Politecnico di Torino

Porto Institutional Repository

[Article] Risk and Value in Privately Financed Health care Projects

(Article begins on next page)

Risk and Value in Privately Financed Health Care Projects

Alberto De Marco, Ph.D.[1]; and Giulio Mangano[2]

Abstract: An empirical study is presented to investigate the risk factors affecting the value for money that can be obtained from using the public-private partnership delivery system to develop social facility projects. Based on a model describing the main risks affecting a project, a linear regression analysis is conducted on a data set of privately financed health care projects in the United Kingdom to explore the main factors that might have significant relationships with the annual unitary charge payment. The results reveal that the economic and political environment, the hospital capacity, the construction duration, and the concession period are significant factors of the price paid by the granting authority. The study confirms that the unitary charge is not only affected by investment, operations, and financial life-cycle costs, but also by risk factors and the level of risk allocated to the private sponsors. The proposed methodology might help both public and private parties in improving a private finance initiative project's compensation design, in order to achieve a higher value in privately financed infrastructures. The given model might also support the process of better determining the amount of annual payment based on select drivers and appropriately transferred risk factors. **DOI: 10.1061/(ASCE)CO.1943-7862.0000660.**

Introduction

In recent years, the use of public-private partnerships (PPP) to build and operate infrastructure and social facilities has been increasing in many countries worldwide. Her Majesty's Treasury (HMT) (2000) defines a PPP as a contractual and financing arrangement typified by joint working between the public and private sectors. Under this general notion, PPP includes many types of outsourcing and joint ventures. When PPP projects were launched in the United Kingdom under the schemes of the Private Finance Initiative (PFI), the British government appeared to view them primarily as a way of getting infrastructure costs off the public balance sheet, alleviating spending on governments' budget, seeking capital from external financiers and keeping infrastructure investment levels up, and avoiding the constraints imposed on the public sector (Bing et al. 2005; Algarni et al. 2007).

PFI typically involves a consortium of private companies forming a special purpose vehicle (SPV) to design, build, finance, and operate a facility for a specified concession period, which usually spans from 20 to 40 years. Throughout this period, payments are reimbursed by final users or the public sector, which remains ultimately responsible for the delivery of the service (Connolly and Wall 2011).

There is an open debate on the advantages of PPP and the estimation of the benefits obtained by its usage. In this regard, a key driver in the choice of the delivery system of a constructed facility is the evaluation of the value for money (VFM), an expression of the economy, efficiency and effectiveness of service received by a public entity. According to HMT (2007), VFM is the optimum combination of life-cycle costs and quality of good or service to meet the users' requirement. The VFM driver is of great importance for the granting authority when selecting a PPP/PFI delivery system. VFM, in this context, can be thought of as the best price for a given quantity and standard of output measured in terms of relative financial benefit (Grimsey and Lewis 2005). Generally, the risk transfer should be one of the major factors considered in PPP when assessing the VFM (Clifton and Duffield 2006).

In privately financed projects, the evaluation of the VFM is largely affected by the level of public risk transfer to the private sector (Andersen 2000) and it is often stated that a significant contribution to VFM is the transfer of appropriate project risks to private sector party (Andon 2012). A project usually consists of dealing with several potential risks, which can be borne by either one or both private and public parties. The value is gained by both parties identifying and investigating specific risks prior to setting the cost for the project (Clifton and Duffield 2006).

When the private party accepts the responsibility for a large share of risk, the case could be reflected in the payment by the public granting authority of a monthly or annual unitary charge (UC), which is determined based on estimated risks and projected capital, financing, and operating costs. The UC is the income paid by the public authority to compensate the private sponsors for both the capital investment made to develop the constructed facility and the operations and maintenance expenses incurred during the concession period for the provision of facilities management and ancillary services (Hellowell and Pollock 2009). Therefore, the UC can be considered as an indication of the amount of risk paid by the public party to the SPV for taking the project risks, and as an associated important cash flow component to determine the expected rate of return of a PFI investment.

---

[1]Assistant Professor, Dept. of Management and Production Engineering, Politecnico di Torino, corso Duca degli Abruzzi 24, 10124 Torino, Italy (corresponding author). E-mail: alberto.demarco@polito.it

[2]Ph.D. Candidate, Dept. of Management and Production Engineering, Politecnico di Torino, corso Duca degli Abruzzi 24, 10124 Torino, Italy. E-mail: giulio.mangano@polito.it

The UC form of compensation of an investment applies to a variety of PPP social facility projects. In particular, it is largely used in PFI of hospital projects worldwide.

There is another open debate in the literature around the VFM that can be obtained by the public sector in health care projects and the opportunity of using PPP/PFI for the delivery of hospital projects still stands unclear (Pollock et al. 2002). In particular, there is a high need to refine methodologies for determining the appropriate amount of UC associated with the project risks borne by the public authority, in order to gain an understanding of the value that can be obtained. In this regard, De Marco et al. (2012a) have explored the capital structure of health care projects through a risk model and analyzed the associated value with reference to a set of build-operate-transfer (BOT) Italian hospitals. Their model helps to unlock the value of BOT to procure hospital projects, and it confirms that BOT projects are likely to be expensive because of the large non-self-financing portion of the investment required. Their analysis shows that the amount of financial effort borne by public parties is often high because of the risks that are shouldered by private party. Therefore, it is very important to identify the risk factors that impact on the level of UC paid by public authorities, in order to identify a proper level of UC associated to an effective risk sharing policy.

However, the exploration on the relationship between the level of risks and the UC amount in BOT/PFI hospital projects is still unexplored and questions arise among scholars and practitioners regarding how to balance the appropriate level of UC in relation to the risks borne by the parties involved.

With the purpose of overcoming that research gap and addressing the question, this paper aims to understand the risks in health care PPP/PFI projects that could influence the determination of the UC for the delivery of contracted services in order to improve the VFM that can be obtained. Based on the assumption that the capital structure, and, consequently the UC amount, is inherently associated with the project risk profile and allocation between the contract parties (Amatucci and Facci 2006), the analysis explores the main risk factors that might have significant relationships with the UC of a PFI hospital project. The exploration is addressed to public authorities and private sponsors to help refine the process of determining the appropriate level of UC associated with the risk factors allocated to the parties.

In the next sections, we first review pertinent literature and gain an understanding of the risks involved in a PPP project. Second, we develop a risk model to anticipate the relationship between the identified risks and the capital structure of a PPP project. Then, we present a linear regression analysis of a data set of British PFI hospitals in order to understand how risks affect the UC. Finally, we discuss the results as a contribution towards a new methodology for determining the appropriate amount of the UC in health care PPP projects and draw conclusions on potential applicability together with future research directions.

Background

PPP has been being largely used in many western countries, and especially in the United Kingdom, which is first ranked among the Organization for Economic Cooperation and Development (OECD) countries using PPP and where PPP/PFI is one of the key systems to develop public sector services and facilities (Broadbent et al. 2003). The PPP model was cultivated in response to concerns about the increased level of public debt following the macroeconomic dislocation of the 1970s and 1980s when pressure mounted to change the standard model of public procurement

(Connolly and Wall 2011). Services and facilities are often essential for the public and involve a huge amount of capital investment. If all these initiatives are financed solely by the government, it would be a tremendous pressure on the government's financial status (Cheung et al. 2009). During the period from 1990 to 2009, the United Kingdom has accounted for some two-thirds of all European PPP projects. The annual PPP program had increased from nine constructed facility projects valued at £667 million in 1995 to 65 projects with a total value of £7.6 billion in 2002 (HMT 2003), while from 2005 to 2010 more than 200 projects had been closed, valuing up to £26 billion. Since its introduction, PPP has been the UK government's preferred method for public infrastructure procurement (Handley-Schachler and Gao 2003). As a result, PPP now accounts from 10 to 14% of Britain's total annual investment in public facilities.

The success of PPP/PFI is based on claims that it provides for improved service due to private sector's efficiency, reduced burden on public budgets to develop new social facilities, and risk reduction (Lattemann et al. 2009). Askar and Gab-Allah (2002) identify several advantages in using PPP, in particular, the establishment of a private benchmark to measure the efficiency of similar public sector projects.

However, a PPP form of contract should be used only when more VFM is delivered than in the traditional public-sector-funded route (Carrillo et al. 2006). The VFM analysis should be concerned with estimation of total risk and associated sharing between the contract parties (Heald 2003). The assessment of VFM becomes central, especially when the operator model is used to *buy now and pay later* non-self-financing facilities. In these cases, an initial public capital investment is replaced with a UC paid during the whole life cycle that reimburses the private contractor's investments in public infrastructure (Robinson and Scott 2009).

In PPP/PFI, one of the most important drivers of VFM is the risk transfer, which means that appropriate risks are transferred to the relevant private sector stakeholders capable of managing them better and who are thereby capable of providing higher quality, more efficient services (Jin 2010). Complex arrangements and incomplete contracting in PPP projects have led to increased risk exposure for both public and private partners. Effective risk allocation is therefore challenging and demanding (Jin and Zhang 2011). Khadaroo (2008) highlights the importance of risk transfer and illustrates the use of parameters to quantify qualitative factors, even if the assessment of VFM may be hindered by lack of transparency. Typically, the private sector handles the service delivery risks better than the public sector. This is not surprising given their different business drivers. On the one hand, the key driver for the private sector is the profit imperative, which consists of controlling costs and managing appropriately risks. On the other hand, the key driver for the public sector is risk mitigation, which usually leads to more expensive cost. The risk transfer increases VFM only if the price charged by the private sector for managing the risk is less than the cost paid by the government (Hayford 2006). For Nisar (2007) the risk transfer in PPPs is a key VFM driver that is likely to enhance the possibility of PPP solution becoming a viable alternative to traditional methods of service provision.

In particular, when an annual payment is necessary to compensate the financial viability of the project, the UC is determined not only based on the costs of investment, debt charges, operations, and maintenance, but also on the project's costs arising from the transfer of risks onto the private party (Daube et al. 2008; Pitt et al. 2006). The UC is composed of a service fee for the operations of the facility, maintenance charges, and risk premiums. In this notion, the UC also serves as coverage of the project risk borne by the private sponsors. However, despite common acceptance of this

principle, little past research is available to investigate the extent to which the UC is associated with risks in PFIs. In other terms, there is the need to understand how the UC is affected not just by financial ratios, but also by estimated risk and the risk allocation policy (Zhang 2005).

In order to contribute to an understanding of how much the private sector can reasonably charge for taking the risk, and to uncover the VFM that can be obtained when using a PFI scheme, an empirical model is developed based on the identification of the most important risk factors that might affect the UC amount. This is intended to help both the private and public parties in improving PFI project's compensation design and VFM models that can be used to develop social facilities with a PPP delivery system and, in particular, to assist in determining the annual UC paid to the SPV for compensation of social facility operations, maintenance and services.

Methodology

The research is conducted through the following steps. First, we develop a model to identify the risk factors that might have an influence on the UC in PPP/PFI projects. To this end, we associate indicators and corresponding measurable parameters to each identified source of risk.

Second, we collect data through consultation of some HM treasury's databases providing updated comprehensive information on PPP projects developed in the UK (HMT 2011). Based on data collected, a data set of 49 projects is created reporting the annual UC payments over their life cycle from 1992 to 2060. The complete data set is available upon request to the authors. The entire investment totals £2,575.5 million and the average project's size is £52.56 million.

Then, we conduct an exploratory data analysis and investigate the multicollinearity among the risk parameters.

Finally, after assuming that the UC is the response variable and the risk parameters are independent variables, we complete a linear regression analysis to capture the relationship with the project risk profile. In particular, the linear regression analysis, using Minitab software tool, tests if the independent variables considered are relevant factors and whether it has positive or negative impact on the UC paid by the public agency. 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 relationship between a dependent variable and independent variables (Tukey 1977).

Risk Model

The concept of PPP/PFI is founded on the cardinal principle that risk should be taken by the party who can best manage it. In order to formulate an appropriate risk response plan, not only risks must be identified, but also their impacts must be assessed (Iyer and Sagheer 2010).

In a PFI project, the structuring of the financial scheme is a complex process where several agreements are formed to ensure the basic financial flows and the profitability of the investment for every part involved (Xenidis and Angelis 2005). In this process, the issue of risks and risk allocation is a key point in the successful application of a PFI project. Extensive research is available in the area of risk identification in PPP and the importance of risk in structuring the financing/capital structure. For instance, Xenidis and Angelis (2005) focus on the analysis of the financial risks; Schaufelberger and Wipadapisut (2003) take into account political,

financial, construction, operational, and market risks; Thomas et al. (2003) classify risks into four projects phases namely: development, construction, operation, and project life cycle; and the Accounting Standard Board (ASB) (1998) outlines six major risks that have to be considered when drawing up a contract: interest rate, unavailable credit, decline in stock market price, exchange rate depreciation, and slump in domestic demand.

However, very few studies investigate the role of the UC in a PPP/PFI and how risk factors affect in its amount paid by the public party for the delivery of the contracted services. Moreover, little specific research is available in PPP/PFI health care projects and it is mostly related to proving the advantages of hospital facilities development with PPP (Jefferies and McGeorge 2009). With this regard, Holmes et al. (2006) state that the health care sector improves the quality of services by implementing privately financed initiatives. Also, Akintoye and Chinyio (2005) show that the usage of PPP in the health care field is increasing in the UK market in terms of number, capital value, and size of projects, and the main aim is to achieve a better risk management.

Sources of Risk

To fill in this research gap, an analysis of the sources of external risks that are inherent with the UC of PPP/PFI hospital projects in the UK is proposed. Based on models available in the literature to classify risks (Zhang 2005; Schaufelberger and Wipadapisut 2003; Xenidis and Angelides 2005; Accounting Standard Board 1998), we identify various sources of risk with associated representative indicators. One or more parameters are identified to measure each indicator, as summarized in Table 1.

Indicators and Parameters of Financial Risk

Financial risks are important because they may cause negative impact on the project's expected cash flow and endanger the project bankability or limit profitability (Xenidis and Angelides 2005). In this context, the bankability can be determined via the debt service cover ratio (DSCR), which is referred to as the amount of cash flow available to reimburse debt. It is defined as per Eq. (1)

$$\text{DSCR} = \text{Net} \frac{\text{Income}}{\text{Total}} \Big/ \text{payment on outstanding debt} \qquad (1)$$

It is computed as the net cash flow generated over summation of principal and interest for each payment period. It is an indication of the ability of a project to service its debt (Ludeke-Freund and Loock 2011). A DSCR less than 1 indicates the inability of the project's

Table 1. Risk Sources with Associated Indicators and Measurable Parameters

Risk sources	Indicators	Parameters
Financial	Cost of capital	IRS
	Inflation	INFL
Political/	Tax level	TR
Economic	Investment environment	RQ
		GE
		ER
	Availability of capital	PC
Construction	Project size	HC
	Project duration	TI
Market	Revenue generation	CP

Note: IRS = interest rate swap; INFL = inflation rate; TR = tax rate; RQ = regulatory quality; GE = government effectiveness; ER = employment rate; PC = private credit; HC = hospital capacity; TI = time interval; CP = concession period.

3

gross profits to serve its debts, whereas greater than one suggests not only that the SPV is able to serve the debt obligations with the cash flow generated by the project, but also to making profit. The DSCR should meet a target DSCR on each payment period to satisfy the bank's financial covenants (De Marco et al. 2012b).

Financial risks that might affect the respect of a target DSCR are the cost of capital and inflation (Schaufelberger and Widapapisut 2003).

The cost of capital is a key factor in determining the intensity of a debt and internal rate of return, which consequently affects the feasibility, construction and operations of a project (Ling and Lim 2007). The cost of capital risk is measured in our data set via the interest rate swap (IRS). The IRS is an agreement between two parties to exchange a series of interest payments without exchanging the underlying debt. One party pays a fixed rate, while the other party pays the floating amount of interest. This kind of financial instrument provides a hedge against interest rate risk (Bicksler and Chen 1986). It is assumed that a higher interest rate would tend to increase the cost of capital and, consequently, reduce the DSCR so that the UC is also expected to increase. In the data set, the IRS is picked on the date of the project's financial closure with value associated to the length of the concession period (Econonmagic 2011): for example, a 25-year IRS is selected for a project having a 25-year-long concession period. For any project with concession period longer than 30 years, a 30-year IRS has been recorded.

Inflation also plays an important role because it negatively affects the purchasing power and, therefore, the return on investment. When inflation goes up, the project costs increase, therefore the DSCR goes down and consequently the UC has to increase. Inflation here is measured via the Inflation rate (INFL), with historical monthly values as reported by Rate Inflation (2011).

Indicators and Parameters of Political and Economic Risk

Posautz (2012) underlines the importance of taxes in a PPP project, since taxes have an influence on costs and profit. The tax regime is measured by the tax rate (TR) parameter, referred to as the percent fiscal charge on profit. If the TR increases, the net cash flow reduces and so does the DSCR. As a consequence, to compensate for such decrease and keep the DSCR up to the target level, the UC needs to be increased. In the data set, TR is provided by the Institute for Fiscal Studies of HMT (2011).

The investment environment is an expression of the political and economic stability, measured here by four parameters, namely: private credit, regulatory quality, government effectiveness, and employment rate. The political and normative context is very important and it has an influence on the capability of a country to draw investments. The normative and permit environment is reflected on access to politics, level of competition, fiscal terms, and domination of narrow interest that could hinder the efficiency and the performance of a project (Arditi et al. 2010).

The private credit (PC) parameter, provided by World Bank (2011), gives a measure of the financial resources made available to the private sector. The values recorded are expressed as annual percentage of the gross domestic product (GDP). In order to obtain the real amount of financing provided to the private sector, the indicator is multiplied by the annual GDP. As far as the availability of private credit increases, a SPV will have higher chances to get higher debt and the mechanism will drive interest rate down. In turn, the UC will also decrease.

The regulatory quality (RQ) measures the ability of the government to formulate and implement policies and regulations that permit and promote private sector development (World Bank 2011) and, in turn, it captures the predisposition towards outsourcing of public services to the private sector. This parameter is calibrated to be included within a range from −2.5 to +2.5, with 2.5 being the most favorable.

The government effectiveness (GE) measures the perception of the quality of public services, the quality of policy formulation and implementation (World Bank 2011). GE ranges from −2.5, indicating scarce quality, up to +2.5, indicating high quality.

The definition of these three parameters suggests a positive correlation with the UC. As a matter of fact, if governments and local authorities are inclined to outsource services to the private sector and have a high level of credibility, the UC is likely to increase, due to the higher risk that is assumed by the private party. Moreover, a high level of RQ, PC, and GE indicate a favorable environment, wherein the contract power of private parties is higher and, accordingly, the proposed UC would be also higher. On the contrary, a vibrant and favorable environment is likely to increase the level of competition among companies, with a negative effect on the level of the UC. Therefore, it is difficult to anticipate which one of these two elements of political and economic risk prevails on the UC.

The employment rate (ER) represents the percent of the population of those from 16 to 64 years old that are employed in each specific county of the UK. According to a survey carried out by Bloomberg (2009), unemployment is a factor that depresses consumers' spending. This confirms the idea that if the employment rate is high, consumers tend to spend more money and it will be easier for companies to get profits from their investments. A high employment rate represents a good, stable, and nonrisky economy. Thus the higher the ER, the lower the UC, thanks to a lower level of risk borne by the private sponsors.

Indicators and Parameters of Construction Risk

Large projects can gain from organizational and physical economies of scale. As a matter of fact, Scherrer and McQuaid (2010) note that in the European context PPP projects sizing between €10 to €15 million make sense. In the health care sector, some further aspects should be taken into account. First, large-sized hospitals take advantage of greater economies of scale; however, small-sized hospitals require a lower investment if a flexible and potentially expandable facility is designed. Here the project size is measured via the hospital capacity (HC) that is the number of beds available in the hospital. A negative correlation is expected with the UC: the overhead cost will in fact be allocated over a greater number of buildings/services. Given this reduced costs, the same DSCR can be obtained by reducing the UC 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). The parameter associated to the project complexity indicator is the time interval (TI), which is calculated as the difference of number of months between the date of the financial closure and the start date of the first UC payment. The longer the TI, the riskier the project and the greater the UC amount.

Indicators and Parameters of Market Risk

The market risk is related to the project revenue and reflects the capability of a project to generate cash flow in order to make profit

or, at least, reimburse the debt incurred. In our model, we measure the capability to generate revenue with the concession period (CP), as proposed by De Marco et al. (2012a) who prove that the concession period is a good parameter of market risk and that the CP appears to be a significant factor of the percentage of public finding into the total investment in PFI health care initiatives. The CP is the length of the contract expressed in years during which the SPV operates and maintains the service on the behalf of the public party before handing it back.

Projects with a short CP could result in a high tariff regime so that the risk burden due to short concession period may be transferred to the final users (Khanzadi et al. 2012). Typically, a longer CP provides better opportunities for generating income; however, granting an excessively lengthy concession may result in government loss, and the impact of risk uncertainties on the estimation of various economic variables can be heavier (Shen et al. 2002). Therefore, the length of the CP, from occupancy to transfer, is usually determined to assure attractiveness and protect the interest of both the public owner and concessionaire (Shen and Wu 2005).

Focusing on the health care environment, technology has rapidly progressed in the last decades and the trend is anticipated by PPP projects. This implies that hospital activities can change even drastically over the life cycle of a PPP initiative (Hensher and Edwards 1999). Consequently, especially for technologically uncertain medical services, a longer concession period, which implies more difficult forecast, is expected to have a reduced UC, since the amount of money that a public authority would be willing to pay decreases as far as its own risk increases.

Data Analysis

Based on the proposed risk model and data set of PFI British hospital projects, Table 2 summarizes the independent parameters that are supposed to have an influence on the amount of UC, taken as the response variable. The columns report the lower quartile, the median, the upper quartile and standard deviation, respectively. In the model, the ratio of the unitary charge to the total investment, which represents the expected return for the SPV, is the response variable (UC/INV). It ranges from 0.078 to 0.2342 with the median value approximately 0.1567.

The regression analysis aims to test if the independent variables taken into account are significant factors and whether they have a negative or positive impact on the response variable (Tukey 1977). A negative influence signifies that an increase (decrease) in the independent variable determines a decrease (increase) in the independent variable. On the contrary, a positive influence indicates that the same sign is between the independent and response variable variations.

The predictive variables have to be linearly independent: it can happen in multiple regression that the independent variables are correlated and the risk is of amplifying the variance measurement of the regression coefficients (Tabachnick and Fidell 2001). Perfect multicollinearity is a very rare event, but some collinearity is very common. The variance inflation factor (VIF) is used to measure such level of collinearity of a variable versus the others. 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 and 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 INFL, PC, and GE have a very high VIF. Therefore, multicollinearity is avoided by removing these predictors from the model (Table 4).

A first statistical analysis on the dependent variable shows a nonnormality of records (Fig. 1). Therefore, a logarithmic transformation has been applied on UC/INV data, which leads to a normal distribution (Fig. 2).

Fig. 2 shows that the values are all included within the normal distribution curve line. Since the parameters of the data set have different order of magnitude and thus results cannot be compared, the interpretation of results could be awkward. In order to overcome this issue, a regression is carried out on standardized variables (Carroll and Carroll 2002). To this end, for each variable the mean and the standard deviation are calculated, and each observation is normalized using Eq. (2)

$$z = \frac{x - \mu}{\sigma} \qquad (2)$$

where x = value to be standardized; μ = mean of the population; and σ = standard deviation of the population.

The results of the regression analysis are provided in Table 5, where the columns report the estimate of the regression coefficient, the standard error of the estimate, the value of t statistic and the p-value.

The level of significance is associated to the p-value, which ranges from 0 to 1, is obtained 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 it is less than a predetermined critical value, usually equal to 5%, the null hypothesis is rejected. In the regression analysis the null hypothesis states that the coefficient equals zero (Montgomery and Runger 1999).

Results reveal that RQ, ER, HC, TI, and HC are significant factors of the UC amount. Regulatory quality highlights the perception

Table 2. Summary of Exploratory Analysis

Variable	Acronym	Lower quartile	Median	Upper	Standard deviation
UC/investment (response variable)	UC/INV	0.1266	0.149	0.184	0.0372
Interest rate swap (%)	IRS	4.72	4.90	5.54	0.00599
Inflation rate (%)	INFL	1.357	1.547	2.12	0.5321
Tax rate (%)	TR	30	30	30	0.00781
Private credit (million £)	PC	118.5	150.8	188.1	33.82
Regulatory quality	RQ	1.71	1.8	1.81	0.1013
Government effectiveness	GE	1.62	1.86	1.93	0.16
Employment rate (%)	ER	68.9	71	73.9	0.037
Hospital capacity (number of beds)	HC	90	286	516.5	375.4
Time interval (number of months)	TI	0	29	68	44.53
Concession period (years)	CP	30	30	30	2.621

Table 3. Multicollinearity Analysis of the Complete Model

	IRS	INFL	TR	PC	RQ	GE	ER	HC	TI	CP
VIF	4.5	7.2	4.4	28.8	5.1	30.15	1.2	1.6	2.2	1.9

Table 4. Multicollinearity Analysis of the Complete Model

	IRS	TR	RQ	ER	HC	TI	CP
VIF	2.3	2.3	2.4	1.1	1.6	1.7	1.7

of how the government favors outsourced services to the private sector and, therefore, it shows a negative relationship as expected: when public authorities create a favorable environment towards private companies, the level of risk taken by the private party reduces and, as a consequence, the UC amount charged in return for borne risk may be lower. In the same way, ER has a negative influence on the unitary charge over investment ratio. High levels of ER indicates that for favorable general economic conditions, there are less risks for investors and, in turn, lower levels of

UC. A positive correlation emerges with the dimension of the project, in terms of number of beds available in the hospital: this means that economies of scale are inconsistent, but on the contrary large hospitals are considered riskier because of reduced flexibility and higher probability of not being capable of exploiting the whole care capacity.

The complexity of the project, measured by difference of number of months between the date of financial close and the start of the first unitary charge payment, is also a significant factor. As expected in the anticipated risk model, the longer this period the higher the complexity of the project and the higher the UC requested in light of greater risk borne by the SPV.

Also, the concession period shows a negative influence on the UC: shorter CPs can give fewer opportunities to make profit, and therefore the UC needs to be greater in order to make the investment more attractive.

Finally, some tests on residuals are analyzed to validate the consistency of the model. In particular the *residuals versus order* (Fig. 3) does not indicate periodicity, trends or time series; the *residuals versus fits* (Fig. 4) does not show evidence of systematic
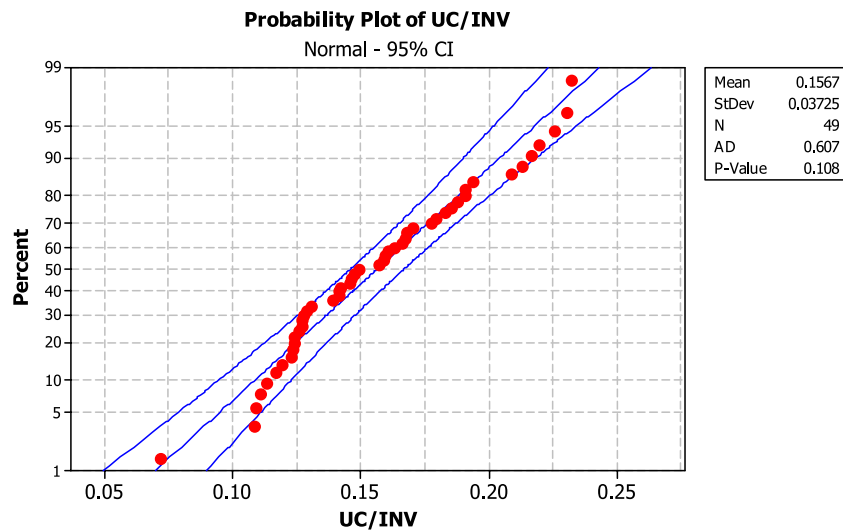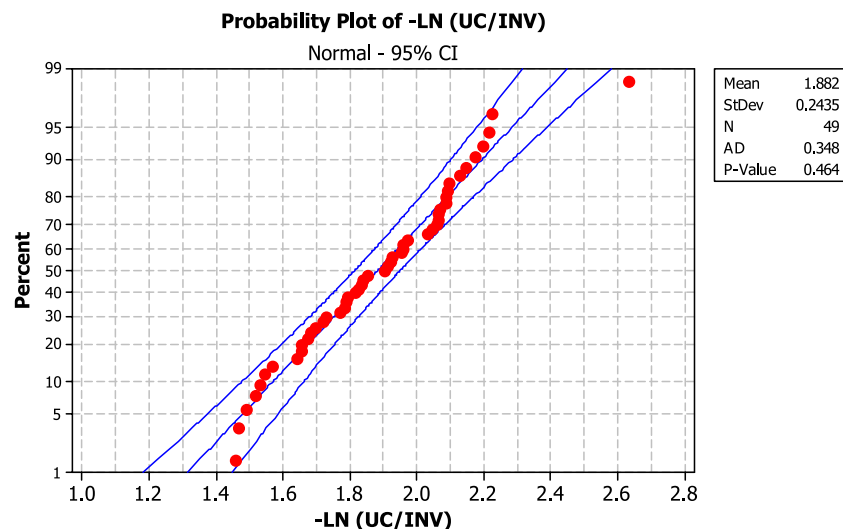

Fig. 1. Plot of unitary charge over investment ratio

Fig. 2. Plot of -ln(unitary charge over investment ratio)

Table 5. Results of Regression Analysis

Variable	Acronym	Estimate	Standard error	t-value	p-value
Interest swap rate	IRS	−0.0600	0.07910	−0.76	0.4520
Tax rate	TR	0.0673	0.07280	0.89	0.3770
Regulatory quality	RQ	−0.4888	0.08010	−6.10	0.0001
Employment rate	ER	−0.1911	0.05279	−3.62	0.0010
Hospital capacity	HC	0.1354	0.06399	2.12	0.0400
Time interval	TI	0.7024	0.06690	10.50	0.0001
Concession period	CP	−0.1952	0.06689	−2.92	0.0060
R-squared	86.9%				
R-squared (adjusted)	84.7%				
Constant	−0.0548				

Fig. 5. Normal probability plot of residuals
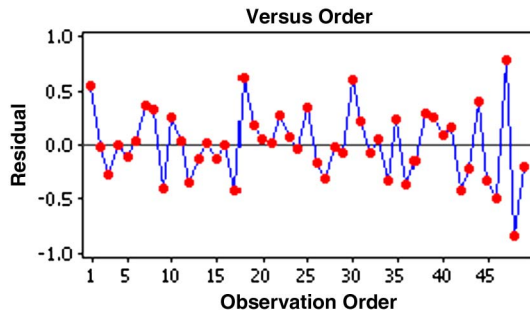
Fig. 3. Residuals versus order
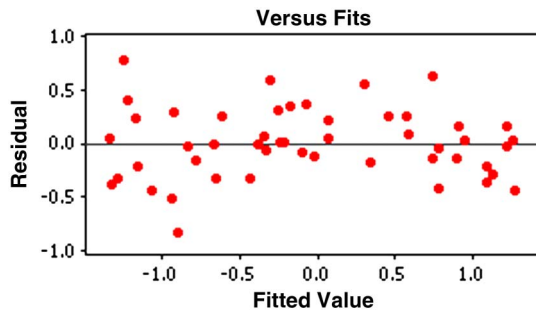
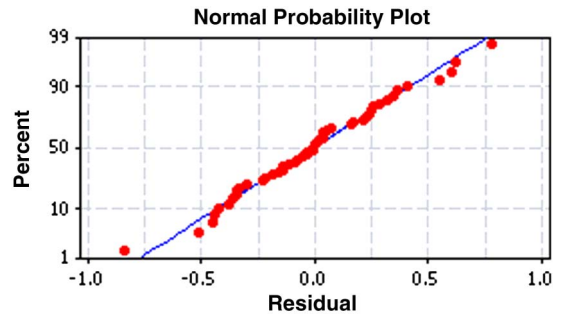
Fig. 4. Residuals versus fits

error in the residuals of the regression (we can assume that the least sum squared of residuals equals zero); and the *normal probability plot* (Fig. 5) shows that it is possible to assume normally distributed residuals.

Discussion of Results

The results of the regression analysis originate some considerations on the motivations for undertaking PPP/PFI hospital initiatives and, in particular, on the relationships between the risk profile and the UC paid by public authorities.

Some of the relevant drivers confirm expected inherent relationships. First, a favorable economic and political environment tends to reduce the amount of UC because of a more competitive market forcing companies to bid lower UC payments, and less risk is borne by private sponsors, with a subsequent lower UC.

Second, the positive relationship with the construction complexity, by some means indicated by the numbers of months between the day of the financial close and the first payment, and the number of beds available in the hospitals, suggests that the public expenditure is lower in small hospitals that are inherently characterized by a shorter construction period. These kinds of projects rely on two aspects: on the one hand, facilities with small capacity are likely to have better utilization rate than large-sized hospitals; on the other hand, small facilities have shorter construction periods and likely reduced construction risk.

Finally, the concession period appears to have a negative effect on the UC: a longer concession period is likely to reduce the amount of UC, which is paid for a longer period of time.

The model addresses some practical implications consistent with the interpretation of the empirical results.

All types of risk sources that have been identified in the model are designated to have an influence on the unitary charge over total investment ratio. De Marco et al. (2012a) underline how public financing allows reducing the burden of project risks on the shoulders of the private party in the health care sector in Italy. Similarly, in the UK market, the UC paid by public owners to private companies represents a way to share risks and reduce the risk exposure of private shareholders.

The data set also provides an opportunity for better understanding other aspects of the UC and VFM in health care PFI projects. For example, it allows for analyzing the potential influence of the experience that both granting authorities and private sponsors acquire in the process of negotiating the UC and obtaining their expected VFM. Although experience is not considered directly into the regression model because it is not a risk factor, the possible impact of experience on the amount of UC is analyzed via comparing the time interval (TI) variable with the UC trend. TI is a good proxy of the experience of the parties: it is defined as the number of months from financial close to the point in time of observation (December 31, 2011) and it addresses the idea that old projects have lower contractual and legislative experience than recent financially closed projects.

The corresponding scatter plot is given in Fig. 6 showing a negative effect: the older the project, the lower the UC charged to the public authority.

An explanation is inherent with the notion that probably in recent years the contractual power of private parties entering PPP contracts has grown, resulting in an increased level of proposed UCs. This presumably can be interpreted as a rising contract power gained by increasingly experienced private sponsors in negotiating UC contracts in the British health care sector.

Implications, Limitations, and Future Research

Even though this work does not provide a model for immediate and direct applicability by contracting professionals, it urges the need for considering some currently neglected but important risk factors when determining the UC, and it is a source of potential implications for both granting authorities and PFI bidders. On the one
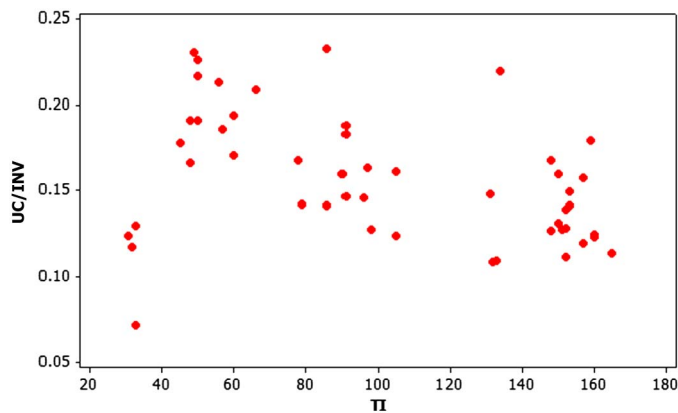
Fig. 6. Scatterplot of UC/INV versus TI

hand, it might serve the purpose of helping public authorities to achieve a higher level of VFM in PFI projects and provideg some guidelines on the main risks factors that can influence the UC. Also, the proposed methodology might support the decision-making process for determining an appropriate amount of UC, by considering the effects that the risk factors statistically have on the annual payment.

On the other hand, project sponsors can use this model to let the granting authorities understand the impact of risk transfer on the UC and achieve a better risk sharing in return for a lower level payment charged to their granting authority.

Future research is primarily directed toward such directions and aimed at encapsulating the results of this analysis into methodologies for ex ante VFM estimation and into the process of determining the amount of UC in financial plans of PFI projects.

Also, future research is addressed to apply the risk model to other types of social facilities to validate its extended applicability.

Another current limitation of the model is that the quality of supplied services has not been taken into account, even if it is a crucial aspect in the evaluation of the VFM and, in turn, in the determination of the UC. The proposed methodology aims at supporting existing models for the evaluation of the VFM, meaning that it addresses the decision maker to consider the risk factors in the determination of a more proper UC. In line with this argument, future research is also directed to the evaluation of the quality of the service that are provided, together with financial elements and significant risk factors, in order to give to both the public and private party a direct methodology capable to effectively size the amount of the UC.

Conclusion

Claiming that the UC is influenced by the project's inherent risk borne by the private sponsors, a model is developed with the purpose of understanding the risk factors that might influence the UC of a PPP/PFI hospital project. In particular, financial, political/economic, construction, and market risks are defined, along with their associated indicators and parameters. Based on this model, various data pertinent to the mentioned risk drivers are collected from a number of PFI hospital projects in the UK. The analysis shows that regulatory quality, employment rate, hospital capacity, construction duration, and concession period have a significant relationship with the unitary charge over the total investment dependent variable.

This methodology might help the purpose of better understanding the main factors affecting the UC periodically corresponded by

public authorities to private SPVs for operating a social facility. Since the UC is an important component of the project's VFM, this model assists in understanding the ideal characteristics of service-performing hospital PPPs. As a matter of fact, in assessing and delivering VFM, it is important to consider the optimum allocation of risks between the parties, and in particular the amount of risk charged to the private sponsors (HMT 2006). The proposed methodology could support both public authorities and private concessionaires in the risk allocation decision and in the associated determination of the UC.

Our empirical analysis shows that it is possible to achieve a higher level of VFM in PPP/PFI hospital projects when developed within a good economic and political environment in order to stimulate the competition and, in turn, to decrease the public expenditure. Moreover, small-sized hospitals requiring a short construction effort and granted for long concession periods are more likely to be better exploited, bear a lower level of construction risk, and, in turn, have a lower UC amount.

The goal of this analysis is to highlight that risk factors should be taken into account into future design models of PPP. Therefore, future research is addressed to develop models that, based on evaluation of significant sources of risk, could provide direct applicability for both private and public contracting professionals and allow predetermining the amount of UC in order to both deliver and obtain the desired value.

References

Accounting Standard Board. (1998). "Application note F to financial reporting standard 5: Reporting the substance of transactions." ASB, London, ⟨http://www.frc.org.uk/asb/technical/pub0106.html⟩ (Oct. 10, 2011).

Akintoye, A., and Chinyio, E. (2005). "Private Finance Initiative in the healthcare sector: Trends and risk assessment." *Eng. Construct. Architect. Manage.*, 12(6), 601–616.

Algarni, A. M., Arditi, D., and Polat, G. (2007). "Build-operate-transfer in infrastructure projects in the United States." *J. Constr. Eng. Manage.*, 133(10), 728–735.

Amatucci, F., and Lecci, F. (2006). "Le operazioni di partnership finanziaria pubblico-privato in sanità: un'analisi critica." *Rapporto OASI 2006 L'aziendalizzazione della sanità in Italia*, E. Cantù, ed., SDA Bocconi Egea, Milano, Italy, 689–731.

Andersen, A. (2000). *Value for money drivers in the private finance initiative*, Arthur Andersen and Enterprise LSE, London.

Andon, P. (2012). "Accounting-related research in PPPs/PFIs: Present contributions and future opportunities." *Account. Audit. Account. J.*, 25(5), 876–924.

Arditi, D., Isik, Z., Dilment, I., and Birgonul, T. (2010). "The role of exogenous factors in the strategic performance of construction companies." *Eng. Construct. Architect. Manage.*, 17(2), 119–134.

Askar, M. M., and Gab-Allah, A. A. (2002). "Problems facing parties involved in build, operate and transport project in Egypt." *J. Manage. Eng.*, 18(4), 173–178.

Bicksler, J., and Chen, A. H. (1986). "An economic analysis of interest rate swaps." *J. Finance*, 41(3), 645–655.

Bing, L., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005). "The allocation of risk in PPP/PFI construction projects in the UK." *Int. J. Proj. Manage.*, 23(1), 25–35.

Bloomberg. (2009). "Unemployment at 10% to depress consumer spending, survey shows." ⟨http://www.bloomberg.com/apps/news?pid=news archive&sid=aSqyoDA4ePbg⟩ (Oct. 4, 2011).

Broadbent, J., Gill, J., and Laughlin, R. (2003). "Evaluating the Private Finance Initiative in the National Health Care Service in the UK." *Account. Audit. Account. J.*, 16(3), 442–445.

Carrillo, P. M., Robinson, H. S., Anumba, C. J., and Bouchlaghem, N. M. (2006). "A knowledge transfer framework: The PFI context." *Constr. Manage. Econ.*, 24(10), 1045–1056.

Carroll, S. R., and Carroll, D. J. (2002). *Statistics made simple for school leaders*, Rowman & Littlefield, Lanham, MD.

Cheung, E., Chan, A. P. C., and Kajewsky, S. (2009). "Reasons for implementing public private partnership projects." *J. Prop. Invest. Finance*, 27(1), 81–95.

Clifton, C., and Duffield, C. F. (2006). "Improved PFI/PPP service outcomes through the integration of alliance principles." *Int. J. Proj. Manage.*, 24(7), 573–586.

Connolly, C., and Wall, T. (2011). "The global financial crisis and UK PPPs." *Int. J. Public Sector*, 24(6), 533–542.

Daube, D., Vollrath, S., and Alfen, H. W. (2008). "A comparison of project finance and forfeiting model as financing form for PPP projects in Germany." *Int. J. Proj. Manage.*, 26(4), 376–387.

De Marco, A., Mangano, G., Cagliano, A. C., and Grimaldi, S. (2012a). "Public financing into build-operate-transfer hospital projects in Italy." *J. Constr. Eng. Manage.*, 138(11), 1294–1302.

De Marco, A., Mangano, G., and Zou, X.-Y. (2012b). "Factors influencing the equity share of build-operate-transfer projects." *Built Environ. Proj. Asset Manage.*, 2(1), 70–85.

Econonmagic. (2011). "Economic time series page." ⟨http://www.economagic.com/fedbog.htm#Monthly⟩ (Dec. 12, 2011).

Grimsey, D., and Lewis, M. S. (2005). "Are public private partnership value for money? Evaluating alternative approaches and comparing academic and practitioner views." *Account. Forum*, 29(4), 345–378.

Handley-Schachler, M., and Gao, S. S. (2003). "Can the private finance initiative be used in emerging economies? Lessons from the UK's successes and failure." *Manager. Finance*, 29(5), 36–51.

Hayford, O. (2006). "Successful allocating risk and negotiating a PPP contract." *Proc., 6th Annual National Public Private Partnership Summit: Which Way Now for Australia's PPP Market?*, Clayton Utz, Sydney, Australia, 1–18.

Heald, D. (2003). "Value for money test and accounting treatment in PFIs schemes." *Account. Audit. Account. J.*, 16(3), 342–371.

Hellowell, M., and Pollock, A. M. (2009). "The private financing of NHS hospitals: Politics, policy and practice." *J. Inst. Econ. Affairs*, 29(1), 13–19.

Hensher, M., and Edwards, N. (1999). "Hospital provision activity and productivity on England since the 1980s." *Br. Med. J.*, 319(7214), 911–914.

Her Majesty's Treasury (HMT). (2000). *Public private partnership: The Government's approach*, The Stationery Office, London.

Her Majesty's Treasury (HMT). (2003). *PFI: Meeting the investment challenge*, The Stationery Office, London.

Her Majesty's Treasury (HMT). (2006). *Departmental Rep. 2006*, St. Clements House, Norwich, UK.

Her Majesty's Treasury (HMT). (2007). *Managing public money*, The Stationary Office, London.

Her Majesty's Treasury (HMT). (2011). "Value for money assessment guidance institute for fiscal studies (2011)." ⟨http://www.hm-treasury.gov.uk/infrastructure_ppp_vfm.htm⟩ (Dec. 2, 2011).

Hoffman, G. J., Thal, J. A. E., Webb, T. S., and Weir, J. D. (2007). "Estimating performance time for construction project." *J. Manage. Eng.*, 23(4), 193–199.

Holmes, J., Capper, G., and Hudson, G. (2006). "LIFT: 21st century healthcare centres in the United Kingdom." *J. Facil. Manage.*, 4(2), 99–109.

Iyer, K. C., and Sagheer, M. (2010). "Hierarchical structuring of PPP risks using interpretative structural modeling." *J. Constr. Eng. Manage.*, 136(2), 151–159.

Jefferies, M., and McGeorge, W. D. (2009). "Using public-private partnership (PPPs) to procure social infrastructure in Australia." *Eng. Construct. Architect. Manage.*, 16(5), 415–437.

Jin, X. H. (2010). "Determinants of efficient risk allocation in privately financed public infrastructure project in Australia." *J. Constr. Eng. Manage.*, 136(2), 138–150.

Jin, X. H., and Zhang, G. (2011). "Modeling optimal risk allocation in PPP using artificial neural networks." *Int. J. Proj. Manage.*, 29(5), 591–603.

Khadaroo, I. (2008). "The actual evaluation of school PFI bids for value for money in the UK public sector." *Crit. Perspect. Account.*, 19(8), 1321–1345.

Khanzadi, M., Nasirzadeh, F., and Alipour, M. (2012). "Integrating system dynamic fuzzy logic model to determine concession period in BOT projects." *Automat. Constr.*, 22(3), 368–376.

Lattemann, C., Stieglitz, S., Kupke, S., and Schneider, A. (2009). "Impact of PPPs to broadband diffusion in Europe." *Transform. Gov. People: Process and Policy*, 3(4), 355–374.

Ling, F., and Lim., H. L. (2007). "Foreign firms' financial and economic risk in China." *Eng. Construct. Architect. Manage.*, 14(4), 346–362.

Ludeke-Freund, F., and Loock, M. (2011). "Debt for brands: tracking down a bias in financing photovoltaic projects in Germany." *J. Cleaner Prod.*, 19(12), 1356–1364.

Montgomery, D. C., and Runger, G. C. (1999). *Applied statistics and probability for engineers*, Wiley, New York.

Nisar, T. M. (2007). "Value for money drivers in public private partnership schemes." *Int. J. Public Sector Manage.*, 20(2), 147–156.

O'Brien, R. M. (2007). "A caution regarding rules of thumb for variance inflation factors." *Quality and Quantity*, 41(5), 673–690.

Pitt, M., Collins, N., and Walls, A. (2006). "The private finance initiative and value for money." *J. Prop. Invest. Finance*, 24(4), 363–373.

Pollock, A. M., Shaoul, J., and Vickers, N. (2002). "Private finance and value for money in NHS hospitals: A policy in search of a rationale?" *Br. Med. J.*, 324(7347), 1205–1209.

Posautz, G. (2012). "The proper taxation of public-private partnership (PPP)." ⟨http://www.wu.ac.at/steuerlehre/dwld/paper_gerald_posautz.pdf⟩ (Jan. 4, 2012).

Rate Inflation. (2011). ⟨http://www.rateinflation.com/inflation-rate/uk-historical-inflation-rate⟩ (Dec. 3 2011).

Robinson, H. S., and Scott, J. (2009). "Service delivery and performance monitoring in PFI/PPP projects," *Constr. Manage. Econ.*, 27(2), 181–197.

Schaufelberger, J., and Wipadapisut, I. (2003). "Alterate financing strategies for build-operate transfer projects." *J. Constr. Eng. Manage.*, 129(2), 205–213.

Scherrer, W., and MCQuaid, R. W. (2010). "The role of public private partnership at the regional level of government and regional innovation policy in particular." ⟨http://hum.ttu.ee/failid/HKAC%202011/HKAC_Scherrer.pdf⟩ (Oct. 5, 2011).

Shen, L. Y., Li, H., and Li, Q. M. (2002). "Alternative concession model for build-operate-transfer contract projects." *J. Constr. Eng. Manage.*, 128(4), 326–330.

Shen, L. Y., and Wu, Y. Z. (2005). "Risk concession model for build-operate-transfer contract projects." *J. Constr. Eng. Manage.*, 131(2), 211–220.

Tabachnick, B. G., and Fidell, L. S. (2001). *Using multivariate statistics*, 3rd Ed., HarperCollins, New York.

Thomas, A. V., Kalidindi, S. N., and Ananthanarayanan, K. (2003). "Risk perception analysis of BOT road project participants in India." *Constr. Manage. Econ.*, 21(4), 393–407.

Tukey, J. W. (1977). *Exploratory data analysis*, Addinson-Wesley, Reading, MA.

World Bank. (2011). "Wordwide governance indicators." ⟨http://info.worldbank.org/governance/wgi/index.asp⟩ (Sep. 8, 2011).

Xenidis, Y., and Angelides, D. (2005). "The financial risks in build-operate-transfer projects." *Constr. Manage. Econ.*, 23(4), 431–441.

Zhang, X. (2005). "Financial viability analysis and capital structure optimization in privatized public infrastructure projects." *J. Constr. Eng. Manage.*, 131(6), 656–668.