Public-Private Partnerships: When and How

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A research partnership

Joint work with:

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Talk based on:

Motivation
Highways
Problems
Promises
Experience
Benchmark model
Sources of differences
Conclusion
Motivation

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Options for infrastructure provision

Three organizational forms:

- public/traditional
- privatization
- public-private partnerships (PPPs)

Generally private firms

Differences in:

- incentives
- political economy

This presentation: public provision vs. PPPs
Public infrastructure:

- long-lasting and irreversible investment used to provide a public service

PPP projects:

- highways, water and sewer plants, power plants, bridges, seaports and airports, hospitals, jails, schools
Inv. in PPPs: low-middle inc. ctries. 1990–2009
Investment in PPPs: Europe 2003–2011
Contracting under public provision and PPPs

PPP:
- bundles finance, construction and operation in a single long-term service contract between the procurement authority and a stand-alone private firm (SPV)
- legally and economically self-contained project
- cash flows of the project pledged to pay the project’s debt
- SPV compensated via user fees and/or government transfers
- government payments may be contingent on certain events

Public provision:
- government directly finances the project with public debt
- government hires separate builders and operators
Contracting under public provision and PPPs

(a) PPPs

Government

Special purpose vehicle

Service contract

Builder

Financiers

Debt & equity

Building contract

Operator

(b) Conventional provision

Government

Builder

Financiers

Debt

Building contract

Operator

O&M contract
Motivation

- Two decades of experience with PPPs:
  - mixed reviews
  - time to take stock

- Arguments in favor of PPPs:
  - invalid
  - valid
  - magnitude?

- Arguments in favor of public provision:
  - invalid
  - valid
  - magnitude?

- Netting out:
  - when is a PPP the best option?
  - how should PPP’s be done?
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Main type of infrastructure with PPPs (by value)

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<td>China</td>
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<td>Brazil</td>
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<td>India</td>
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<td>South Africa</td>
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<td>Colombia</td>
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Physical Characteristics of Highways

- **Investments:**
  - large, sunk upfront, long lived asset
  - usually a natural monopoly (interurban) or part of a network (urban)

- **Operation:**
  - excludable, rival (congestion an issue)

- **Deterioration (and therefore maintenance):**
  - highly nonlinear in axle weight
  - proportional to usage
  - apparent long after it is optimal to restore the road
Physical Characteristics of Highways

- **Quality of service is contractible:**
  - state of road can be verified by independent parties
  - can measure quality of service (e.g.: time needed to remove broken cars)

- **Demand:**
  - high (and mainly exogenous) uncertainty
  - example: Dulles Greenway

- **Why public intervention?**
  - network planning
  - intensive use of public space and rights-of-way
  - monopoly requires toll regulation
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Problems of Public Provision

- Poor choice of projects
  - Brazil, 1979–1984
    - built 6,000 kms of new roads ... while 8,000 kms of existing roads went from fair or good to bad quality

- Enforcing projects that are built fulfill service obligations
  - insufficient and untimely maintenance, too little, too late
  - three times the cost
  - lower quality of service on average
Problems

- Excessive cost of projects chosen
  - cost overruns
  - delays
  - agency problems
  - capture and corruption

- Financing the projects: user fees and taxes
  - inefficient pricing
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Promises of PPPs

- Relieving strained budgets
  - obviously not true if financed via government transfers
  - nor when financed mainly via user fees

- Efficiency gains
  - advantages of bundling ... when service contractible
  - incentives for appropriate maintenance

- Introducing competition
  - Chadwick vs. Williamson
Promises of PPPs

- Charging appropriate user fees
  - Indiana Toll Road

- Filtering white elephants
  - market test ... if financed via user fees and no major government guarantees
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**Experience**

**Benchmark model**

**Sources of differences**

**Conclusion**
Typical contract

- Fixed term: e.g., 30 years
- Firm chosen via competitive auction
- Bidding variable: lowest toll, shortest concession term, highest annual payment to the government (cannon), lowest subsidy
- Minimum income guarantees
- Profit/revenue sharing in high demand scenarios
- Fiscal accounting: poor or totally absent
- Typically the same agency in charge of planning, adjudicating, monitoring and regulating the concession contracts
Poor Fiscal Accounting and Spending Anticipation

PPPs allow off-budget spending.

Useful for politicians/government.

In the UK, only 23% of capital cost of 599 PFI projects up to April 2009 are on balance sheet.

"Cynics suspect that the government remains keen on PFI not because of the efficiency it allegedly offers, but because it allows ministers to perform a useful accounting trick."

*The Economist, July 2nd, 2009.*
Renegotiations and Spending Anticipation

While sometimes necessary, they are problematic

Often lead to additional works unrelated to original project

- circumventing budgetary controls
- paid by future administrations
- allow for pork barrel spending
- Santiago water collectors example

Guasch (2004), Guasch, Laffont and Straub (2007, 2008): analyze 1000+ PPPs in Latin America
Efficiency Costs of Renegotiations

- Lack of competition for additional (renegotiated) works may increase cost substantially
- Adverse selection of inefficient firms good at lobbying
- Moral hazard problem: government becomes careless
- Bad project selection: white elephants more likely
Evidence from Chile

- 50 concessions (28 highways) during 1995–2007
- 147 significant renegotiations (avg.: every 2.5 years)
- Upfront investment: US$ 8.4 bn
- Renegotiations: US$ 2.8 bn
- *When*: 78% of bilateral during construction phase
  - not good news for incomplete contract theories

- *What*: 84% of bilateral is additional investment.
- *Who pays*: 65% of bilateral paid by future administrations.
- *Fraction of PPP investment via renegotiation*:
  - Chile: 25% (EFGH, 2009).
  - Colombia: 63% (Bitrán, 2012).
  - Peru: 19% (Bitrán, 2012).
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Assumptions

- **Infrastructure costs** $I$ to firms, does not depreciate
- No maintenance or operation costs
- Present value of user-fee revenue exogenous, described by $f(v)$, support $[v_{\text{min}}, v_{\text{max}}]$. Corresponds to willingness to pay.
- Risk neutral planner maximizes social surplus by choosing optimal contract
  \[
  \{R(v), S(v)\}
  \]
  with $0 \leq R(v) \leq v$ and $S(v) \geq 0$.
- Risk averse firm, VNM utility $u(\cdot)$, outside option $u(0)$
- Cost of public funds: $1 + \lambda > 1$
- Total surplus only considers consumer surplus
Planner’s Problem

$$\max_{\{R(v), S(v)\}} \quad \overline{SV} \equiv \int CS(v)f(v)dv$$

s.t. $$\int u(PS(v))f(v)dv \geq u(0),$$

$$0 \leq R(v) \leq v,$$

$$S(v) \geq 0.$$
Consumer and Producer Surplus

\[ PS(v) = R(v) + S(v) - I, \]

\[ CS(v) = \left[v - R(v) - (1 + \lambda)S(v)\right] + \lambda[v - R(v)] \]

net consumer surplus + distortionary taxes saved

\[ = (1 + \lambda)[v - R(v) - S(v)]. \]
Planner’s Problem

\[
\min_{\{R(v), S(v)\}} \int [R(v) + S(v)]f(v)dv
\]

s.t. \[
\int u(R(v) + S(v) - I)f(v)dv \geq u(0),
\]

\[
0 \leq R(v) \leq v,
\]

\[
S(v) \geq 0.
\]
Example: Public provision

Public provision in this framework: \( R(\nu) \equiv 0. \)

Government pays upfront \( I' \geq I \) so that firm’s PC is satisfied

Then:

\[
SV(\nu) = (1 + \lambda)[\nu - I']
\]

Social value is maximized at \( I' = I \) attaining

\[
\overline{SV} = (1 + \lambda)[\overline{\nu} - I].
\]
Example: Fixed revenue contract

Consider any contract with $0 \leq R(v) \leq v$ and $S(v) \geq 0$ s.t.

$$R(v) + S(v) = I.$$ 

All these contracts achieve social value:

$$\overline{SV} = (1 + \lambda)[\overline{V} - I].$$
Example: Fixed term contract

Fixed term contract

Rents dissipated

Firm forced to bear risk, social value decreases by the risk premium amplified by the cost of public funds:

$$\overline{SV} = (1 + \lambda) \left[ \overline{v} - l - \sqrt{\frac{\rho}{2}} \sigma(PS) \right].$$

The risk premium can be large: 30% of $l$ (EFG, JPE, 2001).
Result 1: Irrelevance Result

Any combination of toll and subsidy schedules that satisfies 
\[ R(v) + S(v) = I \] for all \( v \), as well as \( 0 \leq R(v) \leq v \) and \( S(v) \geq 0 \), maximizes the social value of the highway project.

They include public provision and many PPP schemes.

If \( v_{\text{min}} \geq I \), they include a PPP financed entirely with user fees.

Optimal social value is given by:

\[ \overline{SV} = (1 + \lambda)[\overline{v} - I]. \]
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Beyond the Irrelevance Result

Differences between public provision and PPP can stem from:

- Differences in the distribution of $\nu$
- Differences in costs: $I$
- Hidden costs
Beyond the Irrelevance Result

- PPPs and public finance:
- Efficiency gains under PPPs:
- Hidden costs of PPPs:
- Risk and differences in financing costs
A. Public finance and efficient revenue collection

Only a fraction $\beta$ of consumer’s willingness to pay can be collected:

- $\beta_p$ under PPP
- $\beta_g$ under public provision

New constraint on $R(v)$:

$$R(v) \leq \beta v.$$ 

New consumer surplus:

$$CS(v) = (1 + \lambda \beta)v - (1 + \lambda)[R(v) - S(v)].$$

Then

$$\overline{SV}_p - \overline{SV}_g = \lambda(\beta_p - \beta_g)\overline{v}.$$ 

Substantial gain under PPPs: 20% of $\overline{v}$ if $\lambda = 0.2$ and $\Delta \beta = 1$. 
A. Public finance and avoiding public agencies

User fees: a very efficient way of putting money in private firms hands to provide infrastructure services

Government transfers are less efficient: rigidities in public spending, inefficiencies, corruption

Cost of putting one dollar in the concessionaire’s hands via government transfers: $1 + \zeta > 1$

Now it’s best to finance the concessionaire only via user fees

If $v_{\text{min}} \geq I$, only optimal contract: $R(v) \equiv I$, $S(v) \equiv 0$.

Social gain under PPP:

$$\overline{SV}_p - \overline{SV}_g = (1 + \lambda)\zeta I.$$ 

Can be large: 44% of $I$ when $\zeta = \lambda = 0.2$
Avoiding public agencies: Implementation

PVR contract:

- regulator sets toll schedule and discount rate
- firms bid on present value of toll revenues
- lowest bid wins
- contract lasts until winning bid collected:
Avoiding public agencies: PVR Auction

Properties of PVR:

- fair compensation is easy to calculate
- sizeable reduction in risk premium (33% of I; EFG, JPE, 2001)
- improves political economy of the contract
- easy to adjust tolls to demand: urban highways
- contractible quality of service important

Experience:

- PVR-type contract: first used in the UK:
  - Queen Elizabeth II bridge at Dartford
- First auction: Chile, 1998
Experience with Flexible Term Contracts: Chile
## Experience with Flexible Term Contracts: Chile

<table>
<thead>
<tr>
<th>Project</th>
<th>Month/Year auctioned</th>
<th>Winning bid (million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruta 68 (Stgo-Valparaiso-Viña)</td>
<td>02/1998</td>
<td>513</td>
</tr>
<tr>
<td>Ruta 160, Coronel-Tres Pinos segment</td>
<td>04/2008</td>
<td>342</td>
</tr>
<tr>
<td>Airport access road</td>
<td>07/2008</td>
<td>56</td>
</tr>
<tr>
<td>Melipilla-Camino de la Fruta connection</td>
<td>08/2008</td>
<td>46</td>
</tr>
<tr>
<td>Ruta 5, Vallenar-Caldera segment</td>
<td>11/2008</td>
<td>288</td>
</tr>
<tr>
<td>Concepción-Cabrero highway</td>
<td>01/2011</td>
<td>318</td>
</tr>
<tr>
<td>Alternative access road, Iquique</td>
<td>01/2011</td>
<td>167</td>
</tr>
</tbody>
</table>
B. Efficiency gains: Better and cheaper maintenance

Quality of service under PPPs often higher and maintenance much better.

Willingness to pay now will be $b\nu$ instead of $\nu$, with $b_p > b_g$.

Maintenance costs will be:

- **PPP**: $c_p R(\nu)$ for the concessionaire and $c_g [\nu - R(\nu)]$ for the government (after the concession ends)
- **Public**: $c_g \nu$. 
B. Efficiency gains: Better and cheaper maintenance

Financing via user fees now better than financing via government transfers: lower maintenance costs

Unique optimal contract implemented via PVR-auction: winning bid is \( I/(1 - c_g) \).

Social gains from reduced maintenance costs:

\[
SV_p - SV_g = (1 + \lambda) [b_p(1 - c_p) - b_g(1 - c_g)] I.
\]

Can lead to large gains under PPPs: 50% of \( I \)
B. Efficiency gains: Bundling

Non contractible effort during construction stage leads to lower maintenance cost $c$.

Construction firm has no incentive to exert effort under public provision.

Because construction and maintenance are bundled into one contract, concessionaire has incentives exert effort.

Similar to previous case, yet now lower costs of maintenance also apply after the concession ends.
C. Hidden costs of PPPs: Expenditure anticipation

Discounted Budget

<table>
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<th>Public provision</th>
<th>PPP</th>
<th>Privatization</th>
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<tr>
<td>Upfront surplus:</td>
<td>$-I$</td>
<td>$0$</td>
<td>$\bar{v} - I - \text{Risk Premium}$</td>
</tr>
<tr>
<td>Discounted user fees:</td>
<td>$\nu$</td>
<td>$\nu - I$</td>
<td>$0$</td>
</tr>
<tr>
<td>Total:</td>
<td>$\nu - I$</td>
<td>$\nu - I$</td>
<td>$\bar{v} - I - \text{Risk Premium}$</td>
</tr>
</tbody>
</table>

Insight extends to the case where PPP financed via government transfers (see EFG book).

Hence: from a fiscal perspective, PPPs are public projects which increase public debt in all but name.

**Recommendation**: public funds spent on a PPP should count as public debt, including future liabilities.
Improving governance of renegotiations

Independent specialized agency reviews and approves projects, reducing space for renegotiations.

Use service and not input standards in the PPP contract.

Additional works should be publicly tendered, if possible.

Independent agency ensures that contract value does not change after renegotiation:

- filters “bad faith” renegotiations
- avoids adverse selection problem
D. Risk and differences in financing costs

Often used argument against PPPs:

*The cost of debt for a PPP is considerably higher (200-300 basis point in normal times) than the cost of sovereign debt. Therefore PPPs should be chosen only if efficiency gains compensate for the higher financing costs.*
Three arguments against a PPP interest rate premium

1. Public financing costs only loosely related to profitability of project:
   - probability of default is main determinant

2. Exogenous risk in a PPP may be too high because of faulty contract design:
   - using a fixed term contract instead of PVR

3. Endogenous risk – higher cost of debt may be the flip side of stronger incentives under a PPP:
   - each dollar costs more, but overall project costs less (or provides higher surplus)
Concessionaire exerts effort $e$ during construction stage that results in cost reduction $\theta$ with probability $p(e)$ that satisfies standard properties.

High demand project: $v_{\text{min}} \geq I$

$U(y, e) = u(y) - ke$

$S(v) \equiv 0$: either $\zeta > 0$ or self-financing constraint

Then, under public provision:

- $e^* = 0$
- $R(v) \equiv I$
- Concessionaire bears no risk
Endogenous risk and PPP: formal model

Planner’s problem under a PPP:

$$\min_{\{R(\nu), e\}} \int R(\nu)f(\nu) d\nu$$

s.t.
$$p(e) \int u(R(\nu) + \theta - I)f(\nu) d\nu + (1 - p(e)) \int u(R(\nu) - I)f(\nu) d\nu \geq u(0) + ke,$$

$$e = \arg\max_{e' \geq 0} \{p(e') \int u(R(\nu) + \theta - I)f(\nu) d\nu$$

$$+(1 - p(e')) \int u(R(\nu) - I)f(\nu) d\nu - ke'\},$$

$$0 \leq R(\nu) \leq \nu,$$

$$e \geq 0.$$
Endogenous risk and PPP: formal model

Assume

\[ p'(0)\theta u'(\theta) > k. \]

Then:

- \( e^* > 0 \) and \( R(v) \equiv R^* < I \)
- Optimal contract attained via PVR auction
- Concessionaire bears risk, government bears no risk
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Conclusion
In favor of PPPs

Suspect:

- Saves public resources

Valid:

- Efficient revenue collection which reduces distortionary taxes
- Avoid public agencies
- Better and cheaper maintenance / bundling
- Filter white elephants
In favor of public provision

**Suspect:**

- Lower financing costs

**Valid:**

- Cannot be used to anticipate public spending
- Fewer opportunities to renegotiate
Taking Stock

- Potentially large welfare gains under PPPs
- Three out of four advantages of PPPs rely on user fees being a major source of revenue for the concessionaire
- Contractible quality of service also important
- We now know the policies to handle the main pitfalls under PPPs
References – Engel, Fischer and Galeovic

“Auctioning Highways in Chile”, *Estudios Públicos*, 1996


“The Basic Public Finance of PPPs,” forthcoming, JEEA.

“Renegotiation and corruption”, work in progress.

“Is there a PPP interest rate premium,” work in progress.