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VALUE FOR MONEY: TO WHAT EXTENT DOES DISCOUNT RATE MATTER?*

CARLOS CONTRERAS
Universidad Complutense de Madrid

This paper proposes a Value for Money test to assess the appropriateness of using public-private partnerships (PPPs), and performs a numerical analysis to verify to what extent the outcomes are sensitive to the discount rates being used. The test is applied to two projects which differ in the length of the concession contract and the level of capital intensity. The paper finds that the higher the discount rate being used, the larger the advantage of using a PPP as the supply method. This conclusion is more visible in the case of projects with longer concession terms. Moreover, using one single discount rate for very different project profiles seems to be inadequate.

Key words: discount rate, project evaluation, public-private partnership, value for money.

JEL Classification: H43, H44.

There are essentially three types of analysis to assess public infrastructure policies: the cost-benefit analysis (CBA), the applied –or computable– general equilibrium models (AGE or CGE), and the value for money assessment (VFM). These respond to very different objectives. CBA is a set of techniques designed to give information on whether to accept or reject a given public sector project, or to ensure that scarce resources are allocated efficiently between alternative competing public projects. It quantifies, in monetary terms, the social costs and benefits of the project being analyzed, and includes items for which the market does not provide a satisfactory measure of economic value. CBA assesses the full range of economic costs, risks and benefits, taking account of their timing. A discount rate (DR) is used to discount the costs and benefits to obtain the expected net present value (NPV) of the project. CBA can be used to rank policies on the basis of the improvement or reduction they will create in overall well-being but, for this traditional approach to be valid, three conditions must hold: i) there are no market failures; ii) welfare distribution is not

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an issue[1]; and iii) technological externalities and other impacts outside the project being analyzed are negligible (secondary effects can be ignored). Hence, CBA is less useful for projects that involve relevant distributional effects or that are big enough to affect macroeconomics. Due to the above limitations, many economists prefer the CGE approach[2]. CGE models are built on rigorous modeling of the behavior of microeconomic agents. It is assumed that the agents are exposed to signals provided by the markets, and make decisions by explicit maximization of their own utility functions, under strictly specified technological or budgetary constraints. The computation of a GE consists of determining a system of signals and an allocation between individuals, sectors, regions, and possibly time periods, such that all agents are at their optimum yet satisfy their respective constraints. One value of CGE models is that the analysis can incorporate much more detail and complexity. However, there is no such thing as a free lunch. One key issue with CGE models is how robust the results are to model pre-selection, as well as to alternative parameter values and elasticity values. The CBA and CGE techniques try to answer the question of whether there are better uses for public resources, but they do not look at the different ways of procuring a given project. By contrast, VFM analysis tries to find the optimal way to supply a given service, once it has been decided that the service must be provided either directly by the public sector or through a public-private partnership (PPP) scheme. In traditional public sector procurement, the government builds or purchases physical assets, retains ownership and uses public sector employees, or a private contractor, to deliver the service. A PPP, on the other hand, is collaboration between the public and the private sector for the purpose of delivering a project or a service which was traditionally provided by the public sector. In a typical PPP, the government signs a long-term contract with a private consortium to supply a service to the government or directly to its citizens. The private consortium designs, builds, owns and runs the physical assets required for the delivery of the service. This paper explores the quantitative relevance of the discount rate (DR) in the policy decision to use –or not to use– a PPP in the procurement of what was once considered a public sector service.

The paper proceeds as follows. Section 1 addresses a number of issues on the appropriate DR to be used in the VFM analysis. Section 2 proposes a test for comparing conventional procurement and PPP schemes that allows the consideration of a set of relevant variables. In Section 3, several numerical calculations are carried out to determine the significance of the choice of the DR in the VFM tests. Section 4 concludes.

(1) In the most common applications of CBA, the aggregation of individual welfare treats all individuals equally, or no one person's welfare is weighted more heavily in the aggregate than that of any other person. A fairness analysis can be introduced into CBA, but then someone must state explicitly what the weights should be for each person or group of people.

(2) See Shoven and Whalley (1984) for an introduction to CGE models, and Ginsburgh and Keyzer (1997) for an advanced textbook.

1. What discount rates should be used in VFM test?

The choice of the appropriate DR to use in the assessment of public policies is still a matter for open debate[3]. For VFM tests, the first decision is whether to use social rates of discount (SDR) or, alternatively, rates coming from the financial markets (FMR). With an SDR, the question is how this should be estimated; while if the decision is to use an FMR, the question is whether it is better to use a "risk-free rate" or the yield on the corporation's debt, or both. Another issue is the appropriateness of using one single DR regardless of the term of the project or the term of the generated effects. For years, the choice of a suitable SDR has occupied a major part of the discussions on CBA. Generally speaking, the SDR measures the rate at which society is willing to trade present consumption for future consumption. It can also be seen as a measure of the importance of the welfare of future generations relative to the welfare of the present generation. It is clear that the selection of the DR may alter the utility for future generations. SDR is calculated as a percentage per year, like an interest rate, but refers to the discount in future "utility" or welfare. If costs and benefits are not discounted correctly, decisions with intergenerational consequences may be taken wrongly. Using a high interest rate means, implicitly, that society does not wish to invest a great deal of capital in projects that may improve the standard of living for people who will be alive in the future: value judgments about inter-temporal equity matter.

A number of welfare analysts use market interest rates as the basis for their present value calculations. Sensitivity analysis typically consists of varying the scalar discount rate up or down in relation to the FMR. Those who defend the use of the FMR believe that the savings decision must be treated as a purely private choice made by members of the present generation who are seeking to maximize their expected utility over time. Then the SDR emerges as a market interest rate through the aggregation of individual saving decisions. However, wide-ranging arguments have been deployed against the use of market rates as SDRs. Market imperfections, such as externalities, distortionary taxation, imperfect information, market power, and sub-optimal distribution of income, may call into question the use of market rates. Moreover, the individualistic pure time preference approach has basically been criticized for placing too little weight on the consumption of future generations[4]. Drèze and Stern (1990) and Cowen (2008) suggest that reliance on market rates may move the SDR upwards by making it depend on the probability of death for individual savers. The above argument is linked to the so-called super-responsibility role of government, which refers to the government's responsibility for the utility of future generations. For these authors, since markets only reveal the preferences of current generations, governmental policy should go beyond market information. Using individuals' behavior, as revealed by the financial markets, to estimate an SDR may be

(3) See Boardman and Greenberg (1998) and Caplin and Leahy (2004)

(4) At its extreme, the argument is that, although individuals die, society lives on and there is no reason to discount the consumption of future generations. According to Broome (1994), from a universal point of view, what is good at one time cannot be judged differently from what is good at another time and, hence, the pure time discount rate must be zero.

problematic: when the effects of a project have a long time-span, individuals may not fully take into account the effects of their spending and saving behavior on future generations. These economists argue that policy-makers should be more patient than private citizens, or, which is the same thing, that the SDR should be lower than the market rate. In a world of perfect capital markets, each individual has the same marginal rate of time preference (MRTP), and so the social rate of time preference equals the individual rate. But, since perfect capital markets do not exist, in practice, no single DR can be taken as a measure of both the individual and the social rate. Regarding the SDR, there are basically two alternatives when valuing public sector investments. First, the social rate of time preference (SRTP)[5], which reflects the rate that society is willing to pay for receiving something now rather than in the future, and second, the social opportunity cost of capital (SOCC)[6], a measure of the marginal cost of the capital used in a public project or, in other words, a measure of the next best alternative use to which the resources employed in the public project might have been put. The SOCC is usually identified with the real rate of return earned on a marginal project in the private sector. The SOCC depends upon whether or not the resources spent on the project are diverted from private consumption or from investment. Thus, it can be seen as the shadow price reflecting the value of the resources transferred from the private sector. The distinction between these two DRs is more important in the second-best world, where distortions such as taxes and externalities, prevent these rates from being equalized. The SRTP and the SOCC differ from each other in how they actually transfer resources between people living at different points in time. In an economy without any distortion, the two rates are identical, but, because distortions exist in any economy, a problem of choosing between them arises. The method of choice consists of classifying the resources according to whether they come from consumption or from investment. The investment component should be converted into consumption-equivalent units through the shadow price of capital. Then, the resulting consumption equivalent flows should be discounted at the SRTP. Although there is no universally accepted formula for estimating the consumption interest rate, the Ramsey (1928) equation has been widely accepted[7]. The equation is the following:

$$\text{SRTP} = \delta + \mu\, g \tag{1}$$

where (δ) is the rate of time preference, i.e. the rate at which utility is discounted, (μ) is the elasticity of the marginal utility of consumption, and (g) is the expected rate of growth in average consumption per capita. The rate of time preference (δ) is affected in turn by two factors: the rate of pure time preference (ρ) and the rate of growth of life chances ($\dot{L}$), such that

$$\delta = \rho - \dot{L} \tag{2}$$

(5) Also known as the ethical choice, this approach has been defended by, among others, Feldstein (1964) and Sen (1967).

(6) Known in the literature as the prescriptive choice, this approach has been defended by Baumol (1968) and Harberger (1972), among others.

(7) This formula has been used by Pearce and Ulph (1995), OXERA (2002) and Spackman (1991, 2004), among others.

Regarding δ, at one end of the spectrum we have those who consider it should be zero. A near zero time preference rate would imply that current generations should dramatically reduce their levels of consumption, in some particular cases, to subsistence levels. For that reason, others feel that a pure time preference rate as large as 0.5% is appropriate. Scott (1989), Pearce and Ulph (1999) and HM Treasury (2003) consider that (ρ) lies in the band 0%-0.5%, but then suggest that survival risk, or life chance, is an additional element in the utility discount rate. Based on death rate statistics, they claim that a figure close to 1% is appropriate. Regarding the rate of growth of life chances ($\dot{L}$), a number of authors have used figures in a range between -2.2 and 1.5[8]. In the empirical research literature, a wide range of SRTP figures has been used. For example Pearce and Ulph (1995) suggested that a range of 2%-4% probably sets the upper and lower bounds of what is a credible SDR. More recently, Evans and Sezer (2005) and Evans (2006) have argued for a standard benchmark European discount rate of around 3%-4% based on SRTP. This rate is somewhat lower than the 5% rate suggested by European Commission (2002) and, as such, its application should result in a more generous allocation of budget funds to longer-term projects. In the same vein, Lopez (2008) offered empirical estimates of SDRs for nine Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Honduras, Nicaragua, Mexico, and Peru) based on the SRTP hypothesis. He highlighted the fact that, depending on the growth expectations of the social planner, these DRs can vary from about 3%-4% in a future low growth scenario to 5%-7% in a high, but still reasonable, growth scenario.

A separate issue arises when considering projects with very long-term effects[9]. There are basically two problems with projects that have intergenerational impacts. First, the absence of financial assets whose maturity extends to the horizon associated with some types of projects: typically government bonds do not extend beyond 30-40 years[10]. And second, since DRs are a reflection of subjective time preferences, one would expect a priori that they could differ for different individuals and across different time horizons. The standard practice in intertemporal welfare analysis assumes that DRs are the same for all time horizons, although market interest rates and growth rates vary over time. Weitzman (1998), Sozou (1998) and Azfar (1999) developed ideas, first formalized by Dybvig *et al.* (1996), showing how uncertainty regarding the interest rate could lead to the idea of time-declining discount rates (DDRs). Behind the far-distant-future interest rate is the long-run productivity of capital, which depends on a host of factors unknowable at the present time. There are fundamental uncertainties about the rate of economic growth, the amount of capital that will be accumulated, the degree of diminishing returns, and other economic features that might be relevant for determining the rate of return on consumption. As such, society faces considerable uncertainty as to the SDR parameters in the future and, to many authors,

(8) See for example Scott (1977, 1989) for positive numbers and Kula (1985, 1987) or Newbery (1992) for negative ones.

(9) See Dasgupta *et al*. (1999).

(10) In the absence of a measure of the long-run discount rate determined by the financial markets, Gollier (2002, 2004) turns to economic theory to provide some answers.

acknowledging this uncertainty implies that DDRs should be used. Moreover, there is experimental evidence that people generally discount the future at declining rates of interest. The so-called hyperbolic discounting literature provides considerable evidence that individuals use time varying discount rates in their everyday decision-making[11]. Regarding the DDR, Moore *et al.* (2004), for example, recommend a procedure that differs depending on whether the project has –or has not– intra-generational effects[12] and on whether there is –or is not– a crowding out of private investment. No wonder that, in this academic context, the practitioner faces a potentially confusing set of rationales and a sense that almost any DR can be applied. In fact, many different rates have been used by governments in valuing public projects over the years. Before 2003, the use of different methods in Europe resulted in the application of widely divergent rates: for example, 8% in France, 3% in Germany and 6% in Britain. Sometimes the DRs have been seen as the low-risk cost of private capital, funded by a mix of debt and equity. This practice was followed by countries such as Australia. New appraisal guidance by the UK Treasury in 2003 saw the official UK rate, now based solely on SRTP, reduced to just 3.5%. In 2005, France followed suit, reducing its rate from 8% to 4%. The European Commission (2002) advocated a benchmark discount rate of 5% for cost-benefit analysis in the case of EU member countries. This was a compromise figure based on the market interest rate, the cost of capital and time preference considerations. Moreover, in practice, different SDRs are used in the analysis of different projects developed by the same government. Some public authorities consider that one single rate –whether an SOCC or an SRTP– is not appropriate in all cases. For example, the European Commission recommends the use of an SRTP for the standard CBA of public projects, but a SOCC in cases where the financial return of the project is an important public concern. In other cases, the differences in the rates also depend on the term of the projects. For example, the U.S. Office of Management and Budget recommends the use of different rates based on the costs of borrowing for the government along the debt yield curve. And finally, some governments use different rates according to the nature of the project. For example, the Spanish government has used a rate of 6% for transport projects but a lower rate of 4% for water projects.

Since VFM tests do not evaluate market failure (as a externality) or distributional effects, concepts such as shadow prices or the shadow price of public capital need not be used: the FMR instead of SDRs should be used. In this context, when evaluating whether a given project should be provided directly by the public sector or in partnership with the private sector, the theoretical debate can basically be restricted to two issues: i) the treatment of the risk and ii) the convenience of using one single or two different rates (one coming from the government debt yield and the other from the yield of the bond issued by the concessionaire).

(11) See Loewenstein and Prelec (1992), Henderson and Bateman (1995), Frederick *et al*. (2002) or Groom *et al*. (2005).

(12) They believe that a project has inter-generational impacts if it lasts beyond 50 years.

The treatment of risk, when evaluating public policies, involves obtaining a figure of risk-adjusted present-value. There are basically two approaches to adjusting for risk. The first is to add a risk premium to an appropriate risk-free discount rate. This risk-adjusted interest rate then reflects a systematic risk rather than the particular risk of the project. The second method consists of valuing the risk of the cash flows: a risk-free DR is applied to a forecasted cash flow that is first adjusted from its risky form to a certainty-equivalent form. Here, the risk reflects the cost of variability in outcomes, or what the government would be willing to pay in order to know with certainty its future outlay on the procurement. To Heald (2003), the idea of using a risk-free DR has an intuitive appeal, while the exercise of adjusting the cash flow appropriately seems particularly difficult to carry through. Note that risk transfer is a key element in the comparison between a PPP and the traditional public procurement method. Shaoul (2005) argues that the measurement and methodology of risk transfer is rendered problematical because all possible outcomes cannot be predicted and weighted. In short, the issue is uncertainty, not risk. In this vein, Grimsey and Lewis (2002, 2004) highlight that not only risk but also uncertainty are important issues when it comes to VFM analysis. While, in the case of risk, the probabilities of the various future outcomes are known (either mathematically or from past experience), in the case of uncertainty, the probabilities of the various future outcomes are merely gross guesses. At a practical level, governments traditionally do not budget for systematic risks or uncertainty and, consequently, in the case of public sector procurement, the calculations only contain quantifications for project-specific risks. The public sector as a whole might be able to ignore uncertainty across its portfolio, but bidders for a PPP project cannot. Yet the fact is that a PPP moves a project out of the government's portfolio and, in a sense, provides some insurance to the government against uncertainty. Of course, this is not true for the private sector, and this fact has implications for the setting of DRs in the VFM tests.

Regarding the convenience of using one or two different yields in a VFM test, Hirshleifer (1964, 1966) and Sandmo and Drèze (1971) argued in favor of the use of one single rate for both procurement methods, with the actual rate depending on the risk class to which the investment belonged. In particular, Samuelson (1964), Vickrey (1964) and Arrow and Lind (1970) argued for the risk-free rate. In the modern context of VFM analysis and despite the lack of unanimity, there has been a tendency for governments to use the same "official" DR for valuing a project, whether the project is publicly or privately provided. Against this, Grout (1997, 2003) and Broadbent *et al.* (2003) argued that, when using one single rate, the VFM test is biased. Their argument runs as follows. When a public sector provision is being valued, a DR is applied to a cost flow representing all the costs linked to the building of the facility. In contrast, for valuing a private provision, a DR is applied to a cash stream that constitutes an outlay for the public sector but a revenue flow for the private entity, the flow of expected benefits according to the prices of the concession contract. Grout notes that there is no reason to suppose that the risk characteristics are equivalent for the two cash flows. Indeed, he argues that, in general, costs are less risky than revenues (particularly when the revenues depend on the quality of the services provided). The cash flow in a PPP includes premiums for project (or idiosyncratic) risks, and systematic (or market-based) risks, and may also incorporate an allowance for uncertainty. If so, the fact that uncertainty will be priced into the PPP cash flow reinforces Grout's argument that the DR to be used in the PPP must be higher than the rate that would be used in the case of public supply. To Grout, failure to use this higher rate suggests that the private supply is less efficient than the public: the present cost of private provision will be overestimated relative to the cost of public procurement. Therefore, the standard practice of using the same DR for both procurement methods in VFM tests is inappropriate: it prejudices private sector supply and leads to excessive reliance on public procurement.

In summary, after many years of academic discussion, the proper DR to use in the evaluation of public investments is still a matter of debate. In the case of CBA, the choice of the best SDR is still being discussed. And when it comes to VFM tests, it is clear that FMRs are preferable. But whether it is better to use one single or two different discount rates, and which rates to use, is still an open question.

2. A VFM TEST

VFM tests determine whether the government obtains the maximum benefit with the available resources[13]. VFM is the optimum combination of whole life cost and quality to meet users' requirements, which does not always mean choosing the lowest cost bid. VFM not only measures the cost, but also takes into account the quality and fitness for purpose, in determining whether goods and services represent good value. In assessing the VFM, typically, the Public Sector Comparator (PSC) is first identified. This represents the hypothetical, risk-adjusted cost of a project which is financed, owned and implemented by the government. As Bain (2010) noted, in procurement decision-making, a PSC is commonly used as a yardstick against which private investment proposals are evaluated. Typically, the setting of the PSC is based on available information from similar public projects. The difference between the costs of the PSC and the private bidding is the ex-ante VFM of the project. By using a financial appraisal, the government determines whether the project cash flow alone is likely to give a sufficient financial return to a given private sector sponsor, or whether a contribution will be required from the public sector. The government will also use a financial model to evaluate alternative private bids in a competitive tender. For a given standard of service, minimizing the cost to the public sector is the central test in the VFM assessment. The most common methods for assessing the financial viability of projects are: the average accounting rate of return, the payback period, the net present value, and the internal rate of return (IRR). All of these compute the expected cash flow from different projects and for the two supply methods in order to get a figure that can be compared. Following in this vein, the present paper introduces a test in which expected cash flows are not risk-adjusted. First, the present cost for the public sector comparator (PC^{PSP}) is estimated by equation [3]:

(13) Literature on the issues of VFM techniques includes Grout (1997); Froud and Shaoul (2001), Kirk and Wall (2002); Heald (2003); English and Guthrie (2003); Broadbent *et al.* (2003) and Edwards and Shaoul (2003).

$$PC^{PSC} = tc^{g} + \sum_{t=1}^{cp} \alpha_t \, ic_t^{g} \, (1+r_1)^{-t} + \sum_{t=cp+1}^{ccl} (opex_t^{g} + lcc_t^{g} - cr_t^{g})(1+e)^{t}(1+r_1)^{-t} + \sum_{t=2}^{ccl} i^{g} \, D_{t-1}^{g} \, (1+r_1)^{-t} + rc\,(1+r_1)^{-ccl} \quad [3]$$

The notations are explained in Table 1. The superscript "g" indicates that the flows correspond to a service managed by the public sector and α_t is the proportion of the initial capex invested each year during the construction period. In order to have a symmetric assessment, and because, for private procurement, a residual cost (*rc*) is incurred at the end of the concession time in order to keep the infrastructure in good shape, the same cost has been included in the case of public procurement. Second, we consider a PPP as the alternative; in this situation the government becomes a purchaser of services supplied by a private company (the concessionaire). The services can be supplied to the government itself or directly to its citizens. In a PPP, the government has to fund the acquired services as specified in the concession contract. Equation [4] expresses the present cost for the government (PC^{PPP}), when tax collection is ignored:

$$PC^{PPP} = tc^{p} + \sum_{t=1}^{ccl} gp_t(1+e)^{t}\,(1+r_2)^{-t} \quad [4]$$

Furthermore, if the concessionaire has profits during the concession period, the government will collect the corresponding corporate tax. While the governmental payments are certain, the fiscal revenue flow depends upon the market evolution of certain variables (basically demand and input costs), and the quality of the concessionaire's management. Equation [5] specifies the net present cost for the government of a service supplied under a PPP scheme, when the expected tax collection is taken into account [$PC^{PPP(T)}$]:

$$PC^{PPP(T)} = tc^{p} + \sum_{t=1}^{ccl} gp_t(1+e)^{t}\,(1+r_2)^{-t} - T_t \sum_{t=1}^{ccl} P_t^{SPV}\,(1+r_2)^{-t} \quad [5]$$

where P_t^{SPV} is the profit of the special purpose vehicle (SPV) established by the concessionaire, such that

$$P_t^{SPV} = -f_t - \sum_{t=1}^{ccl}(ic^{p}/ccl^{p}) - \sum_{t=cp+1}^{ccl}\left(opex_t^{p} + lcc_t^{p}\right)(1+e)^{t} + \sum_{t=cp+1}^{ccl}(gp_t + cr_t^{p})(1+e)^{t} - \sum_{t=2}^{ccl} i^{p}\,D_{t-1}^{p} + cs_{ccl} - rs_{ccl} \quad [6]$$

Again, the notations are explained in Table 1. Here, the superscript "p" indicates that the service is managed by the private sector. As we have seen above, there is a debate on whether it is best to use one single DR in VFM tests. For that reason, equations [3], [4] and [5] include two different nominal DRs (r_1 and r_2), which may or may not be the same. Note that when infrastructure is built, financed and maintained by a private concessionaire, the annual cost to be paid by the government must be compatible with a number of restrictions imposed by the suppliers of equity and debt[14].

In short, according to the present VFM test, a PPP scheme should be chosen when PC^{PSC} [3] > PC^{PPP} [4] if the potential tax collection is ignored, or PC^{PSC} [3] > $PC^{PPP(T)}$ [5], when the estimated tax collection is taken into account.

Table 1: NOTATION AND DESCRIPTION OF VARIABLES

Variable	Concept	Unit	Description
ccl	Concession contract length	years	Concession period
cp	construction period	years	Period in which the asset is built
tc	tender cost	€ million	Cost incurred by public sector when preparing the tender for the outsourcing
ic	initial capex	€ million	Expenditure incurred in building the asset
opex	operating expenditures	€ million	Cost incurred in operating the asset
e	escalator	%	Parameter indicating the rate of growth of prices/costs
lcc	lifecycle cost	€ million	Investments incurred during the contract period to maintain the asset
rc	residual cost	€ million	Cost incurred at the end of the contract period to keep the asset in good shape
cr	commercial revenue	€ million	Any income stream coming from a third party
gp	government payments	€ million	Annual amount paid by the govenrment to concessionaire (in the case of PPP)
T	corporate tax rate	%	Effective corporate tax rate of the concessionaire
i	yield of the debt	%	Yield of the debt used to finance the infrastructure asset
D	outstanding debt	€ million	Outstanding debt issued to finance the infrastructure asset
d	paid dividends	€ million	Dividends paid by the concessionaire to its shareholders
cs	cash surplus	€ million	Cash surplus to be distributed to concessionaire shareholders at the end of the concession period
f	debt structuring fee	€ million	Fee paid by the concessionaire to the lenders
r_1	nominal discount rate	%	DR being used to discount flows in the Public Sector Comparator case
r_2	nominal discount rate	%	DR being used to discount flows in the PPP case

Source: Own elaboration.

3. NUMERICAL ANALYSIS

In the VFM test, the criterion for choosing a PPP as the procurement method is that the present cost for the government is less than the present cost of conventional public provision, for a given standard of service. Obviously, the rate being

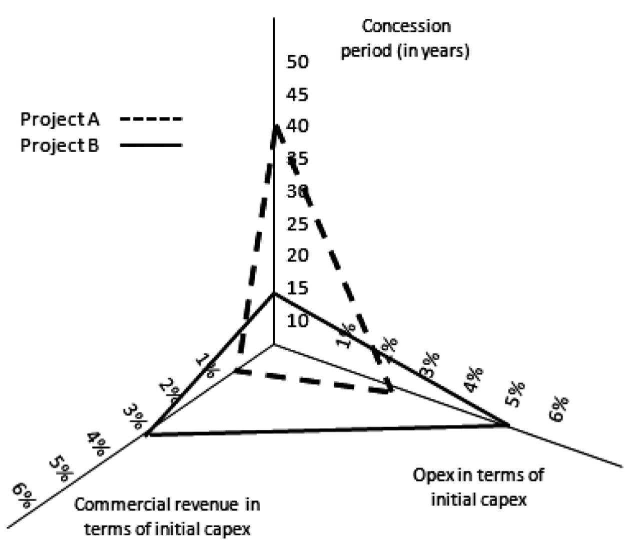
(14) Most PPPs are financed through project finance (non-recourse or limited-recourse) schemes. The lenders need to be confident that the project can repay the debt by itself, without recourse to new equity contributions from the shareholders, even if some contingency occurs. So they require a minimum debt service coverage ratio (DSCR), a ratio that de facto implies a cap in the gearing level, and they impose a debt service reserve account (DSRA) – a cash buffer during periods in which the cash available for debt service (CFADS) is less than the scheduled payments. Moreover, in project finance, there is a cash sweep policy which determines the percentage of cash flow available for debt service (the repayment of principal and interest). This determines the pay-out policy and, thus, the dividends flow. In the same way that the lenders require certain conditions, in order to support the project the capital suppliers require a minimum expected return on equity (ROE).

used to discount the flows matters. This section performs a numerical exercise to analyze how the outcomes of VFM tests are sensitive to the choice of the DR. Four issues are studied: i) To what extent does the relevance of the DR depend upon the nature of the concession? ii) How sensitive are the results to whether the estimated tax collection is considered? iii) How robust are the outcomes to changes in the key parameters of the project? and iv) How do the outcomes of VFM tests change when using two different DRs?

3.1. The discount rate and the nature of the infrastructure assets

For the purposes of this study, it can be said that there are two main types of public services. First, there are those based on infrastructure assets; these have a very high fixed cost but a low operating cost, so that marginal costs are very low. Examples of these services include highways, tunnels and bridges. Second, there are services that are also based on infrastructure assets, but whose provision involves significant variable operating costs. Examples of these services include hospitals, schools and airports. We apply the VFM test described above to two projects (here called A and B). They differ from each other in three main features: i) the concession contract length is 40 years for project A and 15 years for project B; ii) the capital intensity, the annual operating expenditure ratio in terms of initial investment, is 50% higher in project B than in project A; and iii) the commercial revenues in project B are almost four times what they are in project A. See Figure 1.

Figure 1: PROFILE OF PROJECTS A AND B



Source: Own elaboration.

To simplify matters, a number of variables in the model are computed in terms of the initial capex required: β_0 = tc/ic; β_1 = opex/ic; β_2 = lcc/ic; β_3 = cr/ic and β_4 = gp/ic. (See values in Table 2). The model allows the assumption of a number of advantages and disadvantages associated with the use of a PPP. The advantages, in the base case, are the following: a saving in the initial capex of 5%; a lower operating cost of 20%; a lower lifecycle cost of 15%; and higher commercial revenues. On the contrary, the tender offer costs are 5 times higher, while the leverage is lower, the term of the debt shorter and the financing more expensive. Other variables, such as the construction period or the residual costs, are considered equal in the two procurement methods. For the rest of the details, see Table 2.

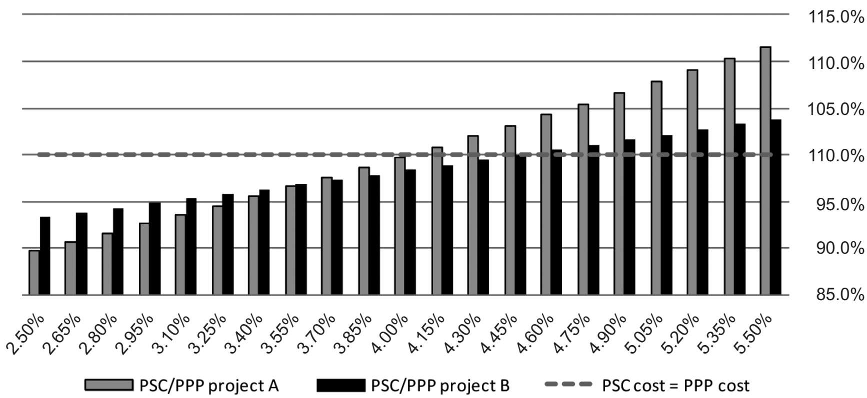
Table 2: BASE CASES

TYPE OF PROJECT: concession period		A (40 years)		B (15 years)	
variable	unit	Common features			
Construction period (cp)	years	6		3	
Escalator (e)	%	2.5%		2.5%	
Residual cost (rc)	%	15%		15%	
	unit	Other features			
		PPP	PUBLIC	PPP	PUBLIC
β_0 = tc/ic	%	1.000%	0.200%	2.000%	0.400%
β_1 = opex/ic	%	1.88%	2.35%	4.40%	5.5%
β_2 = lcc/ic	%	1.70%	2.00%	1.28%	1.50%
β_3 = cr/ic	%	1.00%	0.75%	3.90%	3.0%
β_4 = gp/ic	%	16.00%	0.00%	22.00%	0.00%
Tax rate (T)	%	30%	na	30%	na
		x		x	
Saving in initial capex : $x = [(ic^g - ic^p)/ic^g]$		5%		5%	
Ratio of tender offer costs: $\beta_0^{\ p} = x\ \beta_0^{\ g}$		5.00		5.00	
Saving in opex x: $[(\beta_1^{\ g} - \beta_1^{\ p})/\beta_1^{\ g}]$		20%		20%	
Saving in Liflecycle cost x: $[(\beta_2^{\ g} - \beta_2^{\ p})/(\beta_2^{\ g}]$		15%		15%	
Increase in β_3		from 0% to 1%		30%	
		Financial features of D^g and D^p			
Debt/initial capex ratio	%	75%	100%	80%	100%
Interest rate swap	%	3.00%	3.00%	2.50%	2.50%
Credit spread	%	7.50%	4.00%	6.00%	3.00%
Debt tenor	years	30	40	13	15
Moratorium period	years	5	0	3	na
Tail of debt [1]	years	25%	0%	13.4%	0%
Up front fee -% of notional debt-	%	8%	0%	6%	0%

Superscripts "g" /"p" indicate that the service is provided by public/private sector.
(1).- Time difference between the end of planned debt amortization and the end of the concession period.
Source: Own elaboration.

In the first simulation, we apply the VFM test with the above assumptions and one single DR. The outcome is that the present costs are identical for the two supply methods when using a DR of 4.03% for project A and a DR of 4.45% for project B. As we use a higher DR, the advantage of using the PPP method of procurement increases in both projects. Figure 2 shows the ratio of present cost of PSC and PPP for a range of discount rates.

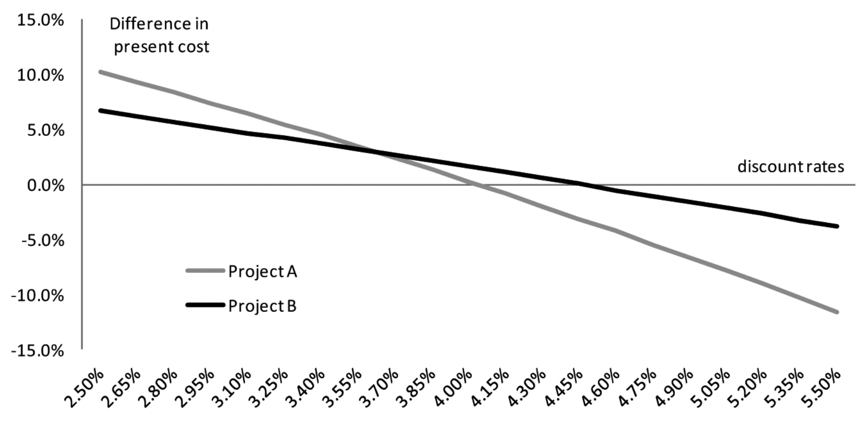
Figure 2: Impact of discount rates on present costs (projects A and B)



Source: Own elaboration.

Each additional percentage point increase in the DR being used increases the ratio by 5.58% in the case of project A and by 3.63% in project B. Thus, the same variation in the DR implies a 35% higher impact in the case of the project with the longest term. Figure 3 shows the different slope of the curve for the two projects.

Figure 3: Differences in present cost between PSC AND PPP (projects A and B)

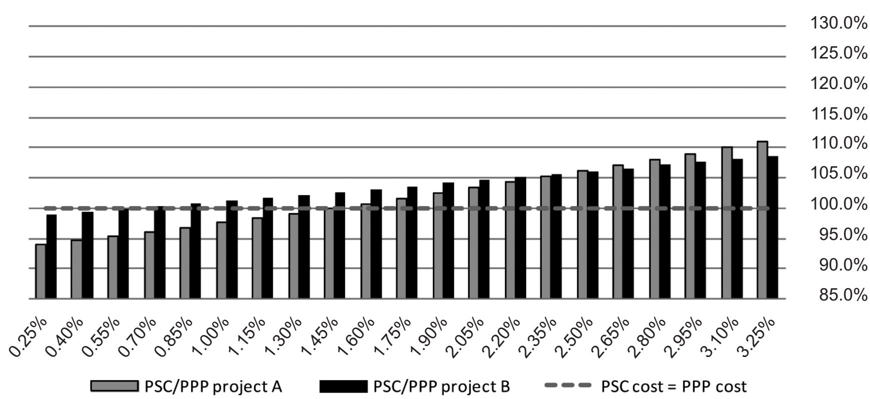


Source: Own elaboration.

3.2. *Discount rates and tax revenue*

When the estimated tax revenues from the concessionaire's profits are taken into account, there is a reduction in the DR required to get a neutral situation. Now, the two supply methods are equivalent for a DR of 1.46% in project A and of 0.60% in project B. See Figure 4.

Figure 4: COMPARATIVE IMPACT OF DISCOUNT RATE ON PRESENT COST WITH ESTIMATED TAX REVENUE



Source: Own elaboration.

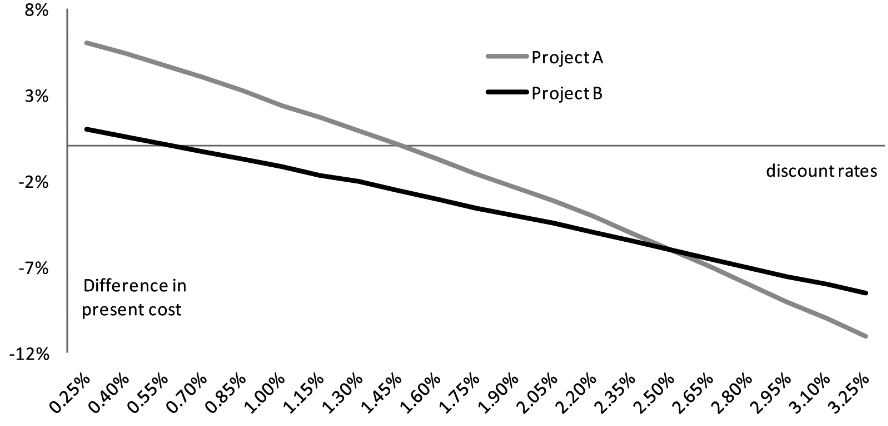
Each additional percentage point in the DR being used increases the ratio of present costs by 5.73% in the case of project A and by 3.25% in project B. Thus, the same variation in the DR implies a 43% higher impact in project A (8 percentage points more than before). Figure 5 shows the difference in the slope of the ratio for both projects in a scenario which takes the tax revenue into account.

3.3. *Robustness of the outcomes to changes in project parameters*

Two key parameters of the VFM test are the government payments to the concessionaire and the tax rate[15]. When ignoring tax revenue, a one percentage point change in the government's annual payment (in terms of initial capital expenditure) means a change of approximately 19 basis points in the DR that makes the present cost of PSC and PPP equal in project A. The equivalent figure is 126 basis points in project B. These changes mean 5% and 28% of the DRs previously estimated. When we take into account the tax revenue, the sensitivity is 88 basis

(15) The rest of the parameters also matter, and basically affect the leverage of the concessionaire and, as a consequence, the return on equity for its shareholders.

Figure 5: DIFFERENCES IN PRESENT COST BETWEEN PSC AND PPP WITH ESTIMATED TAX REVENUE



Source: Own elaboration.

Table 3: SENSITIVITY TO CHANGES IN GOVERNMENT PAYMENTS

	Project A		Project B	
	with taxes	without taxes	with taxes	without taxes
initial β_4	16%		22%	
discount rate to make PC(PSC) = PC(PPP)	1.46%	4.03%	0.60%	4.45%
↑ 1% in β_4	0.85%	0.14%	1.25%	1.20%
↓ 1% in β_4	0.91%	0.23%	1.36%	1.32%
average	0.88%	0.19%	1.31%	1.26%
in %	**60%**	**5%**	**218%**	**28%**

Source: Own elaboration.

points for project A and 131 basis points for project B. This means 60% and 218%, respectively, of the initial DR for projects A and B. These results seem to be robust, particularly when taxes are considered: altering the outcome of the VFM test requires an aggressive modification of the DRs being used. See Table 3.

With respect to the second variable, a one percentage point change in the tax rate applicable to the concessionaire means a change of approximately 12 basis points in the DR that makes the present cost of PSC and PPP equal in project A, and 15 basis points in project B. See Table 4.

Table 4: Sensitivity to changes in tax rates

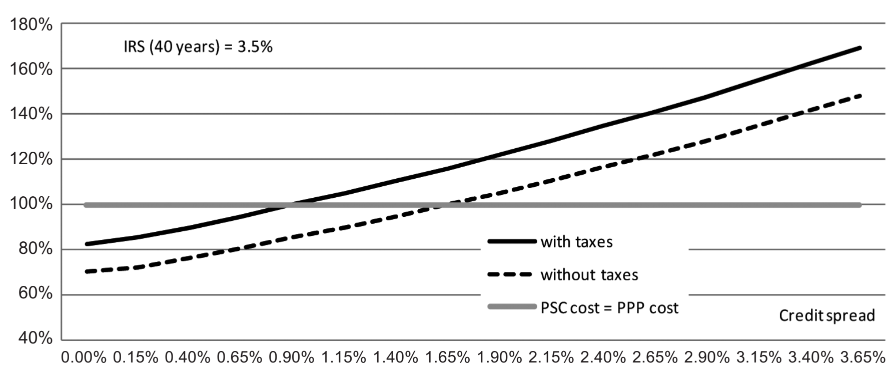
	Project A	Project B
initial tax rate	30%	
discount rate to make PC(PSC) = PC(PPP)	1.46%	0.60%
↑ 1% in tax rate	0.12%	0.16%
↓ 1% in tax	0.12%	0.15%
average	0.12%	0.15%
in %	**8%**	**26%**

Source: Own elaboration.

3.4. Results of the VFM test when using 2 different discount rates

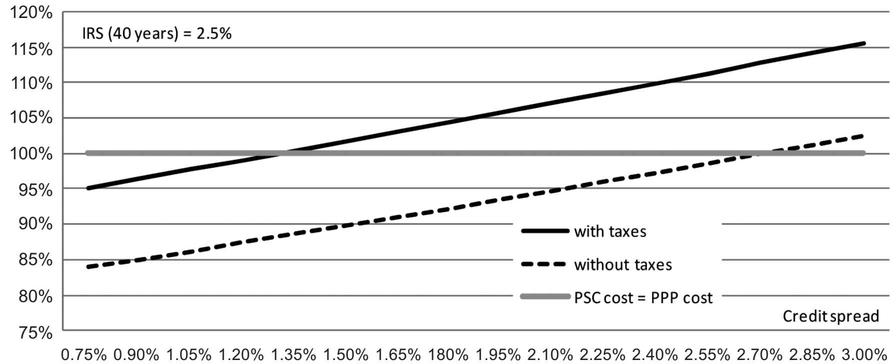
Now, the yields of the debt issued by the public sector and by the concessionaire are used to discount the flows of PSC and PPP, respectively. The credit spread between the two financing instruments affects the outcome of the VFM test. According to our simulation, in the case of project A, if the credit spread is higher than 1.65% (ignoring the tax revenue), the VFM test will come out in favor of the PPP method. Taking into account the fiscal revenue, the required credit spread to make the PPP method preferable is just 0.90%. See Figure 6. In the case of project B, a credit spread higher than 2.70% implies that the result of the VFM test will be in favor of PPP, when we ignore the tax revenue effect (and the figure is 1.35% taking into account the fiscal revenue). See Figure 7.

Figure 6: Credit spread between private and public financing for present cost of PSC and PPP being equal (project A)



Source: Own elaboration.

Figure 7: Credit spread between private and public financing for present cost of PSC and PPP being equal (project B)



Source: Own elaboration.

The conclusion here is that, when using two different discount rates, the credit spread which makes procurement with a PPP preferable is significantly lower for concession projects of longer duration.

4. Final comments

The paper proposes a Value for Money test to assess the appropriateness of public-private partnerships to supply what were once considered public sector services, and performs a numerical analysis to verify to what extent the outcomes are sensitive to the discount rates being used. The test is applied to two projects basically differentiated in their concession period and level of capital intensity. The main conclusions are as follows. First, the higher the discount rate being used, the greater the advantage of using the PPP method. When tax collection from the concessionaire is taken into account, this impact is 43% higher in the case of the project with the longest term. Second, when the flow of the costs of supplying the service is discounted with two different rates (the yield of public debt and the yield of the project finance of the concessionaire) the credit spread that makes the PPP method preferable is relatively low, and is 33% lower for the project with the longest concession period. Finally, using one single discount rate for very different projects seems to be inadequate.

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RESUMEN

El presente artículo propone una prueba de VFM para evaluar si es apropiado el uso de colaboraciones público-privadas, y realiza un análisis numérico para comprobar hasta qué punto los resultados se ven influidos por las tasas de descuento utilizadas. La prueba se aplica a dos tipos de proyectos de infraestructuras que se diferencian esencialmente en el plazo de la concesión y la intensidad de capital. Los resultados indican que cuánto más alta es la tasa de descuento utilizada mayor es la ventaja de utilizar un esquema PPP como método de provisión. Esta conclusión es más visible en el caso de proyectos con mayor plazo concesional. Además, usar tasas de descuento idénticas para analizar proyectos con perfil muy diferente parece ser inadecuado.

Palabras clave: tasa de descuento, evaluación de proyectos, colaboración público-privada, *value for money*.

Clasificación JEL: H43, H44.