Highway Franchising: Pitfalls and Opportunities

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Most developing countries urgently need massive highway construction programs. For this reason, a growing number of countries are auctioning highway franchises to the private sector. In these auctions, it is usual for the regulator to fix the length of the highway franchise, say, for 20 years, and for firms to bid on the toll. The benefits from privatizing highways are well known by now: gains in efficiency, avoidance of "white elephants," easier access to financing, and fewer political pressures to reduce tolls. Assigning the franchise in a competitive auction should lead to the same outcome that would be obtained in a competitive market: competition *for* the field rather than *in* the field (Edwin Chadwick, 1859). Nevertheless, worldwide experience shows that there are some important pitfalls that offset these benefits. Most prominent among them are (a) the frequent use of government guarantees, thereby reducing incentives to control construction costs, and (b) government bailouts for almost every franchise that faces financial trouble.[1] Underlying this unhappy experience is the fact that traffic forecasts are notoriously imprecise, making the highway business very risky. This fact, combined with informational asymmetries, implies that there may be important welfare differences between alternative auction systems (Oliver Williamson, 1985).

In this paper we present a simple framework for evaluating different mechanisms for awarding franchise contracts. We argue that many of the problems stem from the fact that franchises are typically awarded for a fixed period whose length does not depend on demand realizations. We present a simple auction that implements efficient contracts, least-present-value-of-revenue (LPVR) auctions. We will argue that this type of auction solves many of the difficulties that have plagued highway franchises around the world.

This paper originated in work performed for the highway construction and improvement program currently underway in Chile. Investments of more than U.S. $3 billion (6 percent of GDP) in new and existing highways will be auctioned between 1996 and 1999. The importance of this program cannot be overstated: one of the major threats to Chile's solid economic performance in the last decade is the lack of adequate infrastructure, particularly highways. There are early signs pointing toward the problems mentioned above: the government is providing generous guarantees (70 percent of building costs), and there is pressure to renegotiate the terms of one of the existing franchises (the "El Melón" tunnel, inaugurated in 1995). Furthermore, many of the international firms participating in the auctions have previous experience renegotiating contract terms to the detriment of governments, taxpayers, and toll users.

I. A Simple Model

For simplicity assume that demand is constant and completely inelastic. Demand may be high (Q_H), with probability π_H, or low (Q_L), with probability π_L, where $\pi_L = 1 - \pi_H$ and $Q_H > Q_L$.[2] The cost of building the highway is the same for all firms and equal to I, which is common knowledge among firms, but unknown to the government. There are no maintenance or operation costs, and the toll is

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[1] For evidence substantiating both statements, see the case studies in José Antonio Gómez-Ibáñez and John Meyer (1993).

[2] These and other simplifying assumptions are relaxed in Engel et al. (1997).

equal to P. After the franchise ends, tolls fall to zero. All firms are identical, risk-averse expected-utility maximizers, with preferences represented by the strictly concave Von Neumann-Morgenstern utility function $u(\cdot)$.[3] Auctions are competitive, and the planner's objective is to minimize the expected value of tolls paid by users subject to the constraint that firms be willing to build the highway.

A. *Socially Optimal Auctions*

It is useful to start by considering the problem solved by a social planner who knows I. Denote the present value of the income received by the franchise-holder with high and low demand by PVI_H and PVI_L, respectively. Then,

$$(1)\quad \text{PVI}_i \equiv \int_0^{T_i} PQ_i e^{-rt}\,dt = \frac{PQ_i(1-e^{-rt})}{r} \qquad i = \text{H, L}$$

where r is the discount rate common to all firms and T_H and T_L denote the length of the franchise when demand is, respectively, high or low. The planner chooses T_H, T_L, and P to minimize the expected value of toll payments $\pi_\text{L}\text{PVI}_\text{L} + \pi_\text{H}\text{PVI}_\text{H}$ subject to the constraint that firms be willing to participate, that is, $\pi_\text{L}u(\text{PVI}_\text{L} - I) + \pi_\text{H}u(\text{PVI}_\text{H} - I) = u(0)$, where $u(0)$ is the level of utility attained by a firm not undertaking the project.

It is easy to see that $\text{PVI}_\text{L} = \text{PVI}_\text{H} = I$ solves the planner's problem. Since the franchise-holder is risk-averse, it is efficient to insure her completely. To do so, the planner fixes a toll high enough to ensure that the franchise-holder loses no money when demand is low (i.e., $P \geq rI/Q_\text{L}$). It then follows from (1) that, since $Q_\text{H} > Q_\text{L}$, the planner chooses $T_\text{H} < T_\text{L}$ (the term of the franchise is shorter when demand is high). Note that users pay the same amount in both states of nature and thus face no risk.

When the planner does not know I, consider the following auction, which we call least-present-value-of-revenue (LPVR) auction, in which (a) the regulator fixes a toll P larger than rI/Q_L;[4] (b) the franchise is won by the firm that asks the least present value of toll revenue; (c) the franchise ends when the present value of toll revenue is equal to the franchise-holder's bid; and (d) the rate used to discount toll revenue is equal to r. In a competitive auction, firms offer PVI such that $\pi_\text{L}u(\text{PVI} - I) + \pi_\text{H}u(\text{PVI} - I) = u(0)$; that is, $\text{PVI} = I$. Thus, we have shown that an LPVR auction implements the social optimum even when the planner ignores key data such as I, π_i, or Q_i.[5] Moreover, note that equilibrium bids are a function of I only. Demand data such as π_i or Q_i do not affect a firm's bid. It follows that there is no winner's curse.

B. *Fixed-Term Franchises*

Almost all mechanisms that have previously been used to auction highway franchises around the world fix the franchise term in advance.[6] In the mechanism currently in use in Chile, the regulator fixes the term T and allocates the franchise to the firm that offers to charge the lowest toll. Competition among firms implies that the winning bid P will satisfy

$$(2)\quad \pi_\text{L}u[P\cdot\text{PVQ}_\text{L}(T) - I] + \pi_\text{H}u[P\cdot\text{PVQ}_\text{H}(T) - I] = u(0)$$

where $\text{PVQ}_i(T)$, $i = \text{L, H}$, denotes the present value of vehicle flow when the franchise lasts T years and demand is, respectively, low or high.[7] Note, first, that in this case

[3] In our experience, potential bidders are risk-averse. One explanation may be the substantial percentage of building costs that must be financed by the firm itself.

[4] We assume that the planner has an upper bound on rI/Q_L.

[5] In this example, the result continues to hold if the planner is risk-averse.

[6] We are aware of no exceptions.

[7] The same equation holds when the regulator fixes P and the franchise is allocated to the firm asking the shortest term T.

$P \cdot \mathrm{PVQ_L}(T) < I < P \cdot \mathrm{PVQ_H}(T)$: the franchise-holder loses money when demand is low and thus does not receive full insurance, leading to $\pi_L \mathrm{PVI_L}(T) + \pi_H \mathrm{PVI_H}(T) > I$, so that users pay more on average. Second, in the aggregate, users also face risk, as in present-value terms they pay more when demand is high. Third, the winning bid is a function not only of I, but also of demand data π_i and Q_i. Thus the winner's curse is likely to occur.[8]

II. Comparison

A. *Risk*

An important defect of fixed-term mechanisms is that they impose demand risk on the franchise-holder and make users pay more on average. In Engel et al. (1996), we estimate that the savings from switching to LPVR auctions in Chile are 33 percent of the value of investment.

The intuition behind these results is quite simple: a fixed term makes it possible for a franchise-holder to lose money even when the road is profitable in the long run because the term of the franchise may be too short given the state of demand. In fact, as shown by the previous analysis, in a fixed-term auction, firms will bid tolls that result in losses in some states. These losses are compensated by states where the term is more than long enough to pay for the road. In contrast, an LPVR auction takes advantage of the fact that roads may pay for themselves even when traffic grows slower than expected, provided that the franchise term be longer. In doing so it improves bad states and worsens good states, thereby reducing the risk borne by franchise-holders. Moreover, given that revenue from tolls is paid by users and that they pay the same amount in all states, they bear no risk. An LVPR auction eliminates demand risk![9] The general lesson is that, when the timing of revenues is uncertain but the present value of the income stream is sufficient to pay building costs in all states of the world, a contract with a state-independent term creates unnecessary risk for both parties. Thus, risk is not exogenous, but depends on the type of contract.

TABLE 1—VEHICLES PAYING TOLLS: GROWTH RATES IN PERCENTAGES

	Highway		
Year	Angostura	Zapata	Lampa
1987	8.8	21.5	3.8
1988	15.0	14.4	13.4
1989	11.7	13.1	15.9
1990	4.5	8.1	8.9
1991	8.7	7.2	6.8
1992	12.4	5.2	18.0
1993	6.7	2.9	8.8
1994	7.8	3.9	16.2
1995	9.4	4.9	12.5

Notes: The rates correspond to the growth in the flow of vehicles from one year to the next. For example the vehicle flow through the Angostura tollbooth in 1987 was 8.8-percent larger than in 1986.
Source: Ministry of Public Works, Chile.

Under pressure from firms and financiers, the high risk in highway franchising has led governments to provide guarantees. The magnitude of the demand risk facing the owner of a fixed-term franchise is illustrated in Table 1 for the Chilean case. This table shows the rates of growth for the number of motor vehicles paying tolls during the past decade at the three busiest highways near Santiago. Despite the fact that the past decade has been Chile's most stable during this century, with no recessions and with GDP growing 6 percent on average per annum, traffic growth rates have fluctuated considerably, both across years and across roads in a given year. High demand risk and the use of fixed-term auctions explain why the Chilean government has pledged to cover any difference between actual toll income and the sum needed to pay for 70 percent of the government's expected construction costs. These guarantees are undesirable, not only because of government budget constraints, but also because one of the main virtues of private franchises is the reduction in the likelihood of white elephants. Since white elephants are

[8] Firms participating in road auctions in Chile may have been victims of the curse. When the "El Melón" tunnel was auctioned in 1993 to the firm offering the highest annual payment for 20 years, the winner's bid was more than three times the second-highest bid.

[9] Whether this is desirable depends on the source of demand uncertainty. For details see Engel et al. (1997).

usually the result of pressures by interest groups that are better represented in the political process than taxpayers, they should be easily detected by private firms. Thus, it is desirable that franchise-holders bear the risk associated with constructing a road that cannot finance itself. Finally, guarantees reduce the incentives of financiers to screen firms and projects, creating a standard moral-hazard problem.

B. *Renegotiation*

Franchises suffer renegotiation problems due to the incompleteness of contracts. Under fixed-term franchises, future income projections are highly subjective and cannot be inferred from accounting data, which worsens the problems. Opportunistic renegotiations become more likely for several reasons. First, as equation (2) suggests, competition leads to losses in some states of nature. Second, the taxpayer or user is unable to estimate the wealth transfer to the franchise-holder that often results from a renegotiation. Thus governments bear a lower political cost if they cave in to franchise-holders. Third, fixed-term auctions encourage lowballing in the expectation of renegotiation, favoring firms with political connections, not the most efficient firms. Fourth, the lack of an objective standard facilitates expropiation of the franchise without fair compensation, or the lowering of tolls to reap political benefits by arguing that the franchise-holder is making "excessive" profits. While such takings are not frequent, this risk has discouraged franchising in some countries (see Gómez-Ibáñez and Meyer, 1993).

An LPVR auction reduces the problems caused by contract incompleteness. This is partly due to the fact that the term of the franchise depends on the state of demand. Big losses (prompting franchise-holders to ask for renegotiation) and big profits (which may encourage governments to change the contract to prevent "excessive" profits) are less likely. In addition LPVR auctions reduce the scope for renegotiations. Under fixed-term franchises, renegotiations usually concern raising tolls or extending terms. In contrast, under an LPVR auction the effect of raising tolls is just an earlier end to the franchise, and term extensions are impossible by definition. This means that any renegotiation involves an explicit wealth transfer. The winning bid reveals the revenue required by the franchise-holder to obtain a normal profit; it is a clear benchmark for any wealth transfer. Since such a simple figure is easier to understand than a calculation of expected future revenue, government actions can be scrutinized by public opinion. Thus opportunistic renegotiations favoring a franchise-holder have a higher political cost, and it is easier to contest an arbitrary regulatory taking before a court.

C. *Flexibility*

The flip side of opportunistic renegotiation is that there are plausible circumstances under which it becomes socially desirable to modify the contract. Consider the case where traffic grows much faster than expected and it is desirable to widen the highway. In such circumstances there is a potential Pareto improvement in modifying the original contract. Under a fixed-term franchise, however, it is difficult to strike an agreement, because both parties can argue endlessly about the "fair" compensation for early termination. Under an LPVR franchise the winning bid minus the (discounted) toll revenue received is a fair compensation for ending the franchise. If the regulator desires to widen the road she can end the franchise, pay the fair compensation, and auction the new project. Similarly, raising or lowering tolls does not affect the franchise-holder's revenue, since the term of the franchise automatically adjusts.[10]

D. *Effort*

A real limitation of LPVR franchises is that incentives favoring efficient marketing are smaller than when the term is fixed. The reason is that with LPVR mechanisms, any marketing effort that translates into higher demand shortens the term of the franchise but does not change profits. This implies that under LPVR

[10] This analysis ignores maintenance and operating costs. These are relatively small in comparison to the cost of the projects and are fairly easy to estimate.

auctions franchise-holders have fewer incentives than under fixed-term franchises to invest in demand-increasing features such as road quality and maintenance or speedy attention at toll booths. For this reason, LPVR auctions probably need to be supplemented with institutions that determine and enforce minimum quality standards on the franchise (see Jean Tirole, 1997).

E. *Congestion*

In Section I, we showed that LPVR auctions replicate the social planner's auction conditional on the self-financing constraint (i.e., it is a "second best"). For the case in which there is enough traffic for optimal congestion tolls to finance investment in the highway, it is clear that LPVR auctions achieve the first-best solution to the social planner's problem. The reason for this is that LPVR auctions decouple the financing problem from the optimal toll-setting problem. This property is especially relevant for urban projects.[11]

III. Conclusion

The massive highway construction program recently launched in Chile illustrates the pitfalls and the opportunities facing governments that privatize roads. Brazil and Argentina are embarking on similar programs, and other developing countries are expected to follow suit. It is too early to tell whether current interest in infrastructure privatization is part of one more privatization–nationalization cycle (see Michael Klein and Neil D. Roger, 1994), or the beginning of a definitive trend toward privatization. The latter possibility is more likely if franchises are flexible and can avoid white elephants, undesirable renegotiations, and government guarantees (explicit or implicit). In this article we have argued that LPVR auctions are much better suited to achieving these goals than are fixed-term auctions.

[11] According to recent press reports, Chile's Ministry of Public Works is planning to use the LPVR mechanism to auction urban highway projects.

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