Is There Room for a PPP Secondary Market? Financial Analysis of the PPP Transport Sector

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Abstract: Public private partnerships (PPP) projects usually last several decades, so should the initial sponsors sell their project before the end of the contract? A financial framework is developed in this paper to determine the circumstances making such a sale a rational choice, with a superior performance to the nonselling alternative. Application of this framework to transport infrastructure suggests there might be room for a PPP secondary market in developed economies, but this is not so clear in emerging markets. **DOI: 10.1061/(ASCE)ME.1943-5479.0000327.**

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Introduction

Public private partnerships (PPP) are an indirect procurement alternative for public sector infrastructures, facilities, and services. In these projects, the private sector finances, designs, builds, operates, and bears some risks in exchange for economic rights, usually related to future cash flows of the project (Grout 1997; Yescombe 2007).

Even though PPPs account for a relatively small share of infrastructure investment, the capital needs for this procurement alternative are considerable. According to Dobbs et al. (2013), if institutional investors were to increase their allocation of funds for infrastructure financing to their target levels, this would result in an additional US $2.5 trillion in infrastructure investment capital through 2030.

The life span of a PPP project is usually long enough for the project's sponsor to recover the initial investment and a return proportional with the risks taken, unless certain of these risks materialize in a harmful way (Zhang 2005). The average length of a PPP project stands at 30 years, although this timeframe can be from 3 to 99 years in the most extreme cases (S. Araújo, and D. Sutherland, "Public-private partnerships and investment in infraestructure," working paper, OECD Publishing, Paris).

In recent years, a thriving private industry around PPP has flourished. According to Public Works Financing (2013), a specialized publication with a database that tracks PPP projects since 1985, around US $1.03 trillion have been invested in PPP infrastructure projects through the end of 2013. Gurgun and Touran (2013) review of the state of the art in regions where PPPs are broadly used, as well as a review of the PPP experience in the U.S. Many companies in the private sector have become specialized in this business, such as developers or sponsors, operators, infrastructure investment funds, and financial institutions, among others (Carpintero 2011). Some of these companies have long-term investment horizons, but others focus on medium-term investments. In a survey carried out amongPPP financiers by Demirag et al. (2010), about 20% of respondents intended an early exit and only two-thirds reported their intention to stay with a PPP until the end of the contract, with the remaining 13% selling the project sometime in between. However, a medium-term investment strategy in PPP projects requires a secondary market, that is, a sufficient set of rules, best practices, and potential participants in PPP transactions.

The existence and correct functioning of PPP secondary markets are beneficial to the economy in at least two ways: such a market increases competition in PPP primary markets, and it provides interesting investment opportunities for risk-averse agents. Agents with short-term investment horizons are willing to enter the PPP market only if there is a clear and satisfactory exit option, provided for instance by a PPP secondary market. The participation of agents with short-term and long-term investment horizons means increased competition in the PPP primary market (project tenders issued by the public sector), leading to greater efficiency and savings for the public sector. Also, since PPP project risk profiles decrease over time (see M. Dailami, et al., "Infrisk: A computer simulation approach to risk management in the infrastructure project finance transactions," working paper, World Bank, Washington), a PPP secondary market provides attractive investment opportunities to pension funds and similar institutions seeking low-risk and long-dated cash flows against pension liabilities. The development of efficient PPP secondary markets could also lead to a higher specialization of companies—risk management plans could be better tailored and adjusted to the particular risks present at some stages of the project, instead of being comprehensive of all the risks that comprise the project.

There are important regulatory issues concerning early exits in PPP projects. When awarding PPP projects, the granting authority looks for private sector partners with proven technical and economic capabilities. Regulations in many countries allow these partners an early exit of the PPP projects as long as they are replaced with private sector companies that offer at least the same technical and economic solvency. Depending on local legislation, it may be necessary, however, to introduce special provisions in the tendering

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documentation that specify the requisites that potential future shareholders of the project must meet, depending also on the stage of the project.

There is already an extensive academic body of literature on PPPs (Sánchez Soliño and Vassallo 2009; Tang et al. 2010; Chou et al. 2012), but the question of PPP secondary markets remains, however, largely untreated. Few authors explicitly address cash flow modeling in the context of project finance (F. Weber, et al., "Simulation-based valuation of project finance - does model complexity really matter?," working paper, CEFS, Munich), a necessary tool to address the issue of PPP secondary markets.

In this paper we aim to

1. Develop a simple theoretical framework to identify key variables in the decision of selling or not selling a PPP project from a private sector point of view;
2. Apply the theoretical framework to the transport infrastructure sector; and
3. Identify restrictions that may exist in the transport infrastructure PPP secondary market, in developed and emerging economies.

Related Literature

PPP projects usually involve large-scale investments, and to a large extent, rely on project finance for their structuring (S. Kleimeier, and W. Meggison, "An empirical analysis of limited recourse project finance," working paper, Maastricht Research School of Economics of Technology and Organization, Maastricht). The generally agreed upon definition of project finance usually includes as its main characteristic the creation of a legally independent company (special purpose vehicle or SPV) financed with equity from the sponsors and nonrecourse debt (Esty 2004).

Financial project valuation is performed usually though discounted cash flow (DCF) analysis (Esty 1999). According to standard valuation theory, the equity investment in a project can be valued in two different ways:

1. Discounting the expected project free cash flow (PFCF) using the weighted average cost of capital (WACC), and subtracting the debt value; and
2. Discounting the expected free cash flow to equity (FCFE) using the cost of capital to shareholders.

Valuation theory for integrated capital markets states that a project discount rate should incorporate only systematic or market risk, while the cash flow should reflect unsystematic or diversifiable risks. Thus, the calculations should be based on expected cash flow. To address the issue of cash flow distribution, Vose (2008) suggested using a scenario-based modeling approach (which are probabilistically weighted), or the application of Monte Carlo simulation–depending on the modeling capabilities available, computational power, the knowledge of correlation between variables, and other factors. The cost of capital to shareholders can be determined through the capital asset pricing model (CAPM) or arbitrage pricing theory (APT).

Relevant academic literature on PPP financial modeling is related to project finance or, even better, cash flow modeling in the context of project finance, but the literature available is not vast (see Esty 2004; F. Weber, et al., "Simulation-based valuation of project finance - does model complexity really matter?," working paper, CEFS, Munich).

Some relevant papers that explicitly address cash flow modeling in the context of project finance are Esty (1999), Dailami et al. ("Infrisk: A computer simulation approach to risk management in the infrastructure project finance transactions," working paper, World Bank, Washington), Mandron (2000), Gatti et al. (2007), and Weber et al. ("Simulation-based valuation of project finance - does model complexity really matter?," working paper, CEFS, Munich).

Esty (1999) describes the standard approach to project valuation through discounted cash flow (DCF), pointing out the problems with this method. In particular, the author discusses the use of a constant discount rate by practitioners, when project capital structure evolves over time. He proposes the use of multiple discount rates that take into consideration changes in the leverage of the project. He also notes the importance of estimating the cost of equity based on market values and not on book values, through the use of quasi-market valuation (QMV) or similar techniques. He briefly describes the advantages of Monte Carlo techniques, which are dynamic simulations offering more information than the traditional static sensitivity analysis conducted in DCF valuation. He finally introduces the technique of real options analysis, which takes into account the possibility of managers to postpone decisions and to adapt to changing circumstances. He acknowledges, nevertheless, the increased complexity introduced by these techniques.

Mandron (2000) suggests the use of variable discount rates in DCF, justified by changes in capital structure (as suggested by Esty 1999) and the evolution of business risk.

Dailami et al. ("Infrisk: A computer simulation approach to risk management in the infrastructure project finance transactions," working paper, World Bank, Washington) develop a model and tool to assess risks in infrastructure project finance. The user can assign in the model different probability distributions (uniform, normal, lognormal, and beta) to key variables and run Monte Carlo simulations. The model provides project sponsors with internal rate of return (IRR) and net present value (NPV) distribution histograms, and financiers with default probabilities. The authors highlight the importance of correctly selecting the probability distribution of each key variable. The model relies on discounted cash flows (DCF) using a constant discount rate, and recognizes differences in the construction and operation phases, as per the following equation:

$$\mathrm{NPV} = \sum_{i=1}^{c}(-1)\frac{\mathrm{ES}_i + \mathrm{LS}_i + \mathrm{BS}_i}{(1+r)^i} + \sum_{i=1}^{o}\frac{\mathrm{NCF}_i}{(1+r)^{i+c}} \qquad (1)$$

where c and o = respective number of construction and operation periods; ES_i = equity allocation during ith construction period; LS_i = loan allocation during ith construction period; BS_i = bond allocation during ith construction period; NCF_i = net cash flow associated with the project in ith operating period; and r = a specified discount rate.

Gatti et al. (2007) developed a model to determine value-at-risk in infrastructure project finance. Their model uses Monte Carlo simulation techniques and studies on debt providers.

Finally Weber et al. ("Simulation-based valuation of project finance - does model complexity really matter?," working paper, CEFS, Munich) develop a model based on Monte Carlo simulation techniques, in order to assess the impact of model complexity on the valuation results. They use multiple discount rates in order to take into account the evolution of the leverage of the project over time, calculated through quasi-market valuation. Complexity is introduced in the valuation procedure (number of iterations, time-resolution, and the cost of capital calculation method) and in the complexity of the forecast models (volatility and correlation).

Theoretical Framework

In this section, a theoretical framework is developed, from the perspective of a private sector project sponsor, to identify key variables and determine the best available option in terms of selling versus nonselling in PPP projects.

In this paper, an approach is used that relies on a valuation based on discounted equity cash flow using shareholder cost of capital. According to Esty (1999) this method is superior to discounted project cash flow using the weighted average cost of capital, as since the actual estimated tax rates can be used, it does not assume the net present value of debt to be zero and is easier to value multiple rounds of equity financing at different times. Mandron (2000) argues that valuation through discounted project free cash flow using WACC should be abandoned altogether. The framework relies on single estimate points for key variables and a single discount rate, despite the varying capital structure of the project over time, for the following reasons:

1. The likelihood that gains achieved through more complex modelling would be offset by the likely errors introduced, such as estimating the cost of capital for each period and the correct distribution probabilities for the main variables (see for instance Alcaraz, unpublished data, 2014);
2. Set up a project model that can also be easily used by practitioners; and
3. The model starts with the analysis of two companies that use different investment strategies:
   - Company 1: Investment in a PPP project to receive its net cash flows. This company invests in PPP projects and keeps them in its portfolio during their full cycle, until the expiry of the contract.
   - Company 2: Investment in a PPP project to sell it once the construction phase is completed. Company 2 portfolio has only PPP projects in construction phase.

These companies could be either infrastructure funds or construction and concession groups. In any case the following hypotheses are adopted, but they may not always be completely true in all PPP projects:

1. Company 1 and Company 2 characteristics are the same, except for their investment strategy as described previously. Both firms are identical in terms of production technology;
2. Company 1 and Company 2 have the same amount of money to invest as equity in PPP projects;
3. Company 2 has a higher cost of capital than Company 1. The issue of the cost of capital in concession companies depending on their portfolio rotation has received little attention in finance research. This hypothesis is however based on the fact that the risk profile of Company 2 is higher than Company 1, since it assumes the risks of Company 1 several times: Each new project for Company 2 is a new opportunity to fail. Company 2 also runs the additional risk of divesting from PPP projects;
4. Company 1's and Company 2's cost of capital remains unchanged during the analysis period;
5. In terms of cash flow, PPP projects are not affected by the fact that they are developed by Company 1 or Company 2. It could be argued that since Company 2 will not have to stay permanently with the project, it could try to maximize its returns by diminishing its initial investment, even if it meant that lower quality would result in more frequent and costly maintenance during the operation phase. In this paper we assume that this does not happen, based on the following assumptions:
   - PPP projects are highly regulated and supervised by the granting authority, which should not allow low quality standards and is able to enforce penalties in case of nondelivery by the contracting company. The profit made by the exiting investors is thus assumed to be in line with the risks undertaken–taking benefits from future unassumed risks would reduce incentives to provide quality services in the future;
   - It is common practice for companies to form consortia to develop PPP projects. In this context business partners that participate with long-term horizons would not allow for such substandard practices. Debt providers also would not allow for these practices; and
   - High operational expenses during the operation phase would result in lower dividends for future shareholders, diminishing the value of the PPP project and thus the return obtained by Company 2. This would make the incentives for such practices disappear.
6. The production technology is unaffected by whether or not one firm constructs and operates the project or whether two firms split these tasks;
7. PPP projects are awarded to private sector companies through competitive tendering processes; and
8. A PPP project's risk profile decreases over time. Some risks, such as expropriation or construction risk, are localized in the initial stage of the project and will not be present once this phase is over. Another significant risk in greenfield projects concerns traffic forecasts (Flyvbjerg et al. 2006). Demand risk will decrease in importance as soon as the PPP project enters the operational stage and more information is available (concerning for instance the number of users during the initial stages).

To develop the theoretical framework the typical cash flow of a PPP project is analyzed. Then to make a comparison, the net present value (NPV) of both Company 1 and Company 2 are calculated.

Shareholder Cash Flow in a PPP Project

In this model, and in line with the standard valuation theory, calculations are based on expected cash flow, that is, the probability weighted average of various future cash flow scenarios.

The shareholder net cash flow in a PPP project is usually negative during the preparation and construction phase and positive during the operational phase. The examples provided by many authors in academic papers follow this pattern (e.g., Esty 1999; F. Weber, et al., "Simulation-based valuation of project finance - does model complexity really matter?," working paper, CEFS, Munich).

Under a very simplified scheme, the after-tax shareholder cash flow has the following configuration, where c, e, and n = the respective number of construction, operation and total periods; and I = investment made by the sponsor during the construction phase; D = after tax shareholder average yearly net cash flow during the operational phase of the project; G_e = transaction entry costs; and g = growth factor for costs and net cash flows.

Company 1 NPV

The project's NPV for the sponsor company is the result of adding all the discounted net cash flows of the project, using a discount rate r_1 equal to the cost of capital for Company 1

$$\mathrm{NPV}_1 = -I - G_e + \sum_{c}^{n} \frac{D(1+g)^{i-c}}{(1+r_1)^i} \tag{2}$$

The sponsor's IRR can be calculated solving for x in the following equation:

$$0 = -I - G_e + \sum_{c}^{n} \frac{D(1+g)^{i-c}}{(1+x)^i} \tag{3}$$

In highly competitive tendering processes with many similar companies fighting for the project and no collusion amongst them, the procedure will force bidders to diminish their returns. In an extreme case, the internal rate of return (x) would be equal to the cost of capital (r_1), bringing the net present value to 0.

Company 2 NPV

Company 2 invests in a PPP project to sell it once the construction phase is completed. To determine the NPV and IRR of Company 2 it is necessary to analyze the sale of a PPP project together with the sale and reinvestment cycle.

Sale of a PPP Project

The PPP project developer can receive all the future net cash flows of the project, as Company 1 does, or else it may decide to sell the project at a particular time. If the PPP project is sold, the cash flow of shareholders takes the following configuration.

The variables used in the above figure (Figs. 1 and 2) and not explained previously are the following: V = proceedings from the sale of the PPP project; G_s = transaction exit costs; and f = period of time elapsed between the end of the construction phase and the sale of the PPP project.

The proceedings from the sale of the PPP project, V, are calculated by discounting the expected net cash flows that remain in the project for the buyer, using as a discount rate the buyer's expected cost of capital y. Thus the following relationship is obtained:

$$V = \sum_{c+f}^{n} \frac{D(1+g)^{i-c}}{(1+y)^{i}} \qquad (4)$$

Sale and Reinvestment Cycle

After the sale, the developer must decide what to do with the proceeds. One possibility is to reinvest in a new PPP project. Assuming the sale occurs immediately after completion of the construction period ($f = 0$), and the new PPP project is exactly like the old one, the promoter's cash flow would take the following form.

The scheme shown in the above Fig. 3 is only possible if V is greater or equal to all the disbursements to be made in year n. Since the discount rate used to calculate $V(y)$ is smaller than the rate of return required to participate in a new PPP project (x), there will be a range of values for which the following condition is true:

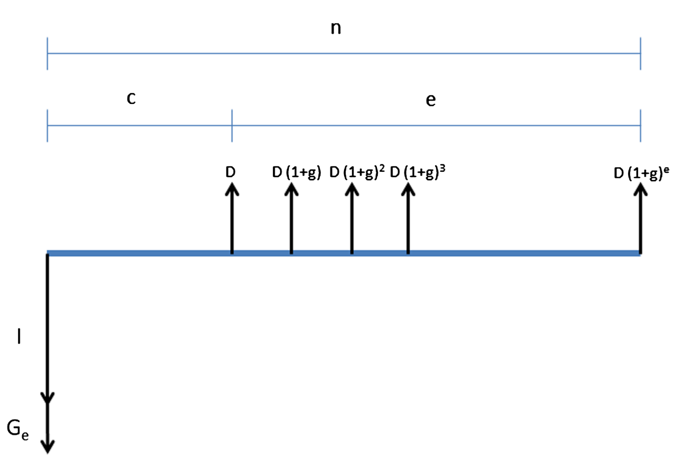

Fig. 1. Shareholder net cash flow in a PPP project

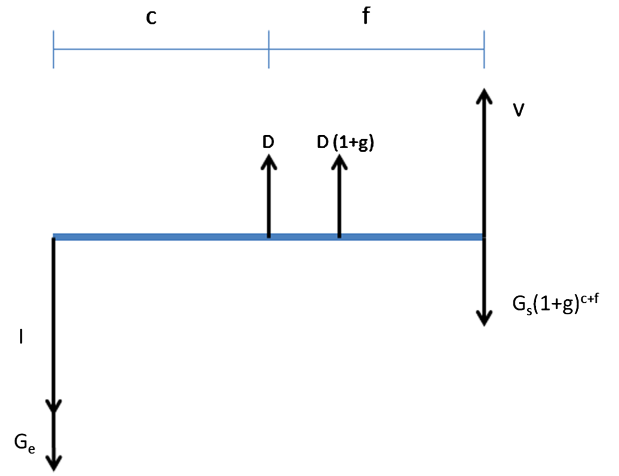

Fig. 2. Shareholder net cash flow in a PPP project that is sold

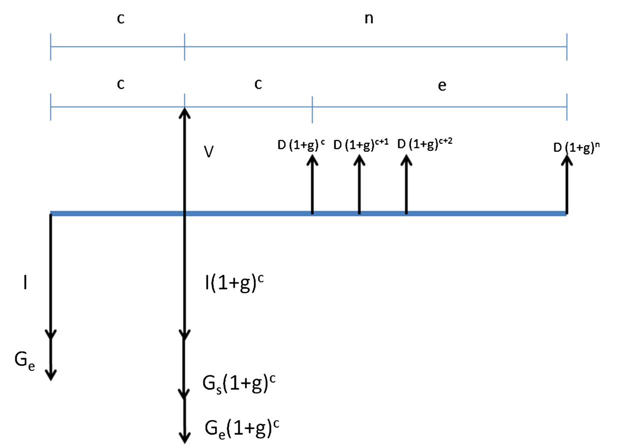

Fig. 3. Shareholder net cash flow after the sale and re-investment in a new PPP project

$$V = \sum_{c}^{n} \frac{D(1+g)^{i-c}}{(1+y)^{i}} > (I + G_s + G_e)(1+g)^{c} \qquad (5)$$

In the event that the company decides to repeat this cycle over a span of n years, giving up cash flows from PPP projects in exchange for the net proceeds from the sale of such projects, the shareholders net cash flow would take the following configuration.

In the above Fig. 4 the appearance of a "$c + f$" year cycle can be observed. During the first c years, there is no cash flow. Then the underlying infrastructure begins to function and shareholders start receiving a net cash flow during f years. Finally, after "$c + f$" years from the beginning of the cycle, the PPP project is sold to reinvest the proceedings in a new PPP project.

The total number of cycles (m) in a period of n years can be obtained from the following equation:

$$m = n/(c+f) \qquad (6)$$

The last cycle is somewhat different from the others. In this final cycle the sale of the last PPP project developed by Company 2 takes place, but the proceedings are distributed to shareholders instead of being reinvested. This makes it possible to compare the performance of Company 1 and Company 2.

From this point onward, and in order to make calculations easier, in this paper, it is assumed that Company 2 sells PPP

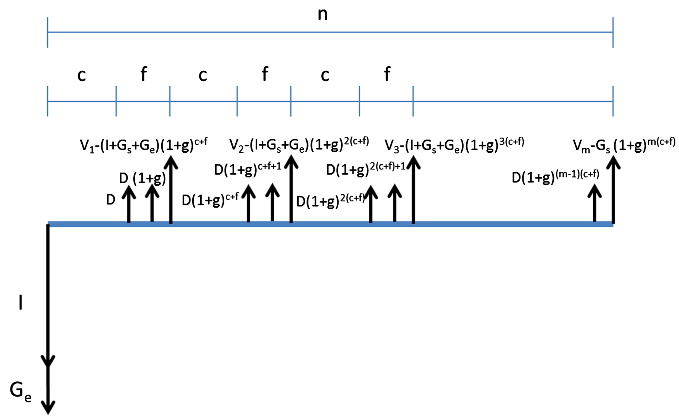

Fig. 4. Company 2 shareholder net cash flow

projects immediately after the construction phase is finished ($f = 0$).

Company 2's NPV is the result of adding all the discounted net cash flows of the project, using a discount rate r_2 equal to Company 2's cost of capital

$$\mathrm{NPV}_2 = -I - G_e + \sum_{1}^{\frac{n}{c}-1}\left[\frac{V_i - (I + G_e + G_s)(1+g)^{i\cdot c}}{(1+r_2)^{i\cdot c}}\right] + \frac{V_m - G_s(1+g)^n}{(1+r_2)^n} \tag{7}$$

Company 2's IRR is calculated by obtaining the value of z in the following equation:

$$0 = -I - G_e + \sum_{1}^{\frac{n}{c}-1}\left[\frac{V_i - (I + G_e + G_s)(1+g)^{i\cdot c}}{(1+z)^{i\cdot c}}\right] + \frac{V_m - G_s(1+g)^n}{(1+z)^n} \tag{8}$$

It is important to emphasize that this approach does not take into consideration IRR over subperiods from the lifetime of the project. However, this affects the IRR of a company that holds projects for subperiods before selling them in order to reinvest the proceeds.

Assuming that the discount rate used is always the same, the relationship between the proceeds from the sale of PPP projects developed by Company 2, is the following:

$$V_n = V_{n-1}(1+g)^{c+f} \tag{9}$$

$$V_i = V_1(1+g)^{(c+f)(i-1)} \tag{10}$$

Comparison of the Performance of Company 1 and Company 2

In this section the performance of Company 1 and Company 2 are compared through analysis of their respective NPVs. The potential results and their interpretation are the following:

1. $\mathrm{NPV}_1 > \mathrm{NPV}_2$: The performance of Company 1 is superior to the performance of Company 2, and there is a strong case for not selling PPP projects;
2. $\mathrm{NPV}_1 = \mathrm{NPV}_2$: The performance of Company 1 and Company 2 are equal, and it is indifferent to sell or to keep their investments in PPP projects; and
3. $\mathrm{NPV}_1 < \mathrm{NPV}_2$: The performance of Company 2 is superior to the performance of Company 1, and there is a strong case for selling PPP projects.

One of the hypothesis adopted was that the PPP project tendering is very competitive, bringing the NPV of PPP projects (and NPV_1) to 0. The analysis therefore focuses on NPV_2, determining the conditions that make it negative, zero, or positive.

The value of NPV_2 is given by Eq. (7). Substituting in this expression $I + G_e$ with the value obtained in Eq. (3), V_i with the value obtained in Eq. (10), V_1 with the value obtained in Eq. (4) and G_s for S · D (so as to establish the exit costs as a percentage of the yearly net cash flow obtained during the operational period of the PPP project), the following equation is obtained:

$$\mathrm{NPV}_2 = D\Bigg[-\sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+x)^i} + \sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+y)^i}\sum_{1}^{\frac{n}{c}-1}\frac{(1+g)^{c(i-1)}}{(1+r_2)^{i\cdot c}} - \left(\sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+x)^i} + S\right)\sum_{1}^{\frac{n}{c}-1}\frac{(1+g)^{i\cdot c}}{(1+r_2)^{i\cdot c}} + \sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+y)^i} \cdot \frac{(1+g)^{n-c}}{(1+r_2)^n} - S\frac{(1+g)^n}{(1+r_2)^n}\Bigg] \tag{11}$$

In determining the conditions under which $\mathrm{NPV}_2 = \mathrm{NPV}_1 = 0$, an equation is obtained that has as variables x (Company 1 cost of capital or PPP project IRR); y (discount rate on the sale of a PPP project); r_2 (Company 2 cost of capital); g (growth factor); S (transaction exit costs); c (duration of the construction phase); and n (total duration of the PPP project contract)

$$0 = -\sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+x)^i} + \sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+y)^i}\sum_{1}^{\frac{n}{c}-1}\frac{(1+g)^{c(i-1)}}{(1+r_2)^{i\cdot c}} - \left[\sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+x)^i} + S\right]\sum_{1}^{\frac{n}{c}-1}\frac{(1+g)^{i\cdot c}}{(1+r_2)^{i\cdot c}} + \sum_{c}^{n}\frac{(1+g)^{i-c}}{(1+y)^i} \cdot \frac{(1+g)^{n-c}}{(1+r_2)^n} - S\frac{(1+g)^n}{(1+r_2)^n} \tag{12}$$

This equation represents the performance frontier between Company 1 and Company 2. Fixing the values of all variables except r_1 and r_2, it borders the area for which $\mathrm{NPV}_1 > \mathrm{NPV}_2$ (making not selling superior to selling) and vice versa.

It should be pointed out that Eq. (12) is not linear. However, the results obtained in this paper for the values of r_1 and r_2 that satisfy this equation enabled consideration of a quasi-linear performance frontier.

From the risk analysis performed previously, it is also known that $y < x = r_1 < r_2$. Introducing this restriction, several regions are identified, as shown in the following figure:

In Fig. 5 there are several well defined regions:

1. Region in which $r_1 > r_2$: This zone has impossible values, since the cost of capital for Company 2 would be lower than that for Company 1 with a higher risk profile, which contradicts hypothesis 3;
2. Region in which $\mathrm{NPV}_1 < \mathrm{NPV}_2$: In this zone the performance of Company 2 is superior to the performance of Company 1, making it advisable to sell PPP projects; and
3. Region in which $\mathrm{NPV}_1 > \mathrm{NPV}_2$: In this zone the performance of Company 1 is superior to the performance of Company 2, making it advisable not to sell the PPP project. This zone can in turn be divided into two subareas:
   - A region in which $\mathrm{NPV}_1 > \mathrm{NPV}_2$ independently of how low is the cost of capital for Company 2 (as long as $r_1 < r_2$); and
   - A region where $\mathrm{NPV}_1 > \mathrm{NPV}_2$, due in part to the high cost of capital for Company 2.

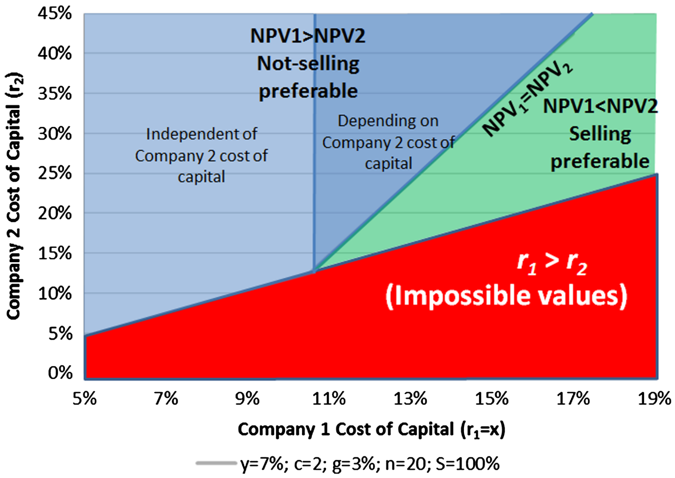

Fig. 5. Regions defined by the performance frontier

Some preliminary conclusions that can be drawn from the model are the following:

1. The size of the investment, the average expected yearly dividend and the entry costs have no influence on the model;
2. The key variables are the length of the pre-operation period (c); the length of the PPP contract (n); the growth factor for costs and net cash flows (g); Company 1 cost of capital (r_1); Company 2 cost of capital (r_2); the discount rate used to calculate the selling price of the PPP project (y); and the exit costs (S).

Values for Key Variables in the Transport Infrastructure Sector

In this section we identify the most common values adopted by the key variables identified in the theoretical framework developed in the previous section for the transport infrastructure sector. These are the following:

1. Return of PPP projects (x);
2. Discount rate on the sale of PPP projects (y);
3. Length of the construction period (c);
4. Length of the PPP contract (n);
5. Transaction exit costs (S); and
6. Growth factor for selling prices and costs (g).

Return of PPP projects ($x = r_1$) and discount rate on the sale of PPP projects (y)

The required return of a PPP project depends on several factors, including

1. The sector (electricity, transport, telecom . . .);
2. The maturity of the project (considerable difference between "greenfield" and "brownfield" projects);
3. The environment in which the project is developed ("Country risk"); and
4. The economic environment, in so far as it facilitates or hinders access to the necessary capital.

Table 1 provides a range of expected returns by transport infrastructure shareholders, depending on the overall risk profile of the project:

Alcaraz et al. (unpublished data, 2009) summarize target returns in the PPP transport sector depending on the location of the project (developed countries and emerging markets) and the maturity of the project (greenfield or brownfield investments).

Table 1. Shareholders' Target Returns from Infrastructure PPP Projects

	Developed country		Emerging country	
Source	Greenfield (%)	Brownfield (%)	Greenfield (%)	Brownfield (%)
Alcaraz et al. (unpublished data, 2009) (transport sector)	12–15	6–7	18–20	15–18
Mansouri and Nadji (2007)		10–14	18	10–14
Preqin (2010)	12		19.3	
Demirag et al. (2010)	12–15			

RREEF Research, part of the Deutsche Bank Group that is specialized in real estate, suggests an expected return over 18% for greenfield infrastructure projects in emerging economies, and between 10 and 14% for brownfield projects (Mansouri and Nadji 2007).

These returns are in line with the average profitability targets set by infrastructure investment funds: an average IRR of 12.0% for projects in developed countries and 19.3% in emerging markets (Preqin 2010).

According to a survey performed in 2010 amongst financiers in PPP projects in the United Kingdom (Demirag et al. 2010), the majority of respondents (51.8%) indicated a target internal rate of return in 2009 for equity finance (all infrastructure sectors) of 12–15% in developed economies.

For modeling purposes we assume that variable x (IRR of a PPP project before construction phase begins) has the return of a greenfield PPP project.

Demirag et al. (2010) mention in their survey an apparent reluctance to be transparent about selling of equity interests in PPP projects, and the fact that any profits or losses do not need to be disclosed under current legislation in most countries. Thus for variable y (discount rate on the sale of a PPP project right after the construction phase is finished) this paper uses the return of a brownfield PPP project; i.e., projects in which the construction and demand risk are highly mitigated, as is the case for PPP projects in the secondary market.

Length of the Construction Period (c)

The construction phase depends on the size of the investment and the sector, ranking usually between two and five years. Large infrastructure projects usually have longer construction periods than small ones.

For modeling purposes of this paper, a construction period of 3 years is used.

Length of the PPP Contract (n)

The average length of a PPP project stands at 30 years, although the range of values goes from 3 to 99 years in the most extreme cases (S. Araújo, and D. Sutherland, "Public-private partnerships and investment in infraestructure," working paper, OECD Publishing, Paris).

The model in this paper considered 30 years as the contract duration.

Transaction Exit Costs (S)

There is very little literature on transaction costs in Public Private Partnerships, and the ones available only cover entry costs, most of them from the perspective of the public sector (see for instance Vining et al. 2005).

Entry costs depend largely on the bidding system used in the award of the PPP project. A quantitative study carried out by Madrid Polytechnic University for the European Investment Bank shows that in greenfield PPP projects in the road transport sector, transaction costs of the winning bidder stood at 2.85% of the capital cost of the project when using the negotiated procedure (Sánchez Soliño and Gago de Santos 2010). Overall transaction costs for all the participants in the procedure stood at 10%, according to this study.

Esty (2004) estimates transaction costs in the context of project finance at 5–10% of the total cost of the project.

In the absence of information on the value of exit costs, as a percentage of the shareholder average yearly net cash flow, this paper uses a wide range of values in order to arrive at a conclusion: 0, 50, 100, and 200%.

Growth Factor for Selling Prices and Costs (g)

This paper uses the consumer price index (CPI) to determine the evolution of prices. This choice is justified by the fact that it is common practice for PPP agreements to establish a link between this index and user fees or availability payments.

The CPI depends on the country or region and the period analyzed. In the U.S. for example, the average CPI in the period 2002–2011 (10 years) stood at 2.43% (Bureau of Labor Statistics 2011). In the European Union, for the same period, the CPI stood at 2.27% (Eurostat 2012). For modeling purposes, a growth factor of 2.3% in developed countries was used.

In emerging markets, the CPI is higher. According to Fraga et al. (2003) it stands at 3.7%.According to the latest International Monetary Fund's (2014) forecast for emerging economies (as of March 2014), it stands at an average of 5,1% for the next five years.

Theoretical Framework Testing and Discussion of Results

In this section, the theoretical framework previously developed is used, with the key variables having values common to the transport infrastructure sector. The objective is to test the model as well as to detect any potential restrictions that may exist, by taking into account Eq. (12), and the average values in transport infrastructure PPP projects, to calculate the acceptable range of Company 2's cost of capital (r_2) that would make $NPV_2 > NPV_1$, and thus selling of PPP projects superior to not selling.

The following Table 2 lists the values adopted by the model variables, and the range of maximum values for Company 2's cost of capital that make selling a better choice than not selling:

In the context of developed countries, and depending on the values of x, y, and S, there is a range of values for r_2 that make the strategy of selling PPP projects a better choice than keeping

Table 2. Cost of Capital for Company 2 Making Selling a Better Choice

Variable	Developed countries	Emerging countries
x (%)	12–15	18–20
y (%)	6–7	15–18
c	3	3
n	30	30
S (%)	0, 50, 100, and 200	0, 50, 100, and 200
g (%)	2.3	3.7
Maximum r_2 (%)	26–39	

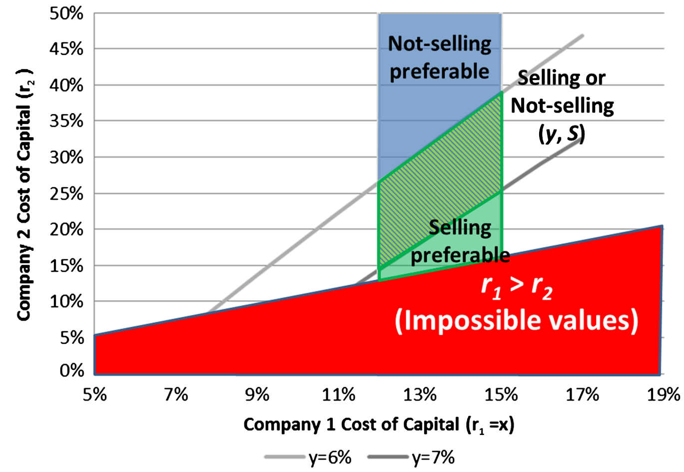

Fig. 6. Performance frontier for Company 1 and Company 2 in developed countries

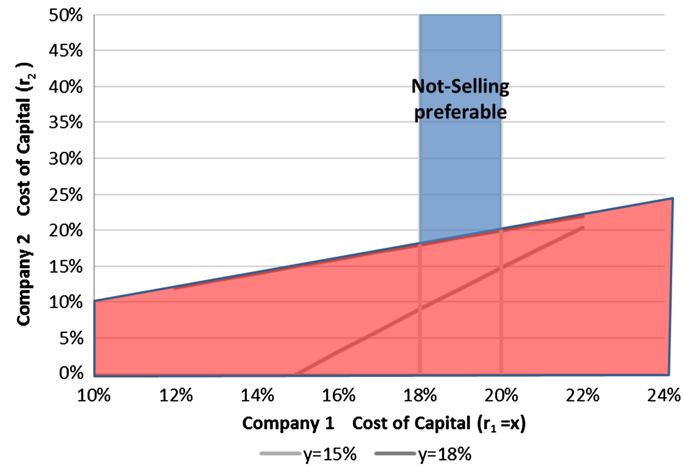

Fig. 7. Performance frontier for Company 1 and Company 2 in emerging countries

these projects in portfolio until the end of operations, as shown in Fig. 6. The area where the strategy of selling PPP projects is preferable is larger when the discount rate on the sale of PPP projects (y) and the transaction exit costs (S) decrease.

In emerging markets however, with the proposed values and the theoretical framework developed in this paper, not selling is a better choice independently of Company 2 cost of capital. This can be seen in Fig. 7.

Fig. 7 shows that there is no area with a superior limit of the frontier lines (for $y = 15$ and 18%) and as an inferior limit the $r_1 = r_2$ line. The frontier line with $y = 18\%$ does not even appear in the graph, since it is displaced further to the right. This suggests that, for the given values, in emerging markets not selling PPP projects offers superior performance to selling them.

Conclusions

This paper develops a theoretical framework that determines whether the early exit from PPP projects offers a superior performance than remaining invested until the end of the project, depending on the values of some key variables.

According to this framework, the size of the investment, the entry costs and the average yearly cash flow to shareholders are irrelevant. The key variables are the PPP project's expected return (x), the cost of capital for companies that use an unbundling strategy (r_2), the discount rate applied on the sale of a PPP project in the secondary market (y), the length of the construction period (c), the length of the PPP contract (n), the transaction exit costs (S), and the growth factor for costs and cash flows (g).

Applying the theoretical framework to the transport infrastructure sector in developed countries determines that there is room for both strategies (selling and not-selling), and for a PPP secondary market. Furthermore, the relationship between key variables can also be calculated to determine which strategy offers a superior performance.

On the other hand, applying the theoretical framework to the transport infrastructure sector in emerging markets establishes that, under current market conditions, the option with a better performance is not selling PPP projects, thus hindering the development of a PPP secondary market. The main reason for this result is the high discount rate on the sale of PPP projects in emerging markets due to the risks involved. In developed countries, most of the risks in PPP projects disappear or are strongly mitigated after the construction phase. In emerging countries, however, some important risks (for example, political or regulatory risks) are still in place during the operation phase.

The main implication would be that companies willing to invest in greenfield PPP projects in the transport infrastructure sector in emerging countries should be aware that, if market conditions do not evolve, selling their projects after the construction phase completion will mean an underperformance when compared to keeping the project in their portfolio. This conclusion may not be true for certain countries in which the emergence of a PPP secondary market is possible if local parameters (such as inflation rates or discount rates applied on the sale of PPP projects) differ substantially from the ones listed in this paper.

Future research could determine the validity of some of the hypotheses considered in this paper. This could in turn modify the main conclusion about emerging markets. Interesting topics are for instance the question of how competitive PPP transactions really are in emerging markets, the underperformance of PPP projects sold at the beginning of the operation phase, or the correlation between asset rotation and the cost of capital for concession companies.

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