FINANCING PPP PROJECTS WITH PVR CONTRACTS: THEORY AND EVIDENCE FROM THE UK AND CHILE[1]

Eduardo Engel Ronald D. Fischer Alexander Galetovic Jennifer Soto

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Abstract

Risk allocation is an essential component of a successful public-private partnership contract financed with user fees. For many of these projects, demand risk is large and mostly exogenous. This suggests that we evaluate 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 have this property. Under a PVR contract, the regulator sets the discount rate and the tariff schedule and firms compete on the present value of tariff revenue. The lowest bid wins and the contract lasts until the winning firm collects revenue equal to its bid.

We provide a theoretical analysis comparing debt financing under a fixed term concession and PVR. We show that, other things equal, debt is less risky under PVR, particularly against large systemic shocks, and therefore debt-to-capital ratios can be higher. In addition, we show that the view that PVR does not mesh easily with fixed maturity debt is wrong. The reason is that demand realizations are independent of contractual forms.

Finally, we analyze the experience with PVR contracts, considering two early examples from the UK and close to thirty PVR contracts for highways and airports in Chile. We conclude that PVR contracts have been at least as attractive to lenders than their fixed term counterparts. We also provide evidence of better incentives under PVR, in particular, a significant reduction of contract renegotiations.

JEL Codes: H44, R42

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[1]Affiliations. Engel: Department of Economics, University of Chile. Fischer: Department of Industrial Engineering, University of Chile. Galetovic: School of Government, Adolfo Ibáñez University; Visiting Fellow, Hoover Institution and Research Associate, CRIEP. Soto: ESE Business School, Universidad de los Andes. We are grateful to participants at the Finance of Infrastructure Symposium held at Hoover institution, Stanford University, for their comments and suggestions. We thank Nicolás Campos and María José Molé for outstanding research assistance. Financial support from the Complex Engineering Systems Institute (CONICYT-PIA-FB0816), the Instituto Milenio MIPP (IS130 0 02) is gratefully acknowledged.

1 Introduction

Efficient risk allocation is an essential component of a successful public-private partnership (PPP) infrastructure contract. This is not the case for the typical transport PPP. In most cases the contracts exhibit a fixed duration and allocate most or all of the demand risk to the concessionaire. Demand risk is large and mostly exogenous, and thus cannot be controlled or managed by the concessionaire. Assigning this risk to the concessionaire is expensive and provides few if any incentives.

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 the demand risk. This approach is appropriate for infrastructure 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. This creates a distortion against other forms of transport and creates a bureaucratic cost by using funds from other sources to pay for the project.[6] Moreover, being able to fund a project with toll revenue reduces or eliminates the risk of white elephants, i.e., projects whose construction is a net cost to society. Projects that are expected to be profitable are not white elephants.[7]

Badly designed PPP programs can be expensive for countries, specially because the contracts tend to be renegotiated in times of severe economic stress. The case of Portugal is an example of the costs that a country can suffer, as shown in Figure 1, taken from Sarmento and Renneboog (2014). In Portugal, most PPPs were either availability contracts or contracts with shadow tolls, i.e., where the State pays the toll in lieu of users. As can be seen in the figure, after 2008 the payments owed to PPPs rose, eventually to more than 1% of GDP, in conditions of acute stress in the economy. Many of the contracts were renegotiated in favor of the private parties, see Sarmento and Renneboog (2014).

The appropriate way to mitigate exogenous demand risk for a highway PPP 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

[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 Pitchford (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 tariff revenue, reducing the fiscal distortion of additional taxes and the costs of going through the government's bureaucracy, see Engel et al. (2013) for a formal model.

[6] For an analysis of the fiscal implications of PPPs see, for example, Heald and Georgiou (2011), Engel et al. (2013).

[7] "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*.

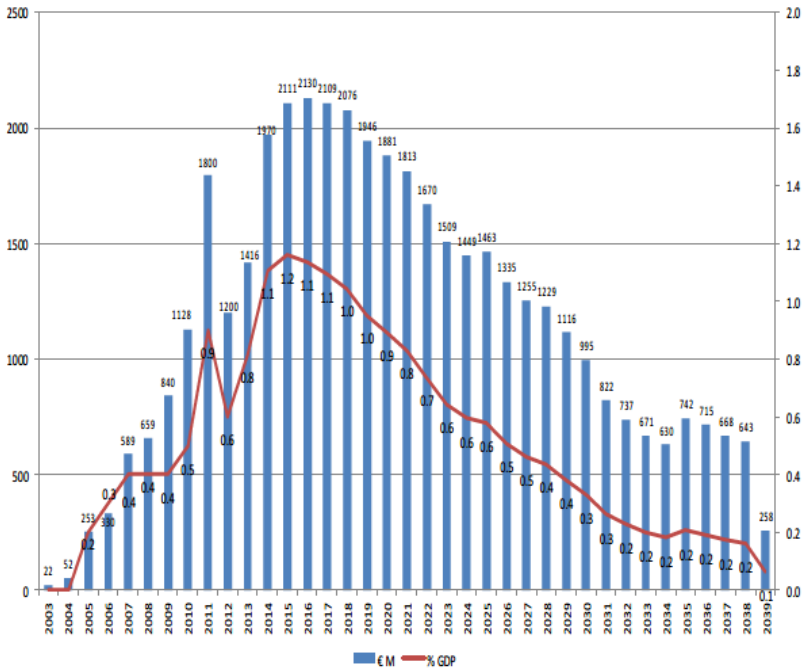


Figure 1: Future annual payments, in value and as a percentage of GDP, for the 35 Portuguese PPPs. Source: Sarmento and Renneboog (2014).

Table 1: A comparison between different PPP contracts

	Availability contract	Fixed term toll road	PVR
Appropriate allocation of demand risk	Yes	No	Yes
Filter white elephants	No	Yes	Yes
Eliminate distortion against other transport modes:	No	Yes	Yes

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 require to finance, build, operate and maintain the infrastructure. The firm that makes the lowest bid gets the concession, which ends when the present value of tariffs collected equals the winning bid.[8] 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.[9] Table 1 summarizes the characteristics of the three main contractual forms for PPPs.

[8]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 to increase these revenues, see Engel et al. (2018) for details.

[9]Even though, as discussed in Section 3.1, the experience with PVR contracts goes back to the 1980s, the first papers analyzing these contracts is Engel et al. (1996). Engel et al. (1997, 2001).

A common objection to the use of PVR contracts is that they are difficult to finance because banks and bondholders find the flexible term that characterizes these contracts unattractive.[10] We believe this concern explains why PVR has not been used more broadly, with the exception of Chile. For this reason, in this paper we focus on showing that this financial argument against using PVR contracts is invalid.[11]

In the paper we present theoretical arguments 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 theoretical conclusion. Conceptually, our analysis is based on the fact that the per period cash flows generated by a PPP are unaffected by the type of contract used, given that they charge the same toll. The main difference between fixed term and a PVR contract is the latter lasts longer in low demand scenarios and ends earlier in high demand scenarios. Both these differences have important implications that we examine 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 prepayment when the PVR contract ends early is not triggered by a fall in interest rates but by an exogenous event –an unexpectedly high demand for the project– that is more likely to happen when the economy is expanding and interest rates are high. Since prepayment risk is usually costly because it is correlated with low interest rates, where lenders face lower 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 were PVR contracts, and they 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 prepayments that accrue because the PPP is doing better than expected from prepayments triggered by interest-rate swings (such as those associated to home mortgages). 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

[10] A valid shortcoming of PVR occurs when demand is endogenous and the actions of the concessionaire cannot be monitored easily. 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 and demand is exogenous. This occurs in some important types of transportation infrastructure such as highways and airports. See Tirole (1997) for an early analysis of pros and cons of PVR.

[11] 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).

are designed to be inflexible. In particular, standard PPP contracts have a hard time incorporating early termination clauses 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 "fair" price for the contract. This fair price corresponds to the difference between the bid value and the present value of toll revenue already received.[12] Because the concessionaire's winning bid determines the total amount of present value revenues it requests, a fair value for the early buy back option can be calculated at any moment in time with verifiable accounting information. Compare this situation with the early termination of a fixed term contract, in which fair compensation depends on the expectations of future demand behavior, which is open to dispute.

The remainder of the paper is organized as follows. Section 2 compares debt-financing under PVR and fixed term contracts along theoretical grounds. This section ends with a brief study of the Dulles Greenway PPP to illustrate the shortcomings of fixed term PPPs. Section 3 studies the experience with PVR in the UK and Chile. Section 4 concludes.

2 Theory

As mentioned above, one of 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 period to repayment. On the other hand, a PVR contract is a loan amount and a revenue amount. We argue that all standard debt contracts available under a 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 on demand.

A simple example

[12] 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.

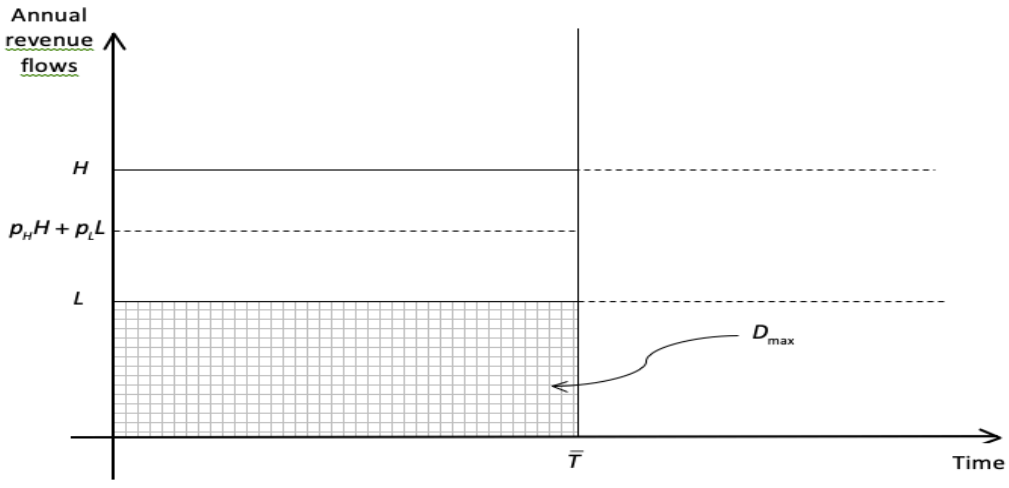
As we mentioned above, one of the main characteristics of transport PPPs is that medium- and long-term traffic forecasts are imprecise. In addition, traffic risk tends to be largely –if not totally– exogenous, that is, beyond the PPP's control.

Of course, debt financiers know this, and take it into account when deciding how much to lend, the 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. 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 incur.

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 it makes the argument in the example easier to follow, so we assume it here. 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

Figure 2: Debt contract: Fixed term PPP



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

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

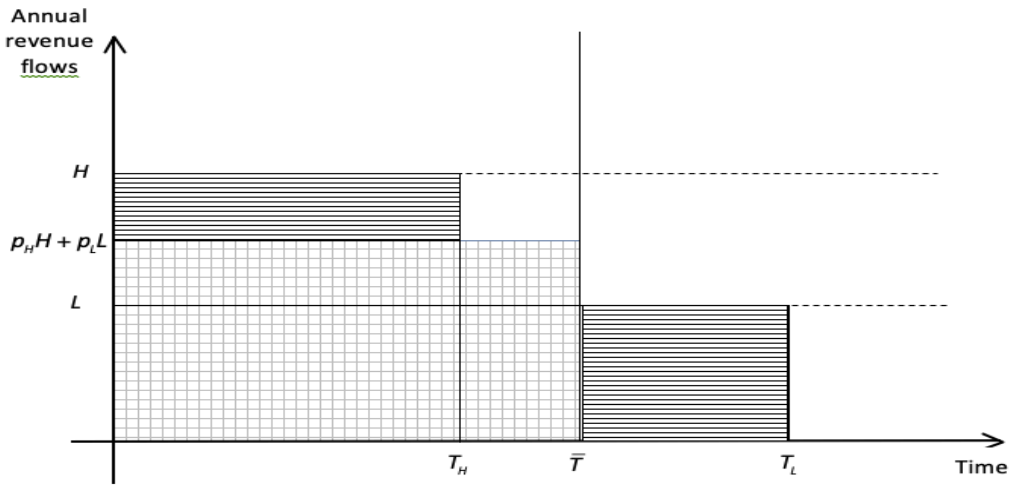
Thus, as can be seen in Figure 2, in the high-demand state the PPP will make profits, because $H\overline{T} > I$ while in the low demand state the PPP will loose money, because $L\overline{T} < I$. It follows that debt financiers can be sure that the PPP will pay back in all states only if they demand annual installments of at most L. Thus, as shown in Figure 2, the maximum debt they can lend with no default risk is $D_{\max} = \overline{T}L$.

Combining the above expression for $D_{\max}$ with (1) implies that the largest loan-to-value ratio with no 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 3: Debt contract: PVR PPP



Next consider a PVR contract which is also assigned in a competitive auction. Now firms bid on the 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 3, when demand is high, the concession term is shorter under PVR than under fixed term. The converse holds when demand is low.

[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.

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 reduce or eliminate risk for lenders, 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 accrue faster, and the PPP may wish to prepay the loan. This will entail the additional cost of a prepayment charge or fine. 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.[14]

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 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 smaller.[15]

Having established that prepayment risk is higher under PVR than under fixed term, we argue 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

[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.

[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.

can refinance their debt on favorable terms. In the case of PVR, however, prepayment due to the termination of the contract is not endogenous. 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 will be low.

Renegotiations

So far we assumed that debt contracts cannot be renegotiated to avoid default. 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] This type of renegotiation may involve either a direct transfer from the Treasury or a term extension.

A simple example helps to make the general point. For the project described above, consider a debt contract with maturity T_H and installments equal to H, and asume a fixed PPP term (equal to $\overline{T}$). If realized demand is high, the PPP can meet its debt obligations, but if demand is low, the PPP needs to renegotiate and obtain an extension of the concession term (and of 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 a variable term contract via a renegotiation. One is that a PVR contract specifies what to do when different demand states occur so in that sense, the contract is complete.[17] By contrast, a term extension of a fixed-term contract is an ad hoc renegotiation which breaks the conditions of the original contract. The fundamental difference between the two types of contracts. is that the cash flows generated by the project are always sufficient to repay the debt under PVR, while under a fixed-term contract only those cash flows received by period $\overline{T}$ can be used for this purpose. The cash flows that the project generates after the end of the original contract can be tapped only after an ad hoc renegotiation.

Another difference between a PVR concession and a fixed term contract that transforms into a PVR via renegotiation is that extending the "fixed" term necessarily involves the Government. This entails additional costs and risks for the parties. By contrast, private parties negotiate directly the modifications that are necessary to adapt to a longer payment period under PVR.

[16] On renegotiations in PPPs see Guasch (2004), who analyzed more than 1.000 concession contracts in Latin America and established several stylized facts. Several theoretical and empirical papers followed. Guasch et al. (2006) developed a theory of the determinants of renegotiations. Guasch et al. (2007) and later Bitrán et al. (2013) applied the theory empirically to quantify the determinants of government-led renegotiations in Latin America. Guasch et al. (2008) empirically studied renegotiations in transport and water in Latin America. Guasch and Straub (2006) and Andrés et al.. (2008) are useful overviews of this line of research.

[17] In our simple model we have only two demand realizations and the issue of completeness is not relevant. In a general case wih many demand states 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.

The Dulles Greenway[18]

The Dulles Greenway PPP illustrates 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 using PVR, the contract term would have extended automatically when demand turned out to be 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, which has 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. Among the proposals were five bridges and 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 paid off the 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 after accruing the necessary toll revenue, the contract terminated in March of 2002, almost ten years before the maximum concession term of 20 years. The SPV in charge of

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

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

the PPP was liquidated, the bridge reverted to public management and the government began collecting tolls, now referred to as charges.

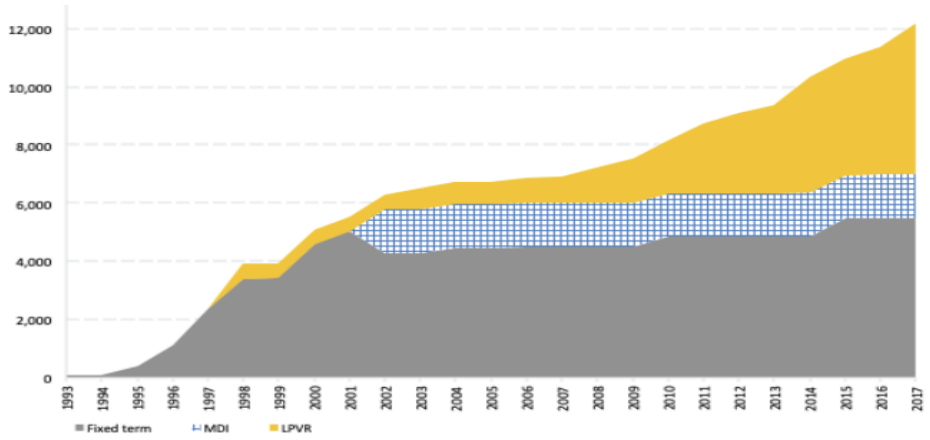
The Second Severn Crossing PPP on the Severn Estuary, which was tendered in 1990 and opened in 1996, also used a PVR contract. The contract stipulated a term of 30 years or until the concessionaire collected £995.8 million (in July 1989 prices), whichever occurred first. As with the Queen Elizabeth II 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 required revenue had been collected. At that point responsibility for operating the bridge passed to Highways England, a public entity.

These two PPPs seem to have been successful, and show that leverage need not be lower with a variable term contract.

3.2 Chile

Figure 4 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. The blue-and-white area represents a group of PPPs that were tendered under a fixed and were renegotiated into PVR contracts in the early 2000s, following a major fall in revenues in the late 1990s as a consequence of the Asian financial crisis of 1997.[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]

Figure 4: Fixed and flexible term PPP investments in Chile



Brief history

The Chilean government launched its PPP program and developed its governance in the early 1990s. A major innovation (to the Chilean civil code) was to allow pledges of the infrastructure's cash flows,

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

[21] The exact number is 43.6 percent. This can be broken up into 32.5 percent that were PVR from their origin, 11.1 percent that began as fixed term contracts but were renegotiated into PVR contracts.

and introducing a central registry of these pledges. The value of a PPP to a private firm stems from its cash flow generation; the asset itself is not a good guarantee because it has no alternative use. Without this regulatory innovation, therefore, finance would have been more expensive or even impossible. Loans would have been classified as high risk, which would have forced banks to set up large provisions against nonpayment risk. Banks were also allowed to lend up to 15 percent of their capital to infrastructure PPPs.

Initially, only banks financed PPPs, usually through banking syndicates. During the construction phase they would charge a relatively high spread and make disbursements as construction milestones were reached. Once the project was built, the debt would be restructured and the spread reduced through a private placement, mainly among banks. The lower spread reflected the 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 lenders argued that otherwise risks would be too large and they would be unable to lend resources for the project.

Very soon, however, the industry realized that institutional investors—pension funds and insurance companies—were interested in providing bond finance after construction, and that it was cheaper than private placements. The problem was that institutional investors could only buy bonds with a AAA risk classification, and had little experience in 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 2008 financial crisis hit, however, monolines failed. The financial model based on monolines was at an end.

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 contract assigned in a PVR auction is the Route 68 concession joining the capital of Chile, Santiago, with the port city of Valparaíso. The project included improvements of the 130 km highway, including the construction of three new tunnels and adding two lanes. The project was auctioned in February, 1998, and opened 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 choose whether they were prepared to pay for them. Two bidders chose to buy a guarantee, the winner was among those who declined.

Bidders chose 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 surprisingly, 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 term projects, thereby ignoring the considerable demand risk reduction associated with PVR. Using a risk premium of between 1 and 2 percent, instead of the 4 percent used, leads to a reasonable return to capital of 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. This shows that 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.[23] 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, specified in the contract, for savings in operation and maintenance costs. In the case of a fixed term contract, there is no simple criterion to determine fair compensation in the case of early termination of the contract.

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 contracts were 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 Public Works. Shortly thereafter, the 2008 financial crisis began, which altered the financing of transport PPPs in Chile (and the world) and made 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. In the operational stage, private placements were used for financing. By this time, banks had a better understanding of transport PPPs, and formed syndicates that financed PPPs throughout their

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

[23] In later PVR contracts, there was no waiting period before the early termination clauses could be invoked by government.

entire life-cycle. That is, the same lenders that participated in the syndicate during the construction phase would take on long-term debt for the operational phase. Initially, only banks participated in syndicates, but over time insurance companies and private funds joined as well. For legal reasons, Chilean pension funds could only participate by investing in open funds created by the syndicate.

Why would insurance companies participate in loan syndicates even during the construction stage, when demand risks are still unknown? 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 regulation forces them to back term mismatches with capital. PPPs, in turn, hedge the interest rate risk with derivatives and prefer to take debts at fixed rates, possibly because PVR contracts usually discount cash flow using fixed (real) rates. Thus, PPPs find a good match in insurance companies, which typically price their loans at a spread over the rate paid by long-term bonds issued by the Chilean Central Bank at the time of the disbursement.

Eleven of the sixteen transport PPPs awarded after the financial crisis were PVR contracts. Why did lenders and, in particular, insurance companies, buy into debt issued by a PPP which has a variable term contract? The key observation about financing in Chile is that when financiers evaluate risks, they examine the cash flows generated by the debtor, independent of whether the contract is fixed term or PVR. Essentially, 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 contract 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 discretionary, that is, 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 the value of debt outstanding if installments were discounted at the initial rate, r_0, and the value when discounted at 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. Thus the PPP pays the same amount it would have paid under the original contract. In contrast, when prepayment is discretionary, as in the case of mortgages, they tend to occur when rates are lower than the original rate, so that by prepaying and refinancing the creditor gains at the expense of the original lender.

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 risks of the cash flows, 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 fundamental risk, but not on whether the term is fixed or variable.

The fundamental observation is that the cash flow depends on demand by users of the infrastructure project, and not on whether the contract is fixed term or PVR. Financial regulation recognizes this indirectly by not making it an issue whether the concession is fixed or variable term. Insurance companies, in contrast, do not have to comply with banking regulation, but can only participate in a lending syndicate if the bank's tranches of the loan are classified as "normal" risk. In this case, insurance companies evaluate the variable term contract as a business proposition that is not constrained by financial regulations.

Renegotiations and PVR

In 1999, after the Asian crisis, several large PPP projects (fixed term) in Chile ran into financial trouble, due to the fall in demand for their services. Several projects were renegotiated in the following years, with the contracts being transformed into flexible term contracts, in exchange for additional works. It is noteworthy that these projects, which were basically bankrupt before the conversion to a flexible term, could afterwards provide additional works as compensation. This is the result of the reduction in risk due to the flexible term of the contract, as indicated by theory.[24]

In general, because of its flexibility, we should expect fewer contractual renegotiations under PVR contracts. The reason is that one of the main reasons for renegotiations, a fall in expected demand that causes financial difficulties, is less relevant for these contracts. Moreover, a protracted conflict with the concessionaire can always be solved, at least in princple, by buying back the project at a just value. The data bear this out, as shown in table 2, which compares the magnitude of renegotiations, as a fraction of initial investments, under both types of contracts, for different vintage PPP contracts.

[24]These renegotiated contracts did not replicate PVR exactly, as they result from bargaining among the parties and not from bids in a competitive process.

Table 2: PPP Renegotiations in Chile as a function of contract age for fixed term and PVR contracts.

	Fixed term		PVR	
Years of operation	No.	Renegotiation (avge.)	No.	Renegotiation (avge.)
2	29	10.5%	10	0.9%
4	29	19.2%	9	5.3%
6	29	27.3%	8	8.2%
8	28	35.3%	6	8.6%

Source: Data from MOP elaborated by the authors.

4 Conclusion

This paper contributes to our understanding of one particular type of PPP contract, the PVR concession, which 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, prominent among them that these contracts may be viewed as a fixed term contract with a built in renegotiation clasue. 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 a 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, financed entirely with debt, 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, because the event that triggers prepayment is exogenous. 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 of loans when market rates are low. These arguments are explain the fact that 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 either public provision or privatization of infrastructure projects. A contract where the concession term adjusts so as to eliminate demand risk and thereby substantially reduce default risk for lenders can only be written for a PPP. This simple idea can play a significant role in understanding how outcomes can improve with PPPs.

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