Opportunism in Public-Private Project Financing

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Background: Previous Research

<table>
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<th>0</th>
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<th>[20,40)</th>
<th>[40,60)</th>
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<th>100</th>
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<tbody>
<tr>
<td><strong>Concession</strong></td>
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<td>20</td>
<td>1</td>
<td>7</td>
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<td><strong>Greenfield project</strong></td>
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<tr>
<td>Build, lease, and transfer</td>
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<td>1</td>
<td>0</td>
<td>1</td>
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<td>11</td>
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<td>0</td>
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<tr>
<td><strong>Management and lease contract</strong></td>
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<td>Lease contract</td>
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<td>8</td>
<td>5</td>
<td>7</td>
<td>61</td>
<td>91</td>
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<tr>
<td>Management contract</td>
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<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>101</td>
<td>123</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td>232</td>
<td>31</td>
<td>162</td>
<td>553</td>
<td>376</td>
<td>307</td>
<td>2716</td>
<td>4377</td>
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</tbody>
</table>

|                | 5%  | 1%   | 4%   | 13%  | 9%   | 7%   | 62% | 100% |

Source: World Bank PPI Project Database

Marian Moszoro
Under conditions of financial advantage of the public sector and know-how advantage of the private sector, hybrid public-private capital structure may be more efficient than solely public or solely private capital structure.
Motivation for the Paper

1. Infrastructure & PPP: out of 4377 projects (9901 obs.), 94% have >20% private financing (World Bank’s PPI Data Base)

2. Utility companies have significant sunk investments & long-term payback

3. Risk of opportunism—public or private—can be an effective deterrent to many potentially successful PPPs
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” (Williamson, 1985)
Setup

1. Players with partially aligned interests:
   a) Private: profit
   b) Public: social output (consumer’s utility) + profit

2. Inelastic demand for infrastructure (≈fixed part in two-part tariff regime)

3. Opportunism
   a) Public agent can expropriate or over-regulate
   b) Investor can lower investments or quality

4. Opportunism for one period and information about deviation revealed in subsequent periods

5. Exit (put) & bail-out (call) over-the-counter options on private shares
Main Results

1. Repeated games increase payoffs achievable for the PPP agents comparing to the Nash stage game

2. Exit/bail-out options reduce the gains from opportunism and foster close cooperation

3. Exit/bail-out option mechanism for PPP combines the advantages of incomplete “once-and-for-all” contracts and long-term with short-term contracts

4. Option mechanism solves problem-free transfer of assets (Posner) and dynamic costs (Williamson)
Agenda

1. Opportunism in regulatory & PPP games
   a) One-shot regulatory game
   b) One-shot PPP game
   c) Repeated PPP game: conditions for public & private opportunism
   d) Example

2. Minimizing risk of opportunism
   a) Public opportunism → exit (put) options
   b) Private opportunism → Bail-out (call) options

3. Long-term, short-term, complete, incomplete contracts vs. exit/bail-out option mechanism

4. Generalization & other applications
One-Shot Regulatory Game

investor

not invest

(0, \(U_{pu}\))

invest

contract fulfillment

profit maximization

public agent

not regulate

penalize

not regulate

penalize

not invest

(0, \(U\))

invest

(0, \(U_{re}\))

(\(-A, \ U_{re} + A\))

(\(\pi_m, \ U_m\))

(\(\epsilon - A, \ U_{re} + A\))
One-shot PPP Game (jv)

**Diagram: One-shot PPP Game (jv)**

- **Investor**
  - Not invest
  - Invest and enter into PPP

- **Public Agent**
  - Not regulate
  - Penalties
  - Regulate

- **Equations:***
  
  - \((0, U_{pu})\)
  - \((-\theta \cdot A, U_{re} + A - (1 - \theta) \cdot A)\)
  - \((0, U^*)\)
  - \((\theta \cdot \varepsilon, U_{jv} + \varepsilon + (1 - \theta) \cdot \varepsilon)\)
  - \((\theta \cdot \pi_m, U_m + (1 - \theta) \cdot \pi_m)\)
  - \((\theta \cdot \pi_{jv}, U_{jv} + (1 - \theta) \cdot \pi_{jv})\)
  - \((\theta \cdot (\varepsilon - A), U_{re} + (1 - \theta) \cdot (\varepsilon - A) + A)\)
  - \((0, V_{pu})\)
  - \((\theta \cdot \varepsilon, U_{re})\)}
Public Opportunism in PPP Repeated Games

1. Unprofitability of opportunism in one period if future losses considered in a sequential game

2. High $r_{pu}$ or low NOPAT/I ratio $\rightarrow$ public agent’s opportunism

3. Public opportunism decreasing in NOPAT contradicts rent appropriation in private opportunism
Public Opportunism in PPP Repeated Games (2)

4. Example: Poznan Water Company in 2002
   a) Possible partial privatization, i.e., good case study
   b) NOPAT/I = 3.5% (2001), 1.3% (2002); \( r_{pu} = 6.65\% \); assuming \( \theta = 0.5 \), NOPAT/I should have been >9.975% to avoid public opportunism
   c) Low profitability and hence high likelihood of public opportunism could have been a deterrent for the private investor in the privatization process

5. Paradox: PPP may improve profitability, but because utility companies’ profitability is low before PPP, public agents are prone to behave opportunistically

6. As \( r_{pu} \) in emerging economies decreases, conditions for public opportunism will become more difficult to satisfy → investors should be more inclined to invest
1. **Contractual provisions** for compensation from the public agent when profit falls below the expected level: public agent in an ambiguous position (judge in own cause)

2. **Insurance** needs a factual trigger (not behavioral)

**Proposition 1**: A perpetual *exit (put) option* at a striking price equal to the annualized investment, where the public agent is short and the private investor long, offsets the gains from public opportunism in a PPP and thus reduces *ex ante* the probability of public opportunism
# Financial vs. Real Options

<table>
<thead>
<tr>
<th></th>
<th><strong>Financial Options</strong></th>
<th><strong>Real Options</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Underlying asset</strong></td>
<td>Investor’s shares in utility company</td>
<td>Physical (&quot;real&quot;) asset</td>
</tr>
<tr>
<td><strong>Form of the contract</strong></td>
<td>Standardized</td>
<td>Over the counter</td>
</tr>
<tr>
<td><strong>Pricing of the underlying asset</strong></td>
<td>Market</td>
<td>DCF-type + flexibility in decision making</td>
</tr>
<tr>
<td><strong>Risk</strong></td>
<td>Market and firm specific risk</td>
<td>Market and firm specific risk</td>
</tr>
<tr>
<td><strong>Decision method</strong></td>
<td>Comparison of market and strike price</td>
<td>Multiple criteria (incl. political and externalities)</td>
</tr>
<tr>
<td><strong>Incidence</strong></td>
<td>Singularly</td>
<td>Sequence of options</td>
</tr>
<tr>
<td><strong>Managing options and influencing their value</strong></td>
<td>Passive management</td>
<td>Active management</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>American/European</td>
<td>Commonly American</td>
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<tr>
<td><strong>Accessibility</strong></td>
<td>Financial markets</td>
<td>Over the counter</td>
</tr>
<tr>
<td><strong>Valuation model</strong></td>
<td>Black-Scholes (continuous data)</td>
<td>Binominal option pricing model</td>
</tr>
<tr>
<td><strong>Complexity level</strong></td>
<td>Standard</td>
<td>High complexity</td>
</tr>
<tr>
<td><strong>Execution right</strong></td>
<td>Option holder</td>
<td>Multiple agents involved</td>
</tr>
</tbody>
</table>
One-Shot PPP Game with Exit Option

Lemma 1: A contract with an exit option held by the private investor in a public-private company is always of non-negative value and satisfies minimax conditions.
Repeated PPP Game

\[ (1 - \sigma) \]

\[ G \]

\[ \sigma \]

\[ (1 - \sigma) \]

\[ -A \]

\[ \sigma \]

\[ (1 - \sigma) \]

\[ -A \]

\[ \sigma \]

\[ (1 - \sigma) \]

\[ -A \]

\[ \sigma \]

\[ (1 - \sigma) \]

\[ -A \]

\[ \sigma \]

\[ (1 - \sigma) \]

\[ -A \]
Repeated PPP Game with Exit Option

**Corollary 3**: The pessimistic private investor’s payoff of a contract with an exit option with a strike price equal to the annualized investment is non-negative and satisfies minimax conditions.
Minimizing the Risk of Private Opportunism

Opportunism strategy is profitable for the private investor if

\[ r_{pr} > 1 - (\pi_m - \text{NOPAT})/I \]

**Corollary 4:** The higher \( \pi_m \) and \( r_{pr} \), the more likely the private investor will behave opportunistically; the higher \( I \) and NOPAT, the less likely the private investor will behave opportunistically.

**Corollary 5:** Low NOPAT/I ratio increases the likelihood of both public and private opportunism.
Trigger to Bail-Out

1. Lack of fulfillment of contract terms regarding investments

2. Appearance of a new technology ("dynamic-costs problem") which the incumbent investor lacks and which can notably improve the effectiveness of the utility company

3. Monopoly profit by curbing production, lowering quality, or raising prices
   → Public agent might find it beneficial to regulate the monopoly or repurchase shares from the private investor and enter into a new partnership, or create a public monopoly
Bail-Out Option

1. Social tranquilizer and lower third-party opportunism (Spiller and Moszoro, 2011)
2. Tool for enhancing the efficiency of utility companies and lowering the costs of opportunistic renegotiations
3. Solves the “dynamic-costs problem” (Williamson, 1976) of periodically repeated auctions, i.e., “short-termism” in the investment behavior of the incumbent firm (Laffont and Tirole, 1993)
Option Mechanism: Conclusions

1. Stability of “once-and-for-all” and long-term contracts, with flexibility short-term contracts

2. Problem-free transfer of assets (Posner) boils down to the strike price of the options

3. Natural monopoly ≈ contestable market: reduce (behavioral) entry barriers

4. Mechanism does not eliminate the problem of human capital, transfer of experienced staff, and the advantage of the incumbent investor
1. Games where players have partially aligned interests and can deviate from cooperation or free-ride for one period, and information about deviation is revealed in subsequent periods:
   a) Mergers & Acquisitions
   b) Principal-agent relations (board options and financial crisis...)
   c) Cooperatives and export consortia

2. Call/put options foster long-term cooperation

3. Call/put options increase the payoffs of the players for each discount factor
1. Please, no mercy in comments and critics
2. Possible databases: factual or counter-factual
3. Email: mmoszoro@iese.edu
One-Shot Regulatory Game

investor

not invest

(0, \( U_{pu} \))

invest

contract fulfillment

profit maximization

public agent

not regulate

penalize

not regulate

penalize

not regulate

regulate

(0, \( U' \))

\((-A, U_{re} + A)\)

\((\varepsilon, U_{re})\)

\((\pi_m, U_m)\)

\((\varepsilon - A, U_{re} + A)\)
1. “Profit maximization” is the dominating strategy for the private investor

2. Public agent’s best response is “Penalization”

3. Subgame Nash equilibrium: “Profit maximization–Penalization”

4. Stage Nash equilibrium: “Not invest”
One-Shot PPP Game (jv)

**Diagram:**

- **Investor:**
  - Not invest
  - Invest and enter into PPP

- **Public Agent:**
  - Not regulate
  - Penalize
  - Regulate

**Equations:**

1. ** Investor (not invest):**
   \[(0, U_{pu})\]

2. ** Investor (invest and enter into PPP):**
   - Contract fulfillment and maximization of the consumer's utility
   \[-\theta \cdot A, U_{re} + A - (1 - \theta) \cdot A\]
   \[(\theta \cdot \pi_m, U_m + (1 - \theta) \cdot \pi_m)\]
   \[(\theta \cdot (\epsilon - A), U_{re} + (1 - \theta) (\epsilon - A) + A)\]

3. **Public Agent (not regulate):**
   \[(-\theta \cdot A, U_{re} + A - (1 - \theta) \cdot A)\]

4. **Public Agent (penalize):**
   \[\theta \cdot \epsilon, U_{jv} + (1 - \theta) \cdot \epsilon\]

5. **Public Agent (regulate):**
   \[\theta \cdot \pi_{jv}, U_{jv} + (1 - \theta) \cdot \pi_{jv}\]

- **Public Agent (not regulate):**
  - Not regulate
  - Penalize
  - Regulate

- **Public Agent (penalize):**
  \[\theta \cdot \epsilon, U_{re} + (1 - \theta) \cdot \epsilon\]
### “Invest and Enter into a PPP” Subgame Payoff Matrix

<table>
<thead>
<tr>
<th>Private investor</th>
<th>Contract fulfillment and welfare maximization</th>
<th>Mixed strategy</th>
<th>Profit maximization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Public agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not regulate</td>
<td>Regulate</td>
<td>Penalize</td>
</tr>
<tr>
<td></td>
<td>(0, $U^*$)</td>
<td>(0, $U_{re}$)</td>
<td>(-$\theta \cdot A$, $U_{re} + A - (1 - \theta) \cdot A$)</td>
</tr>
<tr>
<td></td>
<td>(0, $U^*$)</td>
<td>(0, $U_{re}$)</td>
<td>(-$\theta \cdot \pi_j$, $U_{re} + (1 - \theta) \cdot \pi_j$)</td>
</tr>
<tr>
<td></td>
<td>(0, $U^*$)</td>
<td>(0, $U_{re}$)</td>
<td>(-$\theta \cdot \pi_m$, $U_{re} + (1 - \theta) \cdot \pi_m$)</td>
</tr>
</tbody>
</table>

Note: $\pi_m$ – monopoly profit; $\pi_{re}$ – regulated monopoly profit; $\pi_j$ – public-private joint venture profit.
Normalized “Invest and Enter into a PPP” 
Subgame Payoff Matrix

<table>
<thead>
<tr>
<th>Private investor</th>
<th>Public agent</th>
<th>Profit maximization</th>
<th>Profit maximization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract fulfillment and welfare maximization</td>
<td>Not regulate</td>
<td>Regulate</td>
<td>Penalize</td>
</tr>
<tr>
<td>(0, G)</td>
<td>(0, 0)</td>
<td>(−A/2, A/2)</td>
<td>(0, G)</td>
</tr>
<tr>
<td>Mixed strategy</td>
<td>(G/2, G/2)</td>
<td>(ε/2, ε/2)</td>
<td>(G/2, G/2)</td>
</tr>
<tr>
<td>Profit maximization</td>
<td>(πm/2, Um − Ure + πm/2)</td>
<td>(ε/2, ε/2)</td>
<td>(πm/2, Um − Ure + πm/2)</td>
</tr>
</tbody>
</table>

Normalizations: \( U^* - U_{re} = G \), \( U_{iv} = U_{re} \), \( \pi_{iv} = G \), \( \theta = 1 - \theta = 0.5 \); then subtracting \((0, U_{re})\) from payoff matrix
Normalized “Invest and Enter into a PPP” Subgame Payoff Matrix

By backward induction, game simplified to choice of strategies made by the investor that correspond to **most effective protective strategies** chosen by the public agent.

<table>
<thead>
<tr>
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<th><strong>If</strong></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>$G &gt; \varepsilon + A$</td>
</tr>
<tr>
<td><strong>Private investor</strong></td>
<td>(0, G)</td>
</tr>
<tr>
<td>Contract fulfillment and welfare maximization</td>
<td></td>
</tr>
<tr>
<td>Mixed strategy</td>
<td>(G/2, G/2)</td>
</tr>
<tr>
<td>Profit maximization</td>
<td>(((\varepsilon - A))/2, (\varepsilon + A)/2)</td>
</tr>
</tbody>
</table>

Note: cases of weak inequalities disregarded

**Corollary 1:** *In a one-shot PPP game the best strategy for the private investor consists either of investing and implementing a mixed strategy of moderate profit if $G > \varepsilon + A$, or completely refraining from investing in all other cases. If $G < \varepsilon + A \leq I$, the private investor will not invest and will not enter into a public-private partnership.*
Pricing PPP Exit Option

\[
V_{\text{put}} = \text{NPV}_{pr\_put} - \text{NPV}_{pr}
\]

\[
V_{\text{put}} = 0 \cdot \frac{\sigma \cdot G}{(1 + r_{pr})} - 0 \cdot \left[ \frac{\sigma \cdot G - (1 - \sigma) \cdot A}{(1 + r_{pr})} \right]
\]

\[
V_{\text{put}} = 0 \cdot \frac{(1 - \sigma) \cdot A}{(1 + r_{pr})}
\]

**Lemma 1:** A contract with an exit option held by the private investor in a public-private company is always of non-negative value and satisfies minimax conditions.
Corollary 3: The pessimistic private investor’s payoff of a contract with an exit option with a strike price equal to the annualized investment is non-negative and satisfies minimax conditions
Pricing PPP Exit Option in Repeated Game (2)

In financial notation:

\[
\text{NPV}_{pr} = -I + \sum_{t=1}^{T-1} \frac{\theta \cdot \pi_{jv}}{(1 + r_{pr})^t} + \theta \frac{I \cdot (1 + r_{pr})}{(1 + r_{pr})^T}
\]

\[
\text{NPV}_{pr} = -I + \theta \cdot \left[ \pi_{jv} \frac{1 - (1 + r_{pr})^{-(T-1)}}{r_{pr}} + \frac{I}{(1 + r_{pr})^{T-1}} \right]
\]

Profit \( \pi_{jv} \) in all periods from 1 to \( T - 1 \) indicates that the cost of capital has been covered, while \( I/(1 + r_{pr})^{T-1} \) ensures that, upon execution of the option during the period \( T \) when the private investor incurs loss, the cost of capital will be recovered.
Contractual Characteristics of PPPs

1. “Serious contractual difficulties”: bounded rationality and opportunism

2. Complete “once-and-for-all” contracts (Stigler 1968): save on transaction costs; but claims from unforeseen circumstances, unrealistic

3. Incomplete long-term contracts (Demsetz 1968): enable renegotiation, soothe claims dispute from unforeseen events; but successful bidders can renegotiate terms, regulatory agent required

4. Renewable short-term contracts (Posner 1972): solve adapting long-term agreements; but questionable low transaction cost, equal conditions for incumbent bidders, and new bidders during contract renewals
Exit/Bail-Out Option Mechanism in Finance Language

<table>
<thead>
<tr>
<th></th>
<th>Bail-out (Call) option</th>
<th>Exit (Put) option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>long</td>
<td>short</td>
</tr>
<tr>
<td>Private</td>
<td>short</td>
<td>long</td>
</tr>
</tbody>
</table>
Public Long Call Option

![Diagram of a public long call option payoff graph]

- **Share Price at Maturity** vs **Profit**
- **Strike Price**
- **Payoff**
- **Profit**
- **Premium**

Marian Moszoro
Public Short Put Option
Private Long Put Option

![Graph of Long Put Option]

- **Profit**
- **Premium**
- **Payoff**

**Axes:**
- **X-axis:** Share Price at Maturity
- **Y-axis:** Profit

**Legend:**
- **Strike Price**
- **Long Put**
Private Short Call Option
Call/Put Options “Net”