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Factors Influencing the Equity Share of Build-Operate-Transfer Projects

Abstract

Purpose – To determine the fundamental factors influencing the equity share in Build-Operate-Transfer (BOT) investments in relation to the project risk profile.

Design/methodology/approach – The relationships between risk factors and equity participation into the capital structure of a BOT contract are examined using regression analysis of a dataset of toll road projects.

Findings – Results suggest that the inflation rate, the size of the investment, the construction period, the solidity of the vehicle company, and the organizational structure of the project are significant variables of the equity portion of financing.

Practical implications – The analysis may support project promoters with better understanding of the factors that might facilitate high debt leverages and lending institutions with valuable information to integrate the method of determining the appropriate debt resources to be injected into a BOT project.

Originality/value – The study contributes towards growing the body of knowledge regarding the way public-private partnership initiatives are carried over and helps refine the capital structures of BOT projects.

Keywords Build-Operate-Transfer, Infrastructures, Project Finance, Project Management, Regression Analysis, Risk management, Roads

Paper type Research paper

Introduction

The Build-Operate-Transfer (BOT) delivery system has gained worldwide popularity as a mechanism to limit public spending on governments' budgets and facilitate private financing of desirable public facility projects (Algarni et al. 2007). In particular, pay toll road projects have been accounting for an important share of the investment among all types of BOT arrangements in the past two decades in both, developed and developing, countries (Medda and Carbonaro 2007; World Bank 2007).

Under a BOT scheme, the funding required to meet the capital expenditure necessary to construct or renovate an infrastructure is provided in the forms of both equity and debt sources. Even though the capital structure varies, equity financing typically covers from 10 to 30% of total project costs, while debt financing is obtained for the remaining 70 to 90% (Finnerty, 2007).

On the one hand, one or more private organizations, such as construction firms, service providers, and investors share the equity funding of a special purpose vehicle (SPV) company to design, build and operate the infrastructure for a specified concession period of time, intended to sufficiently pay off the debt incurred and earn an acceptable profit. At the end of this period, the ownership of the project is transferred back to the awarding authority (Jefferies and McGeorge, 2009).

On the other hand, lending institutions provide the debt portion of funding under the terms of nonrecourse financing in a way that lenders have no recourse for repayment of their loans against the shareholders, but only through the SPV's segregated cash flows and assets (Zhang 2005a).

Moreover, some BOT highway projects may also include the financial support from host governments at one or more stages of the project, usually under the form of either funding aid fiscal subsidies for operations, off-take agreements or a combination of them.

The debt to equity ratio for financing the capital structure of a BOT project varies according to the risk profiles borne by the contract parties. To obtain an attractive rate of return on equity (RRE) through a minimized equity investment and associated risk, equity holders usually seek to maximize the debt leverage as much as the project cash flow can justify.

On the contrary, lending institutions tend to require a large equity commitment in the SPV to reduce the risk of a heavy debt service burden on the project cash streams (Walker 1995) and avoid investors from being in a position of easily walking away from the project (Nevitt and Fabozzi 2000). Lenders calculate debt service coverage ratios (DSCR) as a supporting method to establish the project's debt capacity and, as a result, to determine the matching equity contribution to the capital investment. Usually, high DSCRs are requested by lending institutions to bear high project risks; this requires a high level of equity level, which brings subsequent reduced profitability.

Therefore, it is of great interest to both, shareholders and lenders, to achieve the capital structure that maximizes the RRE with a tolerable debt level (Dias and Ioannou 1995). Several studies have been proposed to investigate the risk, in association with an optimized capital structure of a BOT infrastructure project. Nevertheless, little work has explored the empirical effects and other macro risk factors that might have a relationship with the equity level of BOT projects.

To this end, a statistical analysis on the capital structures of a set of recent BOT toll road contracts is provided to study some relevant factors that might have significant relationships with the equity participation in project funding.

In the next sections, we first review pertinent literature and gain an understanding of the risks involved in the capital structure of a BOT project. Then, a risk model is developed to anticipate the relationship with the equity investment. Finally, we present a linear regression analysis and discuss the results as an attempt to draw potential applications for the establishment of improved capital structures in infrastructure BOT projects.

Literature review

Extensive literature and discussion is available around various issues related to the study of the BOT contracting system. A number of authors, conveniently reviewed by Shen et al. (2002), have recently developed a variety of methods and models mainly focusing on BOT organization, contracting procedure, financial attractiveness, and concession period. Moreover, a relevant stream of research is committed to developing suitable methodologies to optimize the capital structure and, in particular, to integrate the effect of risks as part of those factors that are involved in a BOT financing scheme.

Professional practice and previous research have found evidence that the DSCR is a sound indicator for establishing the debt leverage and, in turn, for determining the corresponding equity participation into the initial investment (Bakatjan et al. 2003). DSCR is referred to as the amount of cash flow available to meet annual interest and principal payments on debt, including any sinking fund payments, and it is computed as the ratio between operating cash flow and debt service during a one-year period (Esty 2006). The minimum DSCR must be greater than the one to meet the debt capacity. But, the lending agencies actually ask for a higher value, according to the expected operating cash flow and anticipated risk of the project. Thus, since the concessionaire takes an important commitment to the project and a broad scope of risk, it appears that DSCR is set at high levels not only whenever a high debt risk is anticipated, but also whenever several potential risk factors are associated to the equity portion of investment (Zhang 2005b). Moreover, a high level of equity plays an important role to assure the granting government against future uncertainty of project financing (Tiong 1995).

With regard to this aspect, antecedent authors propose models to identify risks inherent with BOT contracts and provide linkages between risk sources and the capital structure. These studies can be subsumed into two main streams. A first course of study explores the effects of risk on project profitability. With this regard, Zhang (2005a) builds a theoretical methodology to optimize the capital structure and evaluate the project financial viability when the project is subject to construction risk, bankruptcy risk, and other various economic uncertainties. So that an optimal capital structure is determined to safeguard the diverse interests of both, equity investors and debt lenders. Similarly, based on the notion that the equity amount to be injected to the facility varies according to risk, Ng et al. (2010) explore the risks faced by private partners in a concession-based road project. Furthermore they illustrate a Monte Carlo simulation model, where the revenue is the uncertain parameter considered under the influence of inflation, traffic flow and operational cost risks to determine the equity level and associated RRE.

A second pertinent stream of research is dedicated to identifying risks inherent with BOT project financing. Three studies, addressing this subject, are acknowledged to be seminal antecedents of our risk model, namely: the proposal, by Zayed and Chang (2002), of a consistent procedure for assessing BOT project risk through the definition of a risk index and project ranking methodology based on actual performance of eight main risk areas, i.e., political, financial, revenue, promoting, procurement, development, construction, and operations risks; the analysis, by Schaufelberger and Wipadapisut (2003), on transportation and power-generation projects that identifies political, financial, construction, operational, and market risks, and states that the risks reported to be most significant in financing strategy selection are the political, financial, and market risks; and Xenidis and Angelides' (2005) comprehensive list of state-rooted, concessionaire-rooted, and market-rooted financial risks with classification based on the stage at which they occur and the sources of their origin.

However, even though equity risk is affirmed to be central in the definition of the optimal capital structure and risk taxonomies are provided, very little previous work is reported with focus on the empirical assessment of the risk factors that might affect the equity portion of funding.

To overcome this limitation and understand the extent to which risk factors might influence the equity share of the investment, risk identification, covering different aspects of BOT toll road projects, is unveiled in the next sections together with a statistical analysis.

Methodology

The research is developed according to the following steps. First, an original model is developed based on the reviewed seminal literature for indentifying the main risk factors that might influence the level of equity participation in BOT toll road projects. Based on this, risk sources are listed with associated indicators, which, in turn, are measured by one or more corresponding measurable parameters. Second, data are gathered through public web sources and websites of the main private partners of the projects, and consistently checked with direct enquiries. Afterwards, an exploratory data analysis is conducted and finally, after assuming that the equity share (ES) is the response variable and the risk parameters are the independent variables, a linear regression analysis is performed using MiniTab™ software package to understand the relationship between the project risk profile and the capital structure. In particular, the linear regression analysis tests if the independent variables considered are relevant factors and whether they have positive or negative impact on the equity portion of funding. Linear regression has proved to be a valuable and widely used tool for investigating managerial factors and reflecting relationships among variables within datasets. This predominant methodology can be applied to quantify the strength of a relationship between a dependent variable and independent regressors (Tukey 1977).

Risk Model

Managing risks in BOT projects is a challenging job due to the uncertainty related to forecasted cash flows and a scrupulous risk analysis is desirable, because of the role it plays in determining the capital structure of a project (Jin 2010).

Table 1 reports a novel classification of risk sources, indicators, and measurable parameters that are reported to affect BOT projects. The risks are categorized into different areas of origin, namely: country, financial, revenue, project, and SPV originated risks. These categories are identified with reference to the above seminal literature works: the country and financial risks match the political or state-rooted risk; revenue risks represent the market areas of risks; the project risk is intended to cover the construction and operations risks; and the SPV-related risks are inherent with the concessionaire-rooted risks.

A further explanation of the table is given in the following sections.

Risk sources	Indicators	Parameters
Country	Investment environment	Country index
	Attractiveness	Government effectiveness
		Regulatory quality
Financial	Cost of equity capital	Average beta of partners
	Inflation	Inflation rate
	Currency	Currency exchange rate
Revenue	Utility	Population within the area
Project	Size	Investment
	Complexity	Construction duration
	Profitability	Concession period
SPV	Composition	Number of partners in SPV
	Solidity	Average size of partners

Table 1. Risk identification

Country risk

The country risk concerns the credibility and political conditions of the host country (Kumaraswamy and Zhang 2001). In this paper, country risk is described by means of two indicators, namely: the ‘Investment environment’ and the ‘Attractiveness’. The ‘Investment environment' expresses the political and economic stability, measured by a numerical transformed parameter of the COFACE (2008) alphanumerical 'Country index' (CI): a low figure standing for a high ranking to show off steady political and economic environment, good payment records and very weak default probability. The 'Attractiveness' indicates whether a country is able to draw investments, which depends upon the access to politics, level of competition, fiscal terms, and domination of narrow interests that could hinder the efficiency of the project. For the purpose of the model and with specific regard to BOT projects, a country's Attractiveness is measured via two select parameters provided by World Bank (2011): the 'Government Effectiveness' (GE) parameter, ranked on a scale from -2.5 (low efficiency) to 2.5 (high efficiency), captures the perceptions that investors have of a country with regard to the quality of public services, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies; the 'Regulatory Quality' (RQ) parameter, that ranges from -2.5 (scarce quality) to 2.5 (high quality), is recorded to indicate the perception of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Financial Risk

Financial risk is driven by cost of capital, inflation and currency (Schaufelberger and Wipadapisut, 2003). From a business perspective, it is the risk of financial loss due to changes in the competitive environment, or the extent to which the organization could timely adapt to external changes (Doff, 2008).

Since the purpose of this study is to explore the factors affecting the equity share in BOT toll road projects, the cost of equity is specifically taken into consideration to address the cost of capital financial risk. The cost of equity capital is measured by the proxy parameter "Average Beta of Partner", which is referred to as the correlated risk between the SPV and the associated market. The expected RRE can be estimated using the capital asset pricing model (CAPM); according to CAPM, the expected return is a function of a firm's equity Beta (Tofallis, 2008). A high Beta stands for elevated risk, which, in turn, determines a highly expected interest rate on the equity capital brought into the project. The Beta figures considered are provided by the Financial Times (2009).

Inflation also plays a major role in affecting revenue and costs. Typically, the equity sources of financing reduce as an effect of inflation-increased cash flow generation, and vice-versa. Inflation, here, is measured by the "Inflation Rate" (IR), referred to as the annual percent variation of market prices, as reported by Inflation Data (2011).

A BOT project might be funded with foreign investment. So, we consider how the currency risk might affect the level of equity. In fact, since both, toll revenue and operations costs, might be generated in local currency, while capital repayments might be in foreign currency, a downfall of the exchange rate could jeopardize the equity investment (Kapila and Hendrickson, 2001). Here, the currency exchange is measured as the rate of conversion of the local currencies into US dollars, as reported by XE (2011).

Revenue risk

The revenue risk lies in the project's market demand and concerns its ability of generating enough income to repay the debt incurred and to assure fair equity profitability. In BOT toll-road projects, overoptimistic estimation of traffic flows, due to inaccurate assumptions, or the opening of alternative routes may jeopardize toll-booth income. Off-take agreements with the granting authority are sometimes negotiated to assure steady cash flows over the concession period, in spite of market fluctuation (Beidleman et al. 1990). However, this research considers projects with revenue risk only, that is, with risks inherent to booth collection of tolls.

The revenue risk is specified by the ‘Utility’ gain that the new highway road brings to the regional community of potential toll payers. Rather than a projected traffic flow factor, here we adopt a more reliable ‘Population within the area’ (POP) parameter to proxy the motorization of the region: a larger population, potentially affected by the infrastructure, enhances the utility and gives the project a higher chance of revenue. The parameter, in units of millions of people, sums up the 2008 population records of all cities crossed by the road (Wikipedia, 2008).

Project risks

‘Size’, ‘Complexity’, and ‘Concession’ are specific drivers of project risk. Typically, the size of a project is an important factor to determine the financial resources required and the burden for promoters to raise equity funds. Also, a large-sized scope of work might experience the risk of great cost overruns (Tiong 1990). ‘Investment’ (INV) is the numerical parameter used here for measuring the project ‘Size’, indexed in millions of US dollars as per the 2009 present value.

Risk is also driven by the project complexity resulting from construction site conditions, sophisticated design, tight schedule pressure, innovative building technologies, and construction logistics. Project complexity typically results in delayed completion, increased amount of loan interest, and deferred revenues. It is assumed here that long construction duration is an inherent significant characteristic of a complex project (Hoffman et al. 2007), so that the parameter, ‘Construction duration’ (CDUR), evaluated in number of years, is used for the purpose of quantifying the project complexity.

The riskiness of a project is also inherently driven by the objective capability of its cash flow to repay the debt and return profit. Typically, a longer period of operations provides better opportunity for generating incomes (Shen et al. 2002). Therefore, the length of the concession period, from occupancy to transfer, is usually determined to assure attractiveness and protect the interests of both, the public owner and the concessionaire (Shen and Wu 2005). A proposed project, with an expected high RRE, typically, tends to have a shorter concession period. On the contrary, if a project lacks appropriate profitability, the public party will most likely have to consider a longer concession period in order to safeguard the multiple interests of the public sector and the profit-making attraction of the private sector (Zhang 2009). Thus, the ‘Profitability’ driver of project risk is quantified through the parameter ‘Concession period’ (CPER) here, defined as the number of years during which the SPV operates the road and collects the toll fees.

SPV risks

Indicators of ‘SPV composition’ and ‘SPV solidity’ are adopted to describe the risks related to the concession vehicle company. The SPV composition reflects the organizational structure of the project. The SPV capital can be shared by construction contractors, professional service providers, funding sponsors, operations management companies, and other various business entities. Local companies most often take part in the SPV because of local policy requirements, expected greater odds of competitive advantages in the tender process, and minimization of currency risk.

A fragmentation of the SPV composition can bring better risk sharing. However, this might also increase the possibility of contractual and management problems occurring during the operations and maintenance period (Trujillo et al. 1997), turning the causal mental model, describing the relationship between SPV composition and equity capital structure of BOT projects, as unclear. The parameter, ‘Number of partners in SPV’ (PART), is used here to quantify the ‘SPV composition’.

The ‘SPV solidity’ measures the durability of the vehicle company as a financially independent business entity to raise the required fund for the project, repay the debt and make profit. Even though the vehicle company is formally supposed to be separated, its strength, largely, depends on the financial robustness and capacity of its shareholders (Parikh and Samson 1999). In this sense, the indicator, 'SPV solidity', is quantified through the solidity of the SPV's partners as a weighted 'Average size of partners' (PART_SIZE) parameter. Here, in order to measure the solidity, the market capitalization value of the mother company, measured in billions of US dollars (Financial Times, 2009), is adopted. It is assumed that the higher the average size of partners, the higher the financial robustness of the SPV.

Data Analysis

Project Dataset

Based on the proposed risk model and dataset of BOT toll road projects, Table 2 summarizes the independent variables that are hypothesized to have an influence on the capital structure of BOT project financing. The figures reported down into the columns are, respectively, the minimum, mean, and maximum value, the low, median and upper quartile, and the standard deviation.

	Min	**Mean**	**Max**	**Low quartile**	**Median quartile**	**Upper quartile**	**Standard deviation**
Dependent variable							
Equity Share [%]	13	29	45	20	27	40	10
Independent variables							
Country index	1.15	1.24	1.40	1.15	1.2	1.35	0.08
Government effectiveness	-0.16	0.94	1.99	0.16	1.18	1.54	0.72
Regulatory quality	-0.33	0.86	1.65	-0.13	1.23	1.46	0.75
Average Beta of partners	0.33	0.77	1.81	0.56	0.73	0.96	0.33
Inflation rate	0.014	0.041	0.094	0.028	0.035	0.054	0.02
Currency exchange rate	0.0012	0.416	1.15	0.018	0.0338	1	0.46
Population in the area [mil]	0.07	13.98	76.00	2.73	5.00	20.57	19.28
Investment [mil $]	13.20	516.04	22,214.20	153.90	412.69	436.10	519.50
Construction duration [years]	1.00	2.93	6.00	2.00	3.00	3.00	1.34
Concession period [years]	12.00	32.09	99.00	24.25	30.00	33.00	16.93
Number of partners in SPV	1	3	6	2	3	3	1.18
Average size of partners [mil $]	0.01	3.77	9.80	1.41	3.54	5.09	2.81

Table 2. Summary of the exploratory analysis on the dataset of BOT toll road projects

The sample is composed of 31 pay toll road projects. The projects, selected from various geographical areas around the world and equally in both, developed and developing, countries, are characterized as having an approximate $500 million average investment and equity share, ranging from 13 to 45 percent of the total investment, with the most frequent value around 29%. This progression goes beyond the expected typical values, ranging between 20% and 30% (Tiong 1995); thus, we have urged a close scrutiny of the factors that might motivate its variability.

Data Sources

Data for the exogenous variables are collected from various public web sources. The 'Country Index' parameter is measured by Coface, a global leader in trade-credit information and protection. Coface assigns a rating to each of the 150 monitored countries; this rating reflects the average risk of short-term non-payment for companies in a specific country. 'Government Effectiveness' and 'Regulatory Quality' are provided by World Bank (2011). They are part of a panel of six parameters reported for 213 countries. 'Beta' values are given by the Financial Time (2009). The 'Inflation rate' is provided by Inflation Data (2011) and this is reported as the difference between the 'Current Consumer Price Index' and the 'Consumer Price Index' a year ago. The 'Currency Exchange' is drawn from XE website (2011), based on independent third-party site rankings. The 'Population within the Area' is recorded from Wikipedia (2008): with this regard, the citizens of all cities crossed by the road are summed up.

Data of project-specific and SPV-related parameters, such as 'Equity share', 'Investment', 'Number of Partners in SPV', 'Construction duration', and 'Concession Period' are collected via several web sources of two natures: concessionaires' websites [1], [2], [3], [4] and public databases [5], [6], and [7]. Table 3 shows the list of the dataset projects with select associated data.

Project #	Equity Share [%]	Investment [€ millions]	No. of Partners in SPV	Avg. Size of Partners [€ billions]	Construction Duration [years]	Concession Period [years]
1	24.51	246.00	3	8.08	2	40
2	28.00	24.70	3	0.01	2	15
3	30.00	13.20	2	0.02	3	12
4	30.00	110.50	2	4.93	4	20
5	42.00	23.40	3	1.17	3	30
6	38.00	32.80	3	0.12	2	20
7	18.18	2,214.20	5	8.30	3	30
8	36.93	1,113.20	6	4.15	4	30
9	19.40	258.50	2	9.80	2	30
10	29.52	521.00	4	8.10	2	30
11	45.33	560.00	4	4.21	6	30
12	21.55	427.00	1	2.52	1	25
13	25.00	600.00	4	6.61	3	30
14	14.61	956.06	2	2.81	2	50
15	20.03	464.25	1	8.09	5	35
16	17.45	1,405.00	2	5.14	5	75
17	20.91	232.13	4	3.54	3	25
18	23.88	424.08	2	3.29	2	99
19	19.99	436.56	2	3.54	3	35
20	40.00	305.79	3	0.02	3	24
21	20.00	1,225.00	2	4.02	3	40
22	42.49	253.00	3	1.72	2	30
23	33.49	218.00	3	1.85	1	15
24	45.33	560.00	4	4.21	6	30
25	13.30	107.90	2	7.31	1	30
26	18.00	85.80	3	3.17	2	15
27	26.71	1,460.00	2	3.86	3	34
28	44.37	1,010.21	3	4.09	5	30
29	40.00	401.30	3	1.31	2	30
30	16.07	280.00	2	2.81	3	30
31	37.60	166.70	5	1.86	1	30

Table 3: List of the dataset projects with select associated data

Hypotheses

Based on the mentioned research and theory about the risk profile of BOT projects, this paper proposes a model composed of twelve independent variables that are suggested to have influence on the capital structure of BOT projects and, in particular, on the level of equity. Specifically, it is assumed that the equity portion of the capital structure of a BOT project is not only determined so as to optimize the profitability of the projected cash flow, but it is also a function of the risk profile and, in turn, the main risk factors, uncovered so far, might affect its optimal level. Indeed, the equity share is affected by risk as far as debt lenders are likely to carefully scrutinize the risk involved with one project for determining the debt to equity ratio. Thus, it is a primary objective of this work to test if the independent variables considered are relevant factors and whether they have positive or negative impact. A positive influence indicates that, all else remaining equal, an increase (decrease) in the independent variable determines an increase (decrease) of the dependent one, while a negative effect produces opposite outcome between independent and response variable variations.

On the one hand, it is assumed that ‘Country index’, ‘Government effectiveness’, ‘Regulatory quality’, ‘Average beta of partners’, ‘Currency exchange rate’, ‘Construction duration’, and ‘Number of partner in SPV’ shall have a positive influence on the equity share. In particular, ‘Country index’ is expected to show off a positive influence in the sense that, under a stable political and economic environment of the host country, with lower country index, the likelihood that a project will be called to a halt is reduced and the risk that the SPV’s cash flow would be jeopardized is lessened. Consequently, lending institutions are willing to lend more money to a firm if the debt repayment capacity is high, resulting in a reduced need for equity by the borrowing firm.

On the contrary, higher country indices could lead to reluctance in funding projects with high debt leverages. Similarly, the ‘Government effectiveness’ and the ‘Regulatory quality’ parameters are supposed to have a positive impact on the equity share; in fact, high values stand for reliable and stable countries, where private investors are encouraged to invest.

Also, a high ‘Average Beta of partners’, as a proxy measure of a high SPV risk, is likely to require a high level of equity, because lending agencies might be unwilling to provide bulk debt service in such situations.

The ‘Currency exchange rate’ is also expected to have positive impact on the equity level; in the sense that, if the local currency appreciates, revenues converted into US dollars arise, so that private investors are willing to put more funds into the project investment.

‘Construction duration’, as a proxy indication of the project complexity and inherent risk of delay, rework and cost overruns, is likely to be the reason that prevents lending agencies from providing large debt leverage, thus giving SPV participants no choice but to raise higher equity share into the total project investment (Logan 2003).

Finally, the higher the ‘Number of partners in the SPV’, the higher is the expected capability to raise the equity portion of financing.

In contrast, ‘Inflation rate’, ‘Population within the area’, ‘Investment’, ‘Concession period’, and ‘Average size of partners’ might disclose a negative impact on the equity share of the investment. In fact, higher the ‘Inflation rate’, more the debt capacity and lower the equity level. This fact is due to two simultaneous effects directed to increase the DSCR, namely: increased revenue and reduced interest as a derivative macroeconomic consequence of inflation.

Furthermore, a large ‘Population within the area’ would give high chances of revenue, which in turn, would allow the SPV to easily obtain bulk debt packages with a low level of equity. Similarly, a large-sized investment might be an indicator of the project complexity and inherent risk, so that the equity portion of funding is likely to get lower.

Also, a long ‘Concession period’ should justify the maximization of long-term debt through fixed rate financing structuring, which, in turn, relies on a lower share of equity investment (Tiong and Alum 1997).

Finally, a large ‘Average size of partners’ should provide adequate assurance that high debt leverage will be reimbursed and that minimum equity contribution should be required.

With the purpose of challenging the proposed risk model and associated hypotheses, the following section illustrates the linear regression model used for the empirical examination of the twelve theoretically relevant predictors on the 'Equity share', taken as the response parameter.

Regression analysis

The normal probability plot of the data set (Figure 1) testifies that residuals are normally distributed and errors are uncorrelated random variables, so that a linear regression model is applicable to examine the significance of independent variables.

Insert Figure 1 here

First, the presence of multicollinearity among independent variables is explored. Multicollinearity is the correlation among predictors resulting in an increased standard error of estimates, which makes it difficult to accurately interpret the findings of the regression analysis (Tabachnick and Fidell 2001). It occurs whenever a large R results from regressing a single independent variable in a multivariate model. The Variance Inflation Factor (VIF) is used to measure the degree of multicollinearity (Wei et al, 2011) of the independent variable, with the other independent variables in a regression model. VIF evaluates the relationship between an independent variable and all other independent variables within the model and is termed as $1/(1-R^2)$, where R^2 is the coefficient of determination of one predictor on all the other predictors and it represents the proportion of the variance in the independent variable that is associated with the other independent variables in the model. If VIF equals 1, there is no multicollinearity; if it ranges from 1 to 4, predictors may be moderately correlated; if VIF is greater than 4, the regression coefficients are poorly estimated (O'Brien 2007). A suggestion that directly addresses the problem of reducing multicollinearity is to re-specify the model by eliminating one or more of the independent variables that are highly correlated with the other independent variables.

	CI	GE	RQ	BETA_PART	IR	CR	POP	INV	CDUR	CPER	PART	PART_SIZE
VIF	15.463	30.72	18.497	2.68	3.192	4.1	2.39	2.791	1.64	1.783	2.532	2.773

Table 4: Multicollinearity in the complete model

Table 4 shows that multicollinearity exists in our model because CI, GR and RQ have a very high VIF. Therefore these predictors have been discarded in order to avoid multicollinearity as presented in Table 5.

	BETA_PART	IR	CR	POP	INV	CDUR	CPER	PART	PART_SIZE
VIF	1.792	1.667	2.488	1.549	2.41	1.431	1.509	1.705	1.757

Table 5. Proof that the model has no multicollinearity among predictors

After the exploration of multicollinearity, the regression analysis is performed. Table 6 presents the results of the regression analysis, where the columns report the estimate of the regression coefficient, the standard error of the coefficient estimate, the value of t statistic and the p value with the associated level of significance, respectively.

	Acronym	Estimate	Std. Error	t-value	p-value	
Average Beta of Partners	BETA_PART	-0.01125	0.04697	-0.24	0.814	
Inflation Rate	IR	-1.5652	0.7360	-2.13	0.049	*
Currency Exchange Rate	CR	0.03447	0.03847	0.90	0.384	
Population within the area	POP	-0.0005564	0.000680	-0.82	0.425	
Investment	INV	-0.0001156	0.000033	-3.42	0.004	**
Construction Duration	CDUR	0.041676	0.009622	4.33	0.001	**
Concession Period	CPER	-0.0005236	0.000745	-0.70	0.492	
Number of Partners in SPV	PART	0.04278	0.01244	3.44	0.030	*
Average Size of Partners	PART_SIZE	-0.15284	0.005160	-2.96	0.009	**
Multiple R-Squared		79.60				
Adjusted R-Square		68.10				
Constant		0.23815				
Significance notation		0 ***	0.001**	0.01*		

Table 6. Results of the regression analysis

The regression analysis shows that IR, INV, CDUR, PART and PART_SIZE are significant factors, influencing the equity portion of financing of a BOT project. On the contrary, BETA_PART, CR, POP, and CPER are proven to not have significant influence on the capital structure.

The high R-squared value suggests that the regression line is a good fitting curve of real data points and that a large percentage of the variability is accounted for in the statistical model. In addition, the high-adjusted R-Square, which is not notably lower than the R-Square, confirms that the proposed model includes all the explanatory variables and the variation on the response variable is fully measured (Everitt, 2002).

Interpretation of results

Five out of the nine aforementioned independent variables show statistical relevance to the debt-to-equity ratio.

Some of the relevant drivers confirm expected inherent relationships with the equity fraction of capital investment. For instance, an increased project complexity, by some means, indicated by the number of partners and by the length of the construction period, drives a large amount of equity funds. In fact, the higher the number of partners involved in a project, the higher the capacity to raise equity financing. In addition, the positive impact of the construction length underlines that construction risk is an important component: a long construction period implies a high risk of cost overrun and delay, thus making lending agencies reluctant to highly leverage the debt portion of funding.

Similarly, the relationship between the size of the project and the equity allocation is clarified: a large-sized investment imposes a heavy burden on project promoters to contribute with their equity in total amount, but smaller in percent share. The positive impacts on the equity share of the average size of partners is based on the idea that the higher the solidity of a company, the easier for that company to raise the equity contribution.

Also, the inflation rate confirms the negative effect on the equity share of a BOT project, because of its ability to increase cash flow revenue.

Finally, results show that the ‘Concession Period’, ‘Population within the Area’, ‘Currency exchange rate’, and ‘Average Beta of Partner’ variables do not pose significant influence, if any, on the equity share.

Discussion and Implications

The analysis reveals that the inherent characteristics of both, the project and SPV, are significant factors of the fraction of equity funds required to implement a BOT contract, while external factors linked, for instance, to the host country and financial environment, are likely to have lower influence. In particular, the size and complexity of the project, as well as the composition and financial solidity of the partners involved in the SPV, prove to be determinants of the equity share. To be more precise, the size of the investment and the solidity of the SPV prove to have a negative impact on the level of equity, while the complexity of a project and the composition of the consortium carry a higher share of equity.

In other terms, investors of large-sized projects are likely to resort to other financial sources, such as public funds, for transferring out portions of risk; similarly, financially strong consortiums of partners are likely to be capable of borrowing more debt funds and, in turn, be required for raising a lower level of equity. On the contrary, complex projects with typical long construction duration and numerous investing partners will likely require more equity financing.

Finally, inflation is the only exogenous financial variable that is probable to influence the level of equity, as it is possible that a high inflation rate is a factor of an increased debt capacity due to its contribution to cash flow generation.

Both practical and theoretical implications arise from these results.

The implication for investors and lending agencies is the potential undertaking of changes in the way the BOT capital structure is arranged. In fact, the presented regression model might serve as a predictive reference study in refining decision criteria for determining debt leverage in BOT toll road projects. The results may provide some hints to lending agencies for improving the currently used DSCR-based method to determine the equity leverage. In particular, lenders might determine the project risk score through the evaluation of the above proxy variables.

Additionally, results might be considered as a clue for project promoters to better understand what kind of financial contract clauses and business environment might facilitate high debt leverages. For instance, they might take advantage of establishing consortiums composed of just a few solid partners, bidding for middle-sized projects, which are likely to be less complex.

From an academic perspective, this work offers sound contributions. On the one hand, it proposes to consider risk as an intrinsic factor affecting the capital structure of BOT projects. On the other hand, it urges the need for exploring improved methodologies aimed at sizing the debt capacity of a BOT project, in combination with the classical financial covenants used by lending institutions. To this end, future research is addressed in the development of models for the study of the capital structure of various categories and kinds of BOT projects.

Conclusion

Claiming that the capital structure of a BOT project is notably influenced by the project's inherent risks, a model is developed with the purpose of understanding the risk factors that may influence the equity share of a BOT toll road capital investment. In particular, country, financial, revenue, project and SPV related risks are defined along with their associated indicators and parameters.

Based on that model, various data, pertinent to the mentioned risk drivers, are collected from a number of recent BOT pay toll road projects and a linear regression empirical analysis is performed. The analysis shows that inflation, project size, construction duration, financial strength of the SPV, and the number of SPV's partners have a significant relationship with the share of equity into the total investment.

In conclusion, this research might help the purpose of better understanding the main factors affecting the equity contribution to BOT investments, which, in turn, provide opportunities for sponsors to improve the equity profitability and for lending agencies to better handle risks associated with the debt supply.

[1] http://www.hochtief-pppsolutions.com/

[2] http://www.skanska.com/en/Projects/Search-project/

[3] http://www.bamppp.com/

[4] http://www.ohlconcesiones.com/html/espanol/actividades_concesiones.html

[5] http://tifia.fhwa.dot.gov/projects/

[6] http://www.projectfinancemagazine.com/

[7] http://www.tollroadsnews.com/

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