Overcoming Opportunism in Public-Private Project Finance

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March 2013

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March 2013, *Journal of Applied Corporate Finance* 25(1): 89–96

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Abstract:

Opportunism, either governmental or private, is a powerful deterrent against public-private project financing, especially when considering the scale of the investment in infrastructure. The parties can, however, secure themselves against opportunism of the counter-party by exchanging an exit (put) option for the private investor and a bail-out (call) option for the public agent on the private investor's shares. These over-the-counter options combine the stability of long-term contracts and the flexibility of short-term contracts. The exit/bail-out option mechanism reduces entry barriers by streamlining incomplete long-term contracts and avoiding contractual problems related to bounded rationality and opportunism.

Public-private partnerships (P3s hereafter) are hybrid project financing structures involving at least one government entity (public agent) and at least one for-profit company (private investor) to provide public goods. Often the projects involve the construction and/or operation of roads, bridges, harbors, airports, and water and power utilities. These sorts of projects are often known as "natural monopolies" and frequently involve government as either regulator or owner. The private investor in the P3 is expected to provide public services that are of a superior quality and at a lower cost to what the public agent could provide. The private investor is usually also expected to provide most or all of the funding up-front. The public agent is expected to provide a legal framework allowing the private investor to earn an acceptable rate of return on investment.

P3s offer great opportunities to improve social welfare but regularly face obstacles that purely private enterprises rarely do. The biggest problem they face, however, is not the cost of raising the capital for the project. In advanced economies, capital markets are sufficiently deep to fund even very large projects if the economics are compelling.

What often discourages both public agents and private investors from entering into P3 projects is the risk of opportunistic behavior in the future by the other party—the private partner by lowering investment and quality; the government by capping prices or expropriation. Because P3s are often long-lived infrastructure projects involving large up-front investments, they have a "one-shot" feature that encourages opportunistic behavior. P3s do not often involve the repeated interactions common to many commercial transactions that cause buyers and sellers to act in a manner conducive to continuing relationships.

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P3 projects often involve situations where the private party knows more about particular situations or technologies and the public party is likely to know she is at an informational disadvantage ("informational asymmetry" in economics parlance) on *ex ante* unobserved investment and *ex post* delivered quality, and this further discourages P3s.

In sum, the concerns of private and public parties about opportunism are major obstacles that work to deter promising transactions. As a consequence, intrinsically good public investments often never get made.

Many people have attempted to solve this double-sided opportunism problem through extensive contracting between the parties. But lengthy contracting covering many project inputs and project service outcomes has often failed. I will review the relevant literatures to show why "complete contracting" (as it is known in institutional economics) covering all possible future states is not feasible because of limits on human knowledge ("bounded rationality"[2] in Nobel laureate Oliver Williamson's phrase) and of properties of human behavior—"opportunism."

This paper provides a practical way for both parties to overcome the opportunism problem. Rather than contracting for specific operating outcomes, I propose the use of option contracts on the ownership of the project. This solution uses over-the-counter contracts similar to call and put options on an enterprise's shares. One can think of the call option held by the public agent as a "bail-out" option that allows the government to legally purchase the project at a pre-established price if the quality of service is inadequate. Similarly, the put option held by the investor can be thought of as an "exit" option she can exercise to recover her capital if the government starts behaving opportunistically.

Such options would significantly reduce the risk to each P3 partner of the other's opportunistic behavior after the investment is made. The options would also add to social welfare by creating what economists call "market contestability." By allowing the original parties to "exit" and perhaps yet other parties to "enter" a now sunk investment, the option contracts would create a behavioral environment in the P3 that is much more like a "repeated game"—that is, one where a reputation for fair-dealing matters to all parties.

Game theory indicates that the equilibrium position for many potential P3s is unsatisfactory for all involved. Under reasonable assumptions, models of P3s as strategic games between investors and public agents show that the "dominant" strategy for the private party is to attempt to exploit its monopoly at the expense of consumers while the dominant strategy for the public agent is either costly regulation or penalization of the private party.

To best understand the strength of the call and put option model though, we should first review the challenges inherent in long-term contracting and particularly in connection with sunk investments. This will help us understand what a good solution to the opportunism problem would need to provide.

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[2] Bounded rationality is considered "a semistrong form of rationality: it is assumed economic actors are in this case 'intendedly rational, but only limitedly so'" (Oliver Williamson, 1985, *The Economic Institutions of Capitalism. Firms, Markets, Relational Contracting*, New York: The Free Press—Macmillan, p. 45; the latter part of the quotation after: Simon, 1961, p. xxiv).

1. Long-term Contracting and Natural Monopolies

Bounded rationality and opportunism make designing long-term agreements in natural monopolies, including P3s, difficult. One of the seminal figures in institutional economics, Oliver Williamson, describes four cases covering all long-term contracting situations.[3] These are:

1) **Unbounded rationality/non-opportunism**—a condition of "contractual utopia."[4] All parties can see all potential outcomes clearly—including those determined by the other parties—and both will live up to the spirit as well as the letter of any agreements
2) **Unbounded rationality/opportunism**—this is the case where complete contracting would work well. Complete contracts foresee all possible opportunistic actions and their consequences for both parties.[5] So even though the parties are opportunistic, each can see exactly what situation the other might exploit and the two can contract accordingly.
3) **Bounded rationality/non-opportunism**—although neither party has a perfect crystal ball, contracting works well because of the general clause protection against hazards of contractual incompleteness. By signing a "general clause" contract, the parties undertake to reveal all relevant information and cooperate throughout the execution and renewal of the agreement.
4) **Bounded rationality/opportunism**—this is the case that, in Williamson's opinion, corresponds to reality, especially in natural monopolies, and involves all complex contracting problems.

Table 1

Classification of contracts.

		Condition of Bounded Rationality	
		Absent	Admitted
Condition of Opportunism	Absent	Bliss (1)	"General clause" contracting (3)
	Admitted	Comprehensive contracting (2)	Serious contractual difficulties (4)

Source: Williamson (1985, p. 67).

[3] See Williamson (1985), *op. cit*.

[4] In the same book, Williamson (1985, *op. cit.*, p. 47) explains that opportunism is not tantamount to simply pursuing one's interests: "By opportunism I mean self-interest with guile. This includes but is scarcely limited to more blatant forms, such as lying, stealing, and cheating. Opportunism often involves subtle forms of deceit. Both active and passive forms and both *ex ante* and *ex post* types are included."

[5] However, genuinely complete contracts are impossible. Bounded rationality prevents people from predicting all possible future circumstances.

Other economists have proposed three major kinds of contracts that are designed to overcome these contractual challenges:[6]

1. Complete "once-and-for-all" contracts, as developed by George Stigler[7]
2. Incomplete long-term contracts, as proposed by Harold Demsetz[8]
3. Renewable short-term contracts, as proposed by Richard Posner[9]

In the complete "once-and-for-all" contract, the government undertakes a one-time "auction" for the best investor, which results in lower transaction costs. However, the reality of bounded rationality makes such a contract unfeasible because all parties face unforeseen circumstances.

Incomplete long-term contracts,[10] which allow for periodic renegotiation, are a mechanism for soothing disputes resulting from unforeseen events. However, such contracts would not prevent successful but opportunistic bidders from routinely trying to renegotiate terms for their own benefit. Moreover, incomplete long-term contracts, as Williamson points out, differ from regulations only in depth, not in essence.[11] So, a regulatory agent would still be required to assess quality levels, monitor the investor, and negotiate price changes with the utility company.

Posner's suggestion of renewable short-term contracts involving "problem-free transfer of assets" depends on questionable assumptions such as low transaction costs, equal conditions for incumbent bidders, and the emergence of well-informed new bidders during contract renewals.[12] A more realistic assumption would be that the incumbent investor is further along the learning curve and is better informed about the product and the market, making it difficult for potential competitors to bid on short-term contracts.

Table 2 summarizes the advantages and disadvantages of different types of contracts as alternative to regulation in natural monopolies.

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[6] Although Williamson analyzes franchising agreements and focuses rather on services other than public utilities, I believe that the classification is appropriate for analyzing partial or total privatization of natural monopolies. In the public utilities sector, "serious contractual difficulties" have their source in bounded rationality (not so much in intentions as in scope, i.e., developments in technology and changes in the economic environment, etc.), in private and public opportunism, and in the specificity of the assets, since securing these assets triggers the process of concluding contracts.

[7] See Stigler, G. (1968) "The Organization of Industry," Homewood, IL: Irwin.

[8] See Demsetz, H. (1968) "Why Regulate Utilities?," *Journal of Law and Economics*, 11 (1).

[9] See Posner, R. (1972), "The Appropriate Scope of Regulation in the Cable Television Industry," Bell Journal of Economics and Management Science, 3 (1), pp. 98-129.

[10] In the opinion of Viscusi, Vernon, and Harrington (2000, *Economics of Regulation and Antitrust*, Cambridge, MA: The MIT Press, 3rd ed.), such contracts should be designed for the period of 15-20 years. Guislain and Kerf (1995, *Concessions—The Way to Privatize Infrastructure Sector Monopolies*, Viewpoint. Washington, DC: The World Bank) provide examples of long-term agreements spanning from 10 to 95 years.

[11] "At the risk of oversimplification, regulation may be described contractually as a highly incomplete form of long-term contracting in which (1) the regulatee is assured an overall fair rate of return, in exchange for which (2) adaptations to changing circumstances are successively introduced without the costly haggling that attends such changes when parties to the contract enjoy greater autonomy," see Williamson (1976), Franchise bidding for natural monopolies—In general and with respect to CATV, *Bell Journal of Economics*, 7 (73), p. 91.

[12] See Oliver Williamson (1985), *op. cit.*

Table 2

Advantages and disadvantages of contracts as alternative to regulation in natural monopolies.

Contract type	Advantages	Disadvantages
"Once-and-for-all" contracts (Stigler)		
a) complete (including claims for unforeseen events)	• reduce the risk of opportunism: conditions known *a priori*	• very difficult to design, negotiate and execute (practically unfeasible)
b) incomplete	• take into account the limitations of bounded rationality	• increase the risk of opportunism; contracts are always incomplete and, to a large extent, the degree of incompleteness is chosen by the parties[13]
Incomplete long-term contracts (Demsetz)	• allow for renegotiation of conditions in compliance with penalty clauses • provide necessary stimuli in order to invest in long-term assets	• the initial criteria of investor selection are usually forced and dubious • plausible problems with executing provisions concerning prices and costs (possible delays and expenses incurred by court proceedings, uncertainty of technologies, demand, local conditions, inflation, indexation mechanisms, etc.) and political problems (the public agent is reluctant to admit it made a mistake) • ensuring equal rights for the incumbent investor and new bidders during contract renewal is improbable (economic, administrative, and political benefits for the incumbent investor, switching costs)
Renewable short-term contracts (Posner)	• facilitate the continuous decision-making process and the tender mechanism is less limited by bounded rationality (it is not necessary to create the whole long-time decision tree diagram *a priori*) • do not need to include unforeseen events, as in long-term contracts • adaptation only in periods of renewal and only in relation to events which actually took place • eliminate incompleteness, assuming effective competition during the renewal bidding process • awareness of having to compete for a new contract deters from opportunism	• inequalities between incumbent investor and new bidders • human capital is not taken into account • problems with the valuation of plant and equipment, if the investments are specific • possible inefficient investment in facilities and equipment in a short period • possible manipulation of costs and accounting procedures (e.g., depreciation) with the aim of reselling at a higher price • problem-free transfer of assets described by Posner is unattainable

Source: based on Williamson (1985, *op. cit.*) and Viscusi, Vernon, and Harrington (2000, *op. cit.*).

[13] See Spiller (2008), "An Institutional Theory of Public Contracts: Regulatory Implications." *NBER Working Paper* No. 14152.

This overview of the various advantages and disadvantages of various contracts allows us to set the requirements for a much better approach. We would like a package that combines the advantages of:

- Stigler's "once-and-for-all" contracts
- Demsetz's incomplete, long-term contracts; and
- Posner's short-term, renewable contracts

The option contracts that I propose each party in a P3 should offer the other would achieve these advantages. As I will show, the incentives for long-term investments would also deter opportunism and the flexibility of the option contracts would enable continuous cooperation between the investor and the public agent or termination of cooperation without loss to either party. Under such arrangements information asymmetries (e.g., on quality or accounting) are less likely to occur because deviations from the contract are punished in the following period. Furthermore, these option features actually provide what Richard Posner envisioned—namely, the strike price of the exit or bail-out option (purchase of assets at a set price) is a *de facto* "problem-free transfer of assets."

For the private investor, the addition of the option features changes the divergent "either/or" choices of "contract fulfillment" and "profit maximization" into a continuum that ranges from "welfare maximization" to "profit maximization." Additionally, because the public agent will exercise the bail-out option and penalize the investor in the subsequent period in case of contract deviation, there are no incentives ex ante for the private investor to capitalize on information asymmetry on the utility's costs and infrastructure quality. The relationship between the two parties becomes a "quasi-cooperative game."[14]

The strategy of the resulting P3 will be the outcome of negotiations between its partners over their capital and profit shares (in the diagrams, θ represents the private investor's share and $1-\theta$ is the government's share). In this new and significantly improved "game," the investor will propose strategies that will maximize economic profits, but also increase benefits to the public agent through lower regulatory costs and a share in the P3's profits ($1-\theta$).

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[14] Mixed motive games were first introduced by Schelling (1960, *The Strategy of Conflict*, New York: Oxford University Press). Sulejewicz (1994, *Wspolpraca konkurencyjna przedsiebiorstw w swietle teorii gier*, Warsaw: SGH, p. 25) presents the games' scope in the following way:

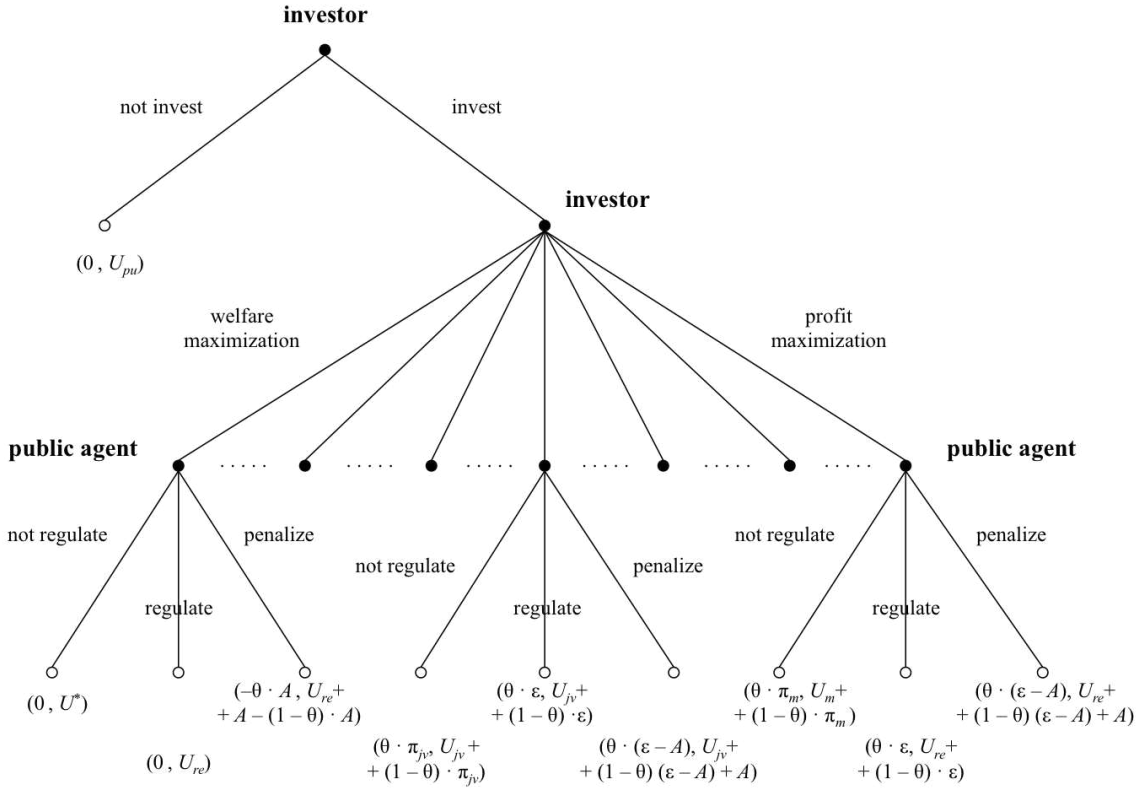
		Communication		
		Lack	**Partial**	**Perfect**
Agreements	Binding			Classical cooperative games
	Conditionally binding		Quasi-no-cooperative games Quasi-cooperative games	
	Not binding	Classical cooperative games		

In utilities companies binding agreements and effective communication occur, at least theoretically, in the case of public monopolies. The lack of binding agreements and weak communication would be typical characteristics of private monopolies. This does not mean that they do not communicate at all, but rather that some objective hindrances occur which justify the assumption of the existence of the informational asymmetry. Analogically, the lack of any binding agreements does not signify that players do not communicate with each other.

Figure 1 shows the payoffs for the private and public parties depending upon the decisions each has made. What results is no longer a pure self-oriented strategy for each of the players, but a "mixed motive strategy" that involves compromises on prices and quality levels. The outcome of the compromise will be visible in both the negotiated capital structure and distribution of profit, i.e., $e \leq \theta \leq 1-h$, where e is the minimum share required by the private investor to transfer its *know-how* and $1-h$ is the minimum required by the public agent to exercise sufficient control over internal processes within the company.[15]

Figure 1

P3 as a strategic joint venture game, where U^* is the first-best welfare output, U_{pu} welfare from public monopoly, U_m welfare from private monopoly, U_{re} welfare from regulated monopoly, and $U_{jv} \in (U_m, U_{pu})$ welfare from P3; π_{pu} is public monopoly profit, π_m private monopoly profit, π_{re} regulated monopoly profit, and $\pi_{jv} \in (\max(\pi_{pu}, \pi_{re}), \pi_m)$ P3 profit; $A \leq I$ are the public agent's rents from penalties, restrictive regulation, and expropriation and ε residual profit over regulated (capped) profit.



For a P3 to be sustainable from the public agent's standpoint, the public-private joint venture profit π_{jv} should be positive and welfare should be bigger than in the case of both public monopoly and regulated private monopoly.

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[15] This problem could, therefore, be perceived as a multi-criterion optimization task. One of the methods of dealing with it is to include those criteria in one objective function whose values are measured by a given ratio. In the proposed simplified model, objective functions are measured as shares in both the capital and the profit sharing θ.

Table 3 shows the payoff matrix for the "invest" subgame.

Table 3

"Invest and enter into a P3" subgame payoff matrix. U^* is the first-best welfare output, U_{pu} welfare from public monopoly, U_m welfare from private monopoly, U_{re} welfare from regulated monopoly, and $U_{jv} \in (U_m, U_{pu})$ welfare from P3; π_{pu} is public monopoly profit, π_m private monopoly profit, π_{re} regulated monopoly profit, and $\pi_{jv} \in (\max(\pi_{pu}, \pi_{re}), \pi_m)$ P3 profit; $A \leq I$ are the public agent's rents from penalties, restrictive regulation, and expropriation and ε residual profit over regulated (capped) profit.

		Public agent								
		Welfare maximization			**Mixed motive strategy**			**Profit maximization**		
		Not regulate	**Regulate**	**Penalize**	**Not regulate**	**Regulate**	**Penalize**	**Not regulate**	**Regulate**	**Penalize**
Private investor	Welfare maximization	$(0, U^*)$	$(0, U_{re})$	$(-\theta \cdot A, U_{re} + A - (1-\theta) \cdot A)$	$(0, U^*)$	$(0, U_{re})$	$(-\theta \cdot A, U_{re} + A - (1-\theta) \cdot A)$	$(0, U^*)$	$(0, U_{re})$	$(-\theta \cdot A, U_{re} + A - (1-\theta) \cdot A)$
	Mixed motive strategy	$(\theta \cdot \pi_{jv}, U_{jv} + (1-\theta) \cdot \pi_{jv})$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$	$(\theta \cdot \pi_{jv}, U_{jv} + (1-\theta) \cdot \pi_{jv})$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$	$(\theta \cdot \pi_{jv}, U_{jv} + (1-\theta) \cdot \pi_{jv})$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$
	Profit maximization	$(\theta \cdot \pi_m, U_m + (1-\theta) \cdot \pi_m)$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$	$(\theta \cdot \pi_m, U_m + (1-\theta) \cdot \pi_m)$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$	$(\theta \cdot \pi_m, U_m + (1-\theta) \cdot \pi_m)$	$(\theta \cdot \varepsilon, U_{re} + (1-\theta) \cdot \varepsilon)$	$(\theta \cdot (\varepsilon - A), U_{re} + (1-\theta)(\varepsilon - A) + A)$

To normalize payoffs, I assume that the welfare loss due to regulation cost equal $U^* - U_{re}$, welfare from P3 equals welfare from a regulated monopoly (i.e., $U_{jv} = U_{re}$), P3 profit equals π_{jv}, and equal public and private share in the P3 (i.e., $\theta = 1 - \theta = 0.5$), and then subtract the vector $(0, U_{re})$ from each term of the payoff matrix (see Table 4).

Table 4

Normalized "invest and enter into a P3" subgame payoff matrix. I assume $U^* - U_{re} = U^* - U_{jv} = \pi_{jv}$, and $\theta = 1 - \theta = 0.5$, and then substract $(0, U_{re})$ from each payoff term.

		Public agent								
		Welfare maximization			Mixed motive strategy			Profit maximization		
		Not regulate	Regulate	Penalize	Not regulate	Regulate	Penalize	Not regulate	Regulate	Penalize
Private investor	Welfare maximization	$(0, \pi_{jv})$	$(0, 0)$	$(-A/2, A/2)$	$(0, \pi_{jv})$	$(0, 0)$	$(-A/2, A/2)$	$(0, \pi_{jv})$	$(0, 0)$	$(-A/2, A/2)$
	Mixed motive strategy	$(\pi_{jv}/2, \pi_{jv}/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$(\pi_{jv}/2, \pi_{jv}/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$(\pi_{jv}/2, \pi_{jv}/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$
	Profit maximization	$(\pi_m/2, U_m - U_{re} + \pi_m/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$(\pi_m/2, U_m - U_{re} + \pi_m/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$(\pi_m/2, U_m - U_{re} + \pi_m/2)$	$(\varepsilon/2, \varepsilon/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$

"Profit maximization" is also a dominating strategy for the private investor in the P3. Nevertheless, the public agent is aware of the strategy to be implemented by the investor. Through backwards induction, this game is simplified to a straightforward choice of

strategies made by the investor in which payoffs would correspond to the most effective protective strategies chosen by the public agent (see Table 5).

Table 5

Normalized "invest and enter into a P3" subgame payoff matrix with backwards induction, public agent's most effective protective strategies, and different penalty levels. I assume that $U_m - U_{re} + \pi_m/2 < (\varepsilon + A)/2$.

		Profit π_m compared to penalties A		
		$\pi_m > \varepsilon + A$	$A/2 < \pi_m < \varepsilon + A$	$\pi_m < A/2$
Private investor	Welfare maximization	$(0, \pi_m)$	$(0, \pi_m)$	$(-A/2, A/2)$
	Mixed motive strategy	$(\pi_m/2, \pi_m/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$
	Profit maximization	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$	$((\varepsilon - A)/2, (\varepsilon + A)/2)$

If $\pi_m < \varepsilon + A \leq I$, the private investor would not invest. If, on the other hand, the investor invests in a one-shot game, her best strategy is a mixed motive strategy, provided she can secure profit $\pi_m > \varepsilon + A$.

2. Financial Standing of Public Utility Companies and Public Agent's Opportunism in Public-Private Partnerships

Therefore, if the best strategy for the public agent is to "not regulate" and "not penalize" the utility company, we must figure out how to convince the private investor of the public agent's good intentions. There is a considerable game theory literature that demonstrates the unprofitability of opportunism in one period if future losses are to be considered in a sequential game.[16] Opportunism makes economic sense for the public agent only if the value of gains from regulation or penalization in the current period exceed the present value of the benefits of better services in all future periods:

$$A - \sum_{t=1}^{\infty} \frac{U_{jv} - U_{pu}}{(1 + r_{pu})^t} > 0$$

$$A > \frac{U_{jv} - U_{pu}}{r_{pu}} \qquad \textbf{(1)}$$

where r_{pu} is the public agent's discount rate.

Since $A \leq I$, inequality (1) can be formulated as:

$$\theta I > \frac{U_{jv} - U_{pu}}{r_{pu}} \qquad \textbf{(2)}$$

[16] The so-called "folks theorem" was developed by Dilip Abreu (1988), "On the Theory of Infinitely Repeated Games with Discounting", *Econometrica*, 56 (2).

When welfare loss due to public inefficient management equals welfare loss due to costly regulation, a proxy for welfare change $U_{jv} - U_{pu}$ is the differencial profit $\pi_{jv} - \pi_{pu}$. Therefore

$$r_{pu} > \frac{\pi_{jv} - \pi_{pu}}{\theta I} \quad \textbf{(3)}$$

The basic insight here is that the public agent becomes more likely to behave opportunistically as investment I increases, the risk-free interest rate r_{pu} increases, and the investor's share θ increases. It becomes less likely to behave opportunistically when the ratio of NOPAT to Investment I increases. This creates something of a paradox. Although intuition might suggest that governments would behave best when they could expropiate higher rents, this is not the case. Because the profitability of public utility companies is typically low before engaging the private sector, public agents are thus often mistakenly believed to be prone to behave opportunistically, when in fact the prospect of future profits may well be the best safeguard for private investors against government expropriation.

Example:

In 2002, the city of Poznan was considering a possible partial privatization of Poznanskie Wodociagi i Kanalizacja Sp. z o.o. (Poznan Water and Sewage Company), which makes it a good case study of potential public opportunism after the private investment.

At that time, the discount rate r_{pu} for the city of Poznan was 6.65%. Assuming $\theta = 0.5$, the profit incremental $(\pi_{jv} - \pi_{pu})/I$ ratio should have been above 3.325% for opportunism not to be a profitable strategy for the public agent, a challenging objective in a low margin sector. Thus low profitability and high public opportunistic likelihood could have been a substantial deterrent for the private investor in the privatization process.

3. Minimizing the Risk of Public Opportunism Through Exit Options

A perpetual exit (put) option[17] at a strike price equal to the annualized investment, granted by the public agent to the private investor, would eliminate the gains of the government from public opportunism at the expense of the private investor, thereby reducing the risk of such opportunism and fears that might have deterred the private investor from entering into that joint venture.[18]

To streamline this demonstration, I assume that output quality depends directly on the amount of investment I, a two-part tariff where capital costs are covered by fixed fees, and

[17] Perpetual put options avoid reverse induction and ineffective equilibria problems. Sequential options renewed annually would yield the same result.

[18] See "abandonment options" in Copeland, Koller, and Murrin (1994), "Valuation: Measuring and Managing the Value of Companies," 2 ed., New York: McKinsey & Co. and "bail-out options" in Zerbe Jr. and Dively (1994) *Benefit-Cost Analysis: In Theory and Practice*, Harper Collins College Publishers.

all economic profit distributed to the shareholders in dividends. Therefore, the face value of the shares equal their market value. This satisfies Richard Posner's suggestion that the initial investment, improvements, and depreciation be taken into account in the valuation of a short-term contract.[19]

These exit and bail-out option contracts present features of both financial and real options:

1. **Undelying asset**: similarly to financial options, stock in the utility company.
2. **Pricing of the underlying asset**: pricing options for shares in a P3 is closer to real options valuation in the sense that P3s usually have no traded market valuation, Valuation would depend on accounting-based or formulaic methods.
3. **Form of the contract**: While financial options are standardized, real options are not. Without markets for them (there is no public issuer or short-seller), they have to be defined and created by the asset holder before being described and valued. Options on shares in a P3 would, like financial options, be defined in a formal contract, but would also, like real options, have unique or idiosyncratic features.
4. **Accessibility**: Like real options, exit and bail-out options must be identified or created. P3s requires a non-standard innovative approach in each case.
5. **Complexity**: P3 options are more complex than standard financial options.
6. **Risk**: P3 option values are determined both by market risk the management—and byspecific risk, which can at least be partly controlled by active management, as is the case of both real and financial options.
7. **Execution rights**: As with financial options, only the option holder decides if and when the option is to be executed.
8. **Execution criteria**: P3 option pricing and decisions to exercise are not based on a simple comparison between the market price and the strike price of the underlying asset (as is also the case with real options). Nevertheless, in the mechanism presented below, the exit option still has positive value when there is an economic loss (thus avoiding complexity).
9. **Incidence**: Unlike financial options, real options linked to an investment project usually form a sequence of options—that is, the execution of one option creates a further set of different options—or a portfolio of options. In the mechanism presented, not executing the exit option creates the possibility of undertaking further common investments and guarantees other public agents that such cooperation with the private investor is possible.
10. **Type**: For the exit option to be valuable, it must be either an "American" option (i.e., can be exercised at any time) or at the end of some reasonably short period (e.g. quarter or annually), as in most cases involving real options.

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[19] See Posner (1972), "The Appropriate Scope of Regulation in the Cable Television Industry," *Bell Journal of Economics and Management Science,* 3 (1), pp. 98-129. It is obvious that the full valuation of the company would be more complex, especially when considering the level of replacement investments. I assume both parties have an interest in maintaining investments at the assets' depreciation rate.

11. **Valuation model**: As with real options, a binomial (lattice model) option pricing model rather than a Black-Scholes model is more useful for valuing P3 exit and bail-out options. The underlying P3 asset value can be estimated only over discrete periods of time rather than in continuous-time.
12. **Value**: The private party in a P3 is an active manager, making the exit option more of a real option. Active management can influence the cash flows, the cost of capital, and therefore the entire present value of the company. Because the expiration date can also be negotiated, this might also increase the value of the option.

4. Protecting the Public With Bail-Out (Call) Options

The private investor can be expected to be opportunistic if the expected one-period profit from monopolist behavior (π_m) is greater than the sum of profit expected by fulfilling the contract and the discounted future penalties. Expressed as an inequality,

$$\theta\left(\pi_m - \pi_{jv}\right) - \sum_{t=1}^{T} \frac{\theta \cdot A}{\left(1 + r_{pr}\right)^t} > \theta \frac{\pi_{jv}}{r_{pr}} \quad \textbf{(4)}$$

where r_{pr} is the cost of capital for the private investor.

Because the sum of discounted penalties cannot exceed invested capital ($\sum_{t=1}^{T} A/\left(1 + r_{pr}\right)^t \leq I$), we get the following as a condition for private opportunism:

$$\theta\left(\pi_m - \pi_{jv}\right) - \theta \cdot I > \theta \frac{\pi_{jv}}{r_{pr}} \quad \textbf{(5)}$$

$$r_{pr} > I \frac{\pi_{jv}}{\pi_m - \pi_{jv}} \quad \textbf{(6)}$$

The corollary is that the higher the potential monopoly profit π_m, the more likely the private investor will behave opportunistically. Conversely, the higher the value of investment I, interest rates r_{pr} and π_{jv}, the less likely the private investor will behave opportunistically.

Interestingly, a low π_{jv} increases the likelihood of both private and public opportunism. Therefore, increasing the expected profitability of the public-private utility company improves the stability of the joint venture.

Just as exit options protect private investors, bail-out (call) options protect the public. The bail-out option[20] gives the public agent the right to purchase, at the end of each period, the investor's shares at the strike price $(1+r_{pr})\theta \cdot I$, i.e., the annualized investment. Because the public agent may exercise the bail-out option with the intent of reselling the shares to

[20] See Zerbe and Dively (1994), *op. cit.*, pp. 387-388.

another private investor,[21] bail-out options are similar to "expansion" or "switching" options referred to in financial literature.[22]

The bail-out option might be executed for any of the following reasons:

a) Lack of fulfillment of contract terms by the private investor, e.g., failing to invest sufficient capital and allowing service quality to fall below acceptable levels..

b) Technological change may erase the private investor's value to the public agent if the private investor lacks the skill or capital to exploit significantly improved technologies. In that case, the public agent would be better off repurchasing shares in the P3 and entering into a new partnership with a different firm.[23]

c) If the private investor attempts to extract monopoly profits by limiting output, lowering quality, or raising prices, the P3 would be like a private monopoly. It would then be beneficial to repurchase shares from the private investor and enter into a new partnership, or create a public monopoly.

This arrangement would also seem to provide another political advantage, though one that is difficult to quantify economically. Awareness of the public agent's bail-out option reduces social (consumers' and voters') concern about potential disagreements between the public agent and the private investor.[24]

To be sure, the exit/bail-out option mechanism does not eliminate all problems relating to P3s. Governments would likely still be at a human capital disadvantage (e.g., it would be hard to transfer experienced staff) and the incumbent investor would still have an advantage over potential competitors. Nevertheless, the option contracts would reduce entry barriers by streamlining incomplete long-term contracts and avoiding contractual problems related to bounded rationality and opportunism. As a result, what had been a natural monopoly becomes more like a contestable market.

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[21] Including the option to bail-out a private investor from utility companies by the public agent is not a novel idea. This option is present, e.g., in cable TV license contracts in Los Angeles (Williamson, 1985, *op. cit.*).

[22] See Copeland, Koller, and Murrin (1994), *op. cit.*, pp. 457–458.

[23] Assuming the shares in the utility company will be sold at the same or better price.

[24] The awareness of the existence of the bail-out option might prove an effective social tranquilizer and reduce third-party opportunism (Moszoro and Spiller, 2012, "Third-Party Opportunism and the Nature of Public Contracts," *NBER Working Paper* No. 18636).