JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS Vol. 48, No. 2, Apr. 2013, pp. 549–577
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doi:10.1017/S0022109013000082

https://doi.org/10.1017/S0022109013000082 Published online by Cambridge University Press

# Risk Management with Leverage: Evidence from Project Finance

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## Abstract

We examine capital structures of 2,572 project-financed investments in 124 countries for the period 1997–2006. In contrast to the general prediction of the trade-off theory, we find that project companies use more leverage when project risk is high, but they use less leverage in the presence of risk-reducing features including offtake agreements. Project companies use less leverage and instead rely more on offtake agreements when the control benefits of cash flow from the project are high, suggesting that leverage and contract structures in the project company are important hedging mechanisms.

## I. Introduction

Project finance involves the creation of a legally independent project company with the sole purpose of executing a project with a finite life. Because project finance uses limited or no recourse debt, it has become an important funding mechanism for capital-intensive projects.[1] Most of what we currently know about capital structure decisions comes from firms that engage in ongoing financing and investment activities, the interactions of which make it difficult to examine these firms' optimal capital structure decisions. In contrast, a typical project company makes its capital structure decision ex ante in order to finance a single project. Our study investigates how project companies choose their capital structures.

The foremost decision faced by the project company is its capital structure when the future cash flow from the project to be built is earmarked as the security for the loan. Accordingly, it is unlikely that the company's capital structure

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[1] A significant amount of capital has been spent worldwide on project finance in recent years. In 2004, firms around the world financed $234 billion of capital expenditures through project finance. In the United States alone, the amount was $34 billion (Esty (2004), (2005)). This compares to $24 billion investments by venture capitalists and $73 billion raised through initial public offerings in the United States in 2004.

affects its investment choice. Thus, in an ex ante capital structure for a single project, the agency problem of asset substitution (Jensen and Meckling (1976)) is irrelevant because such a problem arises from the stockholder-bondholder conflict when investments are chosen after debt is in place. Also, an ex ante financing decision for a single project would not involve assets in place that are subject to the asymmetric information problem of the pecking order theory (Myers and Majluf (1984)). With few growth options available, the main issue in determining the capital structure of a project company is with distributing rather than with reinvesting the cash flows from the project. Consequently, the opportunity cost of underinvestment (Myers (1977)) due to leverage is essentially negligible in the project company, and there is little possibility of investment distortion.[2] The seniority of bank debt and controlled dividend policy in project finance further alleviate under- or overinvestment problems (Berkovitch and Kim (1990)).

The legal separation of the project company segregates project cash flow from that of the sponsor, preventing inefficient investment or cross-subsidization of other divisions (Scharfstein and Stein (2000)). Furthermore, various features of the contracts involved in project finance work to minimize agency costs. In addition to the contract to complete the construction with certain conditions, many other contracts are united in a vertical chain from input suppliers to output buyers in order to reduce various agency problems (Esty (2003)), to modify project-specific risks by dividing them into managed and unmanaged risks (Dailami and Hauswald (2007)), and to increase the verifiability of the cash flow from the project (Subramanian, Tung, and Wang (2008)). Such contracts among multiple parties to project finance also transfer a variety of project risks to those best able to appraise and manage them (Brealey, Cooper, and Habib (1996)).

In short, in project finance, there is little effect of internal equity accumulation, dividend policy, and future financing needs, all of which remain controversial in the ongoing debate surrounding how they affect firms' capital structure decisions (Leary and Roberts (2005), Strebulaev (2007), and Brito and John (2008)). Thus, project finance provides an ideal setting (free from the agency or asymmetric information problem) in which to investigate the relationship between the project's optimal capital structure and project characteristics.

Project finance can be seen as an innovative risk-sharing mechanism that combines organizational structure with its capital structure in order to maximize project value while optimally allocating project risk.[3] Financial hedging may enable firms to optimally coordinate their investment and financing policies (Froot, Scharfstein, and Stein (1993)). In practice, however, financial hedging is limited to marketable and verifiable contingencies; hence, many firms use alternative means of hedging that involve both financial and operating strategies (Petersen and Thiagarajan (2000)). One such strategy is to separate a large project to

[2] See Almeida, Campello, and Weisbach (2011) for such a possibility in a going concern company.

[3] As noted in Esty (2003), the idea that organizational form in general and project finance in particular can be used as a risk management tool rests on the assumption that risk management is value enhancing. Previous studies maintain the same assumption (e.g., Smith and Stulz (1985), Nance, Smith, and Smithson (1993), and Stulz (1984)). Leland (1998) emphasizes the need to explain the joint choice of capital structure and risk.

https://doi.org/10.1017/S0022109013000082 Published online by Cambridge University Press

create a new entity with its own capital structure. Leland (2007) argues that some aspects of project cash flow, such as volatility and default costs, are important determinants of financial synergies in project finance. In particular, the formation of a separate project company with limited or nonrecourse debt provides a firm with valuable options of walking away from the project when cash flows are negative. Leland (2007) also shows that the value of such options is higher for a high-risk project and that the benefits of separating a project increase with leverage.

Expanding Leland's (2007) argument, we hypothesize that nondiversified project sponsors use greater leverage when facing higher project risk, while giving up control over project cash flows. Using high leverage, project sponsors effectively transfer their exposure to project risk to lenders. This hypothesis stands in contrast to the general prediction of the trade-off theory, which is that risky firms use less leverage in the presence of bankruptcy costs. In project finance, however, the lender's control over the project's cash flow prespecifies the procedure when there is a cash flow shortfall. Also, the project company has few growth options to lose in case of bankruptcy. Thus, both direct and indirect bankruptcy costs are negligible in project finance. In addition, typical lenders in project finance are well diversified through syndicated loans across numerous projects; hence, they can make loans to project companies without substantially increasing their risk exposure. Given these, the sponsors of project companies can trade off between leverage and cash flow control in order to optimize their risk and return from the project.

In order to test the hypothesis, we measure project risk by the project's industry cash flow volatility over the past 10 years. We also examine the effect of risk-reducing contracts (e.g., offtake agreements, local government concession grants and support, and multilateral agency involvement) that are present in project finance in order to reduce the project risk. In particular, an offtake agreement is designed to mitigate the price and demand risks of the future output of the project. Thus, in the presence of this contract, the project sponsor has less incentive to rely on leverage as a means to reduce the project risk. The local government and multilateral agency involvement may also reduce the probability and the effect of a local government's adverse actions against the project company. According to our hypothesis, the project risk should be positively associated with leverage, while risk-reducing contracts should be negatively associated with leverage.

Consistent with the hypothesis, our findings suggest that project companies use more leverage when cash flow risk is high and less leverage when risk-reducing measures are in place. We also find that project size, measured by overall project cost, tends to be negatively associated with leverage. If project size, much like firm size, is considered an inverse measure of project risk, then the negative association between leverage and project size implies that project companies with higher project risk utilize more leverage.

The expected cash flow from the project, measured by the 10-year average of industry median cash flows, is negatively associated with the leverage ratio, implying that project companies with higher expected cash flows use less leverage. Project companies may perceive more benefits of cash flow control and use less leverage when the expected project cash flow is greater. Alternatively, sponsors

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may perceive less risk and invest more equity in the project when the expected cash flow is higher.

We find that Economist Intelligence Unit (EIU) risk scores, as a proxy for country risk, are negatively associated with leverage. The results suggest that, unlike project-specific risk that is transferred to lenders through leverage, country risk is not transferable from the sponsor to the syndicated banks. Additionally, we examine whether a country's legal system affects the leverage choice of a project company. Previous studies find that variations in effectiveness of financial systems (e.g., investor protection and law enforcement) around the world can be explained by the origin of a country's legal system (La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997), (1998), Djankov, McLiesh, and Shleifer (2007)). We do not find any significant relationship between project companies' leverage and their legal origins.

We also examine project companies' use of offtake agreements as a means of reducing project risk. An offtake agreement is a form of contract to buy/sell future products from the project. About 19% of project companies in our sample are associated with offtake agreements. Our results from probit regressions suggest that offtake agreements are more likely to be used by large project companies with high cash flow risk and low leverage.

We further explore the interaction between leverage and offtake agreements, given that sponsors can choose both simultaneously for project companies. A simultaneous estimation of leverage and the offtake agreement choice through the Heckman (1978) 2-stage procedure suggests that project companies use offtake agreements as a substitute rather than as a supplement to leverage. Additionally, our results show that project companies with the build-own-operate provision use less leverage and more offtake agreements relative to those companies with the build-transfer provision. This result implies that project companies that are more concerned with cash flow control (i.e., those with the build-own-operate provision) are more likely to adopt offtake agreements in lieu of using more leverage.

Overall, our results suggest that project companies utilize leverage and various contracts in order to manage project risk. In particular, we show that cash flow volatility is positively associated with leverage and offtake agreements. Given the negligible bankruptcy costs resulting from the lender's control over the project cash flow, the sponsors of a project company can rely on high leverage in order to minimize their risk exposure. Traditionally, cash flow volatility has been negatively associated with leverage in the presence of bankruptcy costs (Bradley, Jarrell, and Kim (1984), Wald (1999), and Booth, Aivazian, Demirguc-Kunt, and Maksimovic (2001)). However, other studies show a positive (Toy, Stonehill, Remmers, Wright, and Beekhuisen (1974), Long and Malitz (1985)), nonmonotonic (Kale and Shahrur (2007)), or insignificant (Titman and Wessels (1988)) relationship between leverage and cash flow volatility. Our finding is consistent with the implication of the Leland (2007) model, in which project risk plays an important role in a firm's decision to separate a project with its own capital structure, and the value of the option to walk away from the project increases with leverage. Furthermore, our findings suggest that project companies combine other contracts with leverage in managing project risk. Specifically, project companies that are more concerned with future cash flow control use more offtake agreements

https://doi.org/10.1017/S0022109013000082 Published online by Cambridge University Press

and less leverage, consistent with the argument that project companies optimally choose leverage and contract structures by trading off between project risk and cash flow control.

Project finance is similar to asset securitization in that both project finance and asset securitization are types of structured finance involving asset separation (Leland (2007)). In asset securitization, relatively low-risk financial claims are separately structured, whereas in project finance, relatively high-risk assets (e.g., infrastructure and natural resources) are separately structured. In this vein, both project finance and asset securitization may well be viewed as risk management strategies for various assets with differing risk levels (Esty (2002b), Leland (2007)). Our study suggests that capital and contract structures play a critical role in risk management strategy for project finance.

A spinoff is another form of asset separation. Leland (2007) suggests that project finance achieves financial synergies through separate capital structure and limited liabilities, whereas the principal reason for spinoffs is operational synergies. Chemmanur and John (1996) argue that a spinoff is preferred when the control benefit of its assets is large, whereas project finance is preferred when the control benefit of the project is small. Unlike other forms of asset separation that are structured as a going concern around existing assets, project finance is structured to finance assets that have a finite life and are yet to be built. Thus, the efficient allocation of various risks and future cash flows is the central issue in designing a project company and determining its optimal capital structure. Consistent with the theoretical models, our findings suggest that project sponsors with low control benefits of their projects give up cash flow control to lenders in return for reduced project risk exposure.

The rest of the paper is organized as follows: In Section II, we develop hypotheses. Section III describes the data with detailed sample selection procedures. Section IV delves into the characteristics of the sample. Section V presents the multivariate results with their implications. Section VI provides robustness checks of the results. Section VII offers the summary and concluding remarks regarding the implications of our findings.

## II. The Hypotheses

The sponsor, acting as the manager of a project company, makes the capital structure decision at the start of the project in order to finance it. The total project cost is financed with either senior bank loans or the sponsor's capital. We hypothesize that project companies trade off between the project cash flow control and risk exposure in obtaining their optimal capital structures. The sponsor of a project company (often as an equity holder) contributes its own funds toward the building of the project either as equity or subordinated debt. Given the finite life of the project, it is difficult to attract other equity holders. This means that the sponsor has a relatively large stake in the project and is not well diversified. Under these circumstances, the sponsor would prefer high leverage as a means of minimizing its risk exposure while maximizing its return from the project (Nevitt and Fabozzi (2000)). The Shah and Thakor (1987) model suggests that when there

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is high risk in project cash flow and low benefit of control over the project cash flow, there is a strong incentive for the project sponsor to maximize the return on the capital investment by leveraging the project company to a greater extent. Leland (2007) further argues that the formation of a separate project company with limited or nonrecourse debt provides a firm with valuable options to walk away from the project when cash flows are negative. The value of such options is higher for a high-risk project and with high leverage. In sum, the sponsor of a project company has a strong incentive to increase leverage in order to reduce its exposure to project risk as well as to increase the value of its investment in the project.

However, the sponsor's desire for high leverage is limited by the lender's willingness to provide leverage. We suggest that syndicated banks are willing to provide high leverage for the project company because they are well diversified across various projects through syndicated loans. Consistent with this argument, Kleimeier and Megginson (2000) provide evidence that banks are indeed far more willing to extend their loans to project companies with higher risks than they are to other firms. While assuming the significant part of the high project risk, however, banks require greater control over future cash flows from the project in order to secure the repayment of their lending. The lenders' control over cash flow prescribes the renegotiation process when the project company faces earnings shortfalls. Given the high tangibility of assets and few growth options in project finance, the financial distress cost is very low. In case of default, there is typically a penalty clause that applies; hence, a default can be a source of additional income for banks. This implies that there is little cost associated with bankruptcy. The lenders' control over project cash flow is also an important protection from potential agency problems associated with project finance. Aghion and Bolton (1992) and Dewatripont and Tirole (1994) show that banks are willing to provide more funds when they have greater control over the cash flows from the project. Huang (2009) also finds evidence that banks exert control over free cash flows in order to address the problems of creditor-shareholder conflicts and risk shifting for highly levered borrowers. This leads to the following hypothesis:

*Hypothesis 1.* Ceteris paribus, project companies with higher risk use more debt.

Another way of mitigating project risk is through an offtake agreement in which a producer and a buyer of a resource agree to sell/purchase portions of the producer's future production. An offtake agreement is normally negotiated prior to the completion of a project in order to secure a market for the future output of the project. Thus, an offtake agreement can be another means of reducing project risk. To the extent that an offtake agreement works as an alternative risk-managing mechanism to leverage, we expect project companies with offtake agreements to use less debt. Formally, we hypothesize as follows:

*Hypothesis 2.* Ceteris paribus, project companies with higher risk use more offtake agreements.

*Hypothesis 3.* Ceteris paribus, project companies with offtake agreements use less debt.

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We further explore the association between leverage and offtake agreements as alternative risk-managing mechanisms in project finance. Debt financing requires project companies or their sponsors to give control of the project cash flow to the lender, whereas an offtake agreement reduces uncertainty as to price and demand while maintaining cash flow control. Therefore, project sponsors who highly value cash flow control will use more offtake agreements and less leverage. Since project companies that own and operate the projects after their completion will more highly value the control of project cash flow than will those that transfer the projects to local authorities after their completion, we hypothesize as follows:

*Hypothesis 4.* Ceteris paribus, project companies with the build-own-operate provision use more offtake agreements and less leverage than do those with the build-transfer provision.

Whether or not country risk affects project companies' capital structures is another question we examine. Country risk can arise when there is a possibility that the local government might take adverse actions against the project company, which would result in a reduction of the project cash flow. These government actions can be imposed in various forms: for example, the local government may force the project company to pay higher taxes or to lower prices (e.g., highway tolls) when there are large profits. If country risk is nondiversifiable, banks will be reluctant to provide loans for project companies in high-risk countries. On the other hand, syndicated bank loans may make it more costly for the local government to take actions that jeopardize the repayment of the loans (see Moran (1973), Fruhan (1979), and Esty (2003)). In addition, highly leveraged transactions can ensure that there is little free cash flow to be expropriated by the host country's government. To the extent that syndicated banks prevent any adverse effect of government action on the project cash flow, we expect the sponsor to utilize more leverage in order to reduce country risk exposure. Given the potential effects (both positive and negative) of country risk on leverage, however, the relationship between leverage and country risk is an open empirical question.

In contrast, the local government of a high-risk country may provide concessions (e.g., land usage and tax exemption) and/or government grants in order to attract a project, the presence of which may lower the probability of the local government's adverse action. Also, multilateral agency involvement can negate the effect of an adverse government action.[4] In such cases, the project sponsor has less incentive to use leverage to mitigate the project risk. Thus, our 5th hypothesis follows:

*Hypothesis 5.* Ceteris paribus, project companies with government support or multilateral agency involvement use less debt.

[4]Multilateral agencies include the World Bank, the Inter-American Development Bank, the Asian Development Bank, and the European Bank for Reconstruction and Development. These agencies often act as lenders or cofinancers to projects in developing countries.

https://doi.org/10.1017/S0022109013000082 Published online by Cambridge University Press

## III. The Data

Our primary data on project finance come from the Project Finance database of the Thomson Financial Securities Data Corporation (SDC) for the period 1997–2006. The Project Finance database is a separate and comprehensive database included as part of the SDC Global Public Finance data. During this 10-year period, there were 8,365 project announcements in 149 nations. Previous empirical literature on project finance uses DealLogic or ProjectWare, both of which provide details on the structure and pricing of syndicated loans awarded to project-financed companies. Since many projects are financed with more than one loan tranche, multiple tranches can appear as separate observations in these data sources. In contrast, the primary observations of the Project Finance database are projects themselves based on project finance characteristics (Finnerty (2007)), and are thus more relevant to our inquiries. The Project Finance database also includes detailed descriptions of the most important characteristics of each project in the synopsis. Given that project descriptions in the synopsis are in text format, however, we have to manually extract some of the relevant information for our analyses by reading through the synopsis.

The SDC Project Finance database tracks projects from their preliminary stages, and many project proposals in the database do not materialize into project companies. Thus, we exclude uninitiated projects (classified as "canceled," "defaulted," or "rumored" by the SDC). We further exclude projects classified by the SDC as "nonclassical." Nonclassical project finance involves sponsors and syndicated banks but is not financed with limited or nonrecourse debt. The majority of excluded observations are in this category. We carefully read through the synopsis for each remaining project to verify that all projects in the sample are financed with limited or nonrecourse debt without data inconsistencies. We also exclude a small number of project-financed privatization deals that involve transfer of ownership rather than building a new project. After imposing these screens, our initial sample consists of 2,572 projects across 124 countries. Our sample is larger than any of the samples used in previous studies.

Figure 1 shows the yearly total amount of project finance and the number of projects over the sample period. In 1997, the total cost for 229 projects in the sample amounts to $103 billion. The total number of projects hits the lowest point, 171 projects, in 2001, and the total project cost is reduced to $74 billion in 2002. Both the number and the dollar amount of projects increase significantly after 2002. In 2006, the dollar cost invested in 302 projects drops to $76 billion. Note that the yearly figures in Figure 1 reflect only classic project finance with limited or nonrecourse debt and can differ from some aggregate figures reported in other studies (e.g., Esty (2004), (2005)).

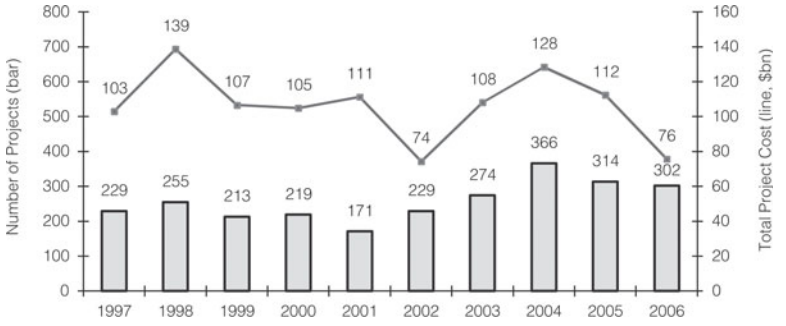
We acquire country risk scores from the EIU. The EIU risk models assess various risks in 120 emerging-market and industrial countries based on 60 indicator variables that include levels and changes in gross domestic product (GDP), inflation rates, foreign-exchange rates, social unrest, corruption, and Organisation for Economic Co-Operation and Development (OECD) short-term interest rates. Details on EIU risk scores are provided in Appendix A. The EIU provides 6 types of monthly risk scores with a scale of 0 to 100 (100 being the highest risk score)

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FIGURE 1

Project Numbers and Total Project Cost by Year

Figure 1 shows the number of projects (a bar graph) and total project cost (a line graph) by year. The total project cost is measured in billions of U.S. dollars. The sample includes 2,572 projects in 124 countries for the 10-year sample period from Jan. 1997 to Dec. 2006. The data are obtained from the Thomson Financial SDC Project Finance database.




as follows: i) sovereign risk, ii) currency risk, iii) banking sector risk, iv) political risk, v) economic structure risk, and vi) overall country risk. A yearly score is defined as the average of monthly scores for a given year. We use all 6 yearly scores in our analyses, but we report only the results associated with the overall country risk score.

The SDC provides 2 sorts of nation codes for each project: project company nation codes and project nation codes. A project company nation can differ from a project nation. For example, a project may be located in Ukraine, while its project company is registered in Kazakhstan. However, these 2 codes are identical in almost all our sample projects; hence, we simply use the project nation codes throughout our analyses.

In order to investigate the impact of legal protection on the project's financial structures, we follow La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1999) and classify project nations by their legal origins: that is, 4 legal families (English common law, French civil law, German civil law, and Scandinavian civil law) plus socialist law.[5] La Porta et al. (1997), (1998) argue that in terms of investor legal protection, common law countries are in general the strongest, and the French civil law countries are the weakest among the 4 legal families.

The SDC reports 4 different types of financing sources for a project company: i) senior debt, ii) subordinated debt, iii) equity, and iv) concession grants. For our main results, we define the leverage ratio (*LEV*) as senior debt divided by total project cost minus concession grants. We do not include subordinated debt in the numerator of the leverage ratio because the sponsor can contribute its own capital in the form of equity or subordinated debt (with equity embedded). Subordinated debt in project finance is often called "quasi" equity, since it effectively represents the residual claim on project cash flow.[6] We exclude concession grants

[5]The Appendix of La Porta et al. (1999) lists 206 nations categorized into 4 legal families plus socialist law.

[6]For example, the Chonan-Nonsan Expressway Project (CNEP), with the "build-own-operate" provision in South Korea, involves 2 sponsors with 100% share ownership. However, the project cost

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from total project costs in defining the leverage ratio in order to examine the effect of concession grants on firms' financing decisions.

In order to measure the expected cash flow (*CF*) and cash flow volatility (*VOL*), we first obtain time series of yearly cash flows (industry median earnings before interest, taxes, depreciation, and amortization (EBITDA) divided by total assets) over 10 years prior to the project installment. We then measure the expected cash flow and cash flow volatility by the mean and the standard deviation of the 10-year time series of industry cash flows. By using data on international firms from the Global Compustat database, we first estimate the expected cash flow and cash flow volatility based on firms in the same country (according to the project nation code) and industry (according to the 2-digit Standard Industrial Classification (SIC) code) as those of project companies. We require a matching firm's asset value to be greater than $1 million. We also require a minimum of 5 firms in the same industry. In this way, we are able to match 1,375 projects in 34 countries. For a robustness check, we also try 3-digit SIC codes to match industries.

As an alternative to the country-industry matching, we also match each project by its 2-digit SIC code using the U.S. Compustat firms. This approach assumes that, given relatively frictionless capital markets in the United States, one could identify an industry's cash flow free from country-specific frictions, and that such cash flow carries over to projects in other countries. This approach also eases the concern that international firms' earnings depend on country-specific accounting conventions that may not be easily comparable across countries. U.S. industry matching allows us to consider a much larger sample: We match 2,361 projects in 118 countries.

## IV. Project Characteristics

Table 1 provides project distribution across 27 industries. Out of 2,572 projects in the sample, there are 1,028 projects related to the utilities industry sector (hydroelectric, nuclear, coal power plants, etc.). Other industry sectors associated with large numbers of project finance include construction, communication, and oil and gas. The *LEV* (leverage) column of Table 1 indicates that there is considerable variation in leverage ratios across industries. The average total project cost (*TC*) of the railroads industry is the highest ($979.6 million), followed by that of the communication sector ($802.6 million). The utilities sector tends to have a higher proportion (38%) of offtake agreements (*OFFT*). Projects in the healthcare, public administration, and construction sectors are associated with more local government concession grants and support (*GSUP*).

Table 2 presents the descriptive statistics of project nations by legal origin and geographical region. About 52% of the projects are located in nations with legal systems originating from the English common law. French civil law nations account for 31% of the total projects. In terms of geographical regions, Europe

for CNEP is 100% debt financed by syndicated and subordinated loans. In this case, the subordinated debt contributed by the sponsors is combined with implicit equity.

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TABLE 1

Projects by Industry

The sample consists of 2,572 projects in 124 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Projects are classified by 2-digit SIC code. Industry mean values are provided for leverage (*LEV*), total project costs (*TC*, $millions), country risk core (*COURISK*), the proportion (%) of projects with offtake agreements (*OFFT*), and the proportion (%) of projects with government grants and support (*GSUP*). Detailed variable definitions are provided in Appendix B.

| Name | No. of Obs. | *LEV* | *TC* | *COURISK* | *OFFT* | *GSUP* |
|---|---|---|---|---|---|---|
| Agricultural products, forestry | 4 | 1.000 | 70.6 | 34.3 | 0.0% | 0.0% |
| Mining | 111 | 0.843 | 219.6 | 39.6 | 14.4% | 9.9% |
| Oil & gas | 141 | 0.864 | 534.5 | 37.5 | 15.6% | 29.1% |
| Construction | 469 | 0.917 | 266.8 | 23.2 | 1.1% | 63.1% |
| Food | 5 | 1.000 | 117.6 | 32.3 | 20.0% | 0.0% |
| Apparel | 3 | 1.000 | 42.4 | 41.3 | 0.0% | 0.0% |
| Lumber, wood products & paper | 12 | 0.736 | 245.4 | 35.2 | 8.3% | 16.7% |
| Chemicals | 86 | 0.802 | 546.4 | 35.2 | 33.7% | 30.2% |
| Petroleum refining, rubber & plastics | 46 | 0.831 | 649.7 | 35.1 | 9.9% | 41.3% |
| Cement & glass products | 15 | 0.874 | 226.8 | 36.6 | 13.3% | 20.0% |
| Steel & nonferrous metals | 54 | 0.807 | 418.4 | 43.2 | 16.7% | 14.8% |
| Machinery | 4 | 0.902 | 34.0 | 28.2 | 25.0% | 25.0% |
| Electronic and electrical products | 18 | 0.909 | 286.2 | 23.2 | 0.0% | 50.0% |
| Transportation equipment | 27 | 0.928 | 606.3 | 32.9 | 7.4% | 22.2% |
| Railroads | 45 | 0.793 | 979.6 | 27.0 | 0.0% | 55.6% |
| Highway transportation | 16 | 0.977 | 348.7 | 28.8 | 0.0% | 12.5% |
| Water transportation | 54 | 0.860 | 300.9 | 35.8 | 1.9% | 27.8% |
| Air transportation | 44 | 0.957 | 611.2 | 32.7 | 0.0% | 40.9% |
| Other transportation services | 15 | 0.863 | 433.1 | 34.2 | 0.0% | 0.0% |
| Communication | 186 | 0.870 | 802.6 | 35.9 | 3.2% | 7.0% |
| Utilities | 1,028 | 0.905 | 405.0 | 27.5 | 38.0% | 23.3% |
| Hotels | 20 | 0.900 | 214.5 | 32.8 | 0.0% | 15.0% |
| Other services | 25 | 0.938 | 126.0 | 22.8 | 4.0% | 56.0% |
| Amusement & recreation | 18 | 0.818 | 701.6 | 23.6 | 0.0% | 55.6% |
| Healthcare | 108 | 0.953 | 105.1 | 18.9 | 1.9% | 79.6% |
| Public administration | 16 | 0.934 | 80.1 | 23.0 | 0.0% | 68.8% |
| Others | 2 | 1.000 | 25.2 | 32.3 | 0.0% | 0.0% |
| Avg. | | 0.892 | 413.4 | 29.1 | 19.2% | 33.4% |

has 42% of the total number of projects, while Asia and the Americas have 25% and 24%, respectively.

Panel C of Table 2 shows that the average values of 6 EIU country risk scores range from 26.46 to 30.85 (out of the 1 to 100 range), with the political risk scores exhibiting the largest variation. The overall minimum score is the U.S. sovereign risk score (2.5) in 1999, while the overall maximum score is Zambia's economic structure risk score (96.5) in 1997.

Table 3 gives the summary statistics for the variables that demonstrate project characteristics. The maximum and minimum leverage ratios (*LEV*) are 100% and 0%, respectively, and the mean value is 89.2%, which is consistent with the high leverage of project companies reported in Esty (2002a), (2003), (2004), and (2005) and Esty and Megginson (2003). The following are the definitions of the other variables reported in Table 3. We also provide descriptions of the variables in Appendix B.

*SIZE* = the logarithm of the total project cost as a measure of project size. An increase in project size can be a proxy for a reduction in default risk or project risk. However, size can also increase project risk if the high-profile nature of a large project draws more attention from the local government, which might in turn increase the probability of the local government taking an adverse action

https://doi.org/10.1017/S0022109013000082 Published online by Cambridge University Press

TABLE 2

Legal Origin, Geographic Distribution, and Country Risk of Project Companies

Table 2 lists the descriptive statistics of project nations by their legal origins, geographical distribution, and risk scores. The sample consists of 2,572 projects in 124 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. The data on legal origins of project nations are from La Porta et al. (1999). Six country risk scores range from 0 (lowest) to 100 (highest): The data are obtained from the Economist Intelligence Unit.

| | No. of Obs. | % of Total | | |
|---|---|---|---|---|
| *Panel A. Legal Origin* | | | | |
| English common law | 1,336 | 51.94% | | |
| Socialist law | 150 | 5.83% | | |
| French civil law | 793 | 30.83% | | |
| German civil law | 278 | 10.81% | | |
| Scandinavian civil law | 13 | 0.51% | | |
| Total obs. | 2,572 | | | |
| *Panel B. Geographical Distribution* | | | | |
| Africa/Middle East | 211 | 8.20% | | |
| Americas | 627 | 24.38% | | |
| Asia/Oceania | 642 | 24.96% | | |
| Europe | 1,092 | 42.46% | | |
| Total obs. | 2,572 | | | |
| | Mean | St. Dev. | Max. | Min. |
| *Panel C. Country Risk Scores* | | | | |
| Overall country risk | 29.12 | 14.39 | 84.50 | 12.50 |
| Sovereign risk | 27.26 | 16.42 | 87.50 | 2.50 |
| Currency risk | 29.83 | 11.83 | 79.25 | 13.00 |
| Banking sector risk | 30.85 | 15.84 | 86.50 | 12.00 |
| Political risk | 26.46 | 18.69 | 86.00 | 6.00 |
| Economic structure risk | 29.08 | 17.16 | 96.50 | 8.00 |

TABLE 3

Descriptive Statistics

The sample consists of 2,572 projects in 124 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Here, *LEV* is the leverage ratio defined as senior debt divided by total project cost net of concession grants; *TC* is total project capitalization; *SIZE* is the natural logarithm of total project capitalization; *SPON* is the number of sponsors; *GSUP* is a dummy variable for the presence of local government grants and support; *MULTIA* is a dummy variable for the presence of multilateral agency; *OFFT* is a dummy variable for the presence of an offtake agreement; *MULT* is a dummy variable for a multinational project; and *F500* is a dummy variable for a sponsor in Fortune 500. Detailed variable definitions are provided in Appendix B. The percentages (%) are the number of observations with dummy variable equal to 1 (Sum) divided by the total number of observations times 100.

| Continuous Variables | Mean | St. Dev. | Max. | Min. | Total Available Obs. |
|---|---|---|---|---|---|
| *LEV* | 0.892 | 0.232 | 1.000 | 0.000 | 2,572 |
| *TC* (million $) | 413.4 | 857.2 | 16,582.4 | 1.2 | 2,572 |
| *SIZE* | 5.037 | 1.408 | 9.716 | 0.182 | 2,572 |
| *SPON* | 2.055 | 1.476 | 12 | 1 | 2,483 |
| Dummy Variables [0,1] | Sum | % of Total | | | Total Available Obs. |
| *GSUP* | 859 | 33.40% | | | 2,572 |
| *MULTIA* | 133 | 5.17% | | | 2,572 |
| *OFFT* | 495 | 19.25% | | | 2,572 |
| *MULT* | 34 | 1.32% | | | 2,572 |
| *F500* | 323 | 12.98% | | | 2,488 |

against the project company. In Table 3, the average project cost (*TC*) is $413.4 million, with a maximum of $16.6 billion.

*SPON* = the number of sponsors in a project company. A sponsor is one who originates and structures a project with equity ownership in the project company.

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If a larger number of sponsors reflects increased equity financing (as an alternative to debt financing), then it will be negatively associated with leverage. In Table 3, the average number of sponsors in a project is about 2, and the maximum number is 12.

*GSUP* = a dummy variable indicating whether project finance includes a concession grant or any support by the local government. Local government support may include equity participation, guaranteeing a concession, tax incentives, providing infrastructure, lending funds to the project, or granting permission to exploit, develop, construct, and operate a facility or a project. A concession grant or government support reflects the willingness of the host government to cooperate with the project company and is often a crucial factor in initiating a project. Thus, government support is considered to be risk mitigating for a project. Table 3 reports that 859 out of 2,572 projects (or 33.4%) have concession grants or support from local governments.

*MULTIA* = a dummy variable indicating whether project finance involves multilateral agency loans or grants. The presence of such agencies can be associated with countries where financing would not occur if not for the involvement of these agencies. On the other hand, the presence of multilateral agencies with worldwide reputations could lower project risk, ceteris paribus. There are 133 projects (5.17%) involving multilateral agencies (Table 3). Here we identify only projects with monetary loans and grants toward project costs from multilateral agencies. For this reason, *MULTIA* may underestimate the true extent of multilateral agencies' involvement, which also includes providing loan guarantees, infrastructure, and other nondirect project costs. Multilateral agencies also provide political risk insurance to protect a project sponsor against the risks of capital controls, expropriation, or other adverse and unexpected political events.

*OFFT* = a dummy variable indicating the existence of an offtake arrangement to purchase all or a substantial part of the product produced by the project. Such an agreement reduces the uncertainty of project cash flow (Esty (2006)). Offtake arrangements also deter opportunistic behavior by a key supplier or mitigate the asset hold-up problem resulting from asset specificity (Esty (2003)). There are 495 projects (19.25%) with offtake agreements.

*MULT* = a dummy variable indicating whether a project is located in more than 1 nation (e.g., telecommunication projects). Multinational projects may be subject to more risk from multiple countries. On the other hand, country-specific risk can be diversified with multinational projects, mitigating the overall country risk. Table 3 indicates that there is a relatively small number (34 or 1.32%) of multinational projects.

*F500* = a dummy variable indicating whether a sponsor is a Fortune 500 firm. This variable is intended to capture any reputation effect that a sponsor might have on the financing ability of a project. There are 323 projects (12.98%) with Fortune 500-ranked sponsors, as indicated in Table 3.

We report the distribution of project companies across 9 contract types and 10 offtake agreement types in Table 4. In Panel A, about 66% of project companies (1,696 out of 2,572) are founded with the provision of build-own-operate. Most remaining project companies include the provision of "transfer." Not

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surprisingly, most public-private partnership projects (93.4%) are associated with concession grants or support from local governments.

TABLE 4

Projects by Contract Type and Offtake Agreement

The sample consists of 2,572 projects in 124 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Projects are classified into 9 contract types and 10 offtake agreement types. Averages are reported for the leverage ratio (*LEV*), total project costs (*TC*), and overall country score (*COURISK*); *OFFT* and *GSUP* are the proportions (%) of projects with offtake agreements and government grants and support, respectively. Detailed variable definitions are provided in Appendix B. Types of offtake agreements are explained in Appendix C.

| | No. of Obs. | *LEV* | *TC* | *COURISK* | *OFFT* | *GSUP* |
|---|---|---|---|---|---|---|
| *Panel A. Projects by Contract Type* | | | | | | |
| Acquisition | 263 | 0.915 | 747.1 | 24.7 | 20.5% | 9.9% |
| Public-private partnership | 166 | 0.895 | 453.3 | 23.4 | 5.4% | 93.4% |
| Build-own-operate | 1,696 | 0.891 | 390.8 | 31.1 | 21.8% | 24.9% |
| Build-own-operate-transfer | 51 | 0.764 | 479.0 | 36.6 | 39.2% | 33.3% |
| Lease-transfer | 24 | 0.779 | 230.8 | 35.5 | 25.0% | 45.8% |
| Build-operate-transfer | 169 | 0.888 | 368.0 | 30.7 | 14.2% | 53.3% |
| Build-own-transfer | 10 | 0.840 | 119.1 | 23.4 | 10.0% | 70.0% |
| Build-transfer-operate | 18 | 0.989 | 148.0 | 27.6 | 5.6% | 72.2% |
| Others | 175 | 0.918 | 187.0 | 18.5 | 5.7% | 66.9% |
| | | No. of Obs. | *LEV* | *TC* | *COURISK* | *GSUP* |
| *Panel B. Projects by Offtake Agreement* | | | | | | |
| Without offtake agreement | | 2,077 | 0.899 | 384.9 | 29.0 | 33.8% |
| With offtake agreement | | 495 | 0.864 | 533.1 | 29.8 | 31.7% |
| Capacity & tolling agreement | | 32 | 0.918 | 544.5 | 17.1 | 6.3% |
| Energy sales contract | | 10 | 0.953 | 462.4 | 34.4 | 30.0% |
| Merchant power plant | | 24 | 0.889 | 545.7 | 17.5 | 12.5% |
| Power purchase agreement | | 261 | 0.859 | 425.2 | 30.0 | 29.1% |
| Take and pay | | 114 | 0.854 | 732.0 | 34.1 | 41.2% |
| Take or pay | | 33 | 0.845 | 554.2 | 35.1 | 48.5% |
| Throughput agreement | | 5 | 0.758 | 1,153.2 | 34.7 | 40.0% |
| Waste supply contract | | 5 | 0.968 | 191.5 | 21.8 | 80.0% |
| Contract for differences | | 3 | 0.843 | 1,822.5 | 24.1 | 33.3% |
| Others | | 8 | 0.872 | 482.1 | 21.2 | 37.5% |

In Panel B of Table 4, the most common offtake agreement is "power purchase agreement," in which the power plant has an agreement to sell a certain amount of electricity at an agreed-upon price.[7] Another common offtake agreement is "take-and-pay," in which the off-taker pays the agreed-upon price for the amount of products taken. "Take-or-pay" is an offtake agreement in which the off-taker is obliged to pay for the specified amount of products on a regular basis, whether or not the off-taker takes the product. We list some of the widely used offtake agreements in Appendix C.

Table 5 reports correlation coefficients among the variables used in this study based on U.S. industry-matched cash flows. Country risk (*COURISK*) is negatively correlated with expected cash flow (*CF*) with a magnitude of −0.20. There is also a significant and positive correlation (0.25) between country risk and the

[7]Given that offtake agreements are dominated by "power purchase agreement," we include project type dummy variables in our regressions. Additionally, we check the robustness of our results for a sample of projects excluding those with "power purchase agreement." The effect of an offtake agreement on leverage becomes weaker but remains significant (not reported).

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multilateral agency dummy variable (*MULTIA*), suggesting that projects in high-risk countries tend to involve multilateral agencies. *CF* is negatively correlated with cash flow volatility (*VOL*) (−0.27), while it is positively correlated with government concession grants and support (*GSUP*) (0.28). It appears that local governments provide more concession grants and support for projects with higher expected cash flows. Project size (*SIZE*) tends to be positively correlated with the number of sponsors (*SPON*) and the Fortune 500 dummy variable (*F500*), suggesting that larger projects are associated with more and larger sponsors. There are also significant and positive correlations between local government support and the number of sponsors, both of which can be risk-reducing features in project finance. There are also significant and positive correlations between the Fortune 500 dummy variable (*F500*) and project size (*SIZE*). An offtake agreement (*OFFT*) is positively and significantly correlated with cash flow volatility (*VOL*) and the Fortune 500 dummy variable (*F500*), while it is negatively and significantly correlated with expected cash flow (*CF*). We address the multicollinearity issue in the robustness section.

TABLE 5

Correlation Coefficients

The sample consists of 2,361 projects in 118 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Table 5 gives Pearson correlation coefficients among variables: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (cash flow volatility); *SIZE* (the natural logarithm of total project costs (*TC*)); *GSUP* (government grants and support); *MULTIA* (multilateral agency); *SPON* (number of sponsors); *F500* (sponsor in Fortune 500); *OFFT* (offtake agreement); and *MULT* (multinational project). Detailed variable definitions are provided in Appendix B. The statistical significance at the 5% level is highlighted in bold.

| Variables | *COURISK* | *CF* | *VOL* | *SIZE* | *GSUP* | *MULTIA* | *SPON* | *F500* | *OFFT* |
|---|---|---|---|---|---|---|---|---|---|
| *CF* | **−0.204** | | | | | | | | |
| *VOL* | 0.029 | **−0.273** | | | | | | | |
| *SIZE* | 0.036 | **−0.050** | **0.057** | | | | | | |
| *GSUP* | **−0.055** | **0.280** | **−0.251** | 0.019 | | | | | |
| *MULTIA* | **0.249** | −0.038 | 0.012 | **0.063** | 0.029 | | | | |
| *SPON* | **0.054** | **0.093** | **−0.139** | **0.255** | **0.172** | **0.108** | | | |
| *F500* | **−0.093** | **−0.105** | **0.175** | **0.248** | **−0.113** | 0.039 | **0.086** | | |
| *OFFT* | 0.013 | **−0.233** | **0.282** | **0.165** | −0.026 | **0.071** | **0.056** | **0.216** | |
| *MULT* | −0.018 | 0.017 | −0.030 | **0.102** | −0.040 | 0.030 | 0.026 | 0.018 | 0.013 |

## V. Multivariate Analysis

### A. Project Risk and Leverage

In order to test how project companies' leverage ratios are associated with their project risk characteristics, we estimate the following regression:

$$(1) \qquad LEVadj = \alpha + \beta_1 COURISK + \beta_2 CF + \beta_3 VOL + \beta_4 OFFT + \beta_5 GSUP + \beta_6 MULT + \beta_7 MULTIA + \beta_8 SPON + \beta_9 SIZE + \beta_{10} F500 + Others + \varepsilon,$$

where *LEVadj* is the industry-adjusted leverage ratio (measured by subtracting from *LEV* the median total debt-to-asset ratio of firms matched by 2-digit SIC

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code in a given year).[8] We adjust project leverage by the median debt-to-asset ratio of industry-year matched firms in order to account for industry-specific effects. The independent variables are as follows: *COURISK* is the EIU overall country risk score; *CF* is the expected cash flow measured by the 10-year average of industry cash flows; and *VOL* is the standard deviation of industry cash flows over the 10-year period prior to the announcement of the project. Other independent variables are defined in the previous section. According to Hypothesis 1, that the sponsor uses leverage to mitigate its exposure to project risk, we expect that the leverage ratio for the project company is positively associated with cash flow volatility (*VOL*) ($\beta_3 > 0$). Since an offtake agreement (*OFFT*) is intended to reduce project risk by reducing uncertainty in supply/demand on the project company's products, Hypothesis 3 predicts a negative relationship between leverage and offtake agreements ($\beta_4 < 0$). Based on Hypothesis 5, we also expect that the leverage ratio is negatively associated with other risk-reducing features, such as local government concession grants and support (*GSUP*) and multilateral agency involvement (*MULTIA*) ($\beta_5 < 0$ and $\beta_7 < 0$). To the extent that the given amount of risk exposure can be shared by multiple sponsors or that large projects are associated with less risk, projects that have more sponsors (*SPON*) or that are larger (*SIZE*) may require less leverage. We also include the Fortune 500 firm dummy variable (*F500*) and multinational project dummy variable (*MULT*) to control for the reputation and size effect of sponsors and the multicountry scope of a project. Project type and legal origin dummy variables (*Others*) are included as additional controls.

We first report the regression results based on the country industry-matched cash flows and median debt ratio in Table 6. The 1st regression is based on the ordinary least squares (OLS). The adjusted leverage ratio (*LEVadj*) has its highest bound at 100%. Thus, we also run censored regressions (Tobit) with robust standard errors. However, the results are similar in both estimations. The coefficient estimates of the expected cash flow (*CF*) are negative and highly significant, suggesting that project companies with higher expected project cash flows use less leverage. Project companies may perceive more benefits of cash flow control and use less leverage when expected cash flows are greater. Alternatively, sponsors may invest more in the project in the form of equity when expected cash flows are larger.

Cash flow volatility (*VOL*) is positively associated with leverage, while an offtake agreement (*OFFT*) is negatively associated with leverage. These estimates suggest that project companies use more leverage when cash flow risk is high and less leverage when there is a risk-reducing offtake agreement in place, consistent with Hypotheses 1 and 3. The coefficient estimates of concession grants and support (*GSUP*) are negative but not significant. The coefficient estimates of multinational project (*MULT*) and multilateral agency involvement (*MULTIA*) are significant and negative. The significant coefficient estimate for *MULTIA* supports Hypothesis 5, that the presence of risk-mitigating features reduces the sponsor's incentive to use leverage. Note that we exclude concession grants or multilateral

[8] We obtain the industry median debt-to-asset ratio from the same firms that we match for cash flow.

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TABLE 6

Leverage Regression Results Based on the Country Industry-Matched Sample

The sample consists of 1,375 projects in 34 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Here, *LEVadj* is the industry-adjusted leverage ratio defined as the total amount of senior debt divided by total project costs minus concession grants, adjusted by industry median debt ratio based on 2-digit SIC code. An OLS and 2 Tobit models are estimated with *LEVadj* as the dependent variable. Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (cash flow volatility); *OFFT* (offtake agreement); *GSUP* (government grants and support); *MULT* (multinational project); *MULTIA* (multilateral agency); *SPON* (number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); and *F500* (sponsor in Fortune 500). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variable: *LEVadj* | | |
|---|---|---|---|
| | | Tobit | |
| Independent Variables | OLS | Model 1 | Model 2 |
| *COURISK* | −0.0007<br>(0.0006) | −0.0012**<br>(0.0005) | −0.0007<br>(0.0006) |
| *CF* | −0.8722***<br>(0.1293) | −0.9695***<br>(0.1394) | −0.9663***<br>(0.1400) |
| *VOL* | 0.7926**<br>(0.3165) | 0.9936***<br>(0.3078) | 0.8026**<br>(0.3167) |
| *OFFT* | −0.0811***<br>(0.0138) | −0.0786***<br>(0.0135) | −0.0824***<br>(0.0137) |
| *GSUP* | −0.0027<br>(0.0133) | −0.0025<br>(0.0134) | −0.0040<br>(0.0133) |
| *MULT* | −0.1363**<br>(0.0641) | −0.1190*<br>(0.0625) | −0.1355**<br>(0.0629) |
| *MULTIA* | −0.3674***<br>(0.1081) | −0.3818***<br>(0.1087) | −0.3684***<br>(0.1074) |
| *SPON* | 0.0021<br>(0.0041) | −0.0002<br>(0.0042) | 0.0020<br>(0.0041) |
| *SIZE* | −0.0056<br>(0.0043) | −0.0046<br>(0.0043) | −0.0059<br>(0.0043) |
| *F500* | −0.0341**<br>(0.0138) | −0.0236*<br>(0.0133) | −0.0345**<br>(0.0137) |
| Intercept | 0.7729***<br>(0.0406) | 0.7676***<br>(0.0396) | 0.7846***<br>(0.0413) |
| Project type dummies | Yes | Yes | Yes |
| Legal origin dummies | Yes | No | Yes |
| $R^2$ | 0.1916 | | |
| Likelihood ratio ($\chi^2$) | | 12.52*** | 210.87*** |

agency financing from our leverage definition so that they do not mechanically decrease the leverage ratio. Country risk (*COURISK*) tends to be negatively associated with leverage, but it is significant only when we exclude legal origin dummy variables. Unlike project-specific risk, country risk appears to be nontransferable from the sponsor to syndicated banks. This implies that banks are less willing to extend their syndicated loans to project companies in high-risk countries. The negative and significant coefficient estimates of *F500* suggest that large sponsors use less leverage.

We also report the results based on the U.S. industry-matched sample in Table 7. The positive and negative coefficient estimates of *VOL* and *OFFT*, respectively, remain highly significant, confirming the results in Table 6 regarding Hypotheses 1 and 3. The estimates of *CF* are now positive but insignificant. *SIZE* is negatively and significantly associated with leverage. Project size, much like firm size, can be considered an inverse measure of project risk. Thus, larger project companies may require less leverage as a means of reducing the sponsor's

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risk exposure. Interestingly, Rajan and Zingales (1995) also find the negative relationship between leverage and firm size in G7 countries. However, most U.S. studies find a positive relationship between leverage and firm size and suggest that larger firms have lower default risk and lower costs of financial distress. The estimates of other risk-reducing features (*GSUP* and *MULTIA*) are significant and negative, supporting Hypothesis 5.

TABLE 7

Leverage Regression Results Based on the U.S. Industry-Matched Sample

The sample consists of 2,361 projects in 118 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Here, *LEVadj* is the industry-adjusted leverage ratio defined as the total amount of senior debt divided by total project costs minus concession grants, adjusted by industry median debt ratio based on 2-digit SIC code. An OLS and 2 Tobit models are estimated with *LEVadj* as the dependent variable. Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (cash flow volatility); *OFFT* (offtake agreement); *GSUP* (government grants and support); *MULT* (multinational project); *MULTIA* (multilateral agency); *SPON* (number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); and *F500* (sponsor in Fortune 500). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variable: *LEVadj* | | |
|---|---|---|---|
| | | Tobit | |
| Independent Variables | OLS | Model 1 | Model 2 |
| *COURISK* | 0.0003<br>(0.0003) | 0.0001<br>(0.0003) | 0.0003<br>(0.0003) |
| *CF* | 0.0798<br>(0.0657) | 0.0508<br>(0.0700) | 0.0515<br>(0.0695) |
| *VOL* | 0.8269***<br>(0.2915) | 0.7201**<br>(0.2920) | 0.7816***<br>(0.2936) |
| *OFFT* | −0.0568***<br>(0.0098) | −0.0557***<br>(0.0097) | −0.0581***<br>(0.0098) |
| *GSUP* | −0.0171*<br>(0.0091) | −0.0175*<br>(0.0091) | −0.0170*<br>(0.0091) |
| *MULT* | −0.0993***<br>(0.0364) | −0.0996***<br>(0.0361) | −0.0995***<br>(0.0362) |
| *MULTIA* | −0.3099***<br>(0.0405) | −0.3128***<br>(0.0402) | −0.3106***<br>(0.0404) |
| *SPON* | −0.0033<br>(0.0028) | −0.0042<br>(0.0027) | −0.0033<br>(0.0028) |
| *SIZE* | −0.0075**<br>(0.0029) | −0.0072**<br>(0.0029) | −0.0076***<br>(0.0030) |
| *F500* | −0.0249**<br>(0.0112) | −0.0208*<br>(0.0111) | −0.0254**<br>(0.0112) |
| Intercept | 0.6728***<br>(0.0290) | 0.6781***<br>(0.0294) | 0.6809***<br>(0.0297) |
| Project type dummies | Yes | Yes | Yes |
| Legal origin dummies | Yes | No | Yes |
| $R^2$ | 0.1606 | | |
| Likelihood ratio ($\chi^2$) | | 12.73*** | 10.88*** |

Overall, the results in Tables 6 and 7 suggest that project companies use more leverage in the presence of higher cash flow risk, but less leverage in the presence of risk-reducing features.

## B. Offtake Agreements

An offtake agreement involves a contract to buy/sell the project's future output, which directly reduces cash flow risk. Thus, we expect project companies

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with high cash flow volatility to prefer offtake agreements (Hypothesis 2). Also, as an alternative risk-managing mechanism to leverage, we expect project companies with offtake agreements to use less leverage (Hypothesis 3). An alternative argument is that an offtake agreement is arranged in order to make it easier for the project company to obtain financing for the construction of the project. In that case, we may observe a positive association between leverage and offtake agreements. In order to test these hypotheses, we estimate the probit model with the offtake agreement indicator (*OFFT*) as the dependent variable and other control variables used in equation (1) and the industry-adjusted leverage ratio (*LEVadj*) as independent variables.

We report the estimation results in Table 8 for both the country industry-matched sample and the U.S. industry-matched sample. Consistent with our hypotheses, the coefficient estimates of cash flow volatility (*VOL*) are positive and highly significant, whereas the coefficient estimates of industry-adjusted leverage ratio (*LEVadj*) are negative and highly significant. The coefficients on

TABLE 8

Offtake Probit Regression Results

The samples consist of 1,375 projects in 34 countries for the country industry-matched sample and 2,361 projects in 118 countries for the U.S. industry-matched sample, respectively, for the 10-year sample period from Jan. 1997 to Dec. 2006. The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. Probit models are estimated with *OFFT* (a dummy variable indicating the use of offtake agreement) as the dependent variable. Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (cash flow volatility); *LEVadj* (industry-adjusted leverage ratio); *GSUP* (government grants and support); *MULT* (multinational project); *MULTIA* (multilateral agency); *SPON* (number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); and *F500* (sponsor in Fortune 500). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variable: *OFFT* | |
|---|---|---|
| Independent Variables | Country Industry-Matched Sample | U.S. Industry-Matched Sample |
| *COURISK* | −0.0157*** | 0.0025 |
| | (0.0048) | (0.0027) |
| *CF* | −1.0012 | 1.9921** |
| | (0.9455) | (0.9078) |
| *VOL* | 13.0222*** | 47.4825*** |
| | (3.2272) | (3.8907) |
| *LEVadj* | −1.3383*** | −0.6052*** |
| | (0.2244) | (0.1688) |
| *GSUP* | −0.0554 | −0.2936*** |
| | (0.1105) | (0.0780) |
| *MULT* | −0.3522 | −0.3007 |
| | (0.3861) | (0.3044) |
| *MULTIA* | 0.1119 | −0.1953 |
| | (0.4422) | (0.1869) |
| *SPON* | 0.0416 | 0.0709*** |
| | (0.0336) | (0.0233) |
| *SIZE* | 0.0845** | 0.1083*** |
| | (0.0335) | (0.0258) |
| *F500* | 0.3793*** | 0.3845*** |
| | (0.1152) | (0.0913) |
| Intercept | −0.6195* | −3.0698*** |
| | (0.3217) | (0.2773) |
| Project type dummies | Yes | Yes |
| Legal origin dummies | Yes | Yes |
| Likelihood ratio ($\chi^2$) | 155.84*** | 316.75*** |
| No. of obs. | 1,366 | 2,339 |

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*SIZE* and *F500* carry significantly positive signs, suggesting that large projects and those with large sponsors tend to have more offtake agreements.

## C. Offtake Agreements and Leverage: A Simultaneous Equations Model

Our results in previous sections show that project companies with offtake agreements use less leverage and vice versa, suggesting that offtake agreements can be important risk-mitigating alternatives to leverage for project companies. This implies that project companies that highly value the control of project cash flow may rely more on offtake agreements and less on leverage. Since project companies are likely to make decisions simultaneously for both leverage and offtake agreements, the regression estimates that include an indicator variable for offtake agreements may be subject to bias. In order to address this issue, we use a simultaneous equations model that allows interactions between the choice of an offtake agreement and the effect of cash flow risk on the leverage ratio. The Heckman (1978) procedure allows us to more closely examine the association between leverage and an offtake agreement.

We proceed in 2 stages. First, we retain the nonselection hazard (or inverse Mills ratio (*IMR*)) from the following probit estimation:

$$\Pr(OFFT = 1) = \frac{1}{1 + e^{\alpha + X\beta'}}, \tag{2}$$

where *OFFT* is the dependent variable with a value of 1 for projects with offtake agreements, and 0 otherwise; and *X* is the vector of independent variables used in equation (1). We drop the project type and legal origin dummy variables but add an indicator variable for a project with the build-own-operate provision (*OPER*). According to Hypothesis 4, if the control of project cash flow is more important when the project company continues to operate the project after its completion (relative to projects with the transfer provision), then we expect the project company to use more offtake agreements and less leverage in order to retain more control over project cash flow while reducing project risk.

Next, we estimate the following Tobit regression model:

$$\begin{aligned} LEVadj = {} & a + b_1 COURISK + b_2 CF + b_3 VOL + b_4 GSUP \\ & + b_5 MULT + b_6 MULTIA + b_7 SPON + b_8 SIZE + b_9 F500 \\ & + b_{10} OPER + b_{11} IMR + \varepsilon, \end{aligned} \tag{3}$$

where *IMR* is the inverse Mills ratio obtained in the 1st-stage probit regression. *IMR* adjusts for the nonzero conditional error terms. If an offtake agreement substitutes for leverage as an alternative risk-reducing mechanism, then the leverage ratio should be lower for project companies with an offtake agreement relative to those without such an agreement. In this case, the expected error in the leverage regression should be negatively correlated with the error in the probit model. This means that the coefficient for the inverse Mills ratio will be negative. On the other hand, if high-risk project companies tend to utilize high leverage and offtake agreements simultaneously in order to mitigate their project risk, we expect the coefficient for the inverse Mills ratio to be positive. We use the formula suggested by Greene (1981) to correct the standard errors for the 2nd-stage Tobit regression.

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In Table 9, we report estimation results for the 2-stage Heckman (1978) procedure for the country industry-matched sample. In the 1st-stage probit regression, the coefficient estimate for the build-own-operate provision (*OPER*) is significant and positive, indicating that project companies that own and operate the projects after their completion are more likely to use offtake agreements than are project companies that transfer the projects to the local agencies. The positive and significant estimates of cash flow volatility (*VOL*) are consistent with the hypothesis that greater project risk leads to a higher probability of adopting an offtake agreement. There is also a significant and negative association between country risk (*COURISK*) and the probability of having an offtake agreement. The positive and significant coefficient estimates of project size (*SIZE*) and large sponsors (*F500*) suggest that project companies are more likely to implement offtake agreements when the project size is larger and when the sponsor is a larger company.

TABLE 9

Estimation Results for the 2-Stage Heckman Model for Offtake Agreement and Leverage: Country Industry-Matched Sample

The sample consists of 1,375 projects in 34 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. In the probit regression, the dependent variable is an indicator variable for a project with an offtake agreement (*OFFT*). In the Tobit regression, the dependent variable is *LEVadj* (industry-adjusted leverage ratio). Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (volatility of cash flow); *GSUP* (government grants and support); *MULT* (multinational project); *MULTIA* (multilateral/bilateral agency); *SPON* (the number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); *F500* (sponsor in Fortune 500); *OPER* (build-own-operate provision); and *IMR* (inverse Mills ratio from the 1st-stage probit regression). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variables | |
|---|---|---|
| | Probit | Tobit |
| Independent Variables | *OFFT* | *LEVadj* |
| *COURISK* | −0.0175*** | −0.0068** |
| | (0.2301) | (0.0027) |
| *CF* | 0.0936 | −0.9385*** |
| | (0.1127) | (0.1148) |
| *VOL* | 12.4853*** | 3.9870** |
| | (2.5590) | (1.6869) |
| *GSUP* | −0.1506 | −0.0332* |
| | (0.1002) | (0.0172) |
| *MULT* | −0.0859 | −0.1494*** |
| | (0.4295) | (0.0574) |
| *MULTIA* | 0.2769* | −0.1524 |
| | (0.1567) | (0.1195) |
| *SPON* | 0.0398 | 0.0137* |
| | (0.0341) | (0.0071) |
| *SIZE* | 0.1018*** | −0.0198 |
| | (0.0321) | (0.0132) |
| *F500* | 0.4747*** | −0.0475 |
| | (0.0942) | (0.0343) |
| *OPER* | 0.4182*** | −0.0383** |
| | (0.0942) | (0.0203) |
| *IMR* | | −0.1184*** |
| | | (0.0451) |
| Intercept | −1.7083*** | 0.5413*** |
| | (0.2301) | (0.0614) |
| Likelihood ratio ($\chi^2$) | 149.34*** | 18.53*** |

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The results from the 2nd-stage Tobit regression model with leverage as the dependent variable are given in Table 9: They confirm the results in Tables 6 and 7. The coefficient estimate of cash flow volatility remains positive and highly significant and is consistent with the prediction of Hypothesis 1. The coefficient estimate of the inverse Mills ratio is significant and negative, indicating that ceteris paribus, a project company that adopts an offtake agreement employs less leverage. This supports Hypothesis 3: Project companies trade off between leverage and offtake agreements in order to reduce project risk. The coefficient estimate of the build-own-operate provision (*OPER*) is negative, suggesting that project companies with the provision of "own and operate" tend to use less leverage (Hypothesis 4), as they value cash flow control more highly than do project companies with the "transfer" provision.

When we use the U.S. industry-matched sample in Table 10, the coefficient estimates are much more significant. After controlling for the simultaneous bias,

TABLE 10

Estimation Results for the 2-Stage Heckman Model for Offtake Agreement and Leverage: U.S. Industry-Matched Sample

The sample consists of 2,361 projects in 118 countries for the 10-year sample period from Jan. 1997 to Dec. 2006: The data are obtained from the Thomson Financial SDC Project Finance database by including projects with detailed financing sources available. In the probit regression, the dependent variable is an indicator variable for a project with an offtake agreement (*OFFT*). In the Tobit regression, the dependent variable is *LEVadj* (industry-adjusted leverage ratio). Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (volatility of cash flow); *GSUP* (government grants and support); *MULT* (multinational project); *MULTIA* (multilateral/bilateral agency); *SPON* (the number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); *F500* (sponsor in Fortune 500); *OPER* (build-own-operate provision); and *IMR* (inverse Mills ratio from the 1st-stage probit regression). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variables | |
|---|---|---|
| | Probit | Tobit |
| Independent Variables | *OFFT* | *LEVadj* |
| *COURISK* | −0.0001<br>(0.0024) | −0.0001<br>(0.0002) |
| *CF* | 2.1064***<br>(0.3680) | −1.3694***<br>(0.2200) |
| *VOL* | 45.9031***<br>(0.5130) | 10.7442***<br>(4.1192) |
| *GSUP* | 0.2822***<br>(0.0758) | −0.0993***<br>(0.0261) |
| *MULT* | −0.1979<br>(0.3277) | −0.0692*<br>(0.0402) |
| *MULTIA* | 0.1660<br>(0.1552) | −0.5625***<br>(0.0227) |
| *SPON* | 0.0653***<br>(0.0220) | −0.0200***<br>(0.0063) |
| *SIZE* | 0.1114***<br>(0.0246) | −0.0355***<br>(0.0105) |
| *F500* | 0.4463***<br>(0.0889) | −0.1219***<br>(0.0073) |
| *OPER* | 0.2186***<br>(0.0750) | −0.0570***<br>(0.0221) |
| *IMR* | | −0.3074***<br>(0.1131) |
| Intercept | −3.3333***<br>(0.2035) | 1.8131***<br>(0.3863) |
| Likelihood ratio ($\chi^2$) | 408.36*** | 91.58*** |

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all the coefficient estimates are highly significant, with the expected signs. These additional results reinforce our main conclusion that a project company's capital structure decision is a function of project risk, but the direction is unexpected: Project companies use more leverage when there is higher cash flow risk and less leverage in the presence of risk-reducing features. The nature of nonrecourse debt in project finance appears to incentivize the sponsor to commit less equity when project risk is greater. Our results also point out that an offtake agreement is an important feature in project finance that is actively utilized by project companies with high cash flow volatility. Our findings further suggest that project companies that highly value the control of project cash flow rely more on offtake agreements and less on leverage.

## VI. Robustness Check

A decision on project size is likely to be made at the same time as the financing decision. To address the issue of endogeneity, instrumental variable Tobit regressions are performed, following the system of equations approach in Esty (2004). In the 1st-stage regression, project size is regressed on all the regressors in equation (1). We examine correlation coefficients along with economic rationale in deciding these instruments. The results (not reported in the table) show that concession grants and government support are positive and significant in explaining project size, indicating that projects with concession grants and government support tend to be larger than those without them. Also, projects with a large number of sponsors or Fortune 500-ranked sponsors are associated with larger projects. On the other hand, whether or not a project has an offtake agreement does not affect project size. The 2nd-stage regression is performed with the fitted values of project size from the 1st-stage regression estimation. After controlling for the endogeneity effect, the result (not reported) suggests that cash flow volatility and offtake agreements remain significant in explaining project leverage.

The SDC continuously updates information on project finance. However, some financing information in the SDC database does not appear to be fully updated. When we drop observations whenever the sum of individual financing sources differs from the total project cost by more than 5% or 10%, the results do not change much. To illustrate the robustness of our findings, we report the regression results in Table 11 for the country industry-matched "clean" sample of 1,101 projects in 30 countries with the 10% cutoff. The results are similar to those reported in Table 9. As an additional check, we reestimate the regressions after removing the observations outside 3 standard deviations from the mean for *LEV*, *CF*, and *VOL*. The results without outliers are virtually identical to the results reported in the previous regressions (for the sake of brevity, we do not report them).

Regarding the issue of multicollinearity, the correlation coefficients among variables, as shown in Table 5, do not pose a serious problem except for the relatively high correlation between expected cash flow and cash flow volatility. When we perform regressions in which these variables alternately enter the regression equations, some coefficient estimates become significant, but the signs remain unchanged. We also compute the multicollinearity condition index suggested by

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TABLE 11

Robust Estimation Results for the 2-Stage Heckman Model for Offtake Agreement and Leverage Using Clean Sample: Country Industry-Matched Sample

The sample consists of 1,101 projects in 30 countries for the 10-year sample period from Jan. 1997 to Dec. 2006, excluding observations with the sum of individual financing sources different from the total project cost by more than 10%. In the probit regression, the dependent variable is an indicator variable for a project with an offtake agreement (*OFFT*). In the Tobit regression, the dependent variable is *LEVadj* (industry-adjusted leverage ratio). Independent variables include: *COURISK* (country risk); *CF* (expected cash flow); *VOL* (volatility of cash flow); *GSUP* (government grants and support); *MULTIA* (multilateral/bilateral agency); *SPON* (the number of sponsors); *SIZE* (the natural logarithm of total project costs (*TC*)); *F500* (sponsor in Fortune 500); *OPER* (build-own-operate provision); and *IMR* (inverse Mills ratio from the 1st-stage probit regression). Detailed variable definitions are provided in Appendix B. All regressions use robust standard errors. Standard errors are shown in parentheses. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

| | Dependent Variables | |
|---|---|---|
| | Probit | Tobit |
| Independent Variables | *OFFT* | *LEVadj* |
| *COURISK* | 0.0191<br>(0.0161) | −0.0057**<br>(0.0021) |
| *CF* | 0.6873<br>(1.2891) | −0.7210***<br>(0.1651) |
| *VOL* | 18.5200***<br>(3.3481) | 4.5090**<br>(2.3904) |
| *GSUP* | −0.1718<br>(0.1273) | −0.0293<br>(0.0237) |
| *MULTI* | 0.4051<br>(0.5517) | −0.1383**<br>(0.0623) |
| *MULTIA* | 0.8207<br>(0.5018) | −0.2529**<br>(0.8935) |
| *SPON* | 0.0298<br>(0.0441) | 0.0152<br>(0.0135) |
| *SIZE* | 0.1558***<br>(0.0434) | −0.0200<br>(0.0146) |
| *F500* | 0.5211***<br>(0.1456) | −0.1629***<br>(0.04512) |
| *OPER* | 0.3830***<br>(0.1183) | −0.0406*<br>(0.0644) |
| *IMR* | | −0.4196***<br>(0.1422) |
| Intercept | −1.2791<br>(0.3035) | 1.7192***<br>(0.3628) |
| Likelihood ratio ($\chi^2$) | 131.42*** | 11.38*** |

Belsley, Kuh, and Welsch (1980); it suggests no significant presence of multicollinearity (not reported).

Five legal origin dummy variables are largely insignificant (not reported), making meaningful inferences difficult. We conclude that legal origins are not significant factors in explaining project leverage after controlling for other country risks. When we estimate regressions omitting the country legal origin dummy variables, the statistical significance of most coefficient estimates remains intact except for the estimates of country risks, which tend to become more significant.

We also consider the following alternative leverage ratios: i) senior debt to total project cost, including concession grants; and ii) total debt, including subordinated debt to total project cost. When using senior debt to total project cost including concession grants as the leverage ratio, we obtain similar results to those reported in the previous sections. However, the results are somewhat different when we include subordinated debt in defining the leverage ratio. As mentioned earlier, subordinated debt is often the sponsor's capital commitment to the project

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and differs little from equity in that the sponsor's equity and subordinated debt are both entitled only to the residual cash flow from the project. Depending on whether it takes the form of interest or dividend, there can be differential tax consequences for the cash flow distribution from the project. We do not explore this issue in this paper.

Finally, we incorporate 3-digit SIC codes to refine our industry matching of cash flows and debt ratios. Some projects can be classified into multiple 3-digit SIC codes (e.g., water supply and hydro electricity plant or copper and gold mining), and some industries do not have enough firms to match. Nonetheless, the results (not reported) lead to the same conclusions we draw from our reported analyses.

## VII. Conclusion

We investigate capital structure decisions in project finance and bring new insights into the literature. In particular, we contribute to the literature in the following ways: i) We explore the SDC project finance database, which is the most comprehensive data set on project financing (previous studies focus on a rather small set of project companies); ii) we examine the cross-sectional determinants of capital structure for an extensive sample of single-project companies (an ex ante capital structure decision made for a single project is free from many complications facing typical firms); and iii) we document new evidence on project companies' use of leverage and offtake agreements as a means of reducing exposure to project-specific risk. In conclusion, the project company combines leverage with its organizational structure in order to manage project-specific risk.

In the absence of going-concern value, such as growth options, the project company has a strong incentive to transfer the project risk to creditors by leveraging the capital structure. On the other hand, syndicated banks (well diversified across projects as they share the risk among syndicated members) readily assume the project risk in return for a greater control over project cash flows. A further examination of the relationship between leverage and cash flow control in corporate finance would be an interesting future study. In fact, there have already been some efforts in this direction. For instance, Nini, Smith, and Sufi (2009) and Garleanu and Zwiebel (2009) show that private lenders and debt covenants work as effective disciplines on management through their effective control over free cash flow under managerial discretion. We delegate a further investigation of this issue to a future study.

## Appendix A. EIU Country Risk Scores

### 1. Descriptions

Appendix A lists descriptions of 6 country risk scores provided by the Economic Intelligence Unit (EIU).

*Sovereign Risk.* This risk category measures the risk of a buildup in arrears of principal and/or interest on foreign- and/or local-currency debt that is the direct obligation of the sovereign or guaranteed by the sovereign.

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*Currency Risk.* This risk category measures the risk of a devaluation against the reference currency (usually the U.S. dollar, occasionally the euro) of 25% or more in nominal terms over the next 12-month period.

*Banking Sector Risk.* This risk category gauges the risk of a systemic crisis whereby banks holding 10% or more of total bank assets become insolvent and unable to discharge their obligations to depositors and/or creditors.

*Political Risk.* This risk category evaluates a range of political factors relating to political stability and effectiveness that could affect a country's ability and/or commitment to service its debt obligations and/or cause turbulence in the foreign-exchange market.

*Economic Structure Risk.* This risk category is derived from a series of macroeconomic variables of a structural rather than a cyclical nature. Consequently, the rating for economic structure risk will tend to be relatively stable, evolving in line with structural changes in the economy.

*Overall Country Risk.* This risk rating is derived by taking a simple average of the scores for sovereign risk, currency risk, and banking sector risk.

### 2. Variables in Risk Scores

The following lists specific factors that are included in measuring the EIU country risk scores.

External conflict; Financial regulation and supervision
Governability/social unrest; Real OECD GDP growth
Electoral cycle; Credit growth
Orderly transfers; Real GDP growth, 48 months
Event risk; Real GDP growth, 12 months
Sovereignty risk; Inflation, 48 months
Institutional effectiveness; Inflation, direction
Corruption; Trade-weighted real exchange rate
Corruption/state intervention in banks; Exchange-rate misalignment
Commitment to pay; Exchange-rate volatility
Quality of policymaking/policy mix; Export receipts growth, 12 months
Monetary stability; Current account balance, latest
Use of indirect instruments; Asset price valuation
Real interest rates; Transfer and convertibility risk
Fiscal balance/GDP; International Monetary Fund programme/excessive deficit procedure
Fiscal policy flexibility; International financial support
Transparency of public finances; Access to financing
Public finance/debt indicator; Gross financing requirement
Unfunded pension and healthcare liabilities; Debt servicing indicator
Exchange-rate regime; Interest charges ratio
Black market/dual exchange rate; Debt term structure
Income level; Foreign-exchange reserves/public debt currency structure
Official data (quality/timeliness); Debt liquidity indicator
Current-account balance, 48 months; Foreign direct investment and external financing
Volatility of GDP growth; Import cover/government deposits as % of interest charges
Reliance on a single goods export; OECD short-term interest rates
External shock/contagion; Nonperforming loans
Public debt/GDP; Banks' credit management
External solvency indicator; Banks' foreign asset position/yield curve
Default history

## Appendix B. Variable Definitions

Appendix B provides variable definitions. The methodology of measuring each variable is specified in the main text.

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*LEV* (Debt-to-total capital): The ratio of senior debt to total project cost net of concession grants and other government support.

*LEVadj* (Industry-adjusted leverage ratio): LEV minus the median debt-to-assets ratio of industry-year matched firms based on 2-digit SIC code.

*TC* (Total project cost): The total project cost in millions of U.S. dollars that sums all financing sources, that is, senior debt, subordinated debt, equity, and concession grant.

*CF* (Expected cash flow): Ten-year average of industry median operating cash-flow-to-asset ratios prior to the project announcement. Operating cash flow is defined as earnings before interest, taxes, depreciation, and amortization (EBITDA).

*VOL* (Cash flow volatility): The standard deviation of the industry median operating cash-flow-to-asset ratio over the 10-year period prior to the project announcement.

*SIZE* (Log of project cost): The natural log of TC.

*GSUP* (Government grants and support [1,0]): One indicates the presence of local government grants and/or support. A concession agreement can be financial support, infrastructure, or permission granted to a project company to exploit, develop, construct, and operate a facility or project.

*MULTIA* (Multilateral agency loans [1,0]): One indicates the presence of multilateral agency (MLA) financing. MLAs include the World Bank, the Inter-American Development Bank, the Asian Development Bank, and the European Bank for Reconstruction and Development.

*OFFT* (Offtake agreement [1,0]): One indicates the existence of an offtake agreement to purchase all or a substantial part of the product produced by a project, which typically provides the revenue stream for a project financing.

*MULT* (Multinational project [1,0]): One indicates a project located in more than 1 nation (e.g., telecommunication projects).

*SPON* (Sponsor number): Measures the number of sponsors. A sponsor is one who originates and structures a project and becomes a shareholder or owner of all or a part of the facility or project.

*F500* (Fortune 500 company [1,0]): One indicates that a project sponsor (or its parent) belongs to Fortune 500 companies.

*COURISK* (Country risk score): Lists overall country risk scores: scale 0–100 (100 highest risk). (Source: Economist Intelligence Unit)

## Appendix C. Types of Offtake Agreements

Appendix C provides the descriptions of various types of offtake agreements commonly used by project companies. Offtake agreements are legal contracts between a producer of a resource and its buyer to buy/sell certain portions of the producer's future production. An offtake agreement is intended to secure a market for the future output of the producer. The following offtake agreements are commonly used in project finance.

*Tolling Agreement.* Agreements between the owner of a fuel such as natural gas and the owner of a power generation station in which the former provides the fuel for the latter in exchange for sharing the revenues from selling electricity.

*Capacity Agreement.* Agreements between the power generator and one responsible for maintaining capacity reserves (against peak power needs) by guaranteeing the sale of the power generator's production capacity.

*Merchant Power Plant.* Agreements in which the producer is not obliged to sell electricity to specific retail consumers, targeting the competitive wholesale power market.

*Power Purchase Agreement.* Agreements between an electricity generator and one looking to purchase electricity on a long-term basis by buying/selling all or most future output, typically at predetermined or inflation-indexed prices.

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*Take-and-Pay Contract.* Agreements in which the off-taker only pays for the product taken on an agreed price basis.

*Take-or-Pay Contract.* Agreements in which the off-taker is obligated to pay agreed prices for the product on a regular basis whether the off-taker actually takes the product or not.

*Throughput Agreement.* Agreements in which a user of the pipeline agrees to channel a certain minimum volume of a product at a minimum price.

*Contract for Differences.* Agreements in which the off-taker pays (receives) the difference to the producer if the market price is below (above) an agreed level.

*Shadow Tolls.* Payments that the government makes to the private sector operator of a road, at least partially, based on the estimated number of vehicles using the road.

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