Regulation Costs and Private-Sector Know-How Spillovers of Public-Private Partnerships

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Abstract

The paper presents comparative statics of organizational modes of natural monopoly in public utilities with a focus on co-ownership and co-governance. Private monopoly lowers output and increases price to maximize profit; public monopoly incurs higher costs due to the lack of know-how; and a regulated monopoly results in regulation costs to overcome informational asymmetries. A public-private partnership arises as an efficient organization mode when it enables the internalization of private know-how and saves regulation costs due to correspondingly sufficient private and public residual and control rights. Public-private monopoly supports higher prices than marginal costs due to rent sharing, with its upper price frontier decreasing in private residual rights.

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Author's Note

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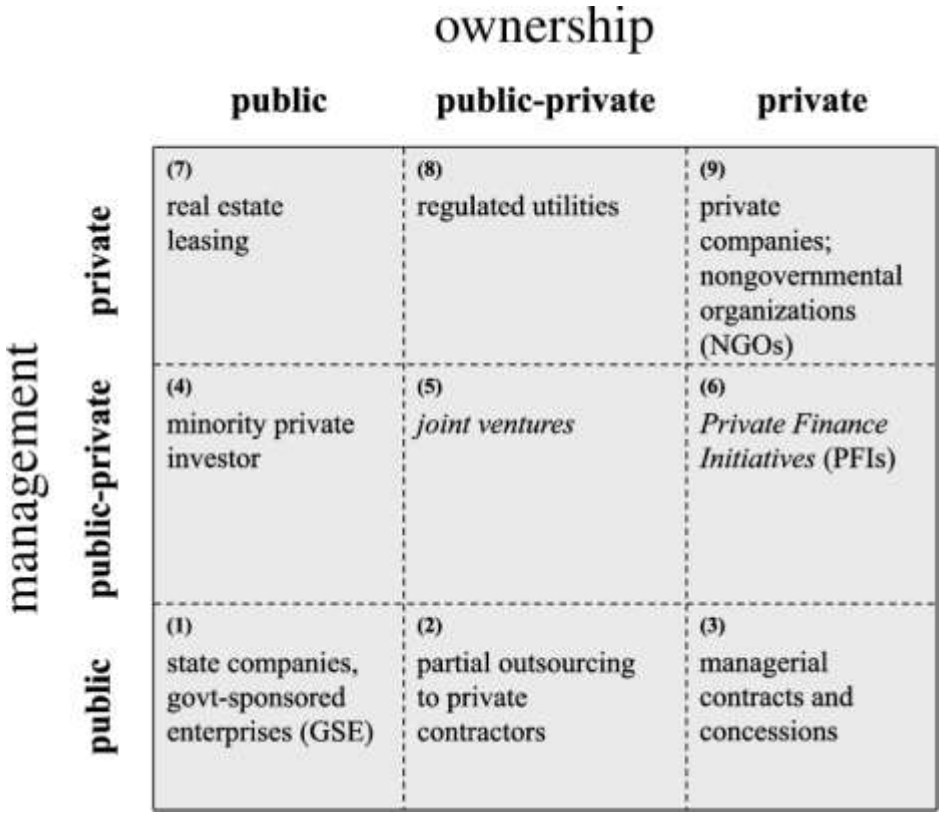
1. Introduction

Milton Friedman (1962, 28) argued that "when technical conditions make a monopoly the natural outcome of competitive market forces, there are only three alternatives that seem available: private monopoly, public monopoly, or public regulation. All three are bad, so we must choose among evils." In this paper, I explore a *fourth*, potentially less evil alternative: public-private partnerships. Public-private partnerships (PPPs) are long-term cooperation agreements between one or more public administrations and private-sector investors for public infrastructure development and service provision. I argue that the advantage of a PPP depends on its ability to introduce the efficiencies of the private sector to the operations of the public sector.

Of the nine combinations of public, semi-public, private ownership and public, semi-public, and private management (see figure 1), seven—that is, all but fully public or fully private schemes—have been regarded in different literatures as public-private partnerships.

Figure 1. Combinations of Public, Semi-Public, and Private Ownership and Public, Semi-Public, and Private Management in Utilities



Source: Marian Moszoro, "Public-Private Monopoly," available through SSRN at http://dx.doi.org/10.2139/ssrn.2383309.

Hereinafter, I focus my analysis on institutional PPPs, also called "equity public-private partnerships" or "public-private joint ventures," which are co-owned and co-managed by a private investor and a public administration. Institutional PPPs are common in Latin America and Europe, but they are alien to the American market.[1]

There are a number of idiosyncratic characteristics of institutional PPPs that make them interesting from the perspective of organizational economics:

[1] Typical design-build-finance-operate-maintain (DBFOM) PPPs in US highways would fall outside of this restriction, since there is no public-sector equity involved. Whereas the public sector provides grants (financial or in-kind, in the form of land or existing real assets), these contributions can be considered equity if they correspond to an increase in the public sector's residual rights share.

1) Institutional PPPs reduce information asymmetry between investors and public administrations regarding output quantity, actual investment, and operating cost.
2) In comparison to private monopoly, institutional PPPs offset transaction costs concerning ex ante negotiation[2] and regulation and ex post possible renegotiation of quality and price between private investors and public administrations.
3) Institutional PPPs enable the internalization of private technology and specific know-how that leads to operating cost reduction (Hart, Shleifer, and Vishny 1997; Iossa and Martimort 2015; Kwak, Chih, and Ibbs 2009) and quality improvement without complex monitoring systems (McDonald 1999; Välilä 2005).[3]
4) Institutional PPPs limit the social perception of opportunistic risk thanks to direct formal and informal audits (Balakrishnan and Koza 1993).
5) Compared to private or regulated monopolies, institutional PPPs are associated with a higher social consent to public aid via guarantees, preferential loans, and direct subsidies (Trujillo et al. 1998).

For simplicity, I limit my analysis to single-product natural monopolies. These monopolies often produce necessity goods. Water supply, sewage, electricity, public

[2] These costs could be high because contractual arrangements can be complex. On a comparative statics analysis, though, they would be higher under private monopoly due to asymmetric information.

[3] The UK's National Audit Office (NAO) reports on PPPs (European Investment Bank 2004; Blöndal 2005) present the following statistics on cost savings by PPPs:

- A report commissioned by the Treasury Task Force found that the average estimated saving against the Public Sector Comparator in Private Finance Initiative (PFI) projects was 17 percent.
- HM Treasury research of 61 PFI projects found that no PFI project increased prices following contract signature (other than where user requirements changed) and 77 percent of public-sector managers stated that their project was meeting their initial expectations.
- Four design-build-finance-operate (DBFO) road contracts appear likely to generate net quantifiable savings of around £100 million (13 percent).
- Out of 98 projects surveyed by the NAO in 2001 on public authorities' perceptions of value for money, 81 percent believed that PFI projects are achieving satisfactory or better value for money—only 4 percent described value for money as "poor."

Also, the UK Ministry of Defence (MoD 1999) reports that PPP contracts result in cost savings of between 5 percent and 40 percent compared with the public-sector comparator.

transportation, and roads undoubtedly fall into this category. I focus on the operations (management) stage; thence I assume that infrastructure is already built (by either the public or the private sector) and that the fixed cost is covered by a fixed fee, and I further analyze the variable part of total cost.[4]

2. Setup

I model PPPs with two players: a private investor and a benevolent public administration (government) responsible for the public good provision who enter an equity joint venture (special-purpose vehicle) to provide the public good. Private investors have specific cost-saving knowledge, such as administrative procedures, and management skills. I refer to the investors' idiosyncratic knowledge as "know-how."

Under public provision, price and quality are set by the public administration directly or by the utility in cooperation with the public administration. Under private provision, price and quality are set normatively by the public administration but effectively by the private provider.

A private operator thus has the incentive to inflate costs (under a cost-plus or rate-of-return contract) or skimp on quality, such as maintenance (under a price-cap contract).[5] This requires careful contracting and government oversight to make sure the infrastructure is maintained to specified standards. A tentative solution is to hold competitive auctions bidding for the price to be charged by a monopolistic utility so that a competitive outcome is achieved (Demsetz 1968). This inter-temporal competition mechanism—inasmuch as it addresses infrastructure development—does not preclude conflict between the government owner and the

[4] Any pricing scheme different from fixed fee plus marginal cost pricing is socially suboptimal. If the price is set at average cost, the consumer bears a price higher or lower than the actual cost. A two-part tariff allows for an efficient welfare allocation. It encourages the producer to supply the required infrastructure, as the fixed cost is covered. With marginal cost pricing, the consumer pays for any additional quantity of the good she consumes.

[5] For example, the private operator may take over a well-functioning system and allow the assets to depreciate so that at the end of the contract, the system is collapsing.

private operator during the operating stage (e.g., the public administration will claim maintenance is substandard according to the contract, while the private operator will claim the terms of the contract are being met) and subsequent renegotiations or termination and re-auctioning costs. In theory, the private operator could be more efficient because of know-how; in practice, however, cost-plus and price-cap contracts provide incentives for inefficiencies—inflating costs and skimping on quality, respectively—which are rooted in the information asymmetries between the private operator and public administration regarding the cost structure.

The government is thus compelled to keep the administrative power to regulate the infrastructure regarding price and quality, or eventually to implement internal regulation in lieu of costly external regulation when information is secured through corporate governance mechanisms (e.g., board directors).

In an institutional PPP, the private investor maximizes profit while the *benevolent* public administration maximizes welfare (i.e., the sum of consumer and weighted producer surplus).[6] At the end, the private investor and the public administration seek their goals by maximizing their share in the operational residual rights. An efficient and sustainable institutional PPP is bound by the actors' minimum requirements for ownership and residual rights. Concurrently, price cannot exceed the monopoly price (otherwise a private monopoly would be preferred over PPP) or drop below average variable cost for the public utility (otherwise the PPP would generate loss).

[6]A public-choice approach (Buchanan and Tullock 1962; Buchanan 1987), which assumes self-interested agents—voters, politicians, and bureaucrats—would require a more complex game setup with at least three parties. Unless politicians or bureaucrats can appropriate rents without pursuing the interests of the voters (corruption), the results would be similar.

3. Governance

In this setup, the goal of regulation is to draw the private monopoly close to the first-best (competitive) benchmark utility company where profit is zero. For this company, price should be close to marginal cost. In private monopolies, the producer knows the cost and quality output, but the regulator does not. So, the regulator bears the costs of overcoming information asymmetry regarding operations, cash flows, cost of capital, and compliance with quality standards (Newberry 2000). That is, in order to assess the marginal cost of a private monopoly, the regulator bears a cost that is passed onto the consumer through taxation or higher price.

Let us assume a public-private ownership space where θ represents private investors' ownership and—for simplicity—residual rights (profit share). Conversely, $1 - \theta$ represents public (government) ownership and share. Let us further assume that in a PPP, the public administration requires a minimum ownership h to exercise internal regulation. If its share is below the minimum h, the PPP will become subject to external regulation, causing the cost of producing one additional unit of output to increase by g (equation 1); however, if the public administration's share is at least h, the PPP will regulate internally so that the marginal cost does not increase (equation 2):

$$MC(x) = MC(x) + g, \text{ if } 1 - \theta < h \text{ (information asymmetry)} \quad (1)$$

$$MC(x) = MC(x), \text{ if } 1 - \theta \geq h \text{ (internal regulation)} \quad (2)$$

In parallel, the average variable cost of the public monopoly depends on technology, administrative procedures, and management skills—in sum, private investors' know-how. Due to a lack of know-how, the public utility's production of each unit x is more costly by k than that of the private monopoly. In Hart, Shleifer, and Vishny (1997), private agents exert higher effort

because they receive the residual profit. The variable k, therefore, corresponds to the private agent's effort to reduce cost.

Let us assume that private investors require price to be greater than or equal to marginal cost (i.e., no loss) and minimum ownership e to transfer know-how. So, if the investors' share is below the minimum, they will not transfer their know-how and the cost of producing an additional unit will increase by k (equation 3) to the public utility level; but if the investors' share is equal to or above the minimum, they will impart their know-how and marginal cost will not increase (equation 4):

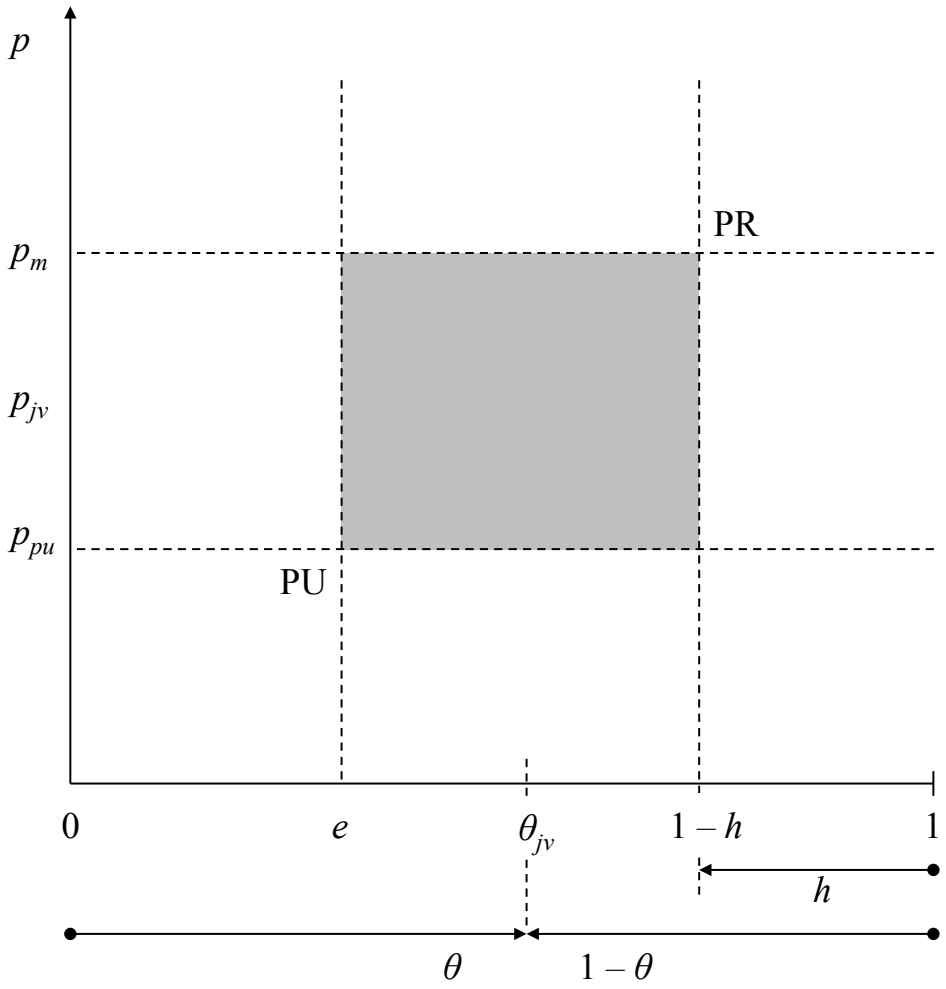
$$MC(x) = MC(x) + k \text{ if } \theta < e \text{ (lack of know-how)} \quad (3)$$

$$MC(x) = MC(x) \text{ if } \theta \geq e \text{ (know-how available)} \quad (4)$$

Thus, private operation leads to lower marginal operating cost, and public operation leads to lower marginal regulating cost.[7] In a PPP, the private investor will aim for monopoly output and price, and the public administration will aim for the output at which price is equal to average cost. PPP feasibility requires $\theta \in [e, 1 - h]$ to be not empty. This parameter space is the contracting (negotiable) area, as shown in figure 2.

[7] Private operation may also lead to lower fixed cost through lower investment outlays and shorter development time (Moszoro 2014). Likewise, public operation may lead to lower regulation setup costs. Both these issues are assumed away to focus on the operating stage of the institutional PPP.

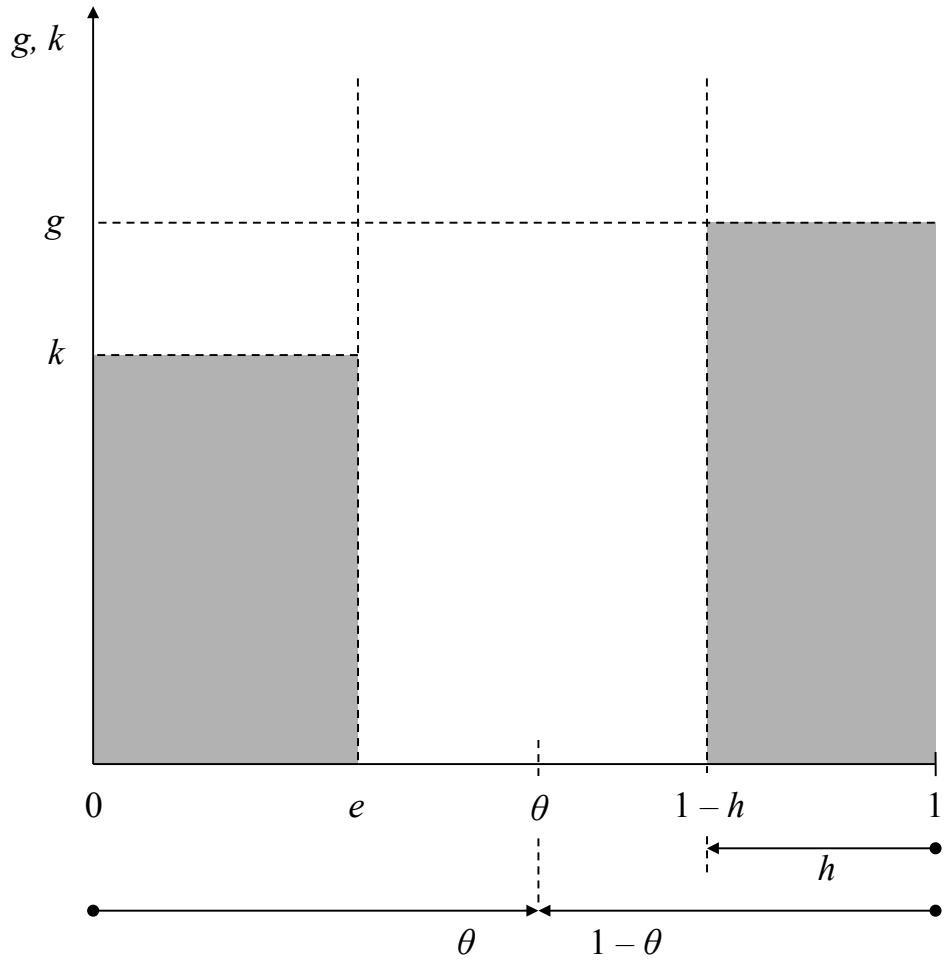
Figure 2. Feasible Institutional Public-Private Partnerships



Source: Marian Moszoro, "Public-Private Monopoly," available through SSRN at http://dx.doi.org/10.2139/ssrn.2383309.

When private ownership θ is above threshold e, private investors will transfer their know-how, causing marginal cost to drop by k; and when public ownership $(1 - \theta)$ is above h, regulation marginal cost drops by g (see figure 3 for a graphical example). PPPs are welfare superior when private ownership (θ) is such that private investors will transfer cost-saving know-how and public ownership $(1 - \theta)$ is such that the public administration will use its administrative power to forgo costly external regulation.

Figure 3. Regulatory and Lack of Know-How Costs as Discrete Functions of Private Ownership Share in a PPP



Note: The relative values of *e*, *h*, *k*, and *g* in this figure are examples for illustrative purposes.

Source: Marian Moszoro, "Public-Private Monopoly," available through SSRN at http://dx.doi.org/10.2139/ssrn.2383309.

For PPPs to produce greater welfare than public monopolies, private monopolies, and regulated monopolies, the following must be true: (1) the marginal cost due to lack of know-how (k) must be sufficiently high, or (2) the marginal cost of regulation (g) must be sufficiently high.

4. Results

Holding financing and development costs constant,[8] the comparative statics on operating efficiency yield the following predictions:

1) A decrease in marginal cost of regulation shifts the optimal utility ownership toward that of a regulated monopoly.
2) A larger gap in technology between the public and the private sectors shifts the optimal utility organization mode toward private or regulated monopoly.
3) Faster learning (technological convergence) by the public sector increases the preference for public monopoly.
4) A larger fraction of the profit that does not constitute welfare (e.g., larger profit expatriation) shifts the optimal utility organization mode toward public monopoly.
5) A decrease in the private ownership threshold, above which private investors transfer cost-saving know-how, along with a decrease in the public ownership threshold, above which the public administration forgoes costly external regulation, increases the probability of the optimal utility organization mode being a public-private partnership.

The model presented in section 3 on governance can be mapped in a continuous public-private ownership space, where regulation cost monotonically increases and operating cost monotonically decreases in private ownership. Then the optimal public-sector ownership share of a utility would be—to paraphrase Ronald H. Coase (1937) on the nature of the firm—the share at which the combined regulatory cost and cost due to lack of private know-how is minimized.

[8] In this paper, I assume away efficiency gains from building and focus on the operations of a PPP.

5. Particular Cases

My focus is on modeling institutional public-private partnerships as a vehicle to internalize regulation costs and private-sector know-how spillovers. I now apply this framework to cases where some of the assumptions are relaxed. I analyze various comparative statics to derive the empirical implications.

5.1. Private-Sector Spillovers

If private-sector profit in public utilities creates spillovers that increase efficiency in other industries, then the maximum negotiable price is not only bounded by welfare considerations but also by income effects and "political" constraints. In other words, PPPs could charge higher prices without decreasing welfare.

Politicians and policymakers are prone to ideological biases regarding the impact of private profit in welfare. An underestimation of the impact of private profit in welfare would bias ownership toward the public sector or require bigger gains from know-how transfer k and internal regulation g. Conversely, an overestimation of the impact of private profit in welfare would bias the results toward the private sector, creating potential distortions and corrective interventions in the long run, including nationalization (or municipalization) when expectations are not met.

Local private participation in infrastructure is more likely to correspond with positive impact of private profit in welfare. On the other hand, foreign direct investment in infrastructure is more likely to be associated with dividend and expatriation transfers from the PPP to the company parenthood (i.e., with negative impact of private profit in welfare). Most of the private investments in PPPs in developing countries come from the foreign sector, which explains in part

why comparable PPPs there tend to be distorted toward lower cap price (p_{jv}) and lower private ownership than in developed countries.

5.2. Bundling

On top of lowering marginal cost, private ownership may decrease fixed cost thanks to lower investment outlays (Moszoro 2014) or may not increase regulation setup cost. In this case, PPPs that bundle investment and operations create inter-temporal tradeoffs that make them viable at a higher price (p_{jv}), higher private ownership θ, lower know-how advantage k, or lower regulation savings g than without bundling investment and operations.

5.3. Quantity-Quality Tradeoffs

Generally, regulators set the quality output of public goods ex ante, thus dismissing possible ex post quantity-quality tradeoffs between the utility company and the customers. Allowing for quantity-quality tradeoffs (e.g., less quantity demanded, but at a higher quality level) would yield a different welfare function, the outcome of which would depend on the endowment and bargaining power of consumers.

5.4. Asymmetric Ownership and Profit Sharing

So far, we have assumed that θ is the private share of both investment and profit from operations—the "equity public-private joint ventures" or "institutional public-private partnerships." However, many PPP structures distinguish between infrastructure ownership (θ^{in}) and control rights of operations and profit sharing (θ^{op}). This division corresponds to the six remaining cases of mixed public and private ownership and management mentioned in the introduction of this paper.

For infrastructure ownership (θ^{in}) different than control rights of operations and profit sharing (θ^{op}),

1) If the distribution of the fixed fee is prorated by θ^{in}, the problem simplifies to the analysis of operations discussed earlier.
2) If the fixed fee is not prorated by θ^{in} and $\theta^{in} < \theta^{op}$, the public sector subsidizes the infrastructure. In the boundary, when $\theta^{in} = 0$ but still $\theta^{op} \in (e, 1-h)$, the public sector owns the infrastructure and leases it to the private sector, which operates it. In the case of many transport PPPs (e.g., toll road operators), the public sector fully finances the infrastructure, contracts out the operation of assets, and takes a share of the profit or gets paid a fixed amount.
3) If the fixed fee is not prorated by θ^{in} and $\theta^{in} > \theta^{op}$,the private sector finances the infrastructure, which is then operated by the public sector. This arrangement is used to develop social public infrastructure, such as courthouses and schools, when the public sector is debt constrained and the private sector has better financing capacity.

6. An Application to WMATA

The infrastructure for the Washington Metropolitan Area Transit Authority (WMATA, or "Metro" for short) was laid in 1969, beginning with the Red Line.[9] The infrastructure passes through the District of Columbia and several counties belonging to two states. The investment (and transaction cost) to install all six lines was prohibitive for a private entity. Now that the infrastructure is in place, we may explore the possibility of transitioning WMATA from public monopoly to an institutional public-private joint venture. In this arrangement, the public sector,

[9] The purpose of this example is to illustrate at a general level the implementation of institutional public-private vehicles for the provision of public goods. It is not intended to provide a specific policy recommendation for the WMATA, for which detailed data and in situ analysis would be required.

which financed the infrastructure, leases to the private investor, who operates Metro. Because the majority of infrastructure was financed by the federal government through an interstate compact as defined by the US Constitution,[10] it is likely that the private sector will take over more operational control than infrastructural ownership.

The greatest challenge with this transition is determining what share of investment and profit should correspond to the private investor. An underestimation of the weight of profit in welfare will bias profit share toward the public sector and undermine private incentives to transfer know-how; an overestimation of the weight of profit in welfare will bias profit share toward the private sector and may induce discontent in the public at large.

The current division of WMATA funding is 29 percent federal, 61 percent state and local, and 10 percent other stakeholders.[11] The District of Columbia, Virginia, and Maryland each have two voting and two alternative directors on the WMATA board. If private operation leads to lower marginal operating cost and public operation leads to lower marginal regulating cost, then WMATA as an incorporated company with shares belonging to federal, state, and local administrations, as well as private investors, could benefit from the use of know-how and internal regulation.

Let us assume that a private investor requires a minimum of 20 percent ownership (e = 20 percent, as per equation 4) to transfer operational know-how. The prorated ownership composition will be 20 percent private investor, 23.2 percent federal, 48.8 percent state and local, and 8 percent other stakeholders. Alternatively, local administrations could render

[10] Originally, 67 percent of the cost to lay Metro's infrastructure was federal money and 33 percent local money (Pub. L. No. 91-143, enacted December 9, 1969). As lines were added, WMATA needed additional funding. The first round of additional funding was 80 percent federal and 20 percent local; the second was 63 percent federal and 37 percent local (see: amendment to the National Capital Transportation Act of 1969 relating to the Washington Metrorail System, authorizing additional federal contributions for construction, Pub. L. No. 101-551, issued on November 15, 1990).

[11] Washington Metropolitan Area Transit Authority, *Maintaining Momentum: FY2016 Approved Budget* (Washington, DC: WMATA, 2015).

ownership proportionally to their subsidies, which presently is allocated to the jurisdictions based on equal shares of each jurisdiction's (1) density weighted population, by jurisdiction of residence (25 percent); (2) ridership, by jurisdiction of residence (15 percent); (3) revenue miles per jurisdiction (35 percent); and (4) revenue hours per jurisdiction (25 percent).[12]

On a comparative basis, a priori negotiation costs between a private investor and public administrations should not be higher than between public administrations. For example, the private investor may serve as an arbitrator to oppose political goals of the WMATA administrations. At first glance, WMATA's financials and operations show several areas that could be improved:[13]

- Approximately 80 percent of the $1.5 billion budget of WMATA corresponds to personnel and services expenses.
- Many DC area commuters, for whom convenient public transportation is available (e.g., Fairfax County 81 percent, Prince George's County 77 percent, Montgomery County 75 percent), are deterred from using it by its low quality.
- Ancillary revenues—for example, parking, advertisement, joint developments, and fiber optics, an area in which the private sector has more experience—represent only 5 percent of expenses.

If this aforementioned PPP can bring marginal cost down (or ridership up) by 10 percent and regulatory costs down by 10 percent—fictional but attainable targets, considering the statistics presented—the outcome will improve the welfare for all stakeholders.

[12] See Washington Metropolitan Area Transit Authority (WMATA), "Metro Budget Overview," February 2011.
[13] See WMATA, "Metro Budget Overview," and Jack Moore, "Fewer Drivers, Longer Commutes: 5 Stats That Explain the Epic DC-Area Commute," WTOP, February 7, 2017.

7. Concluding Remarks

Public-private partnership is not a distinctive organizational mode but a creative hybrid solution designed to internalize transaction costs—namely, regulation and know-how.

Public-private partnerships are arguably closer to the first-best benchmark. Although price can be higher than marginal cost here, this mode has full internalization of know-how and low regulatory cost. Managerial incentives for cost-saving know-how are subject to sufficient private ownership. Likewise, when the public administration holds sufficient control rights in the PPP vehicle, information asymmetry vanishes and quality and price are audited internally. Thus, regulation cost is minimized.

With public and private ownership satisfying their minimum requirements, the decision-making and renegotiations are internalized. When budget constraints are acknowledged, partial public ownership increases the acceptance for subsidies. The public opinion welcomes marrying welfare and efficiency but is sensitive to corruption and favoritism that a close relationship between the sectors usually brings.

Comparative statics, supported by marginal analysis, show that when a public-private partnership enables the internalization of private know-how and saves regulation costs due to correspondingly sufficient private and public ownership, it is welfare superior to private, public, and regulated monopolies. The feasibility, operability, and ultimate efficiency of public-private partnerships is dependent on accurate and unbiased estimates of know-how gains, regulation costs, and the weight of private-sector profit in welfare.

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