Public Financing into Build-Operate-Transfer Hospital Projects in Italy

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Abstract: An empirical analysis is presented to investigate the factors that have significant influence on the share of public financing into the total initial investment required to develop build-operate-transfer (BOT) health-care projects. Based on a model describing the main risks associated with public participation in BOT projects, a linear regression analysis has been conducted on a data set of Italian BOT hospital projects to yield implications. Outcomes reveal that the size of investment, the financial strength of the concessionaire, the duration of the concession period, the number of services, and the level of borrowing of the local health-care granting agency are significant factors of the level of public funding. The study confirms that public funding is provided not only to cover the non-self-financing portion of investment but also as a way to undertake a project in periods of scarce public financial resources. The methodology may be useful to refine the decision criteria for determining the level of public funding of a BOT hospital project in order to gain an understanding of the value that could be obtained from funding similar projects. **DOI: 10.1061/(ASCE)CO.1943-7862.0000545.** *© 2012 American Society of Civil Engineers.*

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Introduction

Build-operate-transfer (BOT) is a delivery method and financing mechanism to establish a long-term public–private partnership (PPP) for the purpose of developing a variety of infrastructure and service facilities. Under the terms of a BOT, and other similar forms of procurement arrangements (e.g., build-lease-transfer, project finance initiative), one or more investors join a special purpose vehicle (SPV) company to finance the design, construction, operations, and maintenance of a public facility for a specified government-granted concession period, at the end of which the ownership of the project is transferred back to the awarding authority. The initial investment is intended to be recovered through revenues from the service provided during the concession period, which is determined to sufficiently pay off the debt incurred and earn an acceptable profit from the project cash flows (Schaufelberger and Wipadapisut 2003; Zhang 2009).

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BOT has been recognized as an effective institutional mechanism to facilitate private finance and to leverage the private sector's improved quality and efficiency in public projects (Iyer and Sagheer 2010). Therefore, it allows the development of desirable constructed facilities with limited further public spending on governments' budgets and additional public borrowing (Shen and Wu 2005; Algarni et al. 2007).

In Western Europe, countries have been using various forms of PPP to build infrastructure and are currently implementing BOT for social facility projects, as the United Kingdom has done since the early 1990s (Esty and Sesia 2007).

In particular, some of the most popular applications can be found in the health-care sector. Since the enactment of the BOT contracting/financing mechanism in 1999, Italy has rapidly grown in its use of project finance (PF) to develop health-care constructed facilities. As of May 2009, after only a decade of PF application, Italy was the second largest market in terms of both number and value of investments in health-care PF initiatives, after the United Kingdom and ahead of all other European countries (Amatucci et al. 2010).

However, despite promises of limited public financing demanded to support BOT projects, financially freestanding privately funded BOT hospitals are rare in Italy owing to the public nature of the health-care fee reimbursement system. That is why the capital structure of most projects requires a considerable share of public funding, on average equal to more than 30% of the initial investment. Typically, investors are responsible for the arrangement of both equity and debt finance for the percentage of the initial investment that can be recovered with a fair profit through net income generated within the operations period, while the non-self-financing part is paid by the conceding government (Zhang 2005a).

In addition, uncertainty and risk related to forecasted project cash flows play an important role in determining the capital structure. Indeed, the portion of investment covered with public funding

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also depends on the project risk profile and the strategy of allocating risk on the private party (Jin 2010), who will commit lower finance to a PPP project in case of high-risk exposure.

These aspects of BOT health-care projects have been raising questions among scholars and practitioners regarding how to create a balanced benchmark of public financing to mitigate the private sector's risks in a project. However, the risk factors to be taken into account for determining a fair percent share of public financing to contribute to the capital structure of hospital PF initiatives are still unexplored.

With the purpose of overcoming the research gap, in this work we present an empirical analysis of Italian BOT hospital projects addressed to answer these questions. On the basis of the assumption that the capital structure and, in particular, the level of public funding is inherently associated with the project risk profile and allocation between the contract parties (Amatucci and Lecci 2006), the analysis explores the main risk factors that might have significant relationships with the ratio of public funding to the total amount of financial resources of a BOT hospital project.

In the following sections, we first illustrate the background of BOT and the state-of-the-art of BOT projects to develop hospital facilities in Italy. Then, after reviewing pertinent literature, we gain an understanding of the risks involved in a PF capital structure. Finally, we present a linear regression analysis and discuss the results. These findings allow conclusions to be done on the factors that can affect the level of public funding into health-care PPP investments in order to facilitate a more appropriate money-for-value oriented policy for public spending.

Background

BOT Project Financing

Based on the value of a project's physical assets and expected financial performance of cash flows, BOT investments require a highly leveraged capital structure to provide an attractive internal rate of return to equity (IRRE) while securing bankability. Even though the capital structure varies, equity financing typically covers from 10 to 30% of the total project costs, while debt financing is obtained for the remaining 70 to 90% (Finnerty 2007).

Financial institutions usually provide the debt portion of funds under the terms of nonrecourse or limited-recourse financing, which means that lenders have no recourse for repayment of their loans against the shareholders but only through the SPV segregated cash flows and assets (Zhang 2005a). To reach a desirable IRRE, project shareholders seek to maximize the debt leverage as much as the project's cash flows can tolerate, while lending institutions and granting authorities tend to require large equity commitment in the SPV to reduce the risk of a heavy debt service burden (Walker and Smith 1995) and to suggest the sponsors' long-term high level of financial commitment to the project (Tiong and Alum 1997).

The appropriate balance between equity and debt is optimized within the limits of an acceptable debt service coverage ratio (DSCR) for both investors and debt lenders (Bakatjan et al. 2003). DSCR reflects the project debt carrying capacity, and thus it is the lender's main criterion for the financial viability of a project. DSCR is referred to as the amount of cash flow available to reimburse interest and principal payments on debt, and it is computed as the operating cash flow over the debt service in any payment period. In practice, the minimum DSCR must be equal to one to meet the debt capacity, but lending agencies usually ask for a higher value according to the anticipated risk profile of the project. So that, in general, the greater the risk shouldered by the private party, the higher the level of private equity.

The apportion of public governmental-granted equity to the capital structure not only reduces the total amount of private finance required but also allows for a higher debt leverage. In fact, the reduced demanded private financing is associated with smaller risk borne by the private investor, who is in turn asked a lower level of equity liability by the committed debt lenders.

As stated above, the appropriate amount of money invested by the government should cover the non-self-financing part of the investment costs, but it often happens that the level of public funding is sized over this limit. The justification of this notion is that the level of public financing serves as coverage of the project risk profile. For this reason, an empirical model based on the identification of the most important risks and associated indicators is developed in order to study the extent to which risks might affect the level of public financing in BOT health-care facility projects.

State-of-the-Art Hospital BOT Projects in Italy

In Italy, the change in health-care service provision (e.g., shorter hospital stays, organizational change from specialties to levels of intensity of treatment), the obsolescence of health-care public infrastructures, and, overall, the limits imposed on public spending and shortage of public financing to carry out necessary investments, have called for the recourse to private finance to build new hospitals or to upgrade existing ones without an ex-ante evaluation demonstrating that this scheme would be more advantageous than traditional public financing (Barretta and Ruggiero 2008; Amatucci and Lecci 2006).

As of May 2009, based on consultation of the database published by the Italian national observatory of PPP (http://www.infopieffe.it), public health-care authorities have put out to bid 42 hospitals and 29 support facilities, such as parking lots, hotels, and production of utilities since 1999. Out of the total 71 initiatives, 47 contracts were awarded to a concessionaire, with an investment totaling 3 billion euro. Among those, only 28 are reported to be awarded hospital facilities, which are today partly into the design phase, under construction, or in operations.

The majority of hospital BOT arrangements provide for the concessionaire to maintain the infrastructure and operate auxiliary activities and commercial services, while the public agency manages and operates the core clinical service with their resources. Operations and maintenance (O&M) services typically apply to equipment, built assets, and utilities; auxiliary services are related to catering, laundry, cleaning, waste management, security, and Information Technology (IT) hardware systems; commercial services might involve shops, parking lots, guest rooms, and children's day care. Only a few contracts require private O&M of health-care equipment, IT software tools, medical gas systems, emergency and operation rooms, diagnosis, and other paramedical services (Finlombarda 2010). To benefit from O&M and, if applicable, paramedical services, the public agency typically pays the SPV an agreed-upon-the-contract service fee. On the contrary, the concessionaire collects fees from tenants and end users for commercial services.

As a consequence of the limited number and scope of contracted auxiliary and nonclinical services, most projects are reported not to have self-financing ability, so that public funds are necessary to cover the non-self-financing portion of the initial investment. As of 2007, public sources of funds are on average 57% of the investment; hence, private financing captures the remaining 43%, which can in turn be decomposed into debt (38%) and equity (5%) capital, so that the debt-to-equity ratio equals about 88%/12%

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(Amatucci et al. 2007). As of May 2009, public financing ranges from 0 to 81% of the total investment, with the decreased median value equaling approximately 36%. Also, it is observed that large projects have a higher share of public funding and a higher award rate: This fact indicates that a high level of public financing reduces the project risk exposure with a resulting increased likelihood of the project to be successful and attractive for promoters and equity investors (Amatucci et al. 2007).

Research Methodology

The research was carried out through the following steps. First, we developed a model to understand the risk factors that might influence the level of public funding in BOT projects. To this end, we identified risk sources and associated indicators, which are in turn measured by corresponding selected parameters.

Second, we gathered data through both consultation of public databases and direct inquiries from local health-care agencies. The data set records information on public funding and the identified risk parameters of the BOT hospital projects awarded in Italy from 1999 to May 2009. All initiatives total approximately 2.6 billion euro, and the average size of projects is about 110 million euro each.

Then, we conducted an exploratory data analysis and investigated the multicollinearity among the risk parameters.

Finally, after assuming that the level of public financing is the response variable and the risk parameters are the independent variables, we completed a linear regression analysis to understand the relationship between the project risk profile and the capital structure. In particular, the linear regression analysis, performed using the Minitab® software tool, tested whether the independent variables considered are relevant factors and whether they have a positive or negative impact on the proportion of public funding to the total investment. Linear regression proves to be a valuable and widely used tool for investigating managerial factors and for reflecting relationships among variables within data sets. This predominant methodology can be applied in order to quantify the strength of the relationship between a dependent variable and independent variables (Tukey 1977).

Risk Model

Pertinent Literature Review

Extensive research and discussion is available for the BOT contracting system because it is a major trend in PF. Studies are focused on BOT organization schemes, contracting procedures, risk modeling, financial attractiveness, and determination of concession period (Shen et al. 2002). However, only a few works explore the role and level of government aid in BOT investments (Kumaraswamy and Zhang 2001). In particular, little work has been carried out to empirically assess the risk factors that might affect the ratio of initial public funding to total investment. The identification of risks that have an impact on the financing of a project is of crucial importance (Xenidis and Angelides 2005).

Moreover, the few studies in health-care BOT projects are mostly related to proving the advantages of PF for hospital facility developments (Jefferies and McGeorge 2009). For instance, Akintoye and Chinyio (2005) show that the usage of PF in the provision of health-care services in the United Kingdom is increasing in terms of number, capital value, and size of projects to achieve better risk management. Also, Holmes et al. (2006) state that in the health-care sector PF improves the quality of services by taking advantage of the private sector's skills.

Sources of Risk

To fill the research gaps, we developed a novel analysis of the risks that are inherent with public financing of BOT hospital projects. Grounded on models available in the literature to classify risks in BOT contracts (Schaufelberger and Wipadapisut 2003; Xenidis and Angelides 2005; Zhang 2005b), we associated an indicator with each source of risk and identified one or more parameters to measure each indicator, as summarized in Table 1.

Indicator and Parameters of Political/Economic Risk

Political and economic sources of risk come from the context of political events, government policies, and economic instability that could influence the profitability of a project and prevent capital from being committed to support investments (Sachs et al. 2007). Doff (2008) defines this kind of risk as a detriment owing to potential changes in general business conditions such as market environment, and as loss owing to changes in the competitive environment. Therefore, we express these risks by means of the investment environment indicator to analyze the political/economic context wherein the project is developed. The investment environment is measured by three parameters, namely, location (Loc), healthcare infrastructure index (HII), and public borrowing (Borr).

Loc identifies the geographical area of Italy in which the project is located. This variable has been selected to represent differences in legislation and policies among various regions of Italy. It is used to understand whether there is a relationship between the hospital location and the share of public funding. Loc is defined as a categorical variable (1 northwest, 2 northeast, 3 center, and 4 south of Italy).

HII reflects the quantity of health-care facilities and services in each geographical area: the higher the index, the more the local investment in health-care services. Therefore, it is expected that a high HII determines the conditions for reduced public sources of funds assigned to the development of hospital facilities. The index is measured and provided by Unioncamere (2009) for each region of Italy. The average national index is set equal to 100, in which a lower figure indicates fewer infrastructures in the area.

The Borr parameter is used to take into account the health-care policies that might be affected by the amount of public borrowing. Borr is the per-capita borrowing of the local health-care granting agency expressed in euro, as reported by Amatucci et al. (2010). It is expected that the higher the Borr, the higher the public expenditure in the health-care sector and, in turn, the lower the commitment of public money to the development of hospital projects.

Table 1. Sources, Indicators, and Parameters of Risk

Risk sources	Indicators	Parameters
Political/economic	Investment environment	Location (Loc)
Financial	Cost of capital	Solidity of SPV (Sol) Banking & financing service index (BFSI)
Construction	Project scope	Project size (Size) Number of SPV's partners (Parts)
Market	Revenue generation	Catchment population (CPop) Number of services (Serv) Concession period (Per)

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Indicator and Parameters of Financial Risk

According to Xenidis and Angelides (2005), financial risk has a direct impact on the cash flow of the business plan in a way that either endangers project viability or limits profitability. One of the most important drivers of financial risk in construction projects is the capital interest rate (Ling and Lim 2007). Financial risk relates to the extent to which capital is easily obtained at an acceptable cost (Schaufelberger and Wipadapisut 2003). Consequently, we describe the financial risk by means of the cost of capital indicator, which is referred to as the ability of the concessionaire to privately finance the investment with both equity and debt sources of funds. In fact, a high level of private financing is likely to limit the need for public funding.

The cost of capital indicator is measured through two variables: the solidity of SPV (Sol) and the banking and financing service index (BFSI). On the one hand, Sol reflects the financial strength of the concessionaire: the greater the solidity, the greater the probability that the SPV can bring more equity and attract more debt capital at a lower cost. Sol is expressed as the annual revenue generated by the main partner of the consortium at the time the project was awarded, as recorded by Deloitte (2009).

On the other hand, the BFSI parameter represents the availability and accessibility of the banking sector. This index measures the number of financial institutions available in the project area. It is measured and provided by Unioncamere (2009). The average national index is set at a value of 100, so that a higher figure shows a higher liquidity that banks are willing to lend more easily to SPVs.

Indicators and Parameters of Construction Risk

Construction risk is inherent with construction schedule delay and cost overrun. Typically, the scale and complexity of the project scope of work is a useful indicator of potential time delay and cost overrun: A large-sized project is likely to be complex to manage by reason of, for example, communication and coordination problems, and, in turn, likely subject to schedule delay and cost overruns (Santoso et al. 2003). The project scope indicator is therefore represented by two parameters, namely, project size (Size) and number of SPV's partners (Parts).

On the one hand, the Size parameter measures the dimension of the investment expressed in euro amount. It is expected that the larger the Size, the greater burden for the project promoters to raise private funds required for the project. Size has a positive influence on the percentage of public funding: In fact, a project that needs more financial resources requires a greater governmental commitment to fund the initial investment.

On the other hand, the Parts parameter is used to quantify the composition of the SPV. A fragmentation of the SPV composition can bring better risk sharing; however, this might also increase the possibility of contractual and management problems occurring (Trujillo et al. 1997). Therefore, it is hard to enforce a mental model to indicate which one of these two effects prevail in the relationship between the SPV composition and the role of public financing in the capital structure.

Indicators and Parameters of Market Risk

Market risk is related to the revenue fluctuation imposed on a project, and it consists of a demand risk and a price risk. The demand risk is the uncertainty regarding the demand for the service provided by the completed project. The price risk is inherent with the fees that can be charged for the service; usually, fees are agreed upon the concession contract.

The market risk reflects the capability of a project to generate revenues or at least to repay debts. In our model we measure the capability to generate revenues with three parameters, namely, catchment population (CPop), number of services granted (Serv), and concession period (Per).

The CPop parameter represents the potential demand for health care and related services. It is defined as the population in the area where the hospital attracts patients and visitors. We assess it through a proxy variable: the population living within the area where the hospital is located, as measured by Unioncamere (2009). A larger population potentially generates a greater demand, thus giving the SPV an enhanced capability to generate profits. It is expected that the greater the population, the greater the governmental public aid to fund the initial investment.

The parameter Serv has been chosen to have an idea of the SPV's revenue stream. It is referred to as the number of types of granted services (e.g., maintenance, laundry, and catering). The more services granted, the higher the probability of cash generation and profitability for the private concessionaire so that the share of public financing is expected to reduce.

The Per parameter reports the length of the concession period during which the SPV collects revenues and runs operations. It is measured in years from the end of the construction. A longer concession period provides the SPV with a better opportunity to make the project profitable (Shen et al. 2002), which can entail a lower public funding.

Data Analysis

Based on the proposed risk model and data set of BOT hospital projects, Table 2 summarizes the independent parameters that are supposed to have an influence on the capital structure of BOT project financing (to get access to the complete data set, please request information from the corresponding author). The columns

Table 2. Summary of the Data Set Analysis of BOT Hospital Projects in Italy

Variables	Acronym	Lower quartile	Median	Upper quartile	Standard deviation
Public funding—Dependent variable	PubFun	0	0.3645	0.81	0.219
Health-care infrastructure index	HII	55.11	109.1	135.27	24.52
Public borrowing (€)	Borr	19	52	167	41
SPV solidity (€)	Sol	108,000	749,715,155	3,703,000,000	1,111,684,234
Banking & financial service index	BFSI	40.95	119.11	160	36.73
Project size (€)	Size	860,491	110,549,478	409,459,958	93,603,041
Number of partners	Parts	1	3	10	2.4
Catchment population	CPop	161,444	1,672,838	4,337,979	1,484,726
Number of services	Serv	0	9	20	4.84
Concession period (years)	Per	10	24	38	6.67

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report, respectively, the lower quartile, the median, the upper quartile, and the standard deviation. In addition, the data set includes the Loc as a categorical variable, with 12 projects in the northwest, 6 in the northeast, 2 in the center, and 4 in the south of Italy.

In the model, public funding (PubFun) is considered as the response variable. This is defined as the percent ratio of public funding to the total initial investment. It ranges from 0 to 81% with the median value worth approximately 36%.

To identify the significant parameters among those taken into account, a linear regression analysis has been carried out. Linear regression is a statistical technique for modeling and investigating the relationship between two or more variables (Montgomery and Runger 1999). Its results indicate the direction, size, and statistical significance of the relationship between predictors and a response variable.

A positive influence indicates that an increase (or decrease) in the independent variable determines an increase (or decrease) in the dependent variable, while a negative influence indicates that there is an opposite sign between independent and response variable variations (Tukey 1977).

We first explored the presence of multicollinearity among independent variables. 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). To assess multicollinearity we used the variance inflation factor (VIF), which measures how much the variance of the estimated regression coefficient increases if predictors are correlated. VIF evaluates the relationship between an independent variable and independent variables within the model. It is termed as $1/(1-R^2)$, where R^2 is the coefficient of determination of one predictor on all the other predictors; 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).

Results (Table 3) prove that multicollinearity exists in the model because HII, BFSI, and Loc have a very high VIF. Therefore, multicollinearity is avoided by removing these predictors from the model (Table 4).

After verification that the response variable is normally distributed, we run the linear regression analysis. Results are provided in Table 5 where the columns report the estimate of the regression coefficient, the standard error of the coefficient estimate, the value of the t statistic, and the p-value with the associated level of significance.

Results reveal that Size, Sol, Per, Serv, and Borr are significant factors of the level of PubFun.

The level of significance is associated with the p-value. The p-value, ranging from 0 to 1, is calculated from the observed sample and represents the probability of incorrectly rejecting the null hypothesis. The smaller the p-value, the lower the probability that rejecting the null hypothesis is wrong. If the p-value of the test is less than a preset cutoff value, which usually equals 5%, the null hypothesis is rejected. In the regression analysis the null hypothesis states that the coefficient equals zero (Montgomery and Runger 1999). Thus, if the null hypothesis is rejected, the coefficient for the response variable is actually different from zero and there is a linear effect of the independent variable.

The interpretation of the regression coefficients can be somewhat awkward because of the noncomparable units adopted to measure the parameters. To overcome this problem, a regression with standardized variables was then performed (Carroll Rovezzi

Table 3. Multicollinearity Analysis of the Complete Model

Factors	Loc	HII	Borr	Sol	BFSI	Size	Parts	CPop	Serv	Per
R^2	0.884	0.961	0.464	0.511	0.978	0.573	0.411	0.584	0.578	0.494
VIF	**8.621**	**25.64**	1.866	2.045	**45.45**	2.342	1.698	2.404	2.37	1.976

Note: Bold values indicate a very high VIF.

Table 4. Proof that the Model has no Multicollinearity among Predictors

Factors	Borr	Sol	Size	Parts	CPop	Serv	Per
R^2	0.126	0.248	0.471	0.269	0.462	0.483	0.176
VIF	1.1442	1.3298	1.8904	1.368	1.8587	1.9342	1.2136

Table 5. Results of Regression Analysis

Variable	Acronym	Estimate	Standard error	t-value	p-value	Significance
Public borrowing	Borr	0.00177	0.00062	2.87000	0.0011	**
SPV solidity	Sol	0.00000	0.00000	4.53000	0.00000	***
Project size	Size	0.00000	0.00000	3.09	0.007	**
Number of partners	Parts	−0.08550	0.01207	−0.71000	0.48900	
Catchment population	CPop	0.00000	0.00000	0.72000	0.48400	
Number of services	Serv	0.02087	0.00548	3.81000	0.00200	**
Concession period	Per	0.00784	0.00341	2.30000	0.03500	*

Note: Multiple R-squared: 86.50%; adjusted R-square: 80.60%; constant: −0.2846; significance notation: 0 ***, 0.001 **, and 0.01 *.

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and Carroll 2002). To this end, for each variable, the mean and the standard deviation were calculated. Then each observation was normalized using Eq. (1)

$$z = \frac{x - \mu}{\sigma} \tag{1}$$

where x = value to be standardized; μ = mean of the population; and σ is the standard deviation of the population. A valid key point here is that z is computed with the mean and standard deviation of the total population and not just the sample ones. It requires knowing the population parameters that are often unrealistic except in standardized tests where the entire population is measured.

Eq. (2) is the result of the regression analysis performed on standardized variables

$$\begin{aligned} \text{PubFun} = {} & 0.263 + 0.0157\text{Cpop} + 0.0874\text{Size} + 0.106\text{Sol} \\ & - 0.0153\text{Part} + 0.0286\text{Per\_Norm} + 0.103\text{Serv} \\ & + 0.0648\text{Borr} \end{aligned} \tag{2}$$

Also, Table 6 shows the coefficients of the significant variables sorted by decreasing level of influence.

According to the results presented in Tables 5 and 6, it can be extrapolated that the SPV Sol shows both a perfect relationship with PubFun and the highest degree of influence, indicating that a solid concessionaire is also likely to take advantage of more public financing. This goes against the assumption that a solid SPV would need a lower public contribution to the initial investment. Then, the Serv factor has a positive influence on PubFun. This finding denies the literature review and mental model, in the sense that we expected that more services are able to generate more cash flow so that public funding should be lower. The positive influence of the Size on the response variable suggests that a large-sized and complex project is likely to demand a high percentage of PubFund. This reaffirms the principle that large projects tend to have a high contribution of public equity on the total finance (Amatucci et al. 2007). In contrast, the relationships of the other significant variables are counterintuitive, which means that significance is assured with a different sign of influence than expected from the risk model, as follows.

The Borr variable has a positive influence on PubFun. This is against the supposed idea that a public health-care local system with large debt can bring less initial share of PubFun. Finally, the Per variable has a positive relationship to PubFun. On the contrary, we would have expected that a long concession period is a factor for the SPV to generate more cash flow so that the need for initial public aid is lessened. This is the variable with the smallest coefficient and, thus, the lowest degree of influence.

On the contrary, Parts and CPop do not result to have significant relationships with the response variable.

Finally, some tests on residuals were carried out to validate the consistency of the model. In particular, the normal probability plot (Fig. 1) illustrates that residuals can be considered normally distributed; the residual versus fits graph (Fig. 2) indicates that there is no evidence of systematic error in the residuals of the regression performed, and the residual versus orders test (Fig. 3) does not present trends, time series, or periodicity.

Table 6. Significant Regression Coefficients with Standardized Variables

Variable	Acronym	Estimate
SPV solidity	Sol	0.10552
Number of services	Serv	0.10318
Project size	Size	0.08741
Public borrowig	Borr	0.06480
Concession period	Per	0.02859

Discussion

Interpretation of Results

The results of the regression analysis originate some considerations on the motivations of PF hospital initiatives in Italy and, in particular, on the relationships between the risk profile and the public

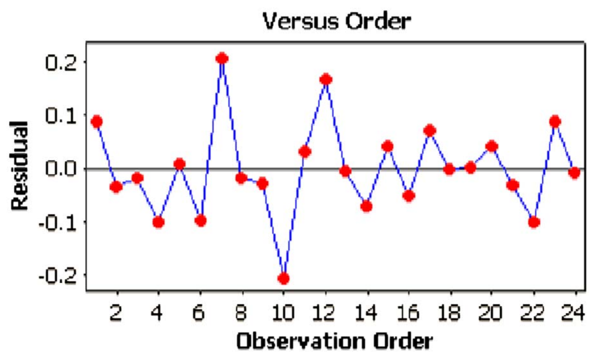

Fig. 1. Normal probability plot of residuals

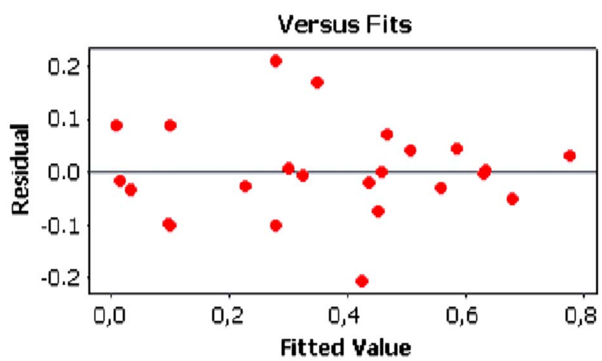

Fig. 2. Residuals versus fits plot

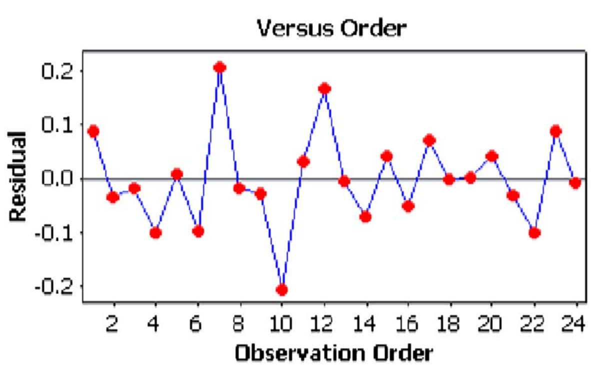

Fig. 3. Residuals versus order plot

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contribution to the capital structure. First, large-sized capital projects, which are typically characterized by scope complexity and high risk, are likely to need large portions of public financial resources. In other words, public funds are intended to cover those risks that the private party is not willing or capable of bearing, so that the financial burden largely falls on the public balance (Treasury 2003).

Second, the positive relationship between Borr and PubFun indicates that public financing is necessary to develop BOT hospital projects even though the local public health-care system is indebted. Basically, it is revealed that BOT projects are one of the few ways to develop new infrastructure that would not be possible with traditional contracting. In fact, traditional procurement requires public financing to cover the investment totally, while BOT projects call for the public party to contribute only to the non-self-financing portion.

Then, it is demonstrated that more financially robust SPVs are likely to negotiate a higher share of public financing than less solid concessionaires. In particular, the financial strength of the major shareholder of the SPV is a form of incentive for the public agency to inject more public equity into the investment. A probable explanation is that a solid SPV is considered a reliable partner capable of giving assurance that the project will be efficiently constructed and managed. Also, a solid concessionaire is not expected to experience financial problems in the long term, so that granting authorities are confident that public equity is efficiently spent in a long-lasting and effective health-care service for the community.

Finally, both the Serv and the duration of the Per appear to be tools to make a BOT hospital project financially viable and attractive for private investors. In fact, regardless of the model expectations that a greater number of services and a longer concession would reduce the need for public financing, we observe that public sources of financing, which are intended to reduce the risk borne by the private sector, are likely to increase if the number of services and the duration of the concession period also increase, that is to say, if the private risk is greater. In particular, the concessionaire's long-term risk of potentially delayed cash flow and late payback period is covered with initial public funding. Therefore, the number and variety of nonclinical services, long concession periods, and considerable public financing are ways to face high levels of risk that the private party is unable to assume. Again, it appears that there is no efficient risk sharing between the parties and the public sector still needs to carry a large portion of the effort.

In summary, because private lenders and investors do not tend to participate in risky projects unless they receive a high rate of return, the duration of the concession period, the variety of granted auxiliary services, and the amount of public funding are three substantial levers that granting authorities have in periods of public funding shortage to attract the contribution of private finance into hospital investments with low/medium rates of return. This confirms that BOT projects, despite being valuable contracting mechanisms to take advantage of the private sector's efficiency in service delivery, are likely to be inefficient and expensive hospital procurement systems for public parties because of the large non-self-financing portion of the investment required. However, BOT is revealed to be currently one of the few available mechanisms to undertake public investments in periods of limited public financial resources.

The fact that only 8 hospital facilities have been built in Italy with a traditional public financing/contracting mechanism (AVCP 2010) for the same 10-year period when 28 BOT hospital projects have been developed is a further confirmation of our results and interpretations. In this context, the private sector is likely to gain contractual power and advantageous conditions in PPP agreements (Amatucci et al. 2007).

Implications, Limitations, and Future Research

The model yields practical implications consistent with the interpretation of the empirical results. This study contributes to the recognition of how risks are shared between the public party and the concessionaire. In fact, all types of risk sources identified in the model are designated to have influence on the percent share of public financing at various degrees, namely, the political/economic risk linked to the level of public borrowing that affects the availability of public resources to undertake the total investments, the financial risk associated with the solidity of the SPV, the construction risk because of the dimensions and complexity of the project scope, and the market risk through both the duration of the concession period and the variety of granted services. In other words, the level of initial public financing is a primary way to reduce the burden of project risks on the shoulders of the private party. In addition, the proposed model helps to unlock the value of PF and gain an understanding of the extents to which benefits can be obtained from using BOT to procure hospital projects and assesses whether a PPP model provides better value for money than traditional public financing and provision of health-care facilities and services (Mehta et al. 2010). Therefore, the proposed regression model might serve as an orienting study to refine decision criteria for determining the level of public funding in BOT hospital projects. Finally, this work might also be used as a template for an investigation that could be repeated in other countries.

With this specific regard, risk assessment of BOT projects in the health-care sector is proven to be central in the definition of the capital structure (Akintoye and Chinyio 2005), and the proposed model with associated findings promises applicability to other geographical locations. To some extents, the results of this study are likely to apply to those countries familiar with similar financing schemes. For instance, a research conducted on a few BOT hospital projects in the United Kingdom by Pollock et al. (2002) reveals that high shares of public funding, up to 50% of the total capital value, are indicators of the high levels of compensation being paid to the private sector for risk transfer. Based on such evidence, this work might be beneficially implemented as a template for an investigation in other countries in order to extend its validity beyond the limited original local context and generalize its results.

A few limitations also apply to some details of the model. On the one hand, the small size of the sample may not be sufficient to appropriately capture all the significant relationships. However, the sample covers almost all of the BOT projects that have been experienced in Italy since PPP has been enacted; also, the high R-squared value of the regression suggests that a large percentage of the variation is explained. Similar considerations apply to the number of independent variables selected for the model: A larger number of risk parameters could have been taken into account, but the restricted number of observations calls for a limited amount of predictors. However, the high R-squared reassures the validity of results.

On the other hand, some of the parameters chosen to indicate the risk drivers might pose questions regarding their responsiveness. For instance, Borr is an expression of the debt of the regional health-care system rather than the one of the specific local medical authority. Also, the number of services does not measure the cash flow generation capability in terms of euro amount. Moreover, CPop is not the real catchment population for each health-care structure, but we considered the population that lives in the area wherein the hospital is located.

In line with these arguments, some main research directions are envisaged. First, the limited geographical boundaries of this study might be overcome through an investigation in other countries in

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order to determine the extent to which its findings can be generalized. Second, this model might be used to develop an improved methodology for making ex-ante evaluations to determine a proper level of public funds and include risk into the estimation of the value that can be obtained from procuring a hospital project with BOT (Pollock et al. 2002), and to develop benchmarks with international best practices. Finally, it might serve as a reference guide to explore the capital structure and value of public funding in other BOT projects, such as infrastructure and social facilities.

Conclusion

An empirical analysis aimed at exploring the factors that can influence the public percent participation into PPPs has been carried out on BOT hospital projects developed in Italy during the last decade. The results provide some hints for both health-care authorities and project promoters to determine the level of public funding with a more value-for-money oriented approach. In particular, the SPV Sol, the number of granted services, the project size, the public borrowing, and the duration of the concession period prove to be significant determinants of the public fraction of financing required to deliver the hospital investment under the provisions of a BOT contract.

In principle, it is appraised that most of the projects did not balance these factors to gain an acceptable level of public financing, but rather that initial public aid was largely used as a way to reduce the private sector's risk and, in turn, to attract the necessary private finance for undertaking the indispensable investments to develop hospital facilities.

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