure, especially when projects are conducted on a nonrecourse basis. The author also emphasizes the significance of selecting credit enhancement measures and implementing monitoring systems to mitigate these risks.

Estys (1999) highlights the value generated by project finance through its positive impact on risk management. Risk management involves the crucial activities of identifying, evaluating, and allocating risks to achieve cost reduction and appropriate incentives. Typically, project sponsors work alongside their financial advisors to identify project risks and assess their severity. To enhance the credibility of the risk management process, independent experts are involved in verifying key assumptions. Esty further simplifies risk analysis by categorizing risks into four general groups: pre-completion risks, operating risks, sovereign risks, and financing risks. A comprehensive risk management matrix, exemplified in Table 1Table 1: Project Finance Risk Management Matrix, Esty (1999), aids in the identification of risks and the determination of responsible parties within project deals.

Table 1: Project Finance Risk Management Matrix, Esty (1999)

Stage and Type of Risk	Description of the Generic Risk	Who Bears the Risk in This Case
PRE-COMPLETION RISKS		
Resource Risk	Inputs are not available in the quantity and quality expected	Sponsors (suppliers)
Force Majeure	"Acts of God" such as earthquakes or political risks such as war, terrorism, or strikes affect completion	3rd party insurers
Technological Risk	The technology does not yield the expected output	Sponsors (contractors)
Timing or Delay Risk	Construction falls behind schedule or is never completed	Sponsors (contractors)
Completion Risk	The combination of technological and timing risks.	Sponsors (contractors)

OPERATING RISKS (POST-COMPLETION)		
Supply or Input Risk	Raw materials are not available in the quality or quantity expected?	Sponsors (suppliers)
Throughput Risk	Ouput quantities are too low or costs are too high.	Sponsors
Force Majeure	See above	3rd party insurers or Sponsors
Environmental Risks	The project fails to comply with national and international environmental regulations	Sponsors
Market Risk: quantity	There is insufficient demand for the output	Conoco (off-taker)
Market Risk: price	Output prices decline	Sponsors (creditors)
SOVEREIGN RISKS		
Macroeconomic Risks		
1) Exchange Rates	Changes in exchange rates reduce cash flows	Sponsors Venezuelan government
2) Currency Convertibility	Inability to convert and repatriate foreign currency proceeds	Sponsors Venezuelan government
3) Inflation	Nominal contracts become vulnerable to price changes.	Sponsors Venezuelan government
Political and Legal Risks		
1) Expropriation	Government seizes the assets or cash flows directly or indirectly through taxes	Sponsors Venezuelan government
2) Diversion:	The government redirects project output or cash flows	Sponsors Venezuelan government
3) Changing Legal Rules	The government changes legal rules regarding contract enforceability, bankruptcy, etc.	Sponsors Venezuelan government
FINANCIAL RISKS		
Funding Risk	The project cannot raise the necessary funds at economical rates	Sponsors/Creditors
Interest-rate Risk	Increasing interest rates reduce cash flows	Sponsors/Creditors
Debt Service Risk	The project is unable to service its debt obligations for any reason	Sponsors/Creditors

Ravis (2013) suggests six important steps for assessing project-level risk:

Review the project's contracts and physical infrastructure that form its foundation.

Evaluate the technology, construction, and operations of the project for potential risks.

Analyze the project's competitive position in the market it operates in.

Assess the risks associated with suppliers and customers involved in the project.

Examine the project's legal structure for any legal risks or vulnerabilities.

Evaluate the cash flow and financial risks that could affect the project's expected outcomes.

By following these steps, project evaluators can gain a better understanding of the risks involved and make informed decisions to manage and mitigate those risks effectively.

The last categorization is provided by Gatti (2007), Bonetti (2009), and Gatti (2013 CH.3) which shows in Figure 9 based on the phases of project that the specific risk can happen. The third category in Figure 9 is included Political and Legal risk; Macro Risk: including Foreign Exchange Risk, Interest Rate Risk and Inflation Risk; and credit/counterparty risk.

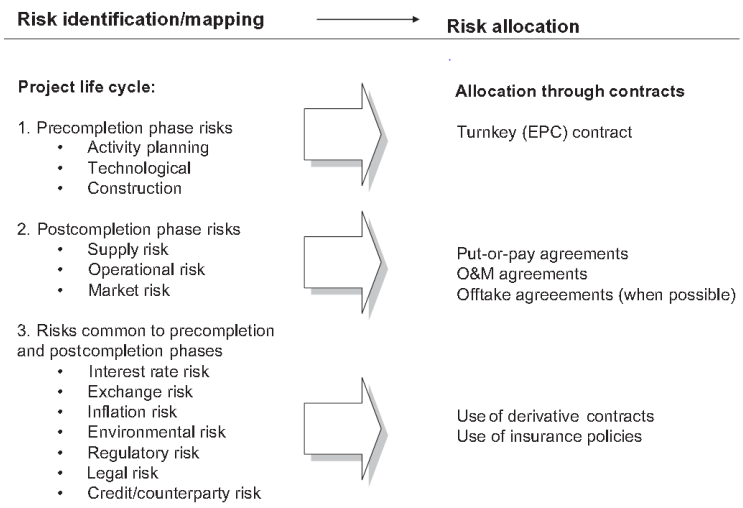


Figure 9: Classification of risks and a suggestive strategy for risk allocation (Gatti, 2013 p44)

Several risks encountered by project financing is similar to or expanded formulations of those found in domestic project financing, as noted by Moore & Giaccio (1986). The project can be divided into two distinct phases: the construction phase and the operating phase (Moore & Giaccio, 1986). Each phase entails different risks that must be identified and allocated among the involved parties from the outset (Moore & Giaccio, 1986). Challenges arise in documenting risk allocation when debt providers aim to assign risk to equity participants while retaining unrestricted rights to the collateral. During the construction phase, lenders face risks associated with political and technological factors. Since there is no cash flow available for repayment at this stage, lenders bear the highest risk of losing both principal and interest if the project remains incomplete, experiences delays, or incurs substantial cost increases due to regulatory changes (Moore & Giaccio, 1986).

It is important for project sponsors to perceive how the lender views risk (Ravis, 2013). Risk from the perspective of a project financier is an event or outcome that impacts the project's ability to remain current on debt service (Ravis, 2013). There are diverse risk analysis frameworks available to evaluate a project finance transaction (Ravis, 2013). Each of the three leading credit rating agencies[2] has published the criteria they utilize in their risk analysis used to rate project finance credits (Ravis, 2013).

Part of this process involves grading the based on two dimensions: the probability of the risk materializing and, the degree of impact that the risk would have on the prospects of the project

[2] Standard & Poor's (S&P), Moody's, and Fitch

(Ravis, 2013). These phases have very distinct risk profiles and impact the future outcome of Project in different ways (Sorge, 2004; Gatti, 2013; Ravis, 2013). There is a third category of risk which exists in both phases, including Sovereign risks, legal risks, financial risks, and macro-economic risks (Esty1999, Gatti, 2007). In keeping with the chosen criterion, the risks to allocate and to cover are: 1) Pre -completion phase risks, 2) post-completion phase risks, 3) Risks common to both phases (Gatti, 2013 CH.3).

4.1.1 Pre-Completion Risks

Pre-completion risks encompass all the risks encountered until a project successfully completes a thorough set of tests. These risks include resource risks (such as insufficient or substandard key resources), force majeure events, technological risks, and timing risks. Managing these risks effectively is crucial for the successful completion of the project. (Esty,1999).

In the construction phase, the main concern is if the project will be finished and, if so, if it will be done on time and within budget. (Moore & Giaccio 1986).

Force majeure risks encompass events beyond human control, such as earthquakes (Acts of God), as well as political risks like war or terrorism. Acts of God, by their nature, are not influenced by any party involved and are typically covered by third-party insurers with extensive and diversified portfolios (Esty, 1999). The term "force majeure" broadly refers to an event that is outside the control of the party making the claim, including acts of God, fire, flood, earthquakes, war, and strikes. The allocation of risk is subject to negotiation, often considering the party most capable of managing each specific force majeure risk (Hoffman, 1989).

For example, in the *Petrozuata* Project, the sponsors took precautions to deal with political risks. They designed the project with underground pipelines and underwater loading facilities, which made it less vulnerable to disruptions. Additionally, Venezuelan troops were deployed to guard the project during construction, providing protection against potential terrorism. These measures were put in place to address and minimize political risks, ensuring the project's smooth execution. Esty (1999) provides insights into these risk management efforts.

Despite these advantages, debtholders desired some assurance that the project would be finished on time and on budget. To address these concerns, Sponsors might promise to pay all project expenses, including any unexpected cost overruns, before the project is completed. The completion guarantees that the sponsors will assume any remaining completion risk. The allocation makes sense when the sponsors are the general contractors. (Esty, 1999).

Planning Risk

Grid analytic approaches (the critical path method [CPM] and the project evaluation and review technique [PERT]), aided by software, allow project activities to be timed (Gantt chart). In fact, the Planning risk is that the structure on which the SPV relies to produce cash flows during the operations phase may not be accessible. This is referred to as planning risk (Gatti, 2013 CH.3).

Technological Risk

In the context of project financing, technology is a crucial risk that might adversely impact project execution. A technological risk refers to the possibility of the project not working as anticipated (Esty, 1999). To mitigate this risk, project sponsors typically adopt a strategy of incorporating more proven and tested technologies.

The concept of technology risk can be further analyzed as a binary risk. It highlights a critical aspect of project financing - the risk of technology failure which might render an asset worthless, thus escalating the overall project risk (Esty, 2002).

Project financing often shies away from involving new technologies, especially without any form of credit enhancement to safeguard against the risk of the technology underperforming. Unproven technologies tend to be unpredictable, constituting an unstable foundation for project financing (Hoffman, 1989). Nevertheless, modern technologies can be incorporated into project financing, given there exists an assurance of technological performance from the participant who either owns or licenses the technology, such as the equipment supplier or contractor (Hoffman, 1989).

As Hoffman explains, the dilemma for project finance participants lies in the potential profitability of new technologies versus their unpredictability and the associated risk. Therefore, despite the possible profitability, the involvement of new technologies in project financing remains uncommon without the support of credit enhancement (Hoffman, 1989).

In some sectors where project finance is implemented, the construction process may necessitate the use of technologies that are innovative or not completely understood. Under typical circumstances, the contractor decides on the most appropriate technology, usually opting for tried and tested ones. However, problems can arise when the technology choice is influenced by other sponsors, separating the contractor from the technology supplier, and leading to technological risk (Gatti, 2013 CH.3).

The complexities and unknown variables surrounding technological risk make it difficult for a project finance venture to base its structure on unproven or unfamiliar technology. Technological risk necessitates a level of managerial flexibility, contradicting the very essence

of project finance, which aims to anticipate every potential future event in order to limit managerial behavior and prevent misuse of project funds (Gatti, 2013 CH.3).

4.1.2 Construction Risk or Completion Risk

One other notable risk factor in project finance is construction risk, often referred to as completion risk. According to Gatti (2013 CH.3), this risk is a pivotal factor and entails scenarios of non-completion or delayed completion due to unforeseen circumstances, cost overruns, performance deficiencies, or the requirement for technical design changes. In most scenarios, the SPV or its lenders seldom bear the construction risk. Instead, the contractor or the project sponsors should bear this risk (Gatti, 2013, CH.3).

To gain a clearer perspective on construction risk, Hoffman (1989) explains that typical construction risks encompass changes in the work contemplated within the construction price. These changes could be technical design refinements, price changes due to currency fluctuations or inflation, construction delays, material shortages, design changes mandated by law, and labor disputes. Furthermore, the risk of unavailability of building materials, often underestimated, can significantly impact project economics. Factors such as the time and cost to manufacture or transport materials, coupled with the implications of import and export laws, can profoundly affect the project. Moreover, pre-existing conditions at the project site, such as hazardous waste issues, may pose a risk that affects both construction and long-term operations (Hoffman, 1989).

To mitigate this type of risk, Moore & Giacco (1986) propose several measures. They suggest that prior to lender involvement, project feasibility studies and necessary permits are required to assess feasibility risks. These include factors like availability and cost of raw materials throughout the project lifespan, potential changes in laws governing the project, and market conditions for the project output. Technological risk could also pose substantial credit challenges if the project, despite being completed on time and within budget, fails to start or achieve its designed capacity (Moore & Giacco, 1986).

Despite these risks, debtholders typically demand guarantees that the project will be completed on time and within budget. To alleviate these concerns, sponsors may offer to cover unexpected project expenses, including cost overruns, prior to completion. This completion guarantee ensures that sponsors bear the residual completion risk, which is a sensible arrangement when sponsors also act as general contractors (Esty, 1999).

A significant risk in project financing is the escalation of construction costs, whereby the

project cost surpasses available funding from construction loans, other debt sources, and equity. Possible causes include inaccurate engineering plans, inflation, and project-related issues (Hoffman, 1989).

A delay in project completion poses another significant risk, as it could lead to increased construction and debt service costs. Such a delay could disrupt the scheduled flow of project revenues needed for service, operations, and maintenance expenses. Moreover, such delays may result in damage payments under project contracts or even lead to the termination of contracts, such as fuel supply and output contracts (Hoffman, 1989).

Operating or Post-Completion Phase Risks

The most critical risk-shifting phase of a project finance is project start-up because achievement of performance assurances through performance testing indicates the end of the contractor risk period and the shifting the risk to the operator and the project owner. Lenders and sponsors demand the contractor to give evidence that the project is capable of functioning at the level of performance required to service debt and pay operational expenditures at the start-up stage. (Hoffman,1989).

The project cash flow's ability to cover the loan becomes the key risk once the project has passed the construction stage. The operational phase is far longer than the construction phase, which increases economic risks. Political threats such as expropriation and civil unrest are clear. More subtle dangers of expropriation include taxation, ownership, or management regulation, and import or export restrictions (Moore & Giaccio, 1986).

After completion phase finished, operational risks arise, such as whether the project operates as anticipated, if it is efficient, and whether the raw material costs, as well as the price and size of the output market, meet the initial forecasts (Moore & Giaccio 1986).

The main risks in the post-completion phase are the supply of input, the plant's performance in comparison to project standards, and the sale of the product or service. The operating risk (or performance risk) occurs when the facility operates but performs poorly in post-completion testing. (Gatti, 2003, CH 3).

Once a project has passed its completion tests, input, throughput, environmental, and output risks become relevant. Shortages or price rises in crucial raw commodities are examples of input or supply risk. (Esty, 1999). Daily operations are thus subject to throughput and environmental risks if sufficient input is provided. Finally, there is the danger that product demand or price would collapse. (Esty ,1999).

The major risks in the post-completion phase involve the supply of input, the performance of

the plant as compared to project standards, and the sale of the product or service (Esty, 1999).

Supply risk

Utilities and raw material supply: Like the function of construction material supply dependability in production income, the project must be assured of a supply of raw materials and utilities at a cost within acceptable financial ranges (Hoffman,1989).

Operator Experience: The facility's efficient and dependable functioning is critical to the project's long-term success. The entity running the project, often under a long-term operating agreement, must have enough experience and reputation to run the project at the levels required to create cash flow at the expected levels. Similarly, the operator must have the financial means to sustain operating guarantees and other operating agreement responsibilities. (Hoffman,1989).

General Operating Expenses: Excessive operating expenses are another risk to the project. These inaccuracies are caused by flaws in design engineering, excessive equipment re-positioning and unscheduled maintenance, low labor productivity, erroneous assumptions about the labor force required to operate, and other operational issues. (Hoffman, 1989)

Management Experience: Likewise, the project sponsor must have the necessary experience to oversee the project in areas other than project operation. Day-to-day project decisions, such as project debt payments, are critical to the project's success or failure. As a result, management's employees, resources, reputation, and experience must be sufficient to address those tasks. (Hoffman 1989).

Market Risk

Market Risk can be divided into demand risk and price risk. Through an off-take arrangement insured by a creditworthy off-taker, the project firm accepted the demand risk. The fourth option is to bear this risk with the sponsors, which they consented to do due to a number of mitigating variables (Esty 1999).

Besides, there was a potential of renegotiation after agreements were made with a sole buyer as off-taker. Such circumstances were limited by the fact that the figures provided in the contract were in accordance with market pricing; this fact reduced the chance that the off-taker would request a price modification. However, with a single buyer, difficulties with counterparty risk remained. According to the financial markets, this risk would have a significant impact on the Project's financial cost. Many project financings are based on long-term, and-pay contracts in which one or more buyers agree to accept project production at a

fixed or predictable price (Hoffman ,1989).

As a result, if the purchaser's credit is acceptable, a market for the goods exists, and the flow to the project is guaranteed if the project functions. Nonetheless, product risk is eliminated simply by executing a long-term take-and-pay contract. Market rivalry with other producers, new technologies, changing demand, increasing operating costs, increased production costs, changes in purchaser, and other factors can all combine to reduce the value of the take-and-pay contract to the project (Hoffman, 1989).

4.2 Risks Found in Both the Pre- and Post-completion Phases

Throughout both phases, tax and regulatory issues in the jurisdictions of both the project and the sponsors influence the project (Moore & Giaccio ,1986).

4.2.1 Sovereign Risk, Political Risk and Country Risk

While mitigating completion and operating risks is important, project finance is the most valuable instrumental tool for diminishing sovereign risks (Esty, 1999). Indeed, it is the one attribute that conventional corporate finance plans cannot imitate. Although the agreement had various provisions to limit sovereign risks, one of the most important provisions was the decision to keep revenues out of the country (Esty, 1999). A company can decrease the collateral damage caused by a bad investment and manage sovereign risks more effectively by investing through a projectable company rather than using its own balance sheet (Esty,2002).

Political Risk

Political risk is classified into three categories: investment risks (local currency convertibility and availability and convertibility, export restrictions, expropriation of the project by the local government, wars, revolutions, and civil unrest (also known as political force majeure); change of law risks; and quasi-political risks due to local government interferences in project management or construction (Yescombe, 2002; Hainz & Kleimeier, 2006). Political risk, according to Standard and Poor's (2004) and Mariani (2008), normally limits project ratings, with the exception of circumstances when the project is regarded strategically vital to the government 2009 (Bonetti).

The project structure itself provides advantages in sovereign risk mitigation that corporate finance arrangements do not come up with (Esty, 1999). Projects are vulnerable to adverse sovereign acts, including partial acts of expropriation such as increased royalty rates, because they are highly indebted, non-recourse enterprises. The goal is to organize the project so that such activities result in default, losses for creditors, and a severe fall in project value. The use of heavy debt also ensures that the company has little cash to attract undue attention. Finally,

the project structure permits participation by local governments, local financial institutions, multilateral organizations such as the International Finance Corporation (IFC), and bilateral agencies such as the United States Export-Import Bank (Esty, 1999).

Political risks in international financing are more acute than in domestic project financing, and the choice of law applicable to all aspects of the project is international in scope (Moore & Giaccio 1986). If the project is located outside of the country, the political climate of the host country must be thoroughly examined to determine the host country's attitudes toward foreign investment (Hoffman, 1989). According to Kobrin (1982) and Minor (1994), governments are more inclined to expropriate international investors than domestic investors (Fotak et al., 2019). The choice of applicable law is discussed in Chapter 3 of this thesis.

According to Sorge (2004), Hainz and Kleimeier (2003) define three main forms of "political risk." The hazards of expropriation, monetary convertibility and transferability, and political violence, including war, sabotage, or terrorism, are included in the first category. The second category includes the risk of unanticipated regulatory changes or the government's refusal to implement tariff revisions due to political reasons. The third group covers quasi-commercial risks that arise when the project is dealing with state-owned suppliers or customers whose ability or willingness to fulfil contractual obligations to the project is in doubt.

In following, we spend some more time on expropriation and the BITs effect on loan price. This session is based on the Fotak et al., (2019) work.

The research by Fotak et al. (2019) supports the idea that Bilateral Investment Treaties (BITs) play a crucial role in reducing political risk and lowering loan costs for foreign investors. These treaties provide a way for foreign investors to seek compensation in case of unfavourable events, discouraging governments from seizing assets. When expropriation does occur, BITs ensure that investors receive better compensation. Additionally, governments can effectively manage property rights risk by allowing foreign courts to handle disputes through BITs. Remarkably, around one-quarter of international lending and foreign direct investment now benefit from BIT protection. This highlights the significant impact and widespread usage of BITs in safeguarding international investments.

Fotak et al. (2019) explain Hainz and Kleimeier (2012) find that loans in high-political-risk countries are more likely to encourage the involvement the development banks and to be structured as “project finance” contracts. Moreover, Hainz & Kleimeier (2008) surprisingly find out that banks grant more PFLs to borrowers in riskier countries.

Girardone & Snaith (2011) provide evidence that the quality of a country's legal and institutional systems impacts loan spreads. Stronger legal systems lead to lower loan spreads,

meaning better borrowing costs for investors. Additionally, loan spreads are higher in countries with less government stability and democratic accountability, indicating increased borrowing costs due to perceived risks. (Girardone & Snaith, 2011).

Fotak et al. (2019) suggest that the risk of government taking over assets is priced in loan contracts and affects loan terms. Unlike weak creditor rights, which lead to larger loan groups for risk diversification, the risk of expropriation is associated with smaller loan groups due to concentrated ownership acting as a deterrent. Stulz (2005) supports the idea that concentrated ownership reduces the likelihood of government expropriations.

According to Fotak et al. (2019), how well property rights protect against government seizing assets has a significant impact on loan agreements. When property rights are strong, thanks to agreements like Bilateral Investment Treaties (BITs), loans have lower interest rates, larger amounts, more lenders involved, and borrowers do not need to offer as much collateral.

The study also found that when governments take over assets, it affects the long-term cost of borrowing from foreign markets. However, if governments agree to be bound by foreign courts through BITs, the negative effects of expropriation can be reduced. These findings show that property rights play a unique role in loan contracts, separate from other rules and institutions (Fotak et al., 2019).

According to Gatti (2013, CH.3) political risk can manifest in different ways, and one such form is the instability of the government, which can be crucial for certain projects. For instance, if there is a change in administration, the SPV associated with a project could be adversely affected if the new government has different perspectives than the previous one. Moreover, citizens can reshape their national context through referendums, as exemplified by an antinuclear referendum, highlighting the broad potential scope of political risk.

Here is a commonly accepted classification of several types of political risk:

Investment risks: relate to limitations on the convertibility or transfer of currency abroad.

Change-in-law risks: include any modification in legislation that can hinder project operations.

Quasi-political risks: This category encompasses a wide range of different circumstances.

Political risks are a major concern for lenders in project finance ventures, especially in developing countries where the economy heavily relies on revenues from natural resource exploitation. This becomes even more significant when these projects are funded during periods of rising raw material prices.

To mitigate these risks, there are two approaches that can be taken. The first involves establishing an agreement with the host country's government, ensuring a favorable or non-discriminatory environment for the project sponsors and the SPV. This agreement, known as a

government support agreement, can include provisions with the following goals:

Providing guarantees on key contracts: The government assures that important counterparties, such as off takers or input suppliers, will fulfill their obligations.

Creating conditions to prevent currency crises: Measures are put in place to avoid adverse effects on the convertibility of debt service and the repatriation of dividends. For instance, the host country may establish special currency reserves through its central bank.

Facilitating the SPV's operational capacity from a fiscal standpoint: This involves offering tax relief or exemptions to enhance the efficiency of the project's financial operations.

Creating favorable institutional conditions: Measures such as customs duty exemptions for importation, streamlined bureaucratic processes, provision of services for the SPV, concessions for using public lands, or accepting international arbitration outside the host country for resolving legal disputes can be implemented.

By incorporating these provisions, lenders aim to safeguard against potential political risks, ensuring a more stable and supportive environment for the project's success.

Another method to protect against political risks is by utilizing the insurance market. Insurance policies are available that provide full or partial coverage against such risks. These policies can be obtained from multilateral development banks, export credit agencies and private insurance companies (Gatti, 2013 CH.3).

Gatti (2013 CH.3), also, considers a type of risk which is associated with any potential adverse impacts that the building project may impose on the surrounding environment. Furthermore, self-regulation within the project finance business has been increasing due to voluntary adoption of the Equator Principles (EPs) (refer to www.equator-principles.com; Esty and Sesia, 2010). Expenditures required to mitigate environmental damage can reduce returns, although it is important to note that most social and environmental risks are not directly accounted for in pricing (Esty, 2002)."

As elucidated in Gatti (2013, CH.3), regulatory risk encompasses various aspects, typically involving the following scenarios:

• There are delays or cancellations in acquiring the necessary permits to launch the project.

• The fundamental concessions for the project undergo unexpected renegotiation.

• The central concession for the project is revoked.

Typically, these delays may be attributed to inefficiencies in public administration or intricate bureaucratic procedures. However, if such delays stem from a specific political intent to impede the initiative, these circumstances align more closely with political risk.

Permits and Licenses

The risk that a project lacks, or might fail to acquire, the necessary permits for construction or operation are a substantial concern for all project participants (Hoffman, 1989). Generally, permits for the project should be attainable without unreasonable delay or effort. As mentioned above, this type of risk may contribute to the increase of the other risk factors such as the issues regarding the "*Regulatory risk*".

Legal Risk

The other risk factor that is discussed by Gatti (2013 CH3), is the Legal risk, which primarily affects the project's lenders, who employ legal counsel to analyze and manage this risk. The focus in the analysis of this risk is on verifying whether the host country's commercial law ensures contract enforceability should complications arise during the construction or post-completion phases. Various research organizations compile indices that measure the degree of corruption and reliability of a country's political and administrative institutions. Legal risk can be mitigated and addressed through careful contract drafting. Inviting legal representation from the initial phase of a venture is crucial. The support of the host government is also of paramount importance.

Change of Law

The concept of 'Change of Law' risk is predicated on the possibility that a governmental institution might introduce, amend, repeal, or interpret laws or regulations differently, thereby impacting a given project. Such risk is not merely limited to legislative alterations but can also be derived from judicial decisions that are detrimental to the project (Hoffman, 1989).

Interplay Between Legal Risk and Debt Ownership Structure: A noteworthy dimension of legal risk pertains to its correlation with debt ownership structure. Observably, debt ownership concentration in tranches is substantial; the predominant single bank typically maintains 20.3% ownership of a tranche, while the leading five banks collectively possess 61.2%. In regions marked by robust creditor rights and reliable legal enforcement, lenders often establish smaller, highly concentrated syndicates. This strategy facilitates diligent monitoring and efficient contracting. However, when legal enforcement mechanisms fall short in safeguarding lenders' claims, they resort to forming larger, more dispersed syndicates as a strategic countermeasure against potential default (Esty & Megginson, 2003).

4.2.2 Financial Risks

Esty (1999) identifies three primary financial risks: interest rate risk, funding risk, and credit risk. Approaches like employing fixed-rate bonds or bank loans with interest rate swaps are

used to tackle interest-rate risk. The objective is to shift the interest-rate risk to insurance companies and other investment fund managers, who can utilize the fixed-rate bonds to offset long-term liabilities. The advantages of bond finance include fewer covenants, greater economies of scale in issuance, and potentially superior equity returns. However, bonds also have downsides, such as negative arbitrage. Bonds, unlike bank facilities that can be utilized as needed to match construction costs, are issued in lump sum. The interest cost on unused funds invariably exceeds the interest income. A good example of this downside can be seen in the Petrozuata project, in which an approximate estimate of the negative arbitrage cost was reported to be $10 million. The usage of bonds can also lead to diminished monitoring; a large group of well-diversified bondholders are less effective monitors than bankers and may be less effective in reducing sovereign risks (Esty, 1999). In the following sections the main financial risks are analyzed and discussed.

Interest Rate Risk The risk of unrealistic interest rate projections can impact on the ability of the project revenues to service debt, in the places that interest rates change over the term of financing (Hoffman, 1989).

There are usually two ways of charging interest, at a fixed rate at variable rates, and a floating rate. Variable rates usually based on the banks' lending rate or an inter-bank borrowing rate plus a margin. A floating rate is calculated by reference to cost of short-term deposits. The spread or margin is expressed in "basis points". One basis point is one-hundredth of 1%. Inter-bank borrowing rates include LIBOR (London inter-bank borrowing rate), EURIBOR (in the EU) and NIBOR (in New York).

Project finance debt tends to be fixed rate, which provides a foreseeable, or at least somewhat stable, repayment profile over time. So the cost of infrastructure services can be reduced. If lenders are unable to provide fixed rate debt and no project participant is willing to bear the risk, hedging or some other arrangements may need to be implemented to manage the risk.

Self-protection of cash flows is the crucial part the advisors looking for. A rise in interest rates effects debt service value through increasing payouts to lenders. This effect will abate over time (given the same rate variation) due to the progressive reduction in the outstanding debt. In any case, ascertain the capacity of operating cash flows is the main point, which means to verify how these flows move over time. Self-protection of cash flows depends on the underlying connection among variables that move industrial cash flows and interest payable. When this correlation is high and positive, any increase in interest rates is counterbalanced by variables that determine operating cash flows. The project, at least in part, will be "self-immunized" from rate risk. If there is no such correlation, an unexpected increase in the cost

of financing would best be avoided because the project would not easily withstand such a contingency (Gatti, 2013 CH.3).

Nominal rates consist are made up of a real component and a premium requested by investors, aim to protect the purchasing power. Ideally, therefore, the SPV would find itself in a situation where a variation in debt service would be compensated by an increase in revenues. The conditional must be used, however, since inflation can be determined with different parameters in terms of revenues and interest rates. The only risk remaining for the SPV to face would be that the trends in actual interest rates may not be in line with the projections given in the financial model. The ideal strategy, then, would be to draw up a swap contract on the true interest rate or to use contracts that cover inflation risk (Gatti, 2013 CH.3).

Similarly, interest rates charged in project financings are typically higher than on direct loans made to the project sponsor risks that are unique to particular industry (Hoffman, 1989).

4.2.2.1 Exchange Rate Risk

Although financial derivative provides and insurances could and do widely use in Project Finance deal, we emphasize on the "self-standing basis" for risk management using its unique characteristics provided by literatures (Gatti 2013 CH.3). In another word, in the third category of risk in Figure 9, we suggest alternative approaches based on the scholars and practitioners works.

Throughout the life of the project, the relationship of the currencies of the sponsors and the project adds to the international risk (Moore & Giaccio 1986).

Among the salient financial risks featured in literature concerning mostly international collaborations, currency risk has attracted a particular attention. Currency risk, in general, can be characterized as an event in which revenues are generated in a currency different from that of the denominated debt. Under such circumstances, lenders would likely insist that the revenue stream is adjusted to account for potential alterations in the exchange rate or devaluation. Absent this adjustment, lenders would expect to see robust hedging arrangements or other strategies to manage the associated currency exchange risk.

The optimal risk mitigation strategy, where feasible, is currency matching. In this scenario, advisors of a Special Purpose Vehicle (SPV) endeavor to denominate as many transactions as possible in the home currency, thus circumventing the use of foreign currency. However, when this strategy is impracticable (often due to the substantial bargaining power of counterparties), various hedging strategies may be employed. One such strategy is the use of Derivatives Contracts, which are defined by Schwartz & Smith (1993) as tools to manage Interest Rate and

Exchange risks:

• Forward agreements for purchase or sale

• Exchange rate futures

• Exchange rate options

• Currency swaps

Typically, structured finance transactions involve distinct negotiated forms of coverage specifically tailored to the project, or they employ rollover strategies on standard contracts as they near maturity (Gatti, 2013, CH.3). In the remining of this section these strategies are explained.

Forward Contracts:

A forward contract stipulates an exchange with a deferred settlement. Traders delineate contract conditions (specifically, the settlement date and price) upon contract initiation, with the exchange materializing at a future, pre-determined date. In the context of project finance initiatives, forward contracts primarily serve as a hedge against exchange rate risks. One notable challenge is that the forward exchange market maintains significant liquidity only for maturities up to 12 months and is essentially absent for periods exceeding 18 months (Gatti, 2013, CH.3).

Forward Contracts on Interest Rate - The Forward Rate Agreement:

The Forward Rate Agreement (FRA) is one of the most commonly utilized futures predicated on interest rates. In an FRA, the buyer commits to pay the seller interest accrued on a principal at a pre-determined rate, commencing at a future date, for a specific duration. Conversely, the seller pledges to pay a fixed interest rate on the principal based on the interest rate at the future date (Gatti, 2013, CH.3). In project finance arrangements, the SPV may acquire forward rate agreements to stabilize financing costs. However, the FRA market exhibits greater liquidity for maturities considerably shorter than the entire tenure of the loan.

Swaps: Swaps are contracts between two parties stipulating mutual exchange of payment streams at pre-established future dates over a specified duration. For interest rates specified in two different currencies, these are referred to as currency swaps, with the two streams potentially fixed or variable.

Futures: A future is a type of forward agreement wherein all contractual stipulations are standardized, including the underlying asset, maturity date, instrument delivery date, and minimum contract lot.

Options and Interest Rate Options (Caps, Floors, and Collars): Options, whether listed on stock exchanges or negotiated over-the-counter, are contracts granting (but not obligating) the buyer the right to buy (call option) or sell (put option) a commodity or a financial asset at a pre-set price (strike price) on a future date in exchange for a premium. In project finance transactions, options are used for hedging both exchange rate risk and safeguarding an SPV's cash flows from interest rate risk. In the latter scenario, interest rate caps, floors, and collars are routinely employed.

4.2.2.2 Inflation Risk

Another risk factor associated with financial risk is inflation risk. This risk factor, which pertains to macroeconomic factors, typically surfaces when the cost dynamics undergo abrupt acceleration, a development that cannot be correspondingly transferred to revenue growth. This risk is fundamentally rooted in the fact that the majority of contracts between SPVs and their commercial counterparts hinge on mechanisms that revise rates or installments based on the variances of a specific price index.

Inflation risk invariably influences both industrial and financial costs and revenues. The impact of inflation on floating-rate loans serves as a prime exemplification of this effect. Considering the long tenor of relevant loans and the compound effect of the capitalization factor applied to actual cash flows in project finance, this aspect proves to be especially crucial. When costs escalate more rapidly than revenues, the operational cash flows allocated for debt service drastically shrink.

The challenge of mitigating inflation risk intensifies, and the mechanisms for managing it become more complex in ventures involving a public entity as the buyer or when a service is rendered for public use, such as in public transportation.

4.2.2.3 Credit Risk or Counterparty Risk

Gatti (2013 CH.3) distinctly categorizes credit or counterparty risk as the risk associated with parties engaging in contracts with the SPV for various intents and purposes. The creditworthiness of various entities, such as the contractor, the product buyer, the input supplier, and the plant operator, is comprehensively evaluated by lenders through a rigorous due diligence process. The financial stability of the counterparties (or their respective guarantors, if the counterparties are in fact SPVs) is an essential consideration for financiers.

4.3 Risk Allocation with Contracts Stipulated by the SPV

An organized account serves to alert project finance participants to the distribution of risks. The following discourse aims to equip both novice and seasoned project financiers with a well-structured approach to risk identification (Hoffman, 1989). Likewise, it is essential that the contractor, subcontractors, and suppliers possess adequate financial resources to fulfill contractual clauses pertaining to liquidated damage payments, workmanship guarantees, indemnities, and self-insurance obligations (Hoffman, 1989).

However, contracts assigning risk to project stakeholders will inevitably be ambiguous or silent regarding the aftermath of some events that may unfold; or they may prove inadequate if these events transpire. This necessitates the renegotiation of initial contracts, emphasizing the role of financing in risk allocation to augment the project's value and curtail renegotiation costs (Brealey et al., 1996).

Experience and Resources of Contractor: One factor that plays an important role in the risks regarding the project are the contractor, subcontractors, and suppliers' experience, reputation, creditworthiness, soundness and financial robustness which should assure the project's completion on time and within the budget (Hoffman, 1989; Esty, 1999).

The subsequent stage involves assigning the risks to parties best suited to influence or control the outcome. When feasible and economically viable, these risks should be contractually allocated. The same principle applies even when it is prohibitively expensive or unfeasible to draft comprehensive contracts: assign residual risks and returns to the party best capable of influencing the outcome. This alignment of risks and returns amplifies the probability that parties will act in a way that enhances efficiency and risk allocation, particularly of residual risks and returns, setting project finance apart from corporate finance. This section aims to analyze how sponsors allocated both contractual and residual risks in a project deal (Esty, 1999).

On the lenders' side, they need to scrutinize how and to what degree the risks identified in the initial step have been distributed among other parties. A core principle in a well-structured project is that risks are assigned to the party best capable of managing the risk (Ravis, 2013). As lenders analyze the output from the initial step, they ask: Can the risk be assigned? Has the risk been assigned? Who has assumed the risk? Are they creditworthy? And how has the risk been assigned? (Ravis, 2013).

The relation of the PF and the risk allocation can be analyzed in the definition of Project financing that is commonly referred to as "contract-based financing." In this regard the risk

allocation, stemming from the network of contracts between the project and other participants, is a key factor in making the project bankable. There are several frequently used mechanisms for distributing risks among various entities in a project financing, the main one being the contract set between the project and other project participants (Ravis, 2013).

The effective distribution of risk, pivotal for making a project bankable, also contributes to the complexity and high transaction costs associated with project financings. Even though a contract may effectively alleviate an original risk, it may introduce a new risk, such as exposure to a utility as the off-taker or to a surety bond provider backing the EPC contractor. This new risk warrants evaluation. Furthermore, an assessment of the interconnectivity of various contracts is necessary, as the project may still be vulnerable to risk if the terms across multiple contracts are not synchronized (Ravis, 2013).

In the realm of risk management, risk is simultaneously identified and allocated to the parties involved in the transaction whenever feasible (Gatti, 2013). To verify that all risks are aptly assigned to various stakeholders, lenders conduct an exhaustive review of the contract network with the SPV. Usually, by the time lenders are approached for funds, the SPV has already established risk allocation through a sequence of preliminary contracts and has insured the residual risk (Gatti, 2013 CH.3). In the following sections, different types of risk allocation have been explored, and the project finance answers to them are presented.

4.3.1 Allocation of Construction Risk: The Turnkey Enginering, Procurement, and Construction (EPC) Agreement

To mitigate pre-completion risk, the prevalent method is the deployment of a fixed-price, date-certain engineering, procurement, and construction (EPC) contract supported by performance guarantees and liquidated damages. Offtake agreements such as "take and pay contracts" can mitigate price risk and market or demand risk, albeit introducing exposure to the creditworthiness of the off-taker (the utility) as well as the legal and regulatory framework environment. While the risk remains with the project, another party now bears that risk (Ravis, 2013).

A turnkey agreement, also known as an EPC (engineering, procurement, and construction) contract, is a construction contract where the SPV transfers the construction risk of the structure to the contractor. In return for a set fee, the contractor guarantees the SPV the completion date, the cost of the works, plant performance, and a warranty period (Gatti, 2013, Ch.3).

4.3.2 Allocation of Technological Risk

Technological risk is challenging to transfer to third parties, particularly if the project's base license is extremely innovative. The options include seeking independent technical advisors' opinion on the technology's effectiveness, obliging the technology supplier to pay penalties (either in a lump sum or proportional to the patent value of the technology), and obliging the contractor to provide performance guarantees on the technology incorporated in the construction contract (Gatti, 2013, CH.3).

When the technology is absolutely new, no wrapping is possible. No contractor, no matter how reliable, would be able to offer such a broad guarantee to the SPV. In these cases, the venture can be financed only if the sponsors guarantee total recourse to lenders during the construction phase. Such recourse is eliminated only if the plant proves functional once construction is complete.

4.3.3 Allocation of Supply Risk: Put-or-pay Agreements

A compelling illustration of risk transfer from the project company to the feedstock supplier can be seen in a petrochemical project's feedstock agreement. The supply agreement's pricing provisions required the supplier to discount the feedstock price if the project needed the discount to meet debt service (Ravis, 2013). To limit or eliminate supply risk, contracts for unconditional supply (put-or-pay agreements or throughput agreements) are drafted. If supply is lacking, usually the supplier is required to compensate for the higher cost incurred by finding another source of input (Gatti, 2013, CH.3).

4.3.4 Allocation of Operational Risk: Operation and Maintenance Agreements

Operations and maintenance contracts serve as another mechanism to transfer post-completion risk away from the project. In wind projects, turbine suppliers offer a long-term fixed-price contract for operations and maintenance services, which includes a guarantee of availability and a long-term warranty on the turbines (Ravis, 2013). Operating risk can be mitigated by the project operator's experience and reputation. As a supplementary guarantee, lenders also request a step-in right, which is the option to remove the original operator and substitute that company with another of the lender’s choosing (Gatti, 2013, Ch.3).

4.3.5 Allocation of Market Risk

Market risk coverage in project finance is crucial. This is because a reduction or elimination of market risk allows the SPV to lock in the first line of cash flows or to reduce its volatility. Minor remedies can be put in place by sponsors, such as conducting sensitivity analyses to estimate users’ reactions to a (potentially substantial) fee reduction or attempting to limit

demand fluctuations by drawing up contracts that ensure minimum use of the structure. In some infrastructure projects with retail users, the public administration can act as a wholesale buyer (Gatti, 2013, CH.3).

4.3.6 Allocation of Risk through Offtake Agreements

When the SPV sells goods or services to a single large counterparty, offtake agreements serve as a powerful tool for structuring a project finance transaction. These long-term contracts in which one counterparty commits to delivering certain volumes/quantities of a good or service, by mitigating market risk, decrease the volatility of future cash flows from operations (Gatti, 2013, CH.3).

4.3.7 Allocation of Macro-risks

Macro Risks as pointed in the previous section is usually resulting from fluctuations in exchange rates, interest rates. The risks related to inflation can be mitigated through hedging contracts, involving the stipulation of interest rate or currency swaps, caps, collars, or floors. Explicit agreements can also be drawn up between parties to allocate such risks (Bonetti, 2009)."

In conclusion to this discourse, the following graph as per (Gatti, 2013, CH.3), provides an approximate depiction of all the previously discussed risks and their associated sectors. Through a horizontal analysis, one can assess the extent of each participant's contribution towards the mitigation of risks assumed by the SPV. Alternatively, a vertical review can validate the identification and coverage adequacy of each of these risks.

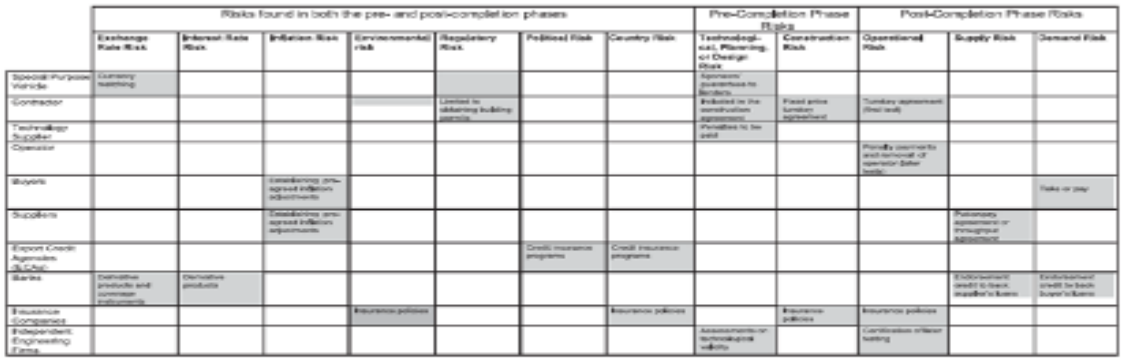


Figure 10 Risk/Participant matrix for PF deal – Source: Gatti 2013: Ch.3

The allocation principle in Project Finance concept, utilizing this graph is straightforward yet insightful: A higher frequency of intersections between actors and risks where the SPV is not implicated translates to a diminished project riskiness for the SPV's lenders. This, in turn, implies a potential relaxation in the stringency of loan terms and prerequisites.

4.4 Analyzing and Mitigating the Unallocated Risk

Not accounting for the risks that remain within the project can lead to tremendous consequences. Without mitigated, unallocated risks can cause the following consequences, which can lead to financial default with the loss of equity value, the project can become insolvent, the lender's rights may be enforced over the collateral, some key project agreements such as the offtake agreement /concession/ the project may be forced to renegotiate the terms of the financing. Some risks cannot be explicitly addressed in the nexus of contracts, comprised of the off-take agreement and debt contract (covenant), is ultimately borne by investors (Dailami & Hauswald, 1999). Minimize the default potential of the project in this step is for avoiding these outcomes (Ravis, 2013).

Now that the risks have been identified, meanwhile, the risks have been allocated to other creditworthy parties as much as possible and what is left in the project is the risks which have not been transferred to another party. The remaining step in the process focuses on overmining the project's ability to absorb those remaining risks. Which means should those risks arise, is the project able to remain current on its obligations (Cited)

Aiming to evaluate an opportunity, several sensitivity cases and scenarios based on the risks identified earlier will developed by the lender, and the project's strengths and weaknesses in light of its ability to remain current on its debt service will be assessed. The first analysis tests the sensitivity of the project's cash flow to changes in a single variable, such as inflation, capacity factor, operating expense, fuel cost, or another factor. The second set of analyses combines a few variables and their values into a scenario to test the project's cash flow generation capability. For example, combining decreased generation with higher operations costs and higher inflation (Cited).

It is equally important to the lender's evaluation that analyze the break-even. It tests how far the values for critical variables can change before impacting the ability of the project to pay debt service on a current basis. Finally, in some cases, a Monte Carlo simulation will be used by the lenders to assess the cash flow generation profile of the project (Cited).

During the creation of the various cases that form the sensitivity and scenario analysis, input independent engineer (IE) will be relayed on by the lender. The IE does the work of evaluating the technical parts of a project and serves as the technical consultant to the lender in the process of the evaluation (Cited).

The metrics resulting from the stress analysis that the lender focuses on are primarily the

average debt service coverage ratio (DSCR) and the minimum DSCR. The primary indicator of a project's strength from a financial perspective is average DSCR The minimum DSCR when compared to average DSCR provides a measure of the project's stability over time and is a useful tool in structuring reserves, dividend blockers, and covenants (Cited).

Other metrics that the lender is concerned with usually include a loan life coverage ratio (LLCR) and the project life coverage ratio (PLCR). The LLCR measures the present value of future cash flow available for debt service over the scheduled term of the financing to the outstanding debt and provides an indication of the total capacity of the project to retire the debt over the term of the loan. On the other hand, what the PLCR measures is the present value of cash available for debt service against the outstanding debt over the entire project life, which can be the term of either the offtake agreement or the concession (Cited).

The financing package that the lender trusts results in a bankable project is the outcome. These elements of the package include the capital structure (level of equity) as well as the parameters of the debt financing terms (amortization profile, dividend lock-ups, sweeps and prepayments, reserve requirements, the target debt service coverage ratio, interest rates, fees, and other features) (Cited).

4.4.1 Credit enhancements

Credit enhancements are tools used by the lender to mitigate exposure to the unallocated risks. These enhancements consist of covenants, reserves, and prepayment provisions. A cash trap and sweep are one of the credit-enhancement mechanism. If the actual DSCR falls below a minimum unfavorable level, any cash remaining after the payment of debt service iis held within the project instead of being distributed to equity. The notion is that there has been degradation from expected performance, and as equity should first bear that risk, it is not entitled to a distribution until the project's performance improves (Cited).

The aim of using this mechanism is to protect the credit by "right-sizing" the debt and serving to reduce the debt load on the project with the notion that the project will be able to support a lower amount of debt (Cited).

During the operations period, the project that the lender is reviewing has no performance guarantee. Based on advises and results from the technical consultant, the lender is concerned that a decrease in performance over the long term may put downward pressure on the cash flow (Cited). Working with the technical consultant, the lender has developed several options to allay this risk. First, a major maintenance reserve will be built by the lender to fund the costs of improvements, which is necessary to rectify the reduction in performance. Second, the

lender will prefer to set the cash trap DSCR at a higher level to provide more cash to prepay the loan. Third, the lender may apply a portion of the cash available after debt service to prepay debt to minimize exposure to long-dated cash flow, even if the project is performing as expected. Fourth, the covenant package may contain some triggers according to decreasing performance. Finally, reviewed the project insurance program to make sure that insurance covers any outages the project may suffer. (Cited).

4.5 Credit analysis / Default

Traditional credit analysis focuses on the company's balance sheet and income statements to determine whether a borrower is generating sufficient cash flow to service its debts. Analyses of the industry, business plan, and management skills collectively provide a gauge on whether sufficient cash flows are likely to persist over the life of the outstanding liabilities, and whether liabilities are likely to expand or contract in the future (Kong et al., 2008). Although models for assessing credit risks have been built by some financial institutions and credit agencies, these models largely target the creditworthiness of an entire firm in general rather than specific projects that may be funded "off-balance sheet" via SPV (Kong et al., 2008).

Default risk is the risk of loss arising from the failure to a counterpart to make a contractual payment (Kong et al., 2008).

Based on Dowd (1998), there are three main components of default risk(Kong et al., 2008):

1. Probability of default: the probability that the counterpart will fail to make a contractual payment.
2. Recovery rate: the proportion of claim that can be recovered if the counterpart defaults; and
3. Credit loss: credit loss or default loss related to the amount the bank or bondholder stands to lose in default.

An upper bound on a confidence interval for the estimated default loss is the maximum default loss It is a measure of default related "*value-at-risk*" (VaR) (Kong et al., 2008). This default-riskiness concept is extremely useful. It can be used to assist borrowers in making decisions, price contracts, allocate capital, etc. Since it estimates the maximum likely loss from the counterparty's default and ignores market risks, it is a natural complement to traditional VaR, which looks at market risks but ignores default-related risks (Kong et al., 2008).

4.5.1 Defining Default for Project Finance Deals

Since Project Finance uses the definitions formulated for corporations or institutions, it needs to identify what default is (Gatti, 2007). To begin to quantify default risk, we need to model the feature cash flows of the project (Cited). With reference to the project cash flows, thereby

default may occur when the cash flows from the project become insufficient to repay the debt service in a pre-defined period (Cited).

Therefore, lenders aim to reduce the risk of default by forcing the SPV to build a debt service reserve account (DSRA) which can cover a pre-defined number of principal and interest repayments, and by linking the possibility to extract cash flows from the project to the maintenance of appropriate levels for ratios such as the debt service cover ratio (DSCR) and loan life cover ratio (LLCR) (Cited).

To see if default occurs, a stepwise analysis is developed (Figure 11). Considering typical cash flow waterfall of projects, the project is defaulting when the generated cash flow from operations (or outstanding debt reserves or stand-by equity or stand-by credit lines) is insufficient to service the debt (Cited).

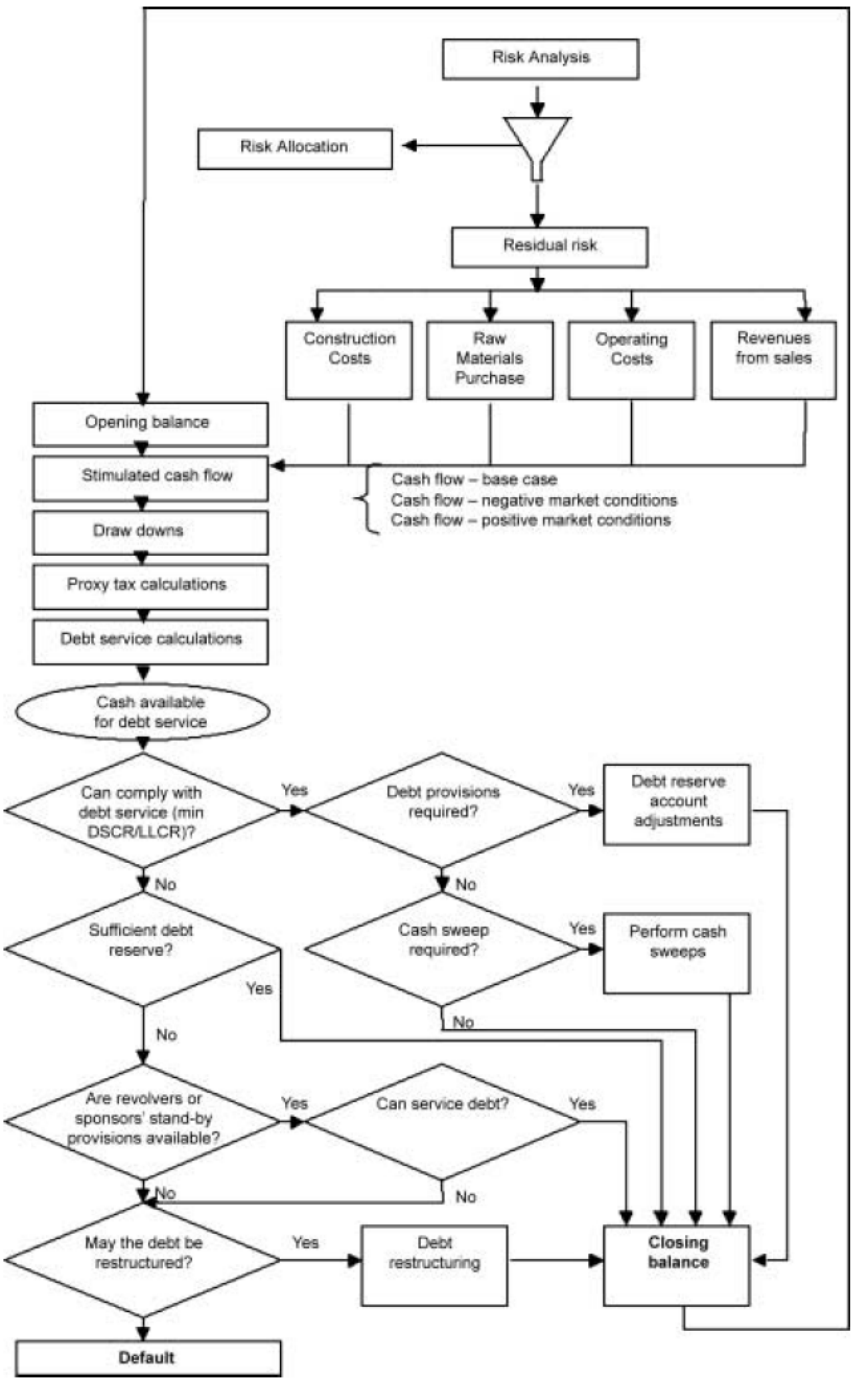


Figure 11: the stepwise approach for the definition of project finance default (Gatti, 2007).

The top part of the Figure 11 shows how through risk analysis some of the risks are allocated to other counterparties, while only residual risk is retained and impacts on costs and revenues Gatti (Cited).

By projecting the cash flows for the SPV, now it is possible to test dynamically whether and when a default condition may occur during the life of the project.

Due to the complex nature of a default event in the case of project finance deals, the simulation has to carefully monitor the values of DSCR, LLCR, and the ratios of EBITDA to senior or total debt. The breach of the pre-agreed minimum levels of these ratios does not necessarily imply default directly, but they can be used as triggers to force the sponsors to act against credit deterioration. (Cited)

The upper segment of Figure 3, as described by Gatti (2007), shows the allocation of risks to counterparties through risk analysis, thereby leaving only residual risk that impacts on costs and revenues. To assess the potential occurrence of a default event during the project's lifespan, the cash flows of the Special Purpose Vehicle (SPV) are projected dynamically.

Given the intricate nature of default events in project finance deals, careful monitoring of key indicators such as Debt Service Coverage Ratio (DSCR), Loan Life Coverage Ratio (LLCR), and Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA) to senior or total debt ratios is crucial. While breaching the predetermined minimum thresholds of these ratios does not automatically result in default, they serve as triggers prompting sponsors to undertake appropriate actions to address deteriorating credit conditions.

Modelling the Project Cash Flows The production of a scenario in project finance deals require passing through the following stages: 1) Define a suitable risk assessment model (Risk Breakdown Structure - RBS); 2). Define project variables and key drivers (Project Breakdown Structure - PBS); 3) Estimate input variables and respective value distribution; account for correlations among variables; 4) Model project cash flows, calculating outputs and valuing results.

4.6 A risk assessment model

Identifying the key risks underlying the project (risk assessment model) and classifying them consistently and hierarchically through the so-called Risk Breakdown Structure (RBS) is the beginning of defining a risk assessment model. A common characteristic of all models is that they need some professional judgments. These opinions are necessary since projects and their execution conditions are unique, historical information is usually not enough to perform historical analysis, and in some cases, they cannot be used to other projects in different targets and size (Cited).

Figure 12 is showing a simplified example of getting a Risk Breakdown Structure through the International Project Risk Assessment Model (IPRA). Typically, the first level of the RBS is composed of four sections, Commercial, Country, Facilities, Production/Operations, plus a fifth section on revenues that is necessary for project finance deals. Each section is then broken

down to get a specific list of project risks. In the IPRA model, risk assessment is based on an estimate of the likelihood of occurrence and relative impact of each of the risks. The result is the Risk Assessment Matrix that helps classify risks by relative importance, considering jointly their likelihood of occurrence and impact in case of occurrence (See also Kong et al. (2008). The resulting risk segmentation provides support in identifying key risks and thus developing a strategy to mitigate and allocate risks to third parties (if possible) and to manage residuals risks, aiming at reducing the volatility of the cash flow components. Risk transfer and risk mitigation strategy and the size and quality of residual risks are, of course, crucial for the project's evaluation from the lender's viewpoint (Cited).

Define project variables and key drivers

The Project Breakdown Structure (PBS) is a hierarchical top-down decomposition to identify all the project variables representing the key drivers of the project's performance/cash flows (Archibald, 2003). One example is shown in Figure 13.

Each of the main project variables is then broken down further into a set of project drivers representing the input variables of the cash flow model (Cited).

The RBS and PBS are then combined into the so-called Risk Package, that represents all key project variables derived through the PBS, identifies whether and how they may be affected by each of the risk categories identified in the RBS. The Risk Package includes all information concerning the parameters of each input variable (see Figure 15). The Risk Package is therefore the starting point for any kind of risk analysis on the project. No matter the risk analysis is from a simpler sensitivity analysis aimed at assessing the impact of a single variable change on the project's performance, or a more sophisticated stochastic analysis of the project cash flows. In the lender's view, the relevant risk package should only consider residual risks remaining after the risk allocation and mitigation treatment (Cited).

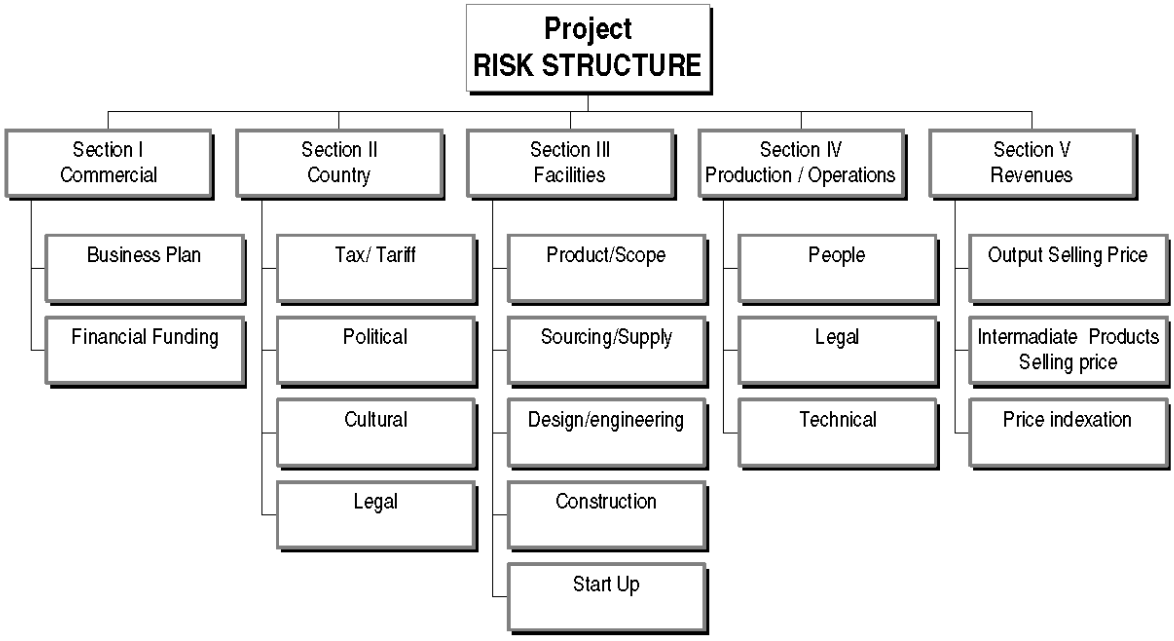


Figure 12: The Risk Breakdown Structure (RBS) – IPRA[3] model, Gatti (2007)

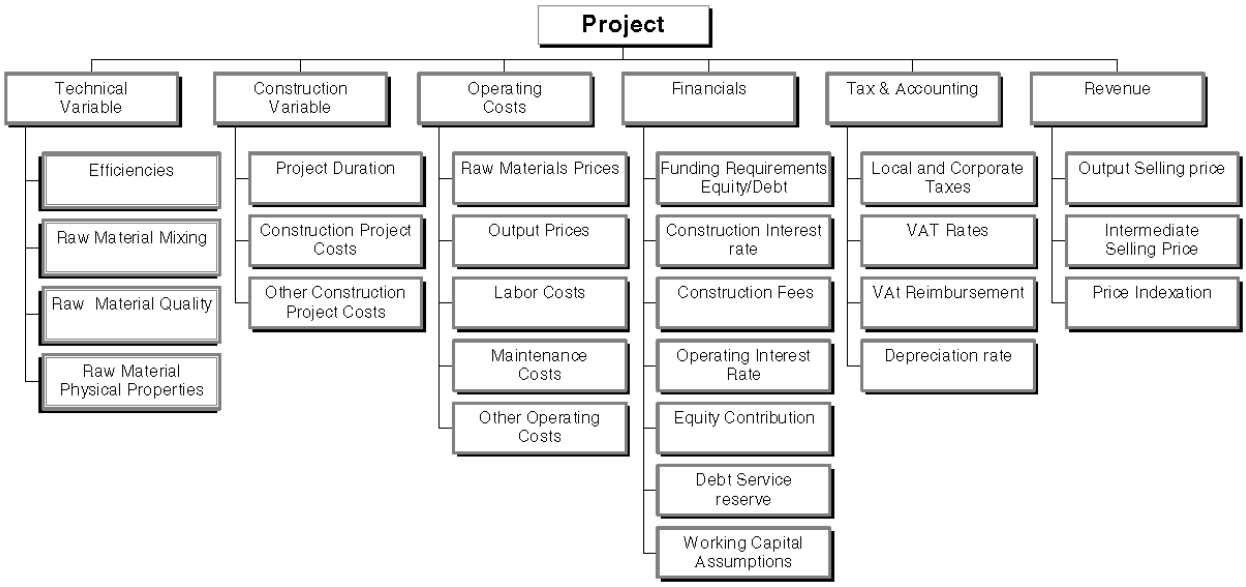


Figure 13: Example of Project Breakdown Structure (PBS), Gatti (2007)

[3] International Project Risk Assessment

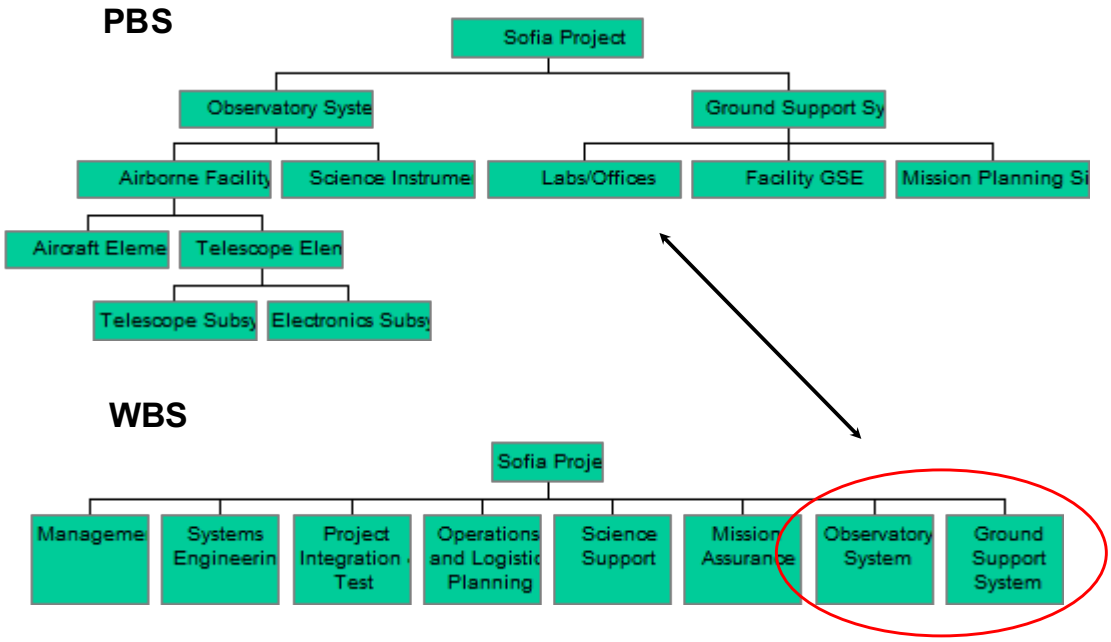


Figure 14: A PBS & WBS Example: NASA's SOFIA Project, Source: NASA SE Handbook

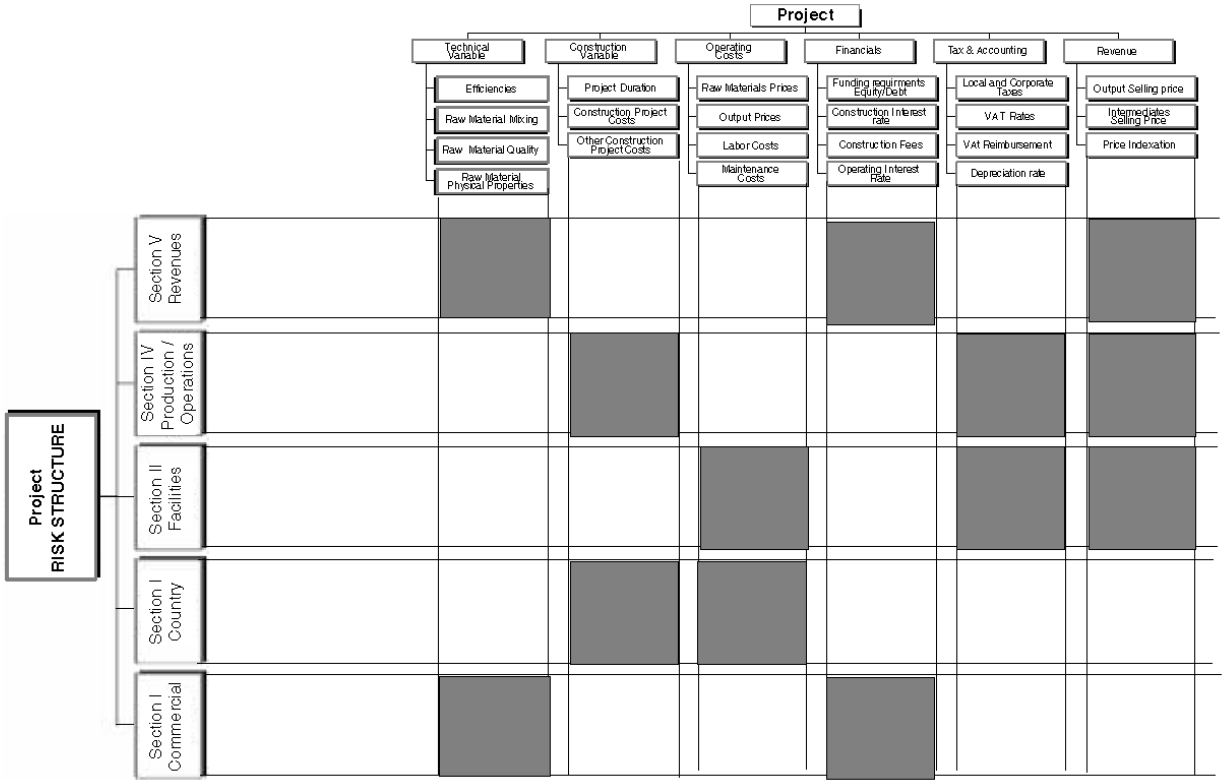


Figure 15: The Risk Package Identification, Gatti (2007)

Input variables: estimation and data collection

The range of admissible values and their frequency distribution must be estimated and defined. The input data collection can beorganised by three methodologies:

• historical data analysis (when historical data about the required variable exist);

• expert judgements, obtained with techniques such as range evaluation (Schuyler, 2001) or the event risk tree (Harrison, 1975);

• hybrid models (combining historical and experts judgements).

Hybrid models are the most widely used, since the analyst would like to use historical data whenever available, while many variables cannot be estimated only through historical and objective data (Cited).

Based on both historical and expert information, Variable probability distribution is collected. Experts start with estimating input variables through a qualitative model, assigning risk scores as well as directly estimating the optimistic, pessimistic, and most likely values of input variables. Judgments are independent, obtained through a Delphi work session, and averages and variances of most likely, pessimistic and optimistic values and risk scores are calculated. All available historical data are included, and risk variables are clustered in some risk levels (see Table2) (Cited).

Table2 Risk Score Matrix - Risk Level Identification, Gatti (2007).

RISK SCORE								
Impact / Probability	0.05	0.1	0.2	0.4	0.8			RISK
0.9	0.045	0.090	**0.180**	**0.360**	**0.720**			Very High
0.7	0.035	0.070	**0.140**	**0.280**	**0.560**			High
0.5	0.025	0.050	0.100	**0.200**	**0.400**			Moderate
0.3	0.015	0.030	0.060	0.120	**0.240**			Low
0.1	0.005	0.010	0.020	0.040	0.080			Very Low

The next step is to quantify the correlations between input variables same correlation values throughout all the years of project life (Cited).

For some financial variables, correlations may be estimated through historical data: this is true for instance for the correlation between interest rate and inflation rate, between inflation rate and raw material prices or output selling prices (Cited).

Like bank lenders and other outsiders, the estimation of input variables and the correlation among them is crucially important. In the business of project finance, there are at least three different categories of outsiders suffering an increasing level of asymmetric information relative to sponsors: the structured finance or project finance team of the bank in charge of the customer relationship, the risk management team, and finally the regulatory authorities (who must decide whether the internal model developed by the bank could be used to calculate

minimum capital requirements for the deal as a substitute to the standard approach) (Cited).

The project finance/structured finance team that typically builds a complex worksheet to evaluate project cash flows in the base case and then applies deterministic, what-if scenario sensitivity analysis may be at least partially in a position to define reasonable estimates for the random variables behind the cash flow model, using both past experience in other projects and tapping external independent consultants (i.e. auditors or technical advisers) who are often involved in certifying the base case analysis. The bank's risk manager should then check the assumptions so as to guarantee that the project finance team has not underestimated the deal risk, either unintentionally or (worse) deliberately for budgetary reasons. Supervisors, finally, should control whether the bank's internal VaR estimate is adequate, or whether the project finance or risk management team have been over optimistic in their evaluation (Cited).

4.7 Modelling project cash flows, calculating output and valuing results

The cash flow model, if fed with appropriate inputs, defines the basis for supporting lenders' decisions in terms of risk valuation and pricing (spreads, fees and minimum acceptable internal rate of return). Traditional risk valuation is based on a definition of a base case and a repeated output stress analysis or subjective scenario analysis. The base case analysis defines an integrated forecast of balance sheets, income statements and cash flow statements for all the years in which the project is operated, conditioned on a number of assumptions.

In a traditional repeated output stress analysis, a shock is applied to one project driver (within a predetermined range), while all the others are kept fixed. In the case of scenarios, a set of variables is changed and the effect of the behaviors of project cash flow is then assessed. A stochastic analysis, instead, allows all (or at least most of) the input variables to vary simultaneously.

Other cash flow components will be different according to the probability distributions specified by the analyst, and as a result, a probabilistic distribution of all output variables will be obtained, so as to allow sponsors' and lenders' advisers to carry out a regression analysis of model inputs.

A sophisticated stochastic model of future cash flows can make it possible for the lender to determine how frequently that the project may reach a situation that can be identified as default, based on the stepwise process discussed in Figure 1. While the overall default probability throughout the life of the project may be relevant information for the risk manager, a bank is typically interested in determining a VaR measure over a much shorter horizon (typically one year). It is therefore critical to clearly define which notion of value the bank is willing to adopt,

and how the deterioration of project cash flows could impact that measure. VaR would then be identified with the maximum potential loss the value of the project may face within a certain confidence level and time horizon (presumably equal to one year) (Cited).

In cases where default occurs, a critical issue is how to model the project value in the event of default (Cited).

It could be a simplified solution to adopt the approach of default-mode credit risk VaR since the debt service could be distributed in many different ways along the life of the project provided that minimum DSCR and LLCR are satisfied, this view could be misleading. Therefore, this solution should be rejected. Another possible solution is to adopt a mark-to-market approach where VaR is identified as the difference between the loan's forward expected value and its forward value in one year's time in the worst-case scenario at the ×% level. For a project finance deal, modeling the relationship between theoretical credit spreads and the project's r is instead much more complex in comparison with bond market, for example. Considering these problems, a third possible solution is to assume that the credit spread may remain the same for the next year and to model the distribution of the forward values of the project by simply discounting the cash flows for debt service repayment in each simulation run. Therefore, in all simulation runs where the project will default (according to the definition outlined in section 2), the present value of the cash flows will be lower than in non-default scenarios (Cited).

This implies that a distribution of loan values for the lender may be built that would enable the lenders to calculate both the expected loss (i.e. the difference between the value of the loan in the case of non-default and its expected value) and VaR or the unexpected loss (i.e., the difference between the expected value and the worst case scenario value within a given confidence level), plus any other risk measure (such as expected shortfall) that may be considered useful (Cited).

4.8 Guarantee

There are essentially two types of guarantors in a project financing: sponsor guarantors and third-party project financing is the sponsor itself. Typically, the sponsor r establishes a special purpose subsidiary to construct, own, and operate the project. The subsidiary, however, lacks sufficient capital or credit rating to support risks associated with the underlying loan obligation. To affect a loan, the sponsor must arrange some form of credit enhancement to cover the identified risks. Often the requisite credit enhancement is provided in the form of a guarantee by the project sponsor of the obligations of the project owner. (Hoffman, 1989)

Limited Guarantees Traditional guarantees represent direct, unconditional commitments by a guarantor to perform all the obligations of a third party. Guarantees limited in amount or time can be used to provide minimum enhancement necessary to finance the project. This approach provides the necessary credit support to a project without considerable impact on the guarantor's credit standing and financial statements. Examples of limited guarantees include guarantees that are effective only during the construction phase of a project or that are limited in amount, whether calculable in advance or not. (Hoffman, 1989)

Here are focus is how to arrange a Project Finance deal without, or with minimum, use of other financial tools such as derivative or options, or guarantees or insurance.

4.9 Perceived Risk – Payoff Risk

"Risk perception refers to people's beliefs, attitudes, judgments, and feelings toward risk, and incorporates the wider social and cultural values, as well as outlook, people adopt toward hazards. Perception is a significant concern for risk communication" (Rother, 2019).

Risk perception and communication represent complex processes managing the tolerated probability, severity and/or potential benefits of risks (Slovic, 1994). Risk perception reflects the current and latent information about hazards (Slovic, 1994). Risk communication addresses gaps in current mental models of interacting persons, influences the comprehension of mitigation strategies shared or imposed and is more effective when tailored to specific audiences, as it advances risk awareness and understanding and promotes specific-protective behaviors (Slovic, 1994).

Decision-theory variables such as probabilities (e.g. loss probabilities), outcomes (e.g. gain outcomes, loss outcomes), volatilities (e.g. volatility of returns) as the main factors affecting financial risk perception (Mellers et al., 1992; Mellers and Chang, 1994; Koonce et al., 2005). (Nguyen et al., 2017)

Risk perception significantly intervened in the risk tolerance/ risky asset allocation relationship. Compared to risk-avoiders, risk-seekers are likely to perceive a particular investment less risky which induces them to allocate more funds to the investment. A potential explanation is that risk-avoiders tend to overestimate negative outcomes, thus perceiving more risk, while risk seekers tend to overweigh positive outcomes, therefore perceiving less risk (Schneider and Lopes, 1986; March and Shapira, 1987 as cited in Sitkin and Weingart, 1995). (Nguyen et al., 2017)

Compared to risk tolerance, risk perception can change easily over time as it reflects how individuals perceive the riskiness of an investment product (Roszkowski and Davey, 2010).

(Nguyen et al., 2017)

Credibility of information sources is, therefore, a key issue in risk communication. Renn & Levine, (1991)

credibility issues have to be studied in the context of the arena in which they occur. Renn & Levine, (1991) public perceptions of probabilities and risks vary considerably. Renn & Levine, (1991). from professional analysis (Slovic 1987; Covello 1983). Whereas experts usually give equal weight to probabilities and the corresponding magnitudes of a given risk, the intuitive risk perception places higher concern for low-probability, high-consequence risks than for high-probability, low-consequence risks, even if the expected values are identical Renn & Levine, (1991)

It is important for project sponsors to understand how the lender views risk (Ravis, 2013).Risk from the perspective of a project financier is an event or outcome that impacts the project's ability to remain current on debt service (Ravis, 2013).

as the risk register is being developed, the lender is acutely aware of changes in the marketplace for either the lenders absorbing more risk or becoming more risk-averse. For example, if either the market is becoming more competitive or banks are becoming more comfortable with technology, lenders may craft a more relaxed financing structure, such as lower-level liquidated damages than they had in prior financings (Ravis, 2013).

Moreover, R. Ma et al. (2019) find that an increased risk perception reduces liquidity around the world.

Investors' risk perceptions have long been recognized to be a function of firm-specific variables and risk factors affecting firm value (DAILAMI & HAUSWALD, 2007).

Securitized project finance still holds considerable uncertainties for issuers and investors alike. Researching the price determinants of project bonds, provide valuable insights into market price patterns and market price risk for market participants in general, and investors and issuers in particular. Project bond prices on traditional corporate and sovereign bonds are co-movements and tend to move in line. Although investors' time horizons differ significantly, prices of all the bonds analyzed turned out to be driven by the same macro- and microeconomic factors, whereas movements of project bond prices are primarily related to the project's sector (or the project bonds tenor) (Richter et al., 2021).

There are very few studies in Project Finance addressing risk perception, at best of our knowledge. DAILAMI & HAUSWALD (1999, 2007) by study RasGas Lafan Project, Esty (1999)by studying Petrozuata Project, and Bonetti et al., (2009) and Dailami & Leipziger (1998) by Quezon's bond Powerplant. The reason for dearth of study is the lack of data. They

show that investor risk perception, do not take in to account the risks which is allocated to third party properly and only pricing the residual risks. Finding a reliable and accurate proxy for measuring the risk perception is difficult and important as the payoff risk. For example, DAILAMI & HAUSWALD (2007) use Project's Bond spread over US Treasuries to gauge market perceptions of changes in Ras Gas' prospects and, hence, the firm's riskiness. They find as predicted by theory, markets do not price risks that are credibly managed through the firm's contractual structure.

Another innovative study is by Buscaino et al., (2010). They study Collateralized Debt Obligation (CDO) backed by Project Finance deals. They find that the nature of the underlying assets has a substantial impact on CDO pricing: Primary market spread is significantly higher when the underlying Project Finance loans bear a higher level of market risk and when the proportion of projects still under construction in the securitised portfolio is larger. This evidence provides an insight about how investor perceived a project risk, which is not the same as risk perception in sovereign or company bonds.

DAILAMI & HAUSWALD (2007) argue that the perceived risk is projecting/showing/manifesting itself in the risk taker/volutility of the bond's premium. Building on this, DAILAMI & HAUSWALD (2007) by using a sample of daily data from January 1997 to March 2000, related Ras Gas' credit spreads to Kepco's credit spreads (proxy for counterparty risk), the Brent oil reference price used to settle LNG sales (output-price risk), Mobil's stock price (debt-service guarantee risk), Korean control variables (country risk), and returns on four regional emerging debt market indices (common economic shocks and spillover effects), to investigate how markets respond to the deliberate modification of fundamental firm risks through a set of interlocking contracts. They find that bond prices quickly react to unmanaged risk factors but do not respond to managed ones provides new evidence both on the efficacy of contractual risk-management techniques and on the informational efficiency of global bond markets.

DAILAMI & HAUSWALD (2007) successfully relate its credit spreads as a measure of investor risk perceptions to firm-specific risk factors in the context of 25-year supply agreements, debt covenants, and a debt-service guarantee contingent on output prices. Consistent with theoretical predictions, They find that unmanaged risk factors affecting the supply agreement drive Ras Gas' credit spreads, whereas managed ones have no effect.

In another study Dailami & Hauswald (1999) find that the risk factors affecting the sales and purchase agreements drive perceptions of market risk for Ras Gas bonds. Ras Gas yield spreads reflect the market's risk assessment of Kepco. Other priced risks are energy price and foreign

currency exposure (which influence Ras Gas credit spreads through their impact on Kepco), Korean economic variables, and spillovers from turbulence in European and Latin American emerging debt markets. They show that the design of each contractual arrangement is not independent, because risk factors relevant to one contract determine the price and risk premium of the other. Despite heavy capitalization and partial guarantees by the parent companies of Ras Gas, the off-take agreement essentially determines the riskiness of the bonds.

Dailami and Hauswald (1999) interpret this as evidence of the nexus-of-contracts view of the firm in the presence of contractual incompleteness: Investors bear all residual risks and price their financial claims accordingly.

With the same methodology, Bonetti et al. (2009) studied the Quezon Power project deal. Bonetti et al. (2009) argue that the effect of an increased market-perceived counterparty risk on the cost of funding that the SPV has to pay for a bond issue. The cost of funding is measured by the yield to maturity of the project bond issued by Quezon Power SPV, and that of a U.S. Treasury Bond with comparable maturity.

They find that the spread of the Quezon Bond and the counterparty risk are positively correlated when counterparty risk is represented by the daily volatility of the returns on common stocks issued by the offtaker, in which a 1% increase in the daily volatility of the shares issued by the offtaker causes an increase of 23 basis points in the spread paid by Quezon Power. Moreover they find an inverse relation between the rating upgrades of the offtaker and the spread paid by Quezon Power.

Indeed, Bonetti et al. (2009) point out that the perceived Quezon power credit risk reflected in the daily credit spread on its project bonds, and pinpoint information that provides an objective evaluation of the risks inherent in the project. An example is counterparty credit risk, which can be measured by means of relative ratings or by referring to the volatility of returns on the offtaker's shares (Bonetti et al., 2009).

Chapter 5 The Application of Project Finance in Space Industry and Discussion

The evolution of the space economy can be divided into three phases, each marked by differing levels of involvement of public and private agents (Sommariva, 2022). The first phase explained by Sommariva (2002) was characterized primarily by governmental space programs, which drove the development of space technologies in the 1950s and 1960s. In contrast, the second phase, spanning 1970-2000, saw the entry of private actors. The rapid growth of computing, digital science and technology during this period significantly impacted downstream space applications and the production of satellite infrastructures, providing ample opportunities for businesses and entrepreneurs to commercialize. The third phase beginning roughly from 2000, presented a radical change in the scene with visionary entrepreneurs rising to the forefront. The space economy witnessed progressively higher private companies participating in space activities, disruptive technological change, and discovering new opportunities for businesses. These new participants have firmly established themselves in the space economy domain, an era known as the *new space.* This new era of space exploring requires not only technological innovation but also financial innovation, along with effective legal frameworks.

The widely accepted definition for space economy is provided in OECD (2011)[4] as "Space Economy was defined as the full range of activities and the use of resources that create value and benefits to human beings in the course of exploring, researching, understanding, managing, and utilising space". However, the exact factors for evaluating these values can be different various institutes regarding their purpose and concerns. The space economy includes public and private agents involved in developing, supplying, and utilizing a full range of space-related products and services. This encompasses everything from launch vehicles, ground stations, and satellites to navigation equipment, satellite phones, meteorological services, and the scientific knowledge generated from these activities.

In this chapter we will briefly discuss the importance of space economy and its promising future. We then introduce the idea of the *Space Bank* proposed by (Cahan ey al., 2016), and investigate the NewDawn satellite project as a case study.

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[4] OECD (2011), "Introduction", in The Space Economy at a Glance 2011, OECD Publishing, Paris.
This definition use by UNOOSA (United Nations Office for Outer Space Affairs) and BEA (The U.S. Bureau of Economic Analysis)

5.1 Growing Space Economy

Established space infrastructure enables new services and applications across various sectors, including energy, telecommunications, meteorology, maritime, aviation, and urban development. This leads to further economic and societal benefits (Morgan Stanley Research reports, (2020). Space: Investing in the final frontier).

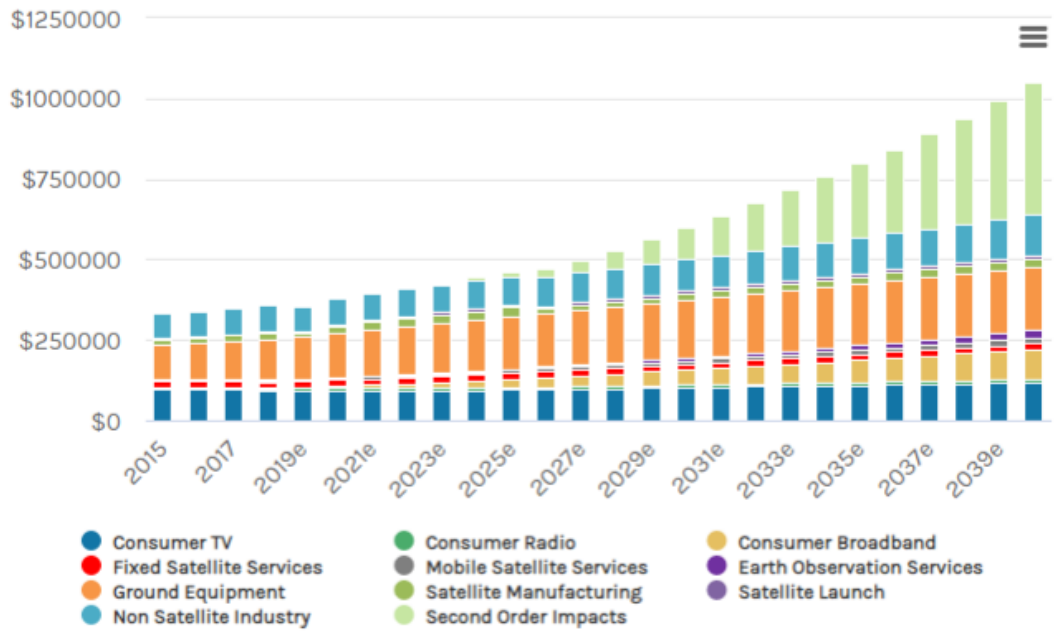

Figure 16: The Global Space Economy ($t) Real and estimate with sectors,

Source: Haver Analytics, Morgan Stanley Research forecasts

As illustrated in Figure 16, a steady growth has been estimated for space economy. Morgan Stanley estimates that satellite broadband will represent 50% of the projected growth of the global space economy by 2040—and as much as 70% in the most bullish scenario. Launching satellites that offer broadband Internet service will help to drive down the cost of data, just as demand for that data explodes.

While reusable rockets will help drive those costs down, so too will the mass-production of satellites and the maturation of satellite technology. Currently, the cost to launch a satellite has declined to about $60 million, from $200 million, via reusable rockets, with a potential drop to as low as $5 million. And satellite mass production could decrease that cost from $500 million per satellite to $500,000.

Other aspects that illuminate the projected growth in the space venture, is coming from start-up ventures. A rapid and steady growth in investment in space-oriented start-up companies provides a glimpse of how the future is shaping up as it can be seen more in details in Figure

17 (Brycetech, 2022).

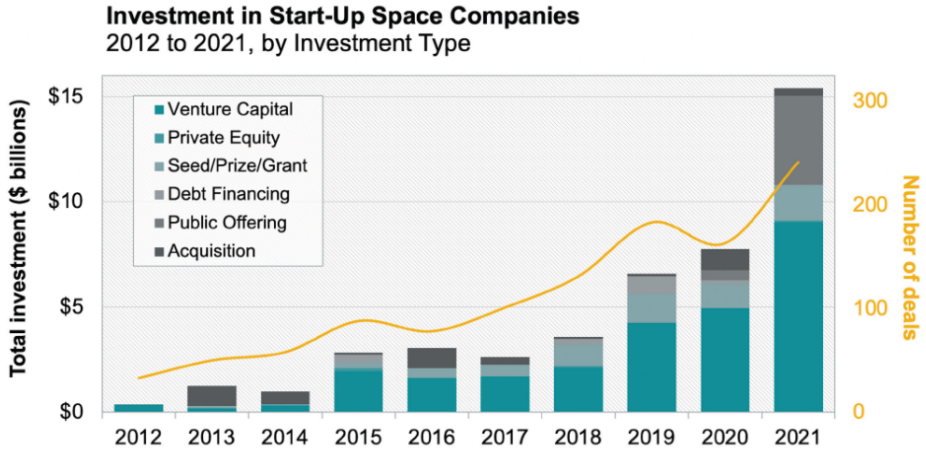

Figure 17: Investment in Start-Up Space Companies. Brycetech, 2022

The space economy is much more than satellites. Exploration of Earth's moon is on the agenda of all major and even newcomer space agencies. Soon, the use of space resources will be crucial for the success of expeditions to the Moon and other planets (such as the Gateway project). Moreover, a new form of public-private partnership is emerging, where governments provide initial support in the exploration and advancement of critical technologies and the construction of space infrastructure. The private sector would then lead in creating new markets and expanding humanity's presence in space. Starship, developed by SpaceX, is a fully reusable launch vehicle and a modified version of the Starship selected by NASA as one of the landing systems for the Artemis Program in April 2020. Moon mining will also present an opportunity to make space-based solar power (SBSP) economically feasible. SBSP is a large-scale solution to climate change or fossil fuel depletion.

Two additional aspects of space economy are the space colonization and asteroid mining. For instance, Planetary Resources (formerly known as Arkyd Astronautics) indicated in 2012 that the platinum from a 30-meter-long (98 ft) asteroid could be worth US$25–50 billion. However, some economists follow the arguments that any outside source of precious metals could sufficiently lower prices to possibly doom the venture by rapidly increasing the available supply of such metals. Nevertheless, the emerging market and demand for resources, fueled by demand in space activities and colonization, can prevent interrupting the economy of asteroid mining. The development of an infrastructure for altering asteroid orbits could offer a significant return on investment.

5.2 Space and Finance

Buzdugan (2009) details traditional structures adopted in Satellite Financing, underlining their pivotal role in shaping the industry. These structures include Recourse Credit Facilities, Export Credit Agencies, and Multilateral Agency Supported Credit Facilities. They also encompass Capital Markets Debt and Equity Offerings, as well as Manufacturer Support or Vendor Financing. These methods of financing, each with its own unique characteristics and implications, constitute the diverse financial landscape in which the satellite industry operates and thrives.

Space assets, as high-value mobile equipment, see their construction, usage, and logistical purposes shift them and their derived value from one location to another (Cahan et al., 2016). Financing movable assets is a particular challenge in the absence of global uniformity of national laws for cross-border asset-based lending (Cited). Because the basis for lending on the space asset as collateral is bespoke, complex, and uncertain, financing for space currently depends largely on the creditworthiness of the borrower, rather than a mix of credit-backed and asset-backed financing (Cited).

This situation places global start-up companies and entities in developing countries at a disadvantage, particularly those without a reliable track record or creditworthy guarantor. They might receive government grants for academic or scientific research and development at the outset for early phases of the work but find it hard to raise commercial project and operations financing from the private sector (Cited).

Such obstacles in bridge and pre-commercialization-stage finance invariably lead to constant cash flow liquidity shortages impeding the development of technical teams and subcontractor arrangements (Cited).

As inflation-adjusted government space budgets (as a percentage of national GDP) are shrinking and funds are being diverted towards immediate economic, environmental, and social crises, new and innovative space projects face failure due to inconsistent financial backing (Cited).

In the pursuit of unifying principles for Space Finance, the current patchwork of international space treaty provisions and reliance on national lending laws and practices may prove difficult to extend to space projects, including to colonies on the moon, Mars, and any beyond. While the lineage and pedigree of the principles of Law of the Sea provide precedent, the lack of a compact on space finance will slow, reduce, and add risk to space finance (Cited).

For decades, governments alone financed launching, operating, and returning space objects and

humans. Scientific exploration of space propulsion, navigation, communication, and life safety advances resulted in commercially viable technologies and business methods. Scientific research and mission goals depended on government space mission priorities and budget appropriation processes. Government funding of exploration still predominates, outspending private sector investments. Commercial satellites are financed based on their terrestrial revenues and the risks of launch and in-service life. Space entrepreneurs are emerging with the wealth and explorer spirit to attract teams to do what governments and space industry contractors have not prioritized or funded: asteroid-hunting satellites, space tourism, space freight, lunar and asteroid mining, and habitats on the Moon and Mars. Concurrently, developing countries are launching satellites and missions, diversifying space entrepreneurship. Space finance can be an inherent barrier or right. It can also serve as a silent technology enabler or conversely pose a risk to mission continuity. Space exploration is a unique setting to reimagine better space and terrestrial finance options and principles based on functional valuation models. (Cited)

Finance is essential to advance peaceful discoveries and uses of space assets. If exploring space is to be truly open to all humankind, then options for financing and insuring space explorers and missions must expand accordingly and inclusively, beyond governments and high net worth entrepreneurs. (Cited)

Cahan et al. (2016) suggest an arrangement for, banking and finance of space-borne assets and activities. Following this argument, they argue for the notion of A ‘space bank’ that is proposed as evidence of viability of banking in space, an improvement upon terrestrial monetary flows for regions destabilized by war, corruption, disaster, or infringements of basic human rights.

space exploration is entering an exciting new phase of market expansion. Leading this expansion are billionaire explorers attracting start-up entrepreneurs and the space mission teams they assemble from industry veterans and new talent, coming together to disrupt previous generations of space industry companies. The new company founders have the capital and seek to grow the market for commercial activities in space. Government space agencies are taking advantage of the new companies’ capital to reduce public funding of commercial missions, while privatizing larger portions of mission prototyping risk and investment return. Privately organized and market-financed space exploration is significant. However, gaps and risks in space exploration arise due to the very passion of tying private space missions to the enthusiasm and capacity of space pioneers to fund them privately. A robust space economy requires growing the market for linked infrastructure investments. (Cited)

A Space bank could also assume roles such as credit agencies or import-export bank within the

space industries. The bank can enhance the space ventures in two ways. First, by providing facilities for space initiation, such as guarantee for related project finance deal, similar those provided by credit agency for traditional Project Finance deals. Second, the space bank also become the expert bank specialized in space industries. This concentration can train and provide necessary practice and knowledge which is unique for this industry.

5.3 NewDawn Satellite, A Satellite Project Finance

In this analysis, we examine the New Dawn Satellite project, financed using the Project Finance method. Data pertaining to Project Finance deals are inherently limited, and this scarcity is especially pronounced in the context of the space industries. The New Dawn Satellite project stands out as one of the few instances where some data is available. It serves as a fitting example of a typical Project Finance deal within the satellite sector. The data is sourced from the African Development Bank Group (2023), Cowing (2013), and Krebs' "New Dawn → Intelsat 28".

NewDawn Project Description

In December 2008, Intelsat, Ltd. revealed a joint venture with a South African investor group, led by Convergence Partners intending to employ project financing to build and launch a new satellite. The Intelsat New Dawn satellite scheduled for launched on 29th March 2011 from Arianespace's launch site in Kourou, French Guiana, represents the first ever private sector communications satellite from Africa.

The New Dawn Satellite Project was initiated by two South African equity investors, Convergence Partners and Altirah Capital, who collectively hold 25.1% of equity share. This project was then further developed as a joint venture, with a consortium led by Convergence Partners and Intelsat S.A., the global leader in the provision and operation of satellite systems. As the primary sponsor, Intelsat S.A. holds 74.9% of the equity share.

The project is in line with the bank's ICT and PSO strategy, the South African CSP, and the South African government's long-term development goals. It aims to meet a rising need for satellite supply capacity, which is being driven by the development of mobile carriers' networks into underserved and underprivileged areas. Furthermore, it had the ability to give support for enterprises, more isolated regions, and to stimulate socioeconomic growth. The project's scope includes designing, building, launching, and operating a Pan-African communications satellite system into the 33o East orbital point, which is ideally positioned to service the African continent.

The project, delivered within its time and financial budget, its proposed $250 million, obtained

around 90% of its financing from African entities. Altirah Telecoms and the non-profit Convergence Partners Foundation were also included in the consortium led by Convergence Partners.

The New Dawn satellite, as well as its 28 C-band and 24 Ku-band 36 MHz transponder modules, are specifically designed to provide crucial communications infrastructure to African clients. Intelsat New Dawn will be ideally positioned to serve Africa from a geostationary orbital slot at 32.8 degrees East, with a payload targeted to supply wireless backhaul, broadband, and media content - the fastest expanding satellite-based services in Africa.

When it goes into service in the second quarter of 2011, Intelsat New Dawn will address the capacity shortage faced by African wireless telecom operators, broadband service providers, corporate network service providers, and media operators, all of whom have experienced exceptional along with the region's economic development.

Customers contracting for capacity ahead of launch include the region's leading communications service providers, including Vodacom International Ltd, Gateway Communications Africa (UK) Ltd, Bharti Airtel (initially signed through Celtel Nigeria), and Gilat Satcom.

As mentioned before, The New Dawn Satellite Project was founded by two South African equity investors, Convergence Partners and Altirah Capital, with Intelsat, the global leader in satellite system provision and operation, as a sponsor. The project has been in the works for five years, with the last two and a half devoted to building.

The hybrid C-band/Ku-band satellite, *developed by Orbital Sciences Corporation* and launched in December 2008, will be operated and sold as part of the worldwide Intelsat fleet, bringing the total number of Intelsat satellites servicing Africa to 22. Arianespace was chosen as the launch partner, and the most powerful variant of the Ariane 5 family, the Ariane 5 ECA (Cryogenic Evolution type A), will be used.

Analyzing the Deal

A scheme of the project is presented in Figure 18. As shown, the project nearly matched the typical Project Finance structure.

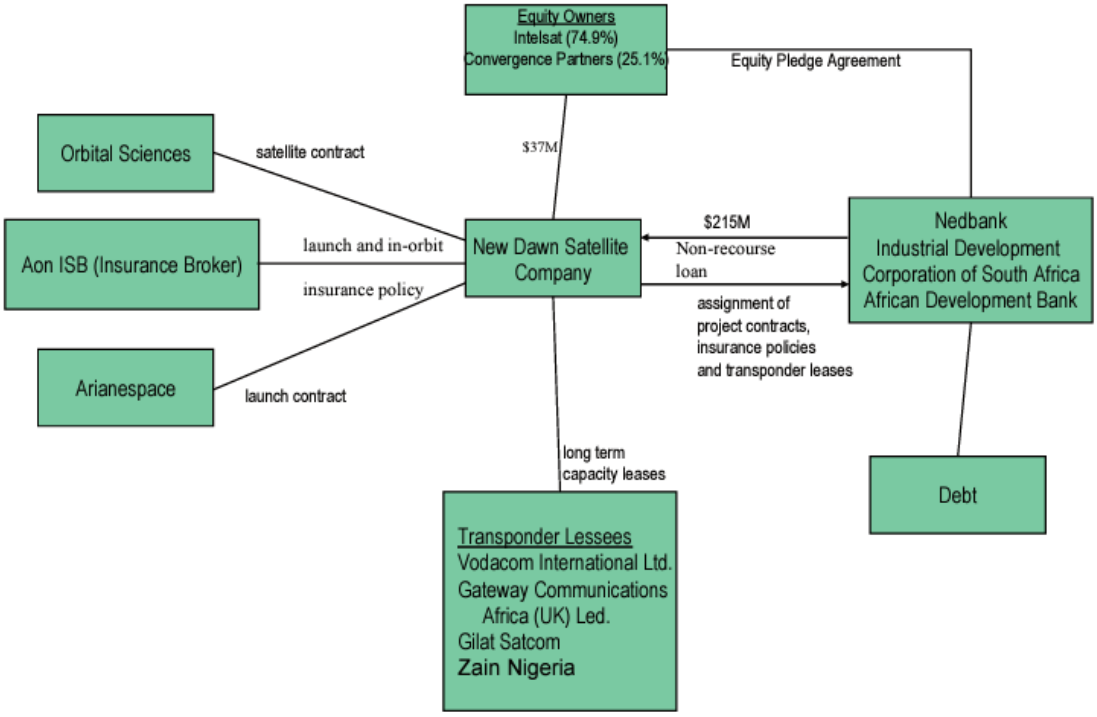

Figure 18:The NewDawb Satelite project structure ,Buzdugan, M. (2009).

About Intelsat New Dawn

The US$250 million project, first announced in December 2008, is funded around 15% with equity and 85% with non-recourse debt. African banks are providing roughly 90% of the total capital required for the joint venture, with Intelsat contributing the remaining 10%. The non-recourse debt financing was handled by Nedbank Capital, a subsidiary of the Nedbank Group (one of South Africa's largest banking groups) and a significant telecom project financier in South Africa. The loan will be funded by a consortium of lenders that includes Nedbank, the Industrial Development Corporation of South Africa, and the African Development Bank. Intelsat (74.9%) and the Convergence Partners-led consortium (25.1%) provide the equity, which also comprises Altirah Telecoms and the non-profit Convergence Partners Foundation.

Table 2: The sponsors of NewDawn Satellite Project

Sponsors (in ti:	% share of equity
1) Convergence Partners (South African equity	Together 25.1%
2) Altirah Capital (South African equity investors)	
3) Intelsat	74.9 %

Convergence Partners is an African investment firm focused on the telecoms, media, and technology (TMT) industry. Convergence Partners' investing philosophy is to take significant

equity positions in high-quality projects and businesses in its target industry and to engage as an active, strategic value-added investor. Convergence Partners specializes on green fields projects that expand access to communications, broadband services, and technology offerings throughout Africa, contributing to higher living standards.

Intelsat is the world's leading provider of fixed satellite services. Intelsat has been providing information and entertainment to many of the world's largest media and network firms, global enterprises, Internet Service Providers, and governmental agencies for over 45 years. Intelsat's satellite, teleport, and fiber infrastructure is unparalleled in the market, setting the standard for video, data, and voice service transmissions. From the globalization of content and the dissemination of HD to the expansion of cellular networks and broadband access, Intelsat brings modern communications to people all over the world.

Altirah Telecoms is the private equity portfolio of Altirah Capital and the Oppenheimer family's special purpose common investment entity. David Frankel and Paul Salomon created Altirah Capital, a South African investing firm. Stockdale Street Limited, led by Peter Maw and Paul Salomon, advises the Oppenheimer family's private equity holdings.

With the help of Intelsat as a shareholder of SPV (NewDawn Satellite Company), the Project company enjoys from the superiority, reputation and experience, of its shareholder in this business sector, and it will be drastic to recognize which IntelSat van be brought to the Project. The present of IntelSat in the Project company board may make it easier for SPV to acquire a loan with better price.

The project has been in development for five years, with the last two-and-a-half focusing on construction (Cowing, 2013). Regarding the construction risk and technology risk, they are allocated to the Orbital Sciences Corporation (NYSE: ORB), one of the world's leading space technology companies (Northrop Grumman Newsroom, 2011). Orbital designed, built and tested the Intelsat New Dawn spacecraft at the company's satellite production and test facility in Dulles, VA, USA. It is designed for a 15-year on-orbit mission life.

Orbital designs and builds small and medium-class rockets and space systems for commercial, military, and civil government clients. Satellites and launch vehicles, including low-Earth orbit, geosynchronous-Earth orbit, and planetary exploration spacecraft for communications, remote sensing, scientific, and defense missions; human-rated space systems for Earth-orbit, lunar, and other missions; ground- and air-launched rockets that deliver satellites into orbit; and missile defense systems that serve as interceptor and target vehicles, are the company's primary products. Orbital also supplies satellite subsystems and space-related technical services to federal agencies and laboratories in the United States.

Another pre-completion risk for a satellite project is launch risk. The satellite is deployed in orbit using Ariane 5ECA VA201, One of the safest launchers in the word with a 95.7% success rate (*Ariane 5,* 2023).

New Dawn was launched successfully on April 22, 2011, but after reaching geostationary orbit, the satellite was unable to deploy its C-band reflector antenna, depriving it of half of its intended functionality, because the antenna's spring-loaded deployment mechanism became entangled in the billows of its sun shield. The same thing happened to the Ku-band reflector, but thanks to the motor-driven deployment mechanism, it was liberated and deployed. The flaw is also projected to cost Intelsat approximately two years of service life for New Dawn. In April and May, the business expended over a year's worth of fuel in an attempt to shake loose the C-band antenna. The commercial life of New Dawn is likely to be curtailed by another year since it must be flown in an unplanned manner, with the C-band antenna still tucked against its frame. As a result, the projected life span was cut to 12 years. (332)

It can be seen that some events of risk occurred, caused both losing capacity to half and reduced the lifetime of project for two years. Consequently, reducing the estimated cash flow and the period which initiative can perform and have a cash flow stream.

IntelSat deep knowledge in the satellite business, combine with the Orbital Sciences Corporation excellence as a highly reliable satellite manufacturer, led to well-planned project which Delivered on time and within the originally announced $250 million budget.

In a nutshell, it may be concluded that about risks related to pre-compilation phase, the project did not face over run, and over cost situation. Moreover, the launch as a major risk in every satellite project was successful. However, the satellite could not achieve to its pre-defined performance which caused significantly lower cash flow and shorter lifetime. These reductions have significant effects on the probability of default, and key indicators such as Debt Service Coverage Ratio (DSCR), Loan Life Coverage Ratio (LLCR), and Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA) to senior or total debt ratios. However, as a mandatory practice in satellite industry, each satellite and its component are supposed to be covered by insurance from the design phase, followed by manufacturing, transport, launch and in the orbit.

IntelSat is the operator of the NewDawn satellite. Since IntelSat is a world class with excellent reputation and creditworthy operator, The project has low or very low operation risk.

Market risk is allocated to the third party by selling the satellite communication capacity in advance. Customers contracting for capacity in advance of launch are the leading communications services providers in the region, including Vodacom International Ltd,

Gateway Communications Africa (UK) Ltd, Bharti Airtel (originally contracted through Celtel Nigeria) and Gilat Satcom (Cowing, 2013).

A consortium of lenders including Nedbank, the Industrial Development Corporation of South Africa (IDC) and the African Development Bank (AfDB) will provide the debt funding (Cowing, 2013).

The IDC must secure its long-term viability through smart financial and human resource management, protect the natural environment, and position itself as a Centre of Excellence for development finance (https://www.idc.co.za/about-us/). The African Development Bank (AfDB) Group's overarching goal is to encourage sustainable economic development and social progress in its regional member countries (RMCs), thereby contributing to poverty reduction (https://www.afdb.org/en/about/mission-strategy).

The African Development Bank Group (AfDB) is a regional multilateral development financing institution designed to support the economic development and social progress of African countries that are Regional Member Countries (RMCs) of the institution (afdb.org). Nedbank Group is a South African financial services conglomerate that provides wholesale and retail banking, as well as insurance, asset management, and wealth management (https://personal.nedbank.co.za/).

One may expect the participation of AfDB and IDC can reduce several legal and political risks. Considering the BB- rating by Standard & Poor's for South Africa Credit Rating, the participation of mentioned bank can diminish the risk and the loan price, respectively.

However, the project was marred by a scandal. The Paradise Papers (offshore leaks database) revealed that the project business paid almost no tax. This contradicts the project's goal and the mission of banks as loan providers (Ezenagu & Fitzgibbon, 2018).

5.4 Conclusion

The present MA study sought to investigate the intricate relationship between project finance, risk management, law, and their application in the aerospace industry. Over the course of this exploration, several key findings emerged, reinforcing the necessity and importance of this area of research.

In the first phase of this study, we undertook an exhaustive literature review of project finance, its history, definition, strategic importance in academic research, and associated capital structure theories. A keen understanding of agency costs, risk management, payoff risks, syndicate loans, the intersection of project finance and law, and the role of public-private partnerships was achieved.

Our study revealed that project finance's structure and characteristics, especially concerning contamination risk, debt overhang, underinvestment, and agency conflict, play critical roles in the success of a project. We also elucidated the role of different types of contracts and syndicated loans in mitigating these risks.

The legal analysis of project financing, including analysis of the articles of incorporation, outsourcing of corporate functions, contract structure, and investor protection laws, revealed the importance of a robust legal framework for the success of project finance initiatives. Special emphasis was given to the legal aspects of project finance in the aerospace industry, suggesting the need for a new legal framework in light of the increasing commercial space activities.

Our examination of risk management within project finance revealed that pre- and post-completion risks, financial risks, and construction risks can significantly affect a project's successful implementation. Effective risk allocation strategies through contracts, analyzing and mitigating unallocated risks, and thorough credit analysis are essential for minimizing the likelihood of default.

We then applied our understanding of project finance to the growing space industry. The case study of NewDawn Satellite illuminated the nuanced challenges and rewards of project finance in this realm.

Overall, our research suggests that the application of project finance in the aerospace industry is both promising and complex, demanding careful risk management, a comprehensive understanding of legal aspects, and innovative financial structuring. While challenges persist, this exploration of project finance's intricacies has provided significant insights and strategies that can serve as guidelines for practitioners and further academic research.

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