FINANCING PPP PROJECTS WITH PVR CONTRACTS: THEORY AND EVIDENCE FROM THE UK AND CHILE

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Abstract

Risk allocation is an essential component of a successful public-private partnership contract. For many of these projects, demand risk is large and mostly exogenous, which motivates considering contract designs that do not force the concessionaire to bear risk it cannot manage. In this paper we study present-value-of-revenue (PVR) contracts, which achieve this objective. Under a PVR contract, the regulator sets the discount rate and tariff schedule and firms compete on the present value of tariff revenue. The lowest bid wins and the contract lasts until revenue collected by the winning firm is equal to its bid.

We provide a theoretical analysis comparing debt financing under a fixed term concession and PVR and show that, other things equal, debt financing is less risky under PVR and therefore debt-to-capital ratios can be higher. We also show that the often held view that PVR does not mesh well with fixed maturity debt financing is wrong, essentially because this view does not consider the fact that demand realizations are independent of contractual forms.

Finally, we analyze the experience with PVR, considering two early examples from the UK that were financed entirely with debt and close to thirty PVR contracts in Chile, mainly for highways and airports. We conclude that PVR contracts have been at least as attractive for debt-financiers than their fixed term counterparts, and that PVR has helped materialize the efficiency gains that are possible when PPPs are financed with user fees.

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1 Introduction

Efficient risk allocation is an essential component of a successful public-private partnership (PPP) infrastructure contract. Nevertheless, most transport PPPs run for a fixed term and in principle allocate demand risk to the concessionaire. Demand risk is typically large, and mostly exogenous, and experience suggests that it is expensive to force the concessionaire to bear a risk it can neither control nor manage.

Having the concessionaire bear demand risk not only entails a higher financing cost, it also has led to opportunistic contract renegotiations in low demand scenarios, renegotiations that have turned the public against PPPs in many countries.[2] This is unfortunate, since PPPs in the transport sector can lead to important efficiency gains,[3] for example, by providing better incentives for maintenance, filtering 'white elephants, [4] and avoiding the cost of bureaucracies.[5]

Availability contracts are sometimes used to shield the concessionaire from demand risk. With these contracts, government pays for both capital and operation costs, and therefore takes on demand risk. This approach is appropriate for infrastructures PPPs where the government might not want to charge user fees, such as schools and hospitals. In the case of transport infrastructure, where user fees can fund the project totally or partially, availability contracts give up on the possibility of charging those that benefit from the project and thus eliminating a distortion against other forms of transport as well as lowering the cost of bureaucracies. In the particular case in which the project can be fully funded by toll revenue, tolling can eliminate the risk of white elephants.[6]

The appropriate way to mitigate exogenous demand risk in highway is a present value-of-revenue (PVR) contract (see Engel et al. (2001)), In this paper we provide a brief review of PVR contracts and we focus on the main objection to these contracts, namely, that they are difficult to structure financially because the flexible term in unattractive to banks and bondholders.

Under a PVR contract, the regulator sets the discount rate and tariff schedule, and firms bid the present value of tariff revenue they desire to finance, build, operate and maintain the infrastructure. The firm that makes the lowest bid gets the concession, which lasts until the present value of tariffs collected equals the winning bid.[7] It follows that the term of the concession automatically adjusts to demand shocks, resulting in a substantial reduction of demand risk borne by the concessionaire. At the same time, since tariffs are the concessionaire's main revenue source, the efficiency gains that are possible under PPPs will materialize.[8]

[2] A prominent example is the London Underground PPP, see House of Lords Select Committee on Economic Affairs (2010).

[3] For potential efficiency gains under PPPs, when compared with public provision, see Hart (2003), King and Picthford (2008) and Engel et al. (2014).

[4] When tariffs are the main source of revenues for the concessionaire no firm will show up at the auction if tariffs are not expected to pay for capital and operational expenses, thereby providing a market test that filters white elephants.

[5] The latter refers to the fact that PPPs allow taxpayers to pay the concessionaire for infrastructure services directly, via tariffs, thereby avoiding the costs of going through the government's bureaucracy, see Engel et al. (2013) for a formal model.

[6] "When high roads, bridges, canals, &c. are in this manner made and supported by the commerce which is carried on by means of them, they can be made only where that commerce requires them, and consequently where it is proper to make them." Adam Smith, *The Wealth of Nations*.

[7] Tariffs correspond to tolls in the case of highways and to aeronautical revenues (passenger and airport fees) in the case of airports. Non-aeronautical revenues are not included in the bidding variable for airports to induce effort in managing these revenues, see Engel et al. (2018) for details.

[8] Even though, as discussed in Section 3.1, the experience with PVR contracts goes back to the 1980s, the first paper analyzing these contracts is Engel et al. (1996). Engel et al. (1997, 2001) establishes the optimality of PVR from a risk sharing perspective,

Perhaps the most prevalent objections to PVR contracts is that they are difficult to finance because banks and bondholders find the flexible term that characterizes these contracts unattractive.[9] We believe this concerns explains why PVR has not been used more broadly (wit the exception of Chile). For this reason, in this paper the focus will be on showing that the objection to the PVR contract based on the financial issues is invalid.[10]

In this paper we present theoretical argumentas that show that the financial argument against PVR is flawed. Moreover, we present evidence from PVR contracts in the UK and Chile that supports our analysis. Conceptually, our analysis is based on the fact that the cash flow generated by a PPP is unaffected by the type of contract if they charge the same toll. The main difference is that, compared with a fixed term contract, PVR lasts longer in low demand scenarios and ends sooner in high demand scenarios. Both these differences have important implications we discuss next.

That PVR contracts last longer in low demand scenarios, means that the concessionaire can tap resources unavailable under a fixed term contract to repay its debt. This implies that the risk borne by debt financiers will be lower under PVR. This is confirmed by two PVR concessions in the UK that were financed entirely with debt (see Section 3.1). On the other hand, the fact that the contract ends sooner under PVR in high demand scenarios implies a higher prepayment risk than for a fixed term PPP. However, prepayment does not come at a significant cost to lenders, since the decision to prepay when the PVR contract ends early is not triggered by a fall in interest rates but by an exogenous event that is more likely to happen when the economy is expanding and interest rates are high. Since prepayment risk is usually costly because of its correlation to low interest rate scenarios, where lenders face smaller returns on their prepaid loans, the fact that PVR is not correlated to these scenarios means this risk is low to inexistent. This is confirmed by the Chilean experience (see Section 3.2).

In the paper, we analyze the experience with PVR contracts in Chile. The first PVR contract was auctioned in 1998. After 2006 PVR became the contract of choice for roads and airport PPPs. By 2017, 29 of the 63 PPPs in the these sectors awarded since 1993 were PVR contracts, which accounted for 44 percent of total investment.

PVR contracts have worked well in Chile. The local financial industry, in particular banks and insurance companies, understand how PVR contracts work, and participate in the financing of PPPs even during the construction phase. Financiers distinguish between prepayments that accrue because the PPP

for projects that can be financed entirely with user fees in any demand scenario ('high demand projects' in what follows). Engel et al. (2018) show that a variante of PVR where firms bidding variable considers only aeronautical revenues, also is optimal for airpots, where providing incentives to attract demand for non aeronautical services plays a central issue. Finally, Engel et al. (2013) propose a public finance perspective that can be applied to projects that are not necessarily high demand, and show that the optimal contract is a two-threshold flexible term contract. The lower threshold determines revenue that is guaranteed to the concessionaire in present value, via subsidies, when demand is below the threshold. The upper threshold caps the present value of revenue collected by the concessionaire in high demand scenarios. This contract simplifies to a PVR concession for high demand projects.

[9] Another shortcoming of PVR, occurs in cases where demand is endogenous and the actions of the concessionaire cannot be monitored easily. If, moreover, there is market power, the concessionaire has few incentives to exert effort in actions that increase the rate at which revenues are accumulated. It follows that PVR is a good option only when quality of service can be contracted and enforced, such as occurs in some important types of transportation infrastructure such as highways and airports. Also see Tirole (1997) for an early analysis of pros and cons of PVR.

[10] For financing of PPPs in general, and the important role of project finance, see, for example, Ehlers, Packer and Remolona (2014), Inderst (2010, 2013), Weber and Alfen (2010), Weisdorf (2007), and Yescombe (2002, 2007).

is doing better than expected from those prepayments that are triggered by interest-rate swings (such as home mortgages), which are normally contractually excluded or involve a high prepayment fine. Moreover, lenders value the fact that the automatic term extension under a PVR contract in scenarios with low demand lowers the probability of default and of bankruptcy of a concession.

In addition to their advantages in risk allocation, PVR contracts address an important weakness of standard PPP contracts. Because of the risk of creeping expropriation in the long term, PPP contracts are designed to be inflexible. In particular, standard PPP contracts have a hard time incorporating early termination risk in a way that avoids opportunistic behavior by the Public Authority. In contrast, in the case of PVR, the public authority has the option to unilaterally buy back the concession by paying a "just" price for the contract. This just price corresponds to the difference between the bid value and the present value of toll revenue already received.[11] Because the concessionaire's winning bid determines the total amount of present value revenues it asks for, a fair value for the early buy back option can be calculated at any moment in time with verifiable accounting information. Compare this with a fixed term contract, in which compensation depends on the expectations of future demand behavior, and where the fair compensation itself becomes a matter for dispute.

The remainder of the paper is organized as follows. Section 2 compares debt-financing under PVR and fixed term contracts along theoretical grounds. Section 3 studies the experience with PVR in the UK and Chile. Section 4 concludes.

2 Theory

The main criticisms of PVR contracts is that, because the concession term is not known in advance, structuring debt contracts is more difficult and expensive. For example, Klein (1997a) argued that:

> *The automatic term extension may be attractive to capital providers, but it does not help debt financiers [who] seek an adequate cash flow to cover debt service within the fixed maturities agreed in the financing contracts. [...] Compared with [...] minimum traffic guarantees, [leverage] will tend to be smaller [...]. Thus, it is very unlikely that debt/capital ratios of 70/30 or higher will be observed in the "typical" project finance contracts.*

According to this argument, fixed term contracts allow financiers to match the maturity of the debt with the term of the concession. By contrast, PVR contracts constrain maturities, because in high-demand states the concession term shortens.

In this section we explain why, other things equal, with a PVR contract debt holders should be willing to increase leverage. To obtain this conclusion, we define a standard debt contract as a loan amount and a length to repayment. On the other hand, a PVR contract is a loan amount and a revenue amount. For simplicity we omit the interest rate in the standard contract, or alternatively we assume it is the same used to discount future values in a PVR contract. We argue that all standard debt contracts available under a

[11] Since damage to the road –and therefore maintenance costs– depends on the accumulated use of the road, maintenance risk is a cost per unit of toll revenue for the concessionaire and does not add risk. The only remaining risk is operations risk, which is small in roads, and can be subtracted from the value that the government pays according to a predefined rule.

fixed term concession can be adapted to PVR, while the converse is not true: there exist debt contracts that can be written only under PVR. In particular there exist contracts that make it possible to finance the project entirely with debt under certain conditions of demand.

A simple example

As we mentioned above, one of the main characteristics of transport PPPs is that medium- and long-term traffic forecasts are imprecise. In addition, traffic risk tends to be largely –if not totally– exogenous, that is, beyond the PPP's control.

Of course, debt financiers know this, and take it into account when deciding how much to lend, what rate to charge and the amount of leverage they will accept. Thus, while in the typical fixed-term contract the maturity of the debt and the payment schedule are fixed in principle, in practice everybody knows that cash flows from the project will vary depending on exogenous demand realizations. The higher the leverage, the higher the probability that in states with low demand the term of the franchise will be too short to repay the debt.[12] Thus, for a fixed term contract, whether the cash flows are "adequate to cover debt service within the fixed maturities agreed in the financing contracts" depends on the risk that financiers are willing to take.

Even though the insights that follow are quite general, we present them using a simple example that helps illustrate the mechanisms at work. Consider a highway for which traffic flows are either high (annual revenue of H, with probability $p_H > 0$), or low (annual revenue of L, with probability $p_L > 0$), with $H > L$ and $p_H + p_L = 1$. For this example, risk aversion is not required, and risk neutrality makes the example easier to follow the argument, so we assume it here. Thus firms are risk-neutral, the discount rate is zero, total investment is I and does not depreciate, the project is built at $t = 0$ and there are neither maintenance nor operational costs.

Default risk

Consider first a fixed-term PPP contract with term $\overline{T}$. The term of the PPP is set in a competitive auction with many identical firms, and since firms are risk neutral, $\overline{T}$ must satisfy

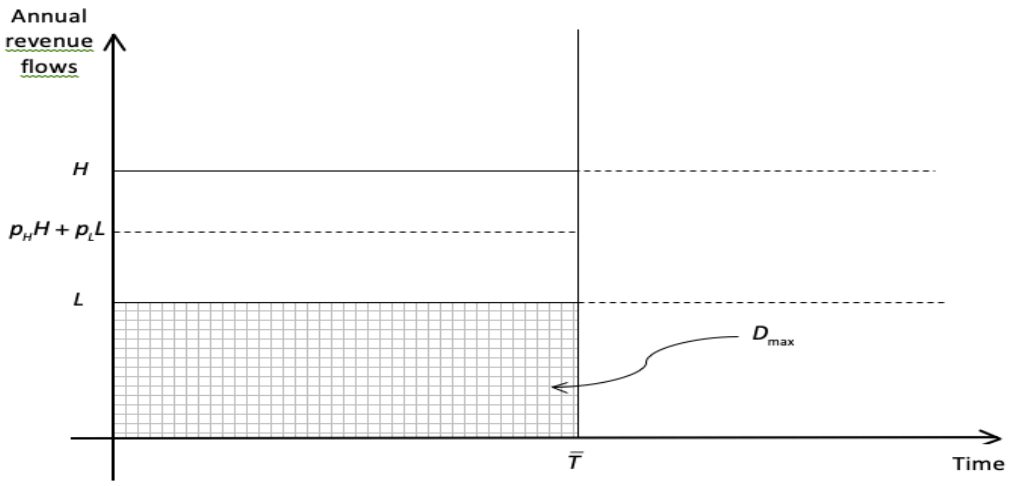
$$[p_H H + p_L L]\overline{T} = I. \tag{1}$$

Thus, as can be seen in Figure 1, in the high-demand state the PPP will make profits, because $H\overline{T} > I$ while in the low demand state the PPP will loose money, because $L\overline{T} < I$. It follows that debt financiers can be sure that the PPP will pay back in all states only if they demand annual installments of at most L. Thus, as shown in Figure 1, the maximum debt they can lend with no default risk is $D_{\max} = \overline{T}L$. If debt financiers lend more than $D_{\max}$, the debt is not risk free, because in the low demand state the PPP will not generate enough cash flow to repay the debt in $\overline{T}$ years.

Combining the above expression for $D_{\max}$ with (1) implies that the largest loan-to-value ratio with no

[12] We assume competition in the bidding state and a monopoly therafter, or the only bidder could set tolls so high that loans can always be repaid.

Figure 1: Debt contract: Fixed term PPP

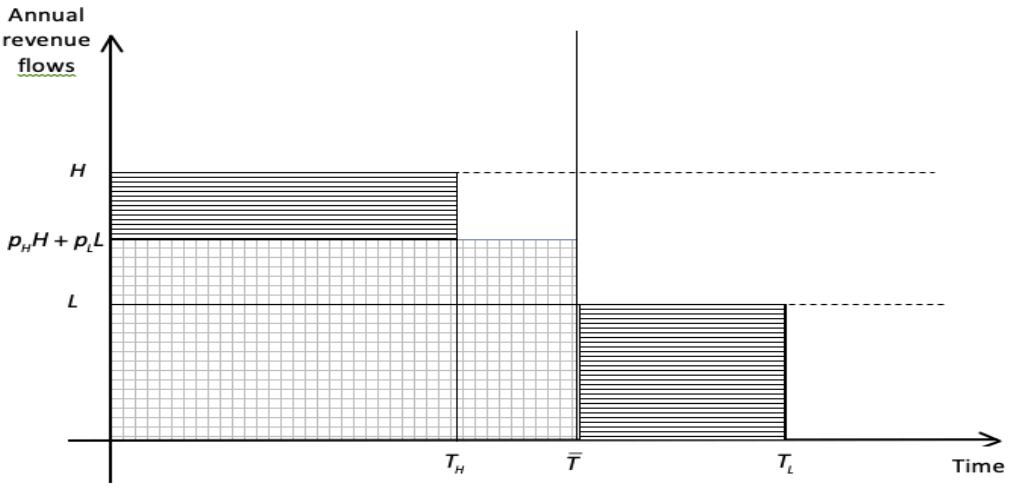


default risk, $D_{\max}/I$, satisfies

$$\text{Largest non-default loan-to-value ratio} = \frac{1}{1 + (1 - p_L)\left(\frac{H}{L} - 1\right)} < 1. \tag{2}$$

That is, more demand uncertainty, as measured by the extent to which H/L is larger than one, leads to lower risk-free loan-to-value ratios.[13]

Figure 2: Debt contract: PVR PPP



Next consider a PVR contract which is also assigned in a competitive auction. Now firms bid on the

[13]Equation (2) also implies that the largest risk free loan-to-value ratio is increasing in the probability of the low demand scenario. The intuition is that, since auctions are competitive, $\overline{T}$ increases with p_L so as to satisfy (1). Thus, if p_L is close to one $\overline{T}$ will be large enough so that the PPP can be financed almost entirely with debt.

present value of toll revenue they desire, the lowest bid wins and the contract lasts until toll collection is equal to this bid. The winning bid will be I and denoting by T_H and T_L the contract length when demand is high and low, respectively, we will have

$$HT_H = LT_L = I. \tag{3}$$

Comparing (1) with (3) we conclude that:

$$T_H < \overline{T} < T_L. \tag{4}$$

As can be seen in Figure 2, when demand is high, the concession term is shorter under PVR than under fixed term, the converse holds when demand is low.

It follows from (4) that loan contracts can have a longer maturity under PVR than under a fixed term concession: with fixed term the longest possible maturity is $\overline{T}$ while under PVR it is $T_L > \overline{T}$. With PVR, any loan that does not last more than T_L, and that pays installments that do not exceed L, will be risk free. Thus, there are many more risk free debt contracts under PVR than under a fixed term PPP, namely any debt contract with installments that do not exceed L and maturity between $\overline{T}$ and T_L. Prominent among them is the loan with maturity T_L and annual installments equal to L. This loan finances the entire project with debt. As we report in the next section, two English bridges, the Dartford and the Second Severn crossings, were fully financed with debt under a PVR contract.

The fundamental point is that the cash flow that the infrastructure generates and which can be used to service the debt does not depend on whether the term of the concession is fixed in advance or flexible, but on exogenous demand realizations. The difference between both types of concessions is that, by design, a fixed term PPP prevents debt holders from accessing the cash flows that the infrastructure generates after $\overline{T}$. By contrast, a PVR contract can use these revenues to eliminate risk for debt financiers thereby achieving a higher loan-to-value ratio.

Prepayment risk

There is no default risk when demand is high, both under fixed term and under PVR, but cash flows will realize faster, and the PPP may wish to prepay the loan. This will entail the additional cost of a prepayment charge or fine.[14] The fact that demand realizations are exogenous and do not depend on whether the PPP term is fixed or flexible, implies that the prepayment risk will be present both under a fixed term contract and under PVR. Yet, as we argue next, prepayment risk will be both more prominent and less costly under PVR.

Consider a loan with maturity $\overline{T}$ and installments equal to L. This is a risk free loan both under fixed term and under PVR, that provides debt financing in the amount of $D_{\max} = \overline{T}L$. Under PVR, in the high demand scenario, financiers will demand that the PPP repay more than L in every period. Indeed, since the contract length in this scenario is shorter than $\overline{T}$, the PPP will repay its debt only if annual repayments average at least $L\overline{T}/T_H > L$. By contrast, under a fixed term contract, in the high demand scenario financiers

[14]Note that setting aside a fraction of the income from high demand scenarios in an escrow account to make the payments scheduled in the debt contract after termination of the PPP offers only a partial solution, since the risk free rate that the funds in this account will presumably receive won't be able to pay the risk premium included in the debt contract's interest rate.

do not have an incentive to demand installments above those stipulated in the original debt contract, since the contract lasts long enough for installments of L to repay the entire debt.

The above example is very particular, yet once the nuances of more complex demand processes and more general debt contracts are considered, the following general point can be made. Under PVR, financiers have a larger incentive to demand prepayment in high demand scenarios than under fixed term, since the contract length is shorter and the cash flow that will accumulate during the PPP will be less.[15]

Having established that prepayment risk is higher under PVR than under fixed term, we argue next that prepayment penalties under PVR should be low. Debt financiers do not like prepayments, because the prepayment decision is usually endogenous—debt holders tend to prepay when interest rates fall and they can refinance their debt in favorable terms. In the case of PVR, however, prepayment due to the termination of the contract will not take place at a time of low rates chosen by the PPP. Indeed, since demand for transport infrastructure tends to be procyclical, and so are interest rates, the rate at the time of prepayment will tend to be higher than average. This suggests (and the evidence we provide in Section 3.2 confirms) that prepayment penalties under PVR are low.

Renegotiations

So far we assumed that debt contracts cannot be renegotiated to avoid default, we consider this possibility next. When demand turns out to be low and debt financing exceeds $D_{\max}$, debt financiers face the possibility of default. In practice, however, governments grant minimum revenue guarantees to the PPP, that is, publicly funded insurance against low demand states. If guarantees turn out to be insufficient, transport PPPs are routinely renegotiated.[16] Sometimes the renegotiation involves a transfer from the Treasury, sometimes a term extension.

A simple example helps to make a general point. For the project described above, consider a debt contract with maturity T_H and installments equal to H, and asume the PPP's term is fixed (and equal to $\overline{T}$). If realized demand is high, the PPP can meet its debt obligation, yet if demand is low, the PPP renegotiates and obtains an extension of the concession term (and the debt maturity) from T_H to T_L. De facto, the renegotiation described above turns a fixed term contract into a PVR contract: in the high demand scenario, the concession term is T_H and debt installments are equal to H, while in the low demand scenario the effective contract term is T_L and effective debt installments equal L.

There are important differences, however, between starting off with a PVR contract and turning a fixed term contract into PVR via a renegotiation. One is that a PVR contract can specify what to do when different demand states realize—in that sense, the contract is complete.[17] By contrast, a term extension in a fixed-term contract is formally a contradiction of terms; in practice, it leads to an ad hoc renegotiation that is not contemplated in the contract. Behind this is a fundamental difference: while the cash flows generated by the infrastructure is always there to repay the debt under PVR; under a fixed-term contract

[15] The flip side is that the PPP makes more profits in high demand scenarios when the PPP has a fixed term. Thus, financiers will be less concerned when the PPP pays dividends under a fixed term contract than under PVR.

[16] Guasch (2004) studied more than 1000 concession contracts in Latin America and found large, and often opportunistic renegotiations were the rule.

[17] In our simple model we have only two demand realizations, yet in the more general case, the difference between the winning bid and the present value collected at any moment in time provides a "sufficient statistic" for the outstanding debt of the PPP.

only those cash flows realized until $\overline{T}$ can be used for this purpose. The cash flow that the infrastructure generates later can be tapped only after an ad hoc renegotiation.

Another difference between a PVR concession and a fixed term contract that turns into a PVR via renegotiation in a low demand scenario, is that extending the "fixed" term necessarily involves the Government, not only debt holders, which may entail additional costs. By contrast, private parties negotiate directly the modifications that are necessary to adapt to a longer payment period under PVR.

The Dulles Greenway[18]

The Dulles Greenway PPP illustrates well the shortcomings of fixed term contracts. It is one of the two major highway PPPs tendered in the US during the 1990s, which adds interest to this case.

The Dulles Greenway is a 14 mile road joining Dulles International Airport with Leesburg, Virginia. Investors put $40 million in cash and secured $310 million in privately placed, taxable debt. Loans were to be repaid with toll revenues. Tendered as a fixed term, 42.5 year concession, it was inaugurated in 1995. Demand turned out to be much lower than expected, with actual traffic equal to only one-fourth of projections. When the PPP defaulted in 1996, lenders restructured its debt and investors wrote off part of their equity. In addition, in 2001 the contract term was extended by 20 years, to 2056.

Despite a major forecast demand error, it was clear that even in low demand scenarios the Dulles Greenway would eventually collect enough tolls to pay for capital and operational expenditures. Therefore, had the PPP been tendered with PVR, the contract term would have extended automatically once demand turned out to be much lower than expected, thereby avoiding losses for investors and bondholders. The contract renegotiation and debt restructuring that followed, essentially turned the original fixed term contract into a PVR contract, yet this happened at a high cost.

3 Evidence

In this section we study the experience with PVR contracts. We first analyze two early PVR contracts for bridges in the UK and then look at the experience in Chile, with close to thirty PVR contracts for highway and airport PPPs. Our analysis pays special attention to how these contracts were financed.

3.1 United Kingdom[19]

The first present-value-of-revenue PPP contract that we know of was awarded to Trafalgar House on September 29, 1986, to build the Queen Elizabeth II Bridge, conditional on approval from Parlament. The proposal by Trafalgar was deemed the best among eight proposals for crossing the Thames River at Dartford, five of them bridges, the remaining three tunnels. Legislation authorizing the contract was approved in July of 1988.

The contract stipulated that Trafalgar would buy the two existing tunnels for £43 million, build a new 450 meter long bridge and operate all three for a maximum of 20 years or until toll fees payed off the

[18] Based on Gifford et al. (2014) and Engel et al. (2014).

[19] Based on Engel et al. (2014) and Levy (1996).

debt and equity, whichever happened first. The project had four shareholders: Trafalgar House (50%), Kleinwort Benson (16.5%), Prudential (16.5%) and Bank of America (17%). The consortium financed the bridge with subordinated debt issued by insurance companies, and term loans by banks. As is usual for PPPs, project finance was used and the concessionaire (Special Purpose Vehicle or SPV) had only nominal equity. Interest on the syndicated loan were floating, at a margin of between 0.75 and 1.25% above prime.

The bridge opened in 1991 and the PPP lasted until March of 2002, almost ten years before the maximum concession term of 20 years. The SPV in charge of the PPP was liquidated, the bridge reverted to public management and the government began collecting tolls, now referred to as charges.

The Second Severn Crossing PPP on the Severn Estuary, which was tendered in 1990 and opened in 1996, also used a PVR contract. The contract stipulated a term of 30 years or until the concessionaire collected £995.8 million (in July 1989 prices), whichever occurred first. As with the Queen Elizabeth II bridge, the PPP was financed fully with debt. Control of the crossing and the original Severn Bridge reverted to the UK government on 8 January 2018, after the project's required revenue had been collected. At that point responsibility for operating the bridge passed to Highways England, a public entity.

Beyond the fact that both variable term PPPs seem to have been successful, they show that leverage need not be lower with a variable term contract.

3.2 Chile

Figure 3 shows cumulative investment in transport PPPs in Chile, in million US dollars. The grey area depicts fixed term contracts while the yellow area shows PVR contracts. In between, in blue-and-white, are a group of PPPs that were tendered as fixed term and renegotiated into PVR contracts in the early 2000s, following a major fall in revenues in the late 1990s due to a recession.[20] As can be seen in the figure, after 2009 most PPPs have been PVR contracts. Roughly half of investments in Chile's transport PPPs via PVR contracts.[21]

Brief history

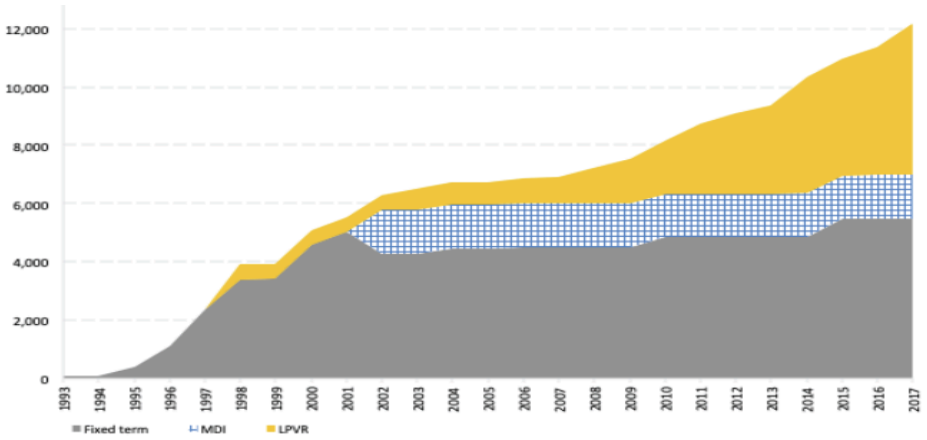
The Chilean government launched its PPP program and developed its governance in the early 1990s. One of the main innovations was the legal possibility of pledging the infrastructure's cash flows, and introducing a central registry of pledges. A PPP's value stems from the cash flows it generates; the asset itself is not a good guarantee because it has no alternative use. Without this regulatory innovation, therefore, finance would have been considerably more expensive or even impossible, because loans would have been classified as high risk, which would have forced banks to make rather large provisions. Banks were also allowed to lend up to 15 percent of their capital to infrastructure PPPs.

Initially, only banks financed PPPs, mostly through syndicates. In the construction phase they would charge a relatively high spread and make disbursements as building progressed. Once the infrastructure was completed, the debt would be restructured and the spread lowered through a private placement, mainly

[20] This contractual change follows closely our analysis of renegotiations of fixed term contracts at the end of Section 2.

[21] The exact number of 43.6 percent. This can be broken up into 32.5 percent that was tendered under PVR and 11.1 percent that was tendered under fixed term but renegotiated into a PVR contract.

Figure 3: Fixed and flexible term PPP investments in Chile



among banks. The lower spread reflected a significant decrease in total risk after completing construction, since unpredictable traffic variation is the main risk that remained at that stage. Nonetheless, from the very beginning of the PPP program, the government mitigated demand risk with minimum traffic guarantees, as financiers argued that without them risks would be too large.

Very soon, however, the industry realized that institutional investors—pension funds and insurance companies—were interested in providing bond finance after construction, which was cheaper than private placements. Yet institutional investors could only buy bonds with a AAA risk classification, and had little experience with evaluating the risks of investing in transport infrastructure assets. Monolines—firms that specialized in insuring bonds—provided the solution: PPPs paid them an insurance premium, and the insurance they obtained in exchange raised the classification of the bond to AAA, thus enabling insurance companies and pension funds to buy them. In 1998 the Santiago-Talca highway PPP issued the first infrastructure bond, and most PPPs followed suit. When the financial crisis hit, however, monolines disappeared and with them the financing model where they played a central role.

First PVR Auction

The UK PVR contracts described above were assigned in competitive auctions, yet firms did not bid on the present-value-of-revenue they desired. Instead, the regulator selected the best proposal (in what is described as a 'beauty contest' in economics). The first PVR contract that was assigned in a PVR auction is the Route 68 concession joining Chile's capital, Santiago, with the port city of Valparaíso and Viña del Mar. The project contemplated improvements and extensions of a 130 km highway, including the construction of three new tunnels. The project was auctioned in February, 1998, and inaugurated in November, 2002. The contract would last either 25 years or until the concessionaire collected tolls equal to its winning bid, whichever happened first.

Five bidders participated in the tender, one of which was disqualified on technical grounds. For the first time in the Chilean concession program, minimum income guarantees were not provided for free and

bidders had to indicate whether they were prepared to pay for them. Two bidders chose to buy a guarantee, the winner was among those who declined.

Bidders could choose between two rates to discount their annual incomes should they win: either a fixed (real) rate of 6.5 percent or a variable (real) rate given by the average rate in the Chilean financial system for operations between 90 and 365 days. A 4 percent risk premium was added to both discount rates. Three firms, including the winner, chose the fixed discount rate.

Somewhat surprising, the present value of revenue demanded by the winner turned out to be below construction and maintenance costs estimated by the Ministry of Public Works (MOP): the winning bid was $374 million while MOP estimated $379 million. A likely explanation is that the 4 percent risk premium used by MOP was the same it had used for previous projects, all of which were fixed, thereby ignoring the considerable reduction in demand risk associated with PVR. Using a risk premium between 1 and 2 percent, to evaluate estimated cash flows, instead of 4 percent, leads to a reasonable return to capital between 10 and 20 percent.

It is often argued that PPPs should be preferred over public provision only when the efficiency gains associated with them compensate for their higher cost of debt (the so called 'PPP premium'). The numbers above suggest that the PPP premium may be largely due to poor risk allocation.[22] Indeed, a reduction in risk between 100 and 200 basis points when using PVR instead of fixed term contracts is in the range of estimates for the PPP premium. For example, Yescombe (2007, p. 150) reports an average premium in the range of 75–150 basis points, with highway projects close to the upper limit. Forcing the concessionaire to bear demand risk that is large and mainly exogenous may come at a high price.

Finally we note that the Chilean government chose to tender Route 68 with PVR not because of the reduction in risk. The reason was that it wanted to retain the option to tender, at some moment during the second decade of the Route 68 concession, a highway that would be an attractive substitute for some users. For this reason, the contract of the Route 68 PPP included an early termination clause that allowed the government to buy back the PPP at any point in time after year 12 of the concession. Compensation for the concessionaire would be the difference (in present value) between the winning bid and tolls collected at the time of termination, with an additional correction for savings in operation and maintenance costs. By contrast with PVR, no simple criterion to determine fair compensation in the case of early termination exists for a fixed term contract. Furthermore, the early termination clauses included in later PVR contracts could be invoked by government from the beginning of the concession, with no need to wait for 12 years.

Summing up, Chile's first PVR concession illustrates two points. First, using a PVR contract may lead to a significant reduction in risk. Second, because in the case of a PVR concession the winning bid reveals the concessionaire's desired revenue, it allows for flexible arrangements that avoid opportunistic behavior and are not possible under fixed term contracts.

Syndicated long-term lending

Following the Route 68 concession, PVR was used only exceptionally until 2007, when it became the method of choice for highway and airport PPPs under the leadership of Eduardo Bitrán, then Minister of

[22] See Klein (1997b) for an alternative explanation for the PPP premium.

Public Works. Shortly thereafter, the 2008 financial crisis began, which altered the financing of transport PPPs in Chile (and the world) and financing more difficult. Following the crisis, a new financing scheme emerged with banks and insurance companies providing long-term syndicated loans. Why were banks and insurance companies willing to finance PVR PPPs?

With bond financing no longer available after 2009, banks returned to syndicated loans to finance construction and private placements for financing the operation stage. But this time, banks had a better understanding of transport PPPs, and moved towards syndicates that finance PPPs throughout their entire life cycle. That is, the lenders that eventually will take the long-term debt when the project enters the operational phase participate in the syndicate during the construction phase. Initially, these syndicates were made up of only banks, but over time insurance companies and private funds entered as well. By contrast, pension funds only participated by investing in public funds that are part of the syndicate.

Why do insurance companies participate in loan syndicates right from the construction stage? One reason is that loan returns are higher for financiers that enter early, and this was particularly attractive in the aftermath of the financial crisis, when yields were very low. But higher returns reward higher risks, so that begs the question why insurance companies and other private funds found it attractive to bear more risk. These lenders were willing to bear higher risks in part because over the years they have developed a good understanding of infrastructure PPPs.

The second reason why insurance companies participate in loan syndicates is that the cash flow structure of a PPP can be split into tranches to accommodate the different needs of banks and insurance companies. Because banks fund themselves with short term funds, their tranches carry a variable interest rate plus a fixed spread. In contrast, insurance companies fund themselves by selling annuities at fixed rates, so for them it is important to lend at fixed rates as well, as regulation forces them to back mismatches with capital. PPPs, in turn, hedge the interest rate risk with derivatives and prefer to take debts at fixed rates, possibly because the PVR contracts discounts cash flow with fixed (real) rates. Thus, PPPs find a good match in insurance companies, which typically price their loans at the rate paid by long-term bonds issued by the Chilean Central Bank at the time of the disbursement, plus a fixed spread.

11 of the 16 transport PPPs awarded after the financial crisis were PVR contracts. Why did financiers and, in particular, insurance companies, take debt issues by a PPP with variable term? The key observation about financing in Chile is that when financiers evaluate risks, they only look at the cash flows generated by the debtor, independent of whether the project is fixed term or PVR. Essentially, then, lending to a PPP is handled like any other loan. The PPP and the agent bank (the bank that leads the syndicate) estimate the most probable cash flow and propose a tentative payment schedule. Each syndicate participant uses this estimate as the base case scenario to build its own scenarios. Again, the key point is that lenders recognize that the cash flows that the infrastructure will generate depend on the concession as a business proposition, not on whether the PPP is fixed term or PVR.

Prepayment risk

Next we describe how prepayments are handled by debt financiers both for fixed and for PVR contracts. The principle used is the same in both cases: syndicates charge more when prepayment is ‘voluntary’ (at

a time chosen by the PPP) than when it is triggered by the termination of a PVR contract (we refer to the latter as 'exogenous').

When prepayment is exogenous, the amount to be prepaid is the maximum between debt outstanding if installments were discounted at the initial rate, r_0, and the market rate at time of prepayment, r_t. Thus, letting $r^* = \min(r_0, r_t)$ and denoting by d annual installments, we have that

$$\text{Prepayment cost at } t = \sum_{i=t+1}^{T} \frac{d}{(1+r^*)^{i-t}}. \tag{5}$$

If anything, PVR contracts are somewhat more likely to end when the economy is booming, that is, when r_t is high. In this case, r_t is more likely to be larger than r_0 than smaller than r_0, and the PPP pays the same it would have paid under the original contract. In contrast, when prepayment is voluntary, debt financiers take off a spread to r^* when calculating the amount to be prepaid, resulting in a higher payment (often described as a 'fine for early termination').

Consider next two PPPs facing the same demand realizations, one fixed term, the other PVR, and assume demand turns out to be high. For the PVR contract, prepayment costs will be low because prepayment is of the exogenous type. Yet if the fixed term contract decides to terminate when the PVR contract ends, it will pay a higher cost since its decision will be voluntary, despite the fact that the cash flow from both projects is identical. The reason for this apparent paradox is that the PPP reveals the revenues it desires only for the PVR case, this revelation leads to a cheaper cost of prepaying the loan.[23]

Summing up, financiers recognize that prepayment triggered by the end of the PVR contract is beyond the PPP's control and charge a lower prepayment penalty in this case. Overall, it seems safe to conclude that prepayment risk does not constitute a significant drawback for PVR, if at all.

Financial regulation and the financing of PVR PPPs

As mentioned above, an interesting feature of Chilean financial regulation is that the risk classification of a loan depends only on the evaluation of the available cash flow, and not of whether the term of the concession is fixed or variable. Similarly, the capital with which the financier must back the loan depends on risk, but not on whether the term is fixed or variable.

The fundamental observation here is, again, that the cash flow depends on how much users use the infrastructure, and not on whether the concession is fixed or PVR. Financial regulation recognizes this indirectly by not making an issue on whether the concession is fixed or variable term. Insurance companies, in contrast, do not have to comply with this regulation, but can only participate in a syndicate if the bank tranches are classified as "normal" risk. So whether they care about the variable term is not a regulatory issue but a business issue.

[23] Recall, though, that as we argued in Section 2, financiers will have fewer incentives to demand prepayment under fixed term than under PVR.

4 Conclusion

This paper contributes to our understanding of one particular type of PPP contract, the PVR concession, that provides an important improvement in risk allocation. The main characteristic of PVR is that user fees collected by the PPP over the life of the concession, in present value, are set in advance. The concession term adjusts to make sure this amount is collected. Thus, compared with a fixed term contract, the concession term is shorter when demand is high and longer when demand is low.

Many arguments in favor of PVR have been made over the last two decades, yet a potential limitation of PVR in the minds of many analysts and practitioners has been the potential difficulties associated with financing a PPP whose term is not known in advance. This paper, we believe, takes care of these concerns on two counts. First, we present some novel ideas on how to understand the financing of PVR contracts. Second, we provide the first detailed analysis of how PVR contracts have actually been financed, focusing on Chile's experience with almost to 30 PVR contracts over the last two decades.

At the conceptual level, all our insights stem from the fact that demand realizations for a given PPP project are the same under a fixed term and PVR contract. It follows that in low demand scenarios, a PVR contract allows debt financiers to tap revenues that are not available under a fixed term PPP, because the term is longer under PVR. Thus, other things equal, under a PVR contract the probability of default will be lower than under fixed term contract and leverage can be expected to be higher. Indeed, the two PVR projects built in the UK in the late 1980s and early 1990s were financed entirely with debt and support this conclusion.

According to some analysts, however, debt financiers will demand higher returns nonetheless, because the concession will end before the debt matures when demand is high. Nevertheless, it is far from obvious that this is an argument against PVR and in favor of fixed term PPPs because revenues will also be higher than expected in high demand scenarios if the concession term is fixed. In fact, as stressed above, revenues will be the same in both cases. We argue that prepayment penalties will be low, if present at all, under PVR. Evidence from the Chilean PPP program confirms this insight, showing that financiers distinguish between early termination triggered by a verifiable exogenous event—the end of a PVR contract because collected user fees have reached the agreed upon amount—and prepayments at times when market rates are low. Furthermore, prepayment penalties are higher for fixed term PPPs.

PVR contracts exploit a unique characteristic of PPPs, namely that the term can vary with unforeseen circumstances in a predictable way. This is not possible under public provision or privatization. A contract where the concession term adjusts so as to eliminate demand risk and thereby substantially reduce default risk for debt financiers, can only be written for a PPP. This simple idea can play a significant role in improving outcomes with PPPs.

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