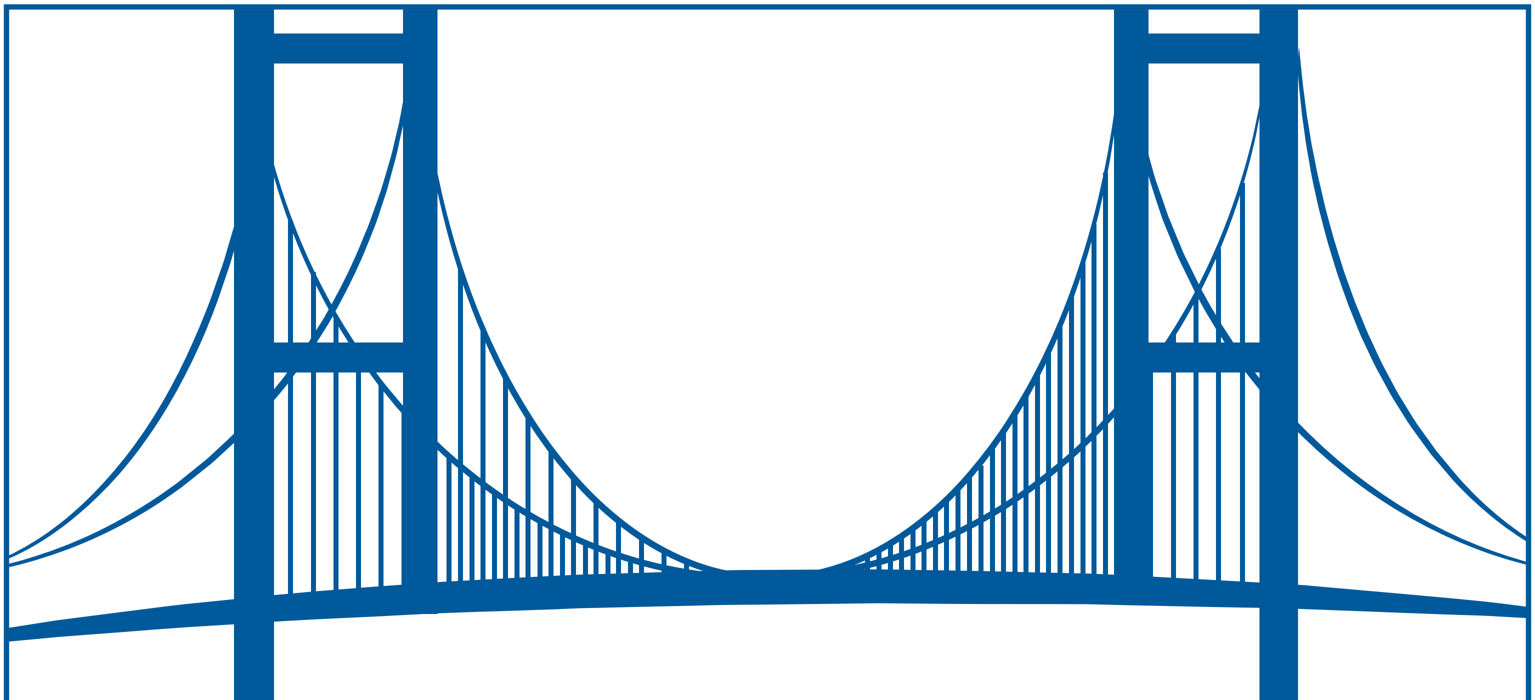

EXPANDING THE MARKET FOR INFRASTRUCTURE PUBLIC-PRIVATE PARTNERSHIPS

ALTERNATIVE RISK AND PROFIT SHARING APPROACHES TO ALIGN SPONSOR AND INVESTOR INTERESTS

U.S. DEPARTMENT OF THE TREASURY
Office of Economic Policy
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Abstract

Realizing the potential taxpayer benefits of public-private partnerships (PPPs) in infrastructure investment, including higher quality per dollar and faster project delivery, depends on allocating project risks to the party best able to manage them. Arguably, demand risk is the most important source of uncertainty affecting an infrastructure project's financial viability, particularly in the case of new build, or "greenfield" projects in which the private partner's compensation is determined by user volume, but for which no history of use exists. PPPs have typically used the basic user fee or availability payments models to allocate all demand risk and (therefore revenue risk) to either the private partner or the government, limiting the number of PPP deals that investors and project sponsors may find attractive. However, recent deals have migrated away from the basic user fee arrangement after several prominent PPPs using it encountered financial difficulty.

This paper presents three alternative incentive structures for PPP contracts that can potentially benefit both public sector sponsors, by delivering higher quality per dollar, and private investors, by generating attractive returns. The rate of return model, price cap model, and "sharing" model all apply principles from the regulation of privately-owned energy and telecom infrastructure to PPP projects that generate user fees. In addition, these alternative risk- and profit-sharing approaches may create choices that are attractive to investors and sponsors with risk preferences and return expectations not accommodated by more commonly used models. By expanding the options for sponsors and investors to consider in PPP negotiations, these incentive structures have the potential to increase the number of PPP deals and improve the odds of the projects' long-term success.

I. Introduction

Infrastructure investment is critical to America's continued economic success.[1] Our nation must modernize and maintain our roads, bridges, and water systems to help ensure that the United States remains a place for businesses to operate productively and grow, which will, in turn, create economic opportunity for Americans. Yet years of underinvestment in our public infrastructure have imposed massive costs on our economy. Drivers in the United States annually spend 5.5 billion hours in traffic resulting in costs of $120 billion in fuel and lost time.[2] U.S. businesses pay $27 billion in additional freight costs because of the poor conditions of roads and other transportation infrastructure.[3] Due to continuing deterioration of water systems throughout the United States, each year there are approximately 240,000 water main breaks resulting in property damage and repairs.[4] Despite the high costs imposed by insufficient or decrepit infrastructure, outlays for both capital investment and operations and maintenance (as a percent of GDP) made by all levels of government in transportation and water infrastructure have declined in recent decades.[5]

The need to reverse years of underinvestment in infrastructure, despite tighter budgets at every level of government, calls for us to rethink how we pay for and manage infrastructure investment. Some state and local governments have entered into public-private partnerships (PPPs) to provide and manage infrastructure that has traditionally been provided by the public sector. PPPs bring private sector capital and management expertise to the challenges of modernizing and more efficiently managing such infrastructure assets. Under a PPP, a government contracts with a private firm to design, finance, construct, operate, and maintain (or any subset of those roles) an infrastructure asset on behalf of the public sector. When the private sector takes on risks that it can manage more cost-effectively, a PPP may be able to save money for taxpayers and deliver higher quality or more reliable service over a shorter timeframe compared to traditional procurement. When sponsors contract with private partners that support strong labor standards, PPPs can also provide local economic opportunity and create good, middle-class jobs that benefit current and aspiring workers alike. Just as there is a range of roles that a private firm or firms can take on in a PPP, the nature of risk-sharing and compensation arrangements for bearing and managing risk can vary substantially from project to project and is

[1] This paper was authored by Elaine Buckberg, Owen Kearney, and Neal Stolleman.

[2] U.S. Executive Office of the President. National Economic Council and Council of Economic Advisers. 2014. *An Economic Analysis of Transportation Infrastructure Investment*. http://www.whitehouse.gov/sites/default/files/docs/economic_analysis_of_transportation_investments.pdf (accessed March 8, 2015).

[3] Ibid.

[4] "Aging Water Infrastructure." *Science Matters* 1, no. 1 (2010). http://www.epa.gov/ORD/sciencematters/april2010/scinews_aging-water-infastructure.htm (accessed April 13, 2015).

[5] Bosworth, Barry and Sveta Milusheva. "Innovations in U.S. Infrastructure Financing: An Evaluation." Presentation at the "Challenges for the Global Economy after the Tohuku Earthquake" Research Conference, Tokyo, Japan, November 7, 2011. http://www.nomurafoundation.or.jp/wordpress/wp-content/uploads/2014/09/20111107_Barry_Bosworth-Sveta_Milusheva_000.pdf (accessed March 8, 2015).

governed by contract. Expanding the options for risk- and profit-sharing is the focus of this paper.[6]

However, infrastructure — whether financed through traditional methods or PPPs — relies on funding sources to repay financing, whether debt, equity, or a combination. All infrastructure investments ultimately depend on either user fees, government tax revenues, or a combination of both. PPPs provide only financing and not funding. Therefore, community and political support for greater investment of government tax revenues or the imposition of user fees is critical to expanding investment in our nation's public infrastructure.

While PPPs cannot eliminate the need for government spending on infrastructure, we can help meet our nation's infrastructure needs by expanding the sources of investment and using those dollars, whether public or private, as effectively as possible to advance the public's interest. Other advanced economies, including Australia, Canada, and the United Kingdom, rely more heavily than the United States on PPPs to secure equity financing for infrastructure. This is due in part to the U.S. municipal debt market being the most developed of its kind in the world. Although the role of PPPs in the U.S. market is limited, the U.S. Department of the Treasury's research and engagement with stakeholders indicate that significant private capital could be mobilized for infrastructure investment. However, in order to attract this capital, U.S. public infrastructure assets will have to support higher rates of return than are currently generated through 100 percent low-cost debt financing in the municipal bond market. The challenge is for PPPs to demonstrate overall cost savings and efficiencies that outweigh the lower-cost financing advantage of traditional procurement.

PPPs allow governments to introduce private sector capital into a project and also harness private sector management and technical expertise. When a PPP transfers risks to the private sector that it can manage more cost-effectively, it can benefit taxpayers by lowering long-term project costs, improving the quality of services, or both. Yet a PPP is not necessarily the best choice for every project, and governments can evaluate whether a PPP achieves the same outcome for lower overall costs compared to traditional procurement by using a "Value for Money" (VfM) analysis. Canada, for example, requires VfM analyses for all major infrastructure projects (i.e., having capital costs greater than $100 million) to determine whether it is more cost-effective to use PPP or conventional procurement.[7]

This paper presents new and alternative PPP incentive structures that can potentially align public and private sector interests in infrastructure provision and management, in contrast to the "basic user fee" (i.e., toll) and "availability payments" models, which historically have been used in PPPs and allocate all demand risk (and therefore, revenue risk) to either the private sector partner or the government. Recently, PPP deals in the United States have begun migrating away from

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[6] U.S. Department of the Treasury. Office of Economic Policy. 2014. *Expanding Our Nation's Infrastructure through Innovative Financing.* http://www.treasury.gov/press-center/press-releases/Documents/Expanding%20our%20Nation%27s%20Infrastructure%20through%20Innovative%20Financing.pdf (accessed March 8, 2015).

[7] VfM methodology involves: 1) creating a Public Sector Comparator (PSC), which estimates the lifecycle cost of carrying out the project through a traditional approach, 2) estimating the lifecycle cost of the PPP alternative, and 3) completing an "apples-to-apples" comparison of the costs of the two approaches.

the basic user fee model, after several prominent PPPs using it encountered financial difficulty, and some recent projects have incorporated revenue-sharing.[8] In order to increase awareness of incentive arrangements that can be mutually beneficial for government sponsors and private investors, we draw upon incentive structures used in private industries that are regulated to protect the public interest — electric power, gas and oil pipelines, and telecoms — and apply them to PPPs. These industries have attracted substantial private investment flows while providing for demand risk to be shared between the government and the private sector.[9]

This paper explains incentive structures that allow for profit-sharing. For example, the private partner may transfer a portion of its earnings directly to the government, thereby sharing with taxpayers, or the private partner's cost savings may lower the price of using the infrastructure, sharing those savings with consumers. As extensions of the basic user fee model, these structures can enhance the private sector's incentive to operate efficiently. By offering options that mitigate the demand risk borne by the private partner, these incentive structures may expand the scope for executing PPP deals. For example, some investors may be attracted by being able to share the project's upside with the government in return for some protection from downside demand risk. In some states, including Texas, Florida, and New Jersey, PPP-enabling legislation specifically provides for various types of sharing arrangements.[10] The appropriate choice of model for any given project will depend on project specifics and the risk preferences of the project sponsor and investors.

The remainder of the paper is organized as follows: section II provides an overview of PPPs, section III presents three incentive structures for PPP contracts meant to expand the set of options beyond the basic user fee and availability payment models, and section IV concludes.

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[8] For example, the Indiana Toll Road, Texas SH 130, and the South Bay Expressway in San Diego all experienced financial strain because actual demand turned out to be less than projected. *See* Mallet, William J. *Indiana Toll Road Bankruptcy Chills Climate for Public-Private Partnerships* (CRS Insights No. IN10156). Washington, DC: Congressional Research Service, 2014. http://www.ncppp.org/wp-content/uploads/2013/02/CRS-Insights-Indiana-Toll-Road-Bankruptcy-Chills-Climate-for-P3s.pdf (accessed March 9, 2015).

[9] Various types of revenue- and profit-sharing mechanisms have been used in the regulated telecommunications, electricity, natural gas, and (in New York state only) water industries. *See* Sappington, David E. M. and Dennis L. Weisman. "Price Cap Regulation: What Have We Learned from 25 Years of Experience in the Telecommunications Industry?" *Journal of Regulatory Economics* 38, no. 3 (2010): 227-257; and The Brattle Group. "Alternative Regulation and Ratemaking Approaches for Water Companies," September 30, 2013. http://www.nawc.org/uploads/documents-and-publications/documents/NAWC_Brattle_AltReg_Ratemaking_Approaches_102013.pdf (accessed March 8, 2015).

[10] Under Florida's PPP-enabling legislation, a negotiated portion of revenues from fee-generating uses must be returned to the public entity over the life of the agreement. *See* http://laws.flrules.org/2013/223 http://www.flsenate.gov/Session/Bill/2013/0085/BillText/er/PDF (accessed April 20, 2015). Under Texas PPP legislation, the responsible government entity may consider the opportunity for revenue-sharing as one of the project selection criteria, among other factors. *See* http://www.statutes.legis.state.tx.us/Docs/GV/htm/GV.2267.htm (accessed April 20, 2015). The PPP between the Bayonne New Jersey Municipal Authority (BMUA) and Kohlberg Kravis Roberts & Co (KKR) was approved pursuant to the provisions of the "New Jersey Water Supply Privatization Act." *See* http://www.nj.gov/dep/watersupply/pdf/statut_58.26-1.pdf (accessed March 12, 2015). The agreement incorporates revenue-sharing. *See* NW Financial Group, LLC. "Why the Bayonne Water/Wastewater Public-Private Partnership Succeeded," April 1, 2013. http://www.nwfinancial.com/pdf/NW-BMUA-Report.pdf (accessed April 14, 2015).

II. Background on Public-Private Partnerships

PPPs as an alternative to traditional infrastructure procurement and management

Publicly-owned infrastructure assets are typically designed, constructed, operated, and maintained through "conventional procurement," in which the sponsoring government owns the asset but separately contracts for each service, often from different private firms. Under conventional procurement, the government first contracts with a private entity to supply the infrastructure design, then seeks bids to build the asset according to that design, likely from a separate firm, and finally, operates and maintains the infrastructure asset, or takes bids from yet another firm. With competitive bidding, this approach allows the public sector to have highly qualified private firms fulfill the requirements of various project phases; however, contracted parties do not have an incentive to minimize lifetime project costs, only costs incurred during their respective phases.

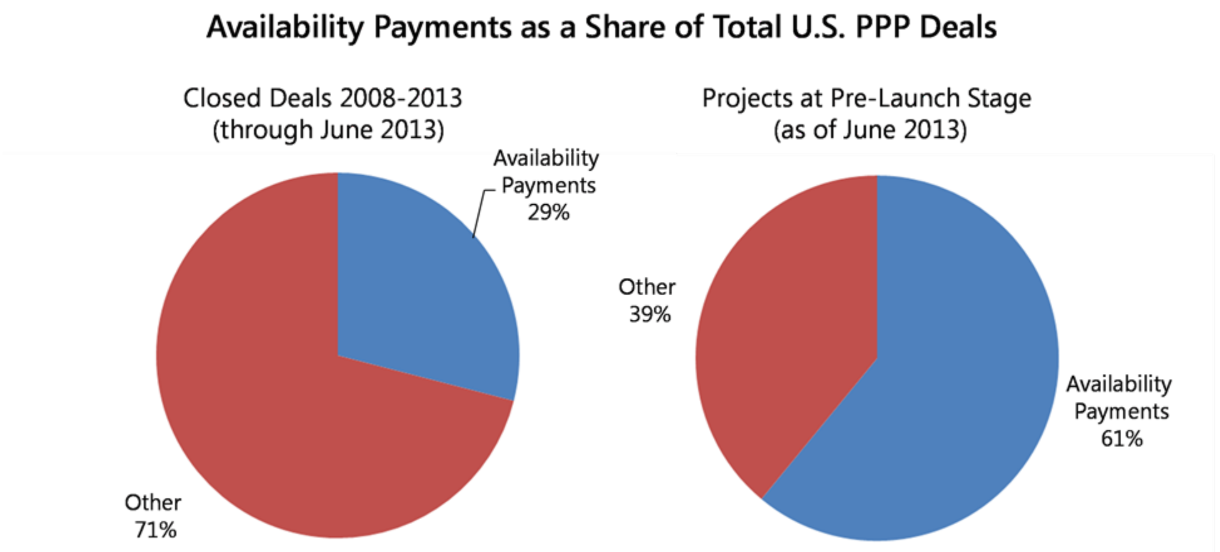
Under a PPP, the government retains ownership of the infrastructure asset, while the private sector is afforded a much greater role in delivering and managing the asset compared to conventional procurement. This paper focuses on PPPs that transfer responsibilities for multiple phases of a project to the private partner. Consider a PPP where the government contracts with a private company to build or improve an infrastructure asset and to subsequently maintain and operate that asset for a number of years in exchange for a stream of revenue during the life of the contract, where the revenue stream will take the form of either user fees or availability payments.[11] This contrasts with conventional procurement, as described above, in that the government is directly contracting with a *single* private entity or consortium to complete the various aspects of the project. As the single responsible party for multiple stages of the project, the private partner is then motivated to minimize costs across those project phases — an incentive that is lacking under conventional procurement. Although the government owns the asset, many PPP contracts extend for 30 years or more, so that the private partner has control over a significant portion of the useful life of the asset. Finally, PPPs can vary in the extent to which they transfer responsibilities from the public to the private sector.

A PPP requires dedicated revenue in order to be financially viable, whether from user fees or the government; a central consideration in structuring a PPP is which party will face uncertain project revenue due to the unknown future demand for the infrastructure asset's service. In the two basic models, the PPP places all demand risk (and therefore revenue risk, as well) with either the government or the private partner. In a basic *user fee* arrangement, the private partner collects and retains all fees from consumers of the service, e.g. bridge tolls and payments for water bills, and so bears all the risk of uncertain demand for the service. Alternatively, in an *availability payments* model, the government sponsor collects any revenue from users and makes fixed, recurring payments to the private partner provided the asset meets contracted quality

[11] *See* page 2 of Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. *The Economics of Public-Private Partnerships*. New York: Cambridge University Press, 2014.

standards; because availability payments do not vary with asset use, the government bears all the demand and revenue risk.[12]

Recently, private investors in PPP projects have sought to reduce exposure to demand risk following some troubled toll road PPP transactions.[13] As use of the basic user fee model has declined, the availability payment model has been adopted in an increasing percentage of U.S. PPPs, as illustrated by the chart below.



SOURCE: Allison, Peter. Welcoming remarks. Presentation at InfraAmericas US P3 Infrastructure Forum 2013, New York City, USA, June 18, 2013.

Driven in part by the loss of the bond insurance markets and a newfound conservatism among senior debt lenders, project sponsors have also found new ways to structure PPPs to mitigate or retain risks that private investors no longer find acceptable.[14] As shown in Table 1 below, a number of projects closed in the last three years incorporate revenue-sharing provisions.

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[12] For example, assume that the government expects 100 cars per week to use a toll road, and that it will use the collected tolls from 100 cars to fund the weekly availability payment to the private partner. If only 20 cars use the toll road during a given week, the government must still pay the private firm the equivalent of the toll collections from 100 cars because the availability payment is a fixed obligation.

[13] Mallet, William J. *Indiana Toll Road Bankruptcy Chills Climate for Public-Private Partnerships* (CRS Insights No. IN10156). Washington, DC: Congressional Research Service, 2014. http://www.ncppp.org/wp-content/uploads/2013/02/CRS-Insights-Indiana-Toll-Road-Bankruptcy-Chills-Climate-for-P3s.pdf (accessed March 9, 2015).

[14] *See* U.S. Department of the Treasury. Office of Economic Policy. 2014. *Expanding Our Nation's Infrastructure through Innovative Financing.* http://www.treasury.gov/press-center/press-releases/Documents/Expanding%20our%20Nation%27s%20Infrastructure%20through%20Innovative%20Financing.pdf (accessed March 8, 2015). Also *see* U.S. Department of Transportation. Federal Highway Administration. 2010. *Public-Private Partnership Concessions for Highway Projects: A Primer*. http://www.fhwa.dot.gov/ipd/pdfs/p3/p3_concession_primer.pdf (accessed March 11, 2015). If performance standards are not met, availability payments can be reduced or eliminated.

Table 1: U.S. PPP Deals, April 2012-April 2015

Project	Sector	Financial Close	Amount ($mil.)	Incentive Structure[15]
Midtown Tunnel	Transport	2012	2,100	Revenue-sharing
Presidio Parkway Doyle Drive Concession	Transport	2012	362	Availability payments
I-95 HOV/HOT Lanes	Transport	2012	923	Revenue-sharing
I-95 North, SR 406 to SR 44,	Transport	2012	118	Availability payments
SR 9B Extension - Duval County	Transport	2012	95	Availability payments
Maryland I-95 Travel Plazas Redevelopment	Transport	2012	56	Revenue-sharing
I-75 Expansion	Transport	2012	72	Availability payments
Rialto Water System	Water	2012	172	Revenue-sharing
Bayonne Water & Wastewater Concession	Water	2012	173	Revenue-sharing
Carlsbad Seawater Desalination Plant	Water	2012	903	Availability payments
Ohio River Bridges Project - East End Crossing	Transport	2013	763	Availability payments
North Tarrant Expressway Segments 3A, 3B	Transport	2013	1,350	Revenue-sharing
Goethals Bridge	Transport	2013	1500	Availability payments
Georgia Northwest Corridor (NWC)	Transport	2013	840	Basic user fees
US 36	Transport	2014	120	Revenue-sharing
I-69	Transport	2014	370	Availability payments
I-4 Ultimate	Transport	2014	2300	Availability payments
SH 183 - Dallas-Fort Worth (Gap Financing)	Transport	2014	848	Revenue-sharing
Pennsylvania Bridges Project	Transport	2015	900	Availability payments
Southern Ohio Veterans Highway	Transport	2015	553	Availability payments

Sources: InfraDeals and project descriptions from state departments of transportation and concession agreements.

Benefits of PPPs

By providing incentives to the private partner to minimize costs across project stages, while also requiring that stipulated quality standards be satisfied, a PPP can lower costs over the life of the asset, lower the cost of using the asset by improving quality of service, and reduce the time until the project is complete and operational. These incentives arise because the PPP contract both holds the private partner responsible for paying the unknown future costs of completing various project phases, and endows the private partner with full decision-making power and control of the asset in completing those phases. In other words, a PPP relies on transferring risks from the public to the private sector in order to ultimately realize efficiency gains.

[15] Projects categorized as "Basic user fees" collect user fees but their contracts do not include any sharing provisions. The projects categorized as "Revenue-sharing" also collect user fees, but their contracts generally stipulate that project revenues are shared between the public sponsor and the private partner in some fashion. In contrast to the basic use fee model, under the revenue-sharing model, the private partner does not bear all of the demand risk (and therefore not all of the revenue risk, either). These revenue-sharing structures may include some but not all of the elements of the incentive structures described in section III.

Mandating quality standards is important because a PPP incentivizes cost-cutting. Consumers care about both cost and quality; cost-cutting becomes undesirable if it results in *unacceptably* lower quality of the infrastructure asset and the service that it provides. Quality is "contractible" if the stipulated level of quality can be translated into contractual terms and readily verified by the government and the private party. Given the importance of contractible quality for potential efficiency gains through PPPs, whether or not quality is contractible carries implications for which types of infrastructure projects are appropriate for PPPs. In instances where quality is not contractible, a PPP contract is more likely to induce the private partner to cut costs in ways that result in suboptimal quality of the infrastructure service.[16]

Because a PPP incentivizes cost-cutting, some private partners may seek to reduce labor costs by lowering wages. Lowering wages for workers on a project may reduce costs but it does not create additional value for taxpayers. On the contrary, cutting wages is likely to reduce the quality of labor. Requiring strong labor standards is one strategy to ensure that the cost reductions from PPPs are not achieved simply through wage reductions.

By both transferring risk and imposing verifiable quality standards, a PPP contract can induce efficiency-increasing reductions in cost via two avenues:

1. **"Bundling" responsibility for multiple project phases** incentivizes the private partner to capture cost savings across phases, such as by making long-view investment choices in earlier phases of the project that reduce costs in later phases. For example, using higher quality but more expensive paving material on a road might prevent potholes and reduce maintenance costs. In conventional procurement, such incentives are absent because different parties are typically responsible for the construction and maintenance phases.[17] Bundling can also encourage accelerated project delivery; if the private partner is responsible for the construction, operation, *and* financing of the project, and receives a share of project revenues, then it will have increased incentives to complete construction and begin operation as early as possible in order to start providing a return to both debt and equity investors.

2. **Contractually obligating the private partner to meet minimum asset and service quality standards** can improve efficiency and produce further cost savings. Minimum standards can prevent the deferral of maintenance and resulting asset deterioration,

[16] In some situations where it is not possible to contract output quality directly, it might still be possible to do so indirectly by stipulating quality standards for the inputs. This is only effective, however, if the choice of inputs determines the quality of the output in a predictable way known by the project sponsor. Also, selection of inputs by the government precludes the private partner from using its technical and managerial expertise to choose the efficient mix of inputs. In these cases, a PPP may not be the best choice for organizing the project.

[17] For discussions of why the government might have difficulty achieving cost savings across project phases on its own, *see* Hall, John. "Private Opportunity, Public Benefit?" *Fiscal Studies* 19, no. 2 (1998): 121-140; and Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. "Public-Private Partnerships: When and How." Working paper, Yale University (2008). http://www.econ.uchile.cl/uploads/publicacion/c9b9ea69d84d4c93714c2d3b2d5982a5ca0a67d7.pdf (accessed March 12, 2015).

therefore lowering the costs to users imposed by a degraded asset (e.g. potholes on a road increase vehicle wear-and-tear).

Finally, the government may not realize the potential cost savings from a PPP discussed above if the procurement process is not competitive or if contract renegotiations resulting in additional reimbursement from the government to the private partner are prevalent. The possibility of successful renegotiation by the contract awardee induces “moral hazard”: if the concessionaire believes that it can extract additional payments from the sponsor to cover its higher costs, then the incentive for cutting costs is blunted. While the benefit of setting minimum contractual quality standards is not unique to PPPs, it is particularly relevant for the long-term transfer of responsibility.

Risk and risk transfer in PPP contracts

The chief mechanism for realizing cost savings in a PPP, bundling, requires the transfer of multiple project risks from the public to the private sector.[18] Under conventional procurement, taxpayers bear most of the risks identified in Table 2 below, even those risks that the government is not well-positioned to influence.[19,20] The net benefit from PPP procurement is maximized when 1) a given controllable risk is allocated, and the related decision-making authority is delegated, to the party that can best influence it, and 2) any risk that no party can control is allocated to the party that is best able to manage or diversify it.[21]

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[18] The term “bundling” can also have another meaning in the context of PPPs: “…contracting with one partner to provide several small-scale PPP projects in order to reduce the length of the procurement process as well as transaction costs.” *See* page 17 of Deloitte Research. “Closing America’s Infrastructure Gap: The Role of Public-Private Partnerships,” 2007.
http://worldbank.mrooms.net/file.php/251/docs/optional_readings/Closing_America_s_Infrastructure_Gap.pdf (accessed April 13, 2015).

[19] An exception is performance risk, which is borne by users.

[20] This even includes the risk of construction cost overruns — which are borne by the construction company under the actual contract — if contract renegotiations are commonplace. *See* Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. *The Economics of Public-Private Partnerships*. New York: Cambridge University Press, 2014.

[21] A party more effectively manages a risk that cannot be directly controlled when it minimizes the expected dollar impact conditional on bad outcomes occurring, minimizes the probability of bad outcomes, or both.

Table 2: Major Risks in an Infrastructure Project[22]

Risk Category	Examples of (Downside) Risks
Design	▪ Design flaws
Construction	▪ Construction cost overruns ▪ Delays to completion
Operations and Maintenance	▪ Higher operations costs ▪ Higher maintenance costs
Performance	▪ Periods of service unavailability ▪ Lower service quality
Policy	▪ New competing capacity
Demand	▪ Lower utilization than initially forecasted
Financial	▪ Higher interest rates ▪ Less favorable exchange rates

In general, as the number of related risks that can be appropriately transferred to the private partner increases, the incentives for cost saving are strengthened. For example, the "design-build" (DB) contract transfers both design and construction risk, which incentivizes the private partner to design the project so as to minimize building costs and the likelihood of design flaws.[23] The "design-build-operate-maintain" (DBOM) model additionally encourages the private partner to select building methods and materials that minimize operations and maintenance costs, while the "design-build-finance-operate-maintain" (DBFOM) structure also incentivizes the private partner to reach the operations phase as early as possible to begin paying back investors. Performance risk is also transferred from users to the private partner when the PPP contract sets quality standards for the infrastructure assets and services.

Some risks to private investors in a PPP are in the public sector's control: for example, a local government could construct a non-tolled road competing for the same users as an existing PPP toll road.[24] Flexible contracts can minimize the need for renegotiation in these cases. Including adaptable competition clauses can help preserve the government's ability to build competing projects that are in the public interest while providing protections to investors. For example, Florida's PPP-enabling legislation for transportation facilities specifically requires that, among other things, proposed projects must have adequate safeguards in place to ensure that the Florida Department of Transportation has the opportunity to add capacity serving similar origins and

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[22] The categorization of risks in Table 2 follows, in part, the discussion in Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. *The Economics of Public-Private Partnerships*. New York: Cambridge University Press, 2014.

[23] In addition, project delivery time may be shortened compared to conventional procurement because of better coordination between the design and build functions.

[24] In some cases, state-specific PPP legislation may restrict the flexibility of PPP contracts, e.g. in Arizona and North Carolina, the public sector is *required* to maintain comparable non-tolled roads when it establishes new toll roads. Also, there are prohibitions against non-compete clauses in Alabama, Florida, Mississippi, North Carolina and Texas. *See* Appendix B of National Conference of State Legislatures. "Public-Private Partnerships for Transportation: A Toolkit for Legislators," October 2010. http://www.ncsl.org/documents/transportation/PPPTOOLKIT.pdf (accessed March 9, 2015).

destinations; having this type of flexibility is especially important if, for example, persistent congestion develops on the privately operated facility.[25]

When user fees comprise the entirety of the private party's revenue stream, demand risk is likely the central determinant of the PPP's financial viability. While all projects are subject to uncertainty regarding future utilization, demand forecasts for so-called greenfield projects are particularly unreliable because there is no past usage baseline.[26] According to the World Economic Forum, excessively positive forecasts have been common in PPP road projects.[27] Not coincidentally, a number of road PPP projects have entered bankruptcy.[28]

Demand risk differs from other risks that can be beneficially transferred to the private partner ─ such as design, construction, operations and maintenance, performance ─ in that the private partner's actions can do little to influence the risk. Yet, as with the models presented in the next section, exposing the private partner to some (if not necessarily all) demand risk might attract potential investors looking for upside potential not possible under an availability payments arrangement (in which they would be completely insulated from demand risk).

III. Innovative Revenue, Profit, and Risk-sharing Arrangements for Infrastructure Provision

Discussions of PPPs in the United States have often focused on user fee or availability payment agreements, where either the private partner or the government sponsor bears all of the demand risk (and therefore all of the revenue risk, as well).[29] Following the financial difficulties of some user fee toll road projects, private investors have looked increasingly to the availability payments model to reduce exposure to revenue volatility.[30] Project sponsors have also found new ways to

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[25] The legislation states that, before approval, the Department of Transportation must determine that the proposed project "would have adequate safeguards in place to ensure that the department or the private entity has the opportunity to add capacity to the proposed project and other transportation facilities serving similar origins and destinations." *See* http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0334/Sections/0334.30.html (accessed March 30, 2015).

[26] A "greenfield" PPP infrastructure project is one in which the private partner designs and constructs a brand new infrastructure asset, and may operate it, depending on the specifics of the PPP arrangement. In a "brownfield" project, the private partner assumes temporary control of an existing asset for purposes of upgrading its capacity and/or quality, and may also operate it.

[27] World Economic Forum. "Strategic Infrastructure – Steps to Prepare and Accelerate Public-Private Partnerships," May 2013. http://www3.weforum.org/docs/AF13/WEF_AF13_Strategic_Infrastructure_Initiative.pdf (accessed March 8, 2015).

[28] Dezember, Ryan and Emily Glaser. "Drop in Traffic Takes Toll on Investors in Private Roads." *Wall Street Journal*, November 20, 2013.

[29] *See*, for example, Sobel, Patrick and Robert Puentes. "Private Capital, Public Good — Drivers of Successful Infrastructure Public-Private Partnerships." Brookings Institution, (2015). http://www.brookings.edu/research/reports2/2014/12/17-infrastructure-public-private-partnerships-sabol-puentes (accessed April 17, 2015).

[30] Mallet, William J. *Indiana Toll Road Bankruptcy Chills Climate for Public-Private Partnerships* (CRS Insights No. IN10156). Washington, DC: Congressional Research Service, 2014. http://www.ncppp.org/wp-

structure PPPs to mitigate or retain risks that many private investors no longer find acceptable, including introducing revenue-sharing. The allocation of demand risk, therefore, need not be limited to user fees or availability payments.

By further broadening the scope for PPP negotiations beyond the two basic models, this paper aims to increase the likelihood that potential partners will find a mutually agreeable structure that aligns public and private interests in infrastructure provision and operation. The remainder of this paper discusses three alternative incentive structures for PPP contracts that may help partners reach agreement and align interests. Which structure, including the basic models, is most suitable for a given project, will depend on the specifics of that project and the risk preferences of the project sponsor and investors. The frameworks discussed in this paper are formulated in terms of a single price for an infrastructure service, such as a toll per vehicle on a highway or rate per gallon of water consumed. However, the concepts are equally applicable to multiple prices within a given infrastructure service, such as variable rate tolling for managing demand and reducing congestion on highways.

In brief, the three alternative models are as follows:

- Rate of return model: The rate of return model balances consumer and investor interests by placing a limit directly on the *allowed* rate of return on investment, and setting a regulated price that generates the revenue the firm anticipates it will require to cover its expected costs and earn the designated return. The regulated price can be adjusted at set intervals so that the firm earns the designated rate of return. The regulated price will be increased if, for example, the actual rate of return falls short of the designated rate, where the time between price adjustments carries implications for risk-sharing and the incentive to operate efficiently. For instance, a long wait until the price can increase places more of the demand risk on the private firm while providing a strong incentive to hold down costs; conversely, a shorter wait until the price can increase places less of the demand risk on the private firm and provides less incentive to lower costs.

- Price cap model: A variation of the basic user fee model, the price cap model balances consumer and investor interests by limiting the price of the infrastructure service instead of the rate of return. Since profits are not directly constrained, there is a powerful incentive to minimize costs; also, the private firm assumes all demand risk because price cannot be increased in response to a demand shortfall. Under this model, the maximum price increases each year by the rate of inflation minus the *expected* rate of improvement in the firm's productivity, which achieves a balance between the public and private sector by compensating the firm for higher nominal input costs, while allowing consumers to benefit from anticipated productivity gains (the private firm retains *all* gains from productivity improvement in the basic user fee model). The built-in expected productivity assumption provides an added efficiency incentive because the firm is able to retain productivity gains in excess of projections; the expected productivity assumption can be varied periodically to keep it aligned with changes in actual performance.

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content/uploads/2013/02/CRS-Insights-Indiana-Toll-Road-Bankruptcy-Chills-Climate-for-P3s.pdf (accessed March 9, 2015).

- Sharing models: Contracts with profit-sharing can directly align sponsor and investor interests. For example, if the project exceeds or falls short of negotiated threshold rates of return, the partners can either share the excess return or absorb the shortfall in contractually defined proportions. This type of flexibility expands the universe of acceptable deals because investors may be more willing to enter into an agreement where they are required to share the project's upside potential with the government if the public sector, in turn, provides some protection from demand risk on the downside.

The rate of return and price cap models adopt principles used in public utility regulation, including the energy and telecom industries, where infrastructure assets are privately owned and regulation is used to protect taxpayer and customer interests while allowing reasonable profits.[31] Different forms of profit- or revenue-sharing have also been incorporated into the regulation of energy, water, and telecommunications sectors, as well as in some highway and water PPP projects.

The alternative incentive structures discussed below could be implemented by incorporating key characteristics of the contract into the competitive bidding process widely used to award PPP contracts.[32] For example, the public sponsor, with the assistance of outside financial experts, could define the structure of the desired contract, and private firms vying for the project would bid on the specific contractual elements, such as their preferred sharing percentages or demand and rate of return thresholds.[33] Similar processes are used in the energy and telecom industries, where regulators set the allowable rate of return after evaluating cost and demand information supplied by the public utility as part of the rate-setting process. In the context of a PPP transaction, the public sponsor would evaluate the bids, selecting the bidder most likely to deliver the project at the lowest lifecycle cost while meeting quality standards, thus maximizing value for taxpayers. Incorporating these additional elements should not impose onerous information requirements on bidders, since much of the required data would be needed for bid preparation in any event.[34]

In the remainder of this section, we provide a conceptual overview of the three incentive structures which can be applied in PPP projects where user fees can be collected, quality standards are contractible, and provision of the infrastructure service is characterized by

[31] In public utility regulation, the "reasonableness" of profits generally is determined by regulators.
[32] Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. "Public-Private Partnerships: When and How." Working paper, Yale University (2008). http://www.econ.uchile.cl/uploads/publicacion/c9b9ea69d84d4c93714c2d3b2d5982a5ca0a67d7.pdf (accessed March 12, 2015).
[33] The agreed upon values for specific contract elements will depend on the specific project; demand uncertainty is greater for a new greenfield project compared to a brownfield project where existing assets with a documented history of demand are temporarily transferred to the private partner.
[34] To take a hypothetical example, if the public sponsor, after consulting with outside financial experts, specifies the contract will include a rate of return threshold of X% and that the sponsor will absorb Y% of any return shortfall, then private firms will simply submit bids on the minimum values of X and Y they are willing to accept, and the sponsor will select from among these. The logical structure of contract terms would be straightforward to implement.

economies of scale.[35] We review each model in terms of the incentives it provides for cost efficiency, technical innovation, and service quality during the project's operational phase, and how demand risk and operations and maintenance risk are allocated between the public and private partners.[36]

1. **Rate of return model: *A regulated price that covers costs and provides a return***

The rate-base rate of return model has been a cornerstone of public utility regulation in the United States since the early 1900s and has been widely used at both the federal and state levels to regulate privately-owned, public utilities such as electricity transmission, oil and gas pipelines, telecommunications, and water utilities, for which there is little or no competition by design. For example, the Federal Energy Regulatory Commission (FERC) is responsible for regulating the rates that interstate oil and natural gas pipelines charge for transportation, while individual state public utility commissions (PUCs) regulate the local distribution companies.

The rate of return model protects consumers from excessive rates by setting a regulated price that approximates what the price would be if the utility had to compete with similar firms instead of operating as a monopoly franchise.[37] At the same time, the price is calculated to explicitly allow the private firm to recover its costs and earn a return on its "rate base," which essentially is the value of fixed assets used to produce the infrastructure service.[38] Although the rate of return model has primarily been used to regulate private firms, we propose that the model offers similar protection to consumers of infrastructure services that exhibit natural monopoly characteristics or that are otherwise imperfectly competitive. Infrastructure project sponsors and private partners can agree to adopt a rate of return model by incorporating its salient features in a PPP contract.

How does the rate of return model work?

This simple formula illustrates how the allowable price is determined.

$$Allowable\ price = \frac{Operations\ \&\ maintenance\ expenses + depreciation + taxes + (rate\ base \times rate\ of\ return)}{Demand}$$

[35] Economies of scale means that a firm's output can be doubled for less than a doubling of cost. This often arises in large-scale infrastructure projects because a high proportion of total costs are fixed, meaning they do not vary with the level of output. The result is that the average cost of producing an additional unit of output falls as output increases.

[36] In situations where user fees cannot be collected or where quality standards are not contractible, conventional public provision of infrastructure may be more appropriate than public-private partnerships.

[37] Large-scale infrastructure is characterized by high fixed costs, e.g. transmission lines and towers for electricity supply or pipelines for gas and water supply, giving rise to economies of scale (because most costs are fixed and the firm's output can double, for example, for less than a doubling of cost). Firms characterized by this type of production are called *natural monopolies*, because one firm can produce the entire output of the market at a cost lower than what it would be if there were several firms.

[38] The rate of return is sometimes defined as a weighted average cost of capital, consisting of the cost of debt and the return on equity, where the weights are the shares of debt and equity in the capital structure.

The terms in the numerator add up to the "revenue requirement," i.e., the amount of money the firm expects it will need per time period (often a year) to cover operating expenses, capital costs, and taxes, while also earning a "fair" return on its rate base that is adequate to attract private capital. The concept of a "fair" return in the context of public utility regulation may include considerations such as whether the return 1) is sufficient to maintain the firm's financial viability, 2) enables the utility to attract additional capital, and 3) is comparable to the return earned by other companies with similar risks.[39] The denominator is the expected level of demand for the infrastructure service during the same time period, e.g. the annual number of gallons of drinking water consumed or projected number of vehicles traveling on a toll road. The ratio is the allowable price per unit, i.e. the price per gallon of water or toll charged per vehicle. Multiplying the allowable price by expected demand at that price yields the revenue requirement needed to cover costs and provide the designated return.

Regulators set the allowable rate of return after evaluating cost and demand information supplied by the public utility as part of an extensive rate-setting process that can involve testimony of expert witnesses for both the regulator and public utility.[40] In a PPP transaction, competitive bids would include supporting information about cost, demand, and the rate of return, and would be reviewed as part of the contract negotiations between the public sponsor and winning bidder.

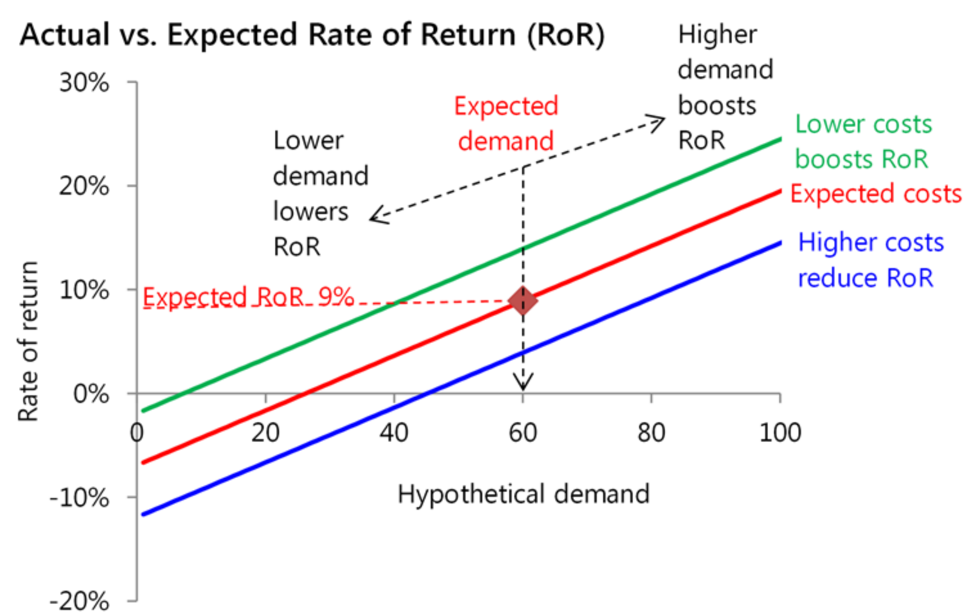
In practice, the realized rate of return may differ from the rate assumed in the regulatory process. Rate of return regulation offers the public utility a *fair opportunity*, but not an ironclad guarantee, to earn its weighted average cost of capital; the regulated firm — or PPP — still has to contend with demand risk and operations and maintenance cost risk. For example, if actual water consumption and the costs of operating water treatment plants match the baseline assumptions used to set the allowable price, then the private firm will earn the designated rate of return. But if actual demand or costs differ from the baseline assumptions, then the realized rate will either fall short of or exceed the expected return until the allowable price is adjusted, either at the next scheduled rate hearing or by a short-term revenue stabilization measure implemented by the regulator.[41] The graph below illustrates these points using hypothetical data. The red line illustrates demand risk: with per unit operations and maintenance costs at the expected level, the rate of return varies with realized demand. For a given level of demand, operations and maintenance cost risk is illustrated by the two lines that are parallel to the red line: the rate of

[39] *See* page 436 of Madden, Sean P. "Takings Clause Analysis of Utility Ratemaking Decisions: Measuring Hope's Investor Interest Factor." Fordham Law Review 58, no. 3 (1989): 427-446. Also see page 42 of Regulatory Assistance Project. "Electricity Regulation in the U.S.: A Guide," March 2011. *See also* www.raponline.org/docs/RAP_Lazar_ElectricityRegulationInTheUS_Guide_2011_03.pdf (accessed March 11, 2015). The Regulatory Assistance Project report cites Federal Power Commission vs. Hope Natural Gas Company and Bluefield Water Works and Improvement Company vs. Public Service Commission, 262 U.S. 679 (1923) as two key Supreme Court cases setting out general criteria that public utility commissions must follow when setting rates of return.

[40] In practice, public utility regulators use either historical data, projections for a future test year, or a combination to obtain cost and demand information for computing the regulated price. For greenfield PPPs, the allowable price would necessarily be based on projections, while for brownfield PPPs, it would incorporate historical data.

[41] *See* The Brattle Group. "Alternative Regulation and Ratemaking Approaches for Water Companies," September 30, 2013. http://www.nawc.org/uploads/documents-and-publications/documents/NAWC_Brattle_AltReg_Ratemaking_Approaches_102013.pdf (accessed March 8, 2015).

return is lower than expected if per unit costs are higher than expected (blue line) or the rate of return is higher than expected if per units costs are lower than expected (green line).



The private partner's incentive to operate in the most cost-efficient manner will be affected by how quickly the allowable price is adjusted when the actual rate of return differs from the target rate.[42] For example, if the contract allows higher costs to be quickly translated into higher prices, then the firm's incentive to hold down costs will be blunted. Similarly, the firm's incentive to use innovative cost-saving technology will be weakened if operational cost savings are swiftly reflected in lower prices.

By contrast, a PPP contract that constrains prices to adjust less frequently strengthens incentives for management to operate the project efficiently because the firm either has to absorb a portion of cost increases or can keep earnings from superior performance.[43] Negotiating this type of adjustment provision in a PPP contract requires the public and private entities to balance their interests in a way that has the potential to maximize expected long-term benefits for everyone.

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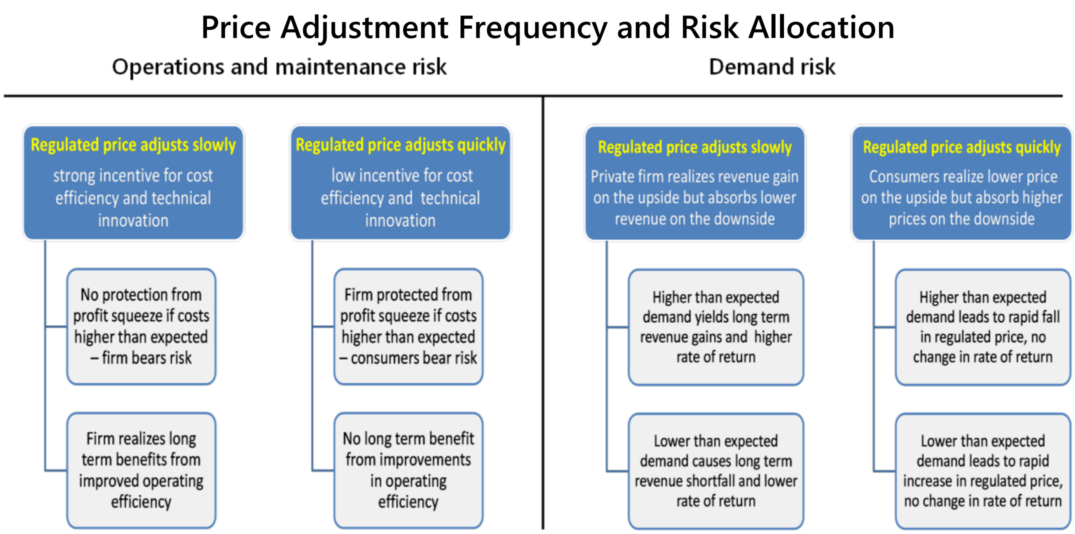
[42] As mentioned earlier, there may be multiple prices for a single infrastructure service: for example, a public transit system might have reduced fares for seniors and/or students. A PPP contract may be designed to limit or exempt certain population segments, such as seniors, from price increases.

[43] *See* Ofwat. 2007. *New Approaches to Expenditures and Incentives.* http://www.ofwat.gov.uk/pricereview/pr09phase1/pap_con_apprchexpincent.pdf?download=Download# (accessed March 8, 2015). In the regulated UK water industry, if companies can deliver outputs with lower capital or operating expenditure than assumed, prices are lowered, but only after five years in order to provide incentives to reduce costs. The regulator also monitors delivery of outputs to make sure cost reductions are due to efficiency improvements and not due to failure to deliver services at acceptable quality levels. Quality monitoring needs to be an important part of PPP contracts, as discussed in Sections II and III.3.

The frequency of price adjustment for deviations in demand from baseline assumptions also determines to what extent the public or private partner bears the project's demand risk. If utilization of a PPP toll road falls short of projections because more drivers use a nearby non-tolled road, the arrangement requires that the allowable toll is increased so that the firm achieves its target rate of return. For regulated gas and electric utilities, annual adjustments are relatively common. Regulated utilities sometimes use "decoupling" to annually adjust rates and stabilize revenues in the time period between formal rate cases, which can be up to three years, depending on the state (annual rate adjustments that are made to stabilize revenue are referred to as "true-ups").[44] The negotiated frequency of price adjustment in a PPP contract must balance the public interest in avoiding sharp toll hikes with the private sector's need for a financially viable project.[45]

The magnitude of the price adjustment needed to restore the allowable rate of return depends in part on the price elasticity of demand, i.e. the responsiveness of demand to a price change.[46] Demand responsiveness tends to be low for infrastructure services because, in general, there are few substitutes readily available to consumers. However, availability of even an imperfect substitute will require a larger price increase in order to make up for the loss of users who shift to a nearby non-tolled but highly congested road.



[44] Eto, Joseph, Steven Stoft, and Timothy Belden. "The Theory and Practice of Decoupling Utility Revenues from Sales." *Utilities Policy* 6, no. 1 (1997): 43-55.

[45] For example, in the regulated UK water industry, if companies can deliver outputs with lower capital or operating expenditure than assumed, prices are lowered, but only after five years in order to provide incentives to reduce costs. In telecommunications, rate case moratoriums are sometimes implemented to guarantee the regulated firm that profits made at current prices will not be taken away. This process imposes a regulatory lag, typically 2-5 years, intended encourage the regulated firm to reduce operating costs (i.e., the firm will be able to retain the resulting increase in earnings). Similar provisions can be written into PPP contracts.

[46] The price elasticity of demand is defined as the percentage change in quantity demanded of a good resulting from a one-percent increase in its price.

Summary

The rate of return model sets a regulated price that allows the private firm to recover its costs and earn a designated return on its "rate base." In the case of a PPP, the project sponsors and their private partners can agree to adopt a rate of return model by incorporating it in a PPP contract. If actual demand and costs differ from the baseline assumptions, the price will be adjusted to enable the firm to earn its allowed rate of return. This feature provides the firm with greater protection against demand risk than does the basic user fee model; it also affords better protection against operations and maintenance cost risk than the user fee and availability payments models. However, the rate of return model provides somewhat less incentive for cost cutting than user fee and availability payment contracts because price is eventually reduced to reflect cost savings or eventually raised to reflect cost increases. As the frequency of price adjustments increases, the incentives for cost efficiency weaken.

2. **Price cap model**: ***The real price is adjusted for efficiency gains***

The price cap model protects consumers from the possibility of excessive price increases but, in contrast to the rate of return model, it does so by setting limits directly on the price of an infrastructure service, not on the rate of return. Since the focus of regulatory control is on prices and not on profitability, private firms have a powerful incentive to minimize costs and improve productivity performance in order to increase their profitability.

Price cap regulation has been used in the United Kingdom since the late 1980s and now applies to all of the privatized British network utilities.[47] In the United States, price cap regulation began replacing rate of return regulation in portions of the telecommunications sector in 1989 and is now used in most states as well as in interstate telecommunications regulation; price caps are also used in many other telecommunication markets throughout the world.[48,49] Other countries use price cap regulation beyond telecommunications, e.g., Australia (energy and transport) and France (postal service).[50,51]

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[47] Green, Robert. "Has Price Cap Regulation of UK Utilities Been A Success?" *Public Policy for the Private Sector* 132 (1997). http://siteresources.worldbank.org/EXTFINANCIALSECTOR/Resources/282884-1303327122200/132green.pdf (accessed March 11, 2015).

[48] Blackman, Colin and Lara Srivastava, editors. *Telecommunications Regulation Handbook.* Washington, DC:The International Bank for Reconstruction and Development / The World Bank, InfoDev, and the International Telecommunications Union, 2011. https://openknowledge.worldbank.org/bitstream/handle/10986/13277/74543.pdf?sequence=1 (accessed March 12, 2015).

[49] Sappington, David E. M. and Dennis L. Weisman. "Price Cap Regulation: What Have We Learned from 25 Years of Experience in the Telecommunications Industry?" *Journal of Regulatory Economics* 38, no. 3 (2010): 227-257.

[50] King, Stephen P. "Principles of Price Cap Regulation," In *Infrastructure Regulation and Market Reform: Principles and Practice*, edited by Margaret Arblaster and Mark Jamison, 46-54. Canberra: Australian Competition and Consumer Commission and Public Utility Research Centre, 1998.

[51] Reisner, Robert A.F. "Price Caps and the U.S. Postal Service: Prospects, Perils and the Public Interest." Paper prepared for the President's Commission on the U.S. Postal Service, Global Insight (2003). http://govinfo.library.unt.edu/usps/offices/domestic-finance/usps/docs/may_26_paper3.pdf (accessed March 12, 2015).

How does the price cap model work?

For public utilities subject to price cap regulation, an *initial* price is often calibrated such that the firm can cover its costs and earn a fair return, similar to the rate of return model. In a PPP contract, the initial rate of return and price would be negotiated between the private partner and project sponsor as part of the competitive bidding process used to award the PPP. From that point forward, as in public utility regulation, the maximum allowable price, or *cap*, would be allowed to increase at a rate tied to, but below, inflation (as measured, for example, by the Consumer Price Index (CPI), and expressed as a proportion):

$$Allowable\ price\ this\ year = Allowable\ price\ last\ year\ \times (1 + CPI - x)$$

where *x*, the so-called "x-factor", is the expected rate of improvement in the firm's productivity over the operational phase of the project.[52] For instance, the output of a bridge — the rate of traffic flow per year — might be increased by adjusting the inputs used to provide the service, e.g. upgrading to real-time, automated toll collection facilities or by installing traffic congestion management technology on approaches to the bridge. The x-factor measures by how much the growth of the firm's output is expected to outpace the growth of its inputs over the course of the project's operation.

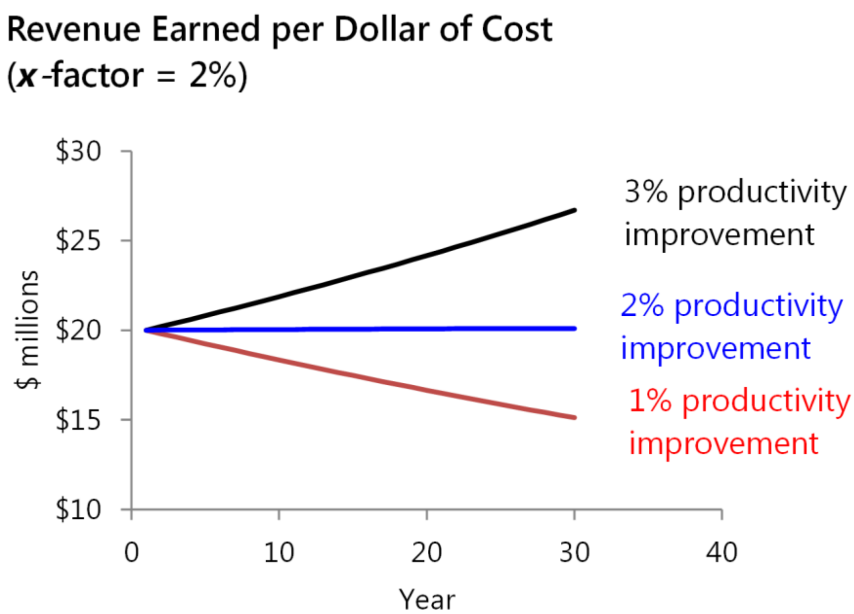
The rationale for this approach is that while price should be allowed to increase with inflation to compensate the firm for higher input costs due to increases in the overall level of prices in the economy, slowing the annual rate of appreciation by subtracting *x* allows consumers to benefit from the firm's *expected* productivity improvement.[53] Put another way, the x-factor pares back the rate by which the price is adjusted to reflect inflation. Regulators also may allow a firm to adjust prices in response to factors beyond its control (via the "z-factor"), which can be a positive or negative adjustment.[54]

[52] The calculation of "x" can be based on the average productivity improvement that has been observed for similar firms, domestically or internationally. In a PPP contract, information developed as part of bid preparation and value for money analysis can be used to estimate the "x-factor" over the operational phase of the project, because these studies estimate project performance over the life of the contract.

[53] Some user fee and availability payments contracts include inflation adjustments and other economic factors but do not include an offset for the firm's expected productivity performance.

[54] The z-factor should reflect cost elements that are beyond the control of the regulated firm and that have a pronounced financial impact on the firm, such as an industry-specific tax change, new legislation, or a force majeure (e.g., floods, hurricanes and tornadoes). *See* Sappington, David E. M. and Dennis L. Weisman. "Price Cap Regulation: What Have We Learned from 25 Years of Experience in the Telecommunications Industry?" *Journal of Regulatory Economics* 38, no. 3 (2010): 227-257. In the UK, the charges distribution companies pay for connections to the transmission network and property taxes are treated as z-factors. *See* Joskow, Paul L. "Incentive Regulation in Theory and Practice: Electricity Distribution and Transmission Networks," In *Economic Regulation and Its Reform: What Have We Learned?* edited by Nancy L. Rose, 291-344. Chicago: University of Chicago Press, 2014. The price cap formula including the z-factor can be written as:
$Allowable\ price\ this\ year = Allowable\ price\ last\ year\ \times (1 + CPI - x\ (+/-)\ z)$.

In the price cap model, the firm has a built-in incentive to minimize costs because the focus of regulatory control is price, not profit; however, there is an added incentive to improve efficiency and reduce costs *beyond* the level required by the x-factor. By taking steps to make its actual rate of productivity improvement higher than *x*, management at the private partner can boost its profit potential. The chart below illustrates the relationship between a hypothetical firm's revenue per dollar of cost and productivity performance. If the firm's rate of productivity improvement just matches the hypothetical x-factor of 2 percent, revenue earned per dollar of cost will remain unchanged. However, if the annual rate of productivity improvement can be raised, revenue per dollar of cost will steadily increase, as illustrated by the 3-percent line. On the other hand, if actual productivity improvement is less than 2 percent because management fails to hold down operations and maintenance costs, revenue per dollar of cost will steadily decline.



In order to realize the price cap model's potential to balance investor and consumer interests while encouraging cost efficiency, contract negotiations must determine an appropriate value of *x*. If the public sponsor underestimates the firm's ability to improve its productivity, then the negotiated *x* value may be too low and a relatively large share of efficiency gains will accrue to the private partner. If *x* is set too high, then the price cap — and revenue — will be too low, possibly putting the project's financial soundness at risk and compromising the private partner's ability to be cost efficient.

The PPP contract should also be flexible enough to adjust to significant differences between the firm's actual and expected productivity performance that, for example, might be due to unanticipated technological innovation. A provision calling for a periodic reevaluation of the x-factor would prevent the contractual value of *x* from getting too far out of alignment with actual performance; it would also ensure that consumers continued to receive a share of efficiency gains and long term price protection, while preserving the firm's incentive to operate efficiently. For example, in the UK, the x-factor applied to British Telecom is reset by the regulator about every five years.[55]

Maintaining acceptable standards of service quality is an important consideration in any PPP contract, particularly in a price cap framework where cost-cutting incentives are especially strong and where the firm directly benefits from higher rates of asset utilization. Since we are dealing with projects in which quality metrics are observable, specific standards can be written into the contract to preclude cost cutting efforts that might otherwise lower quality.[56] In other situations, the private firm may have an incentive to make additional investments in quality if the benefit of a higher rate of asset utilization exceeds the investment cost.[57] A PPP contract could encourage quality-enhancing investments by incorporating these expenditures in the price cap formula as an additional factor.[58]

Similar to the basic user fee model, under a pure price cap model, demand risk is entirely borne by the private partner. The impact of demand variability on revenue is illustrated in the graph below.[59] If demand falls short or exceeds expectations, the firm's total revenue will rise or fall proportionately, as shown by the dashed black line.

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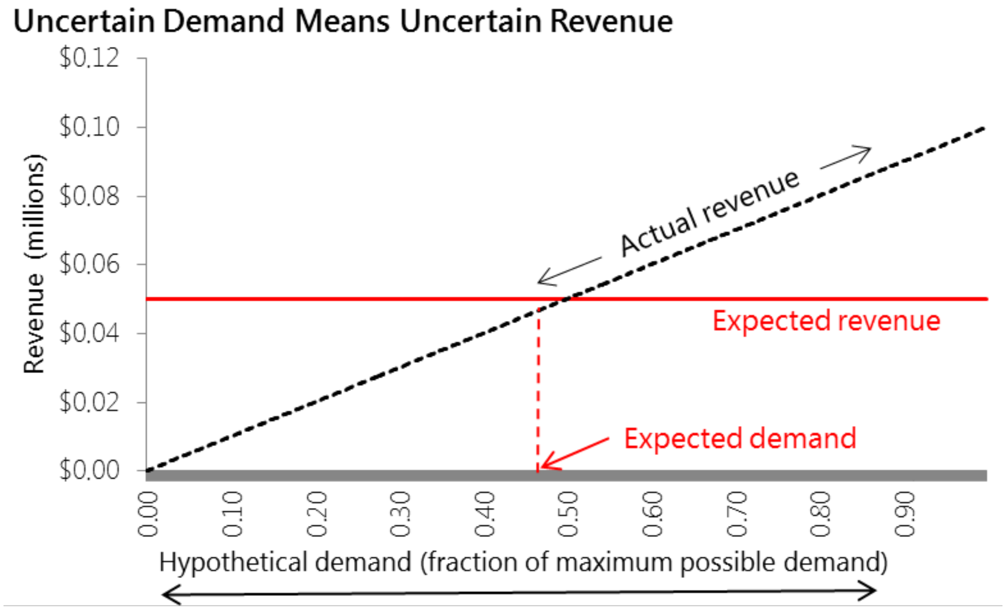
[55] Jamison, Mark A. "Regulation: Price Cap and Revenue Cap," In *Encyclopedia of Energy Engineering and Technology Vol. 3*, edited by Barney Capehart, 1245-1251. New York: CRC Press, Taylor and Francis. 2007.

[56] *See* Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. "Public-Private Partnerships: When and How." Working paper, Yale University (2008). http://www.econ.uchile.cl/uploads/publicacion/c9b9ea69d84d4c93714c2d3b2d5982a5ca0a67d7.pdf (accessed March 12, 2015). Examples of quality metrics include the number of potholes on a road that must be repaired per time period, or percent of on-time arrivals in a transit system. A system of penalties can be included in the contract for failing to meet minimum quality standards, such as adjusting the price cap formula to limit allowable price increases below the rate of inflation, or if quality shortfalls are egregious enough, having a provision that allows the public sponsor to terminate the contract and transfer control to another private consortium (i.e. making the market for the PPP project effectively contestable).

[57] For example, if using a superior brand of cement (to lower the probability of potholes and road buckling) increases the flow of toll-paying traffic enough to more than offset the higher construction costs, then it is in the firm's interests to do so.

[58] Stolleman, Neal. "Dynamic Effects of Regulation on Exchange Carrier Incentives," In *Quality and Reliability of Telecommunications Infrastructure*, edited by William H. Lehr, 63-82. New Jersey: Lawrence Erlbaum Associates, 1995.

[59] Since total revenue = price × quantity, the slope of the dashed black line is equal to the price cap prevailing within a given year (before the cap is adjusted for the next year).



Summary

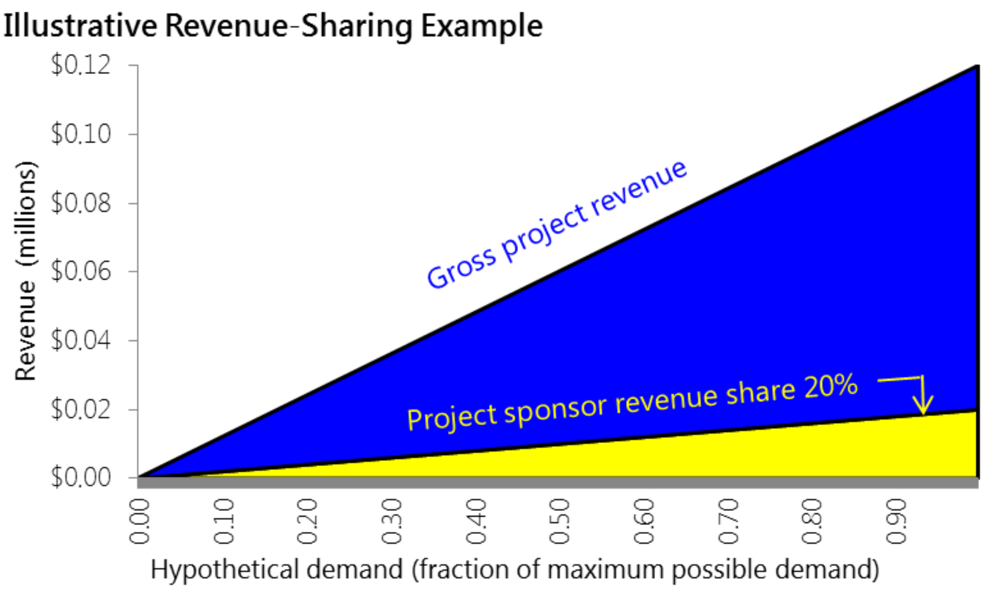
The price cap model enables the project sponsor to transfer all demand risk to the private partner, as in the basic user fee model, while at the same time providing protection to consumers against large and unanticipated price increases. The embedded consumer protections in the price cap model may make PPP arrangements more attractive to project sponsors and local stakeholders. Moreover, the price cap framework encourages the private partner to be more cost efficient than does the user fee model by motivating the firm to do better than the x-factor, which constrains the rate of price appreciation.[60] Where the project sponsor sets the x-factor will determine both the extent of consumer price protection and the attractiveness of the project to potential partners: a higher *x* increases any private partner's efficiency incentives, but too high an *x* may deter or exclude many potential bidders.

3. **<u>Sharing models</u>:** ***A price cap model within rate of return bounds***

Contracts with explicit revenue- or profit-sharing provisions can align sponsor and investor interests in cases where the parties' risk preferences and return expectations are not well-served by the basic user fee or availability payment arrangements.[61] These sharing models have the potential to increase the number of PPP deals and increase the odds of the projects' long-term success by reducing the likelihood of bankruptcy or avoiding costly contract renegotiations.[62]

[60] Like the basic user fee model, firms operating under a price cap framework are exposed to operations and maintenance cost risk.
[61] With the exception of the first very simple example, the models in this section present profit-sharing, or more accurately, the sharing of return on investment. These models can also be applied to revenue-sharing; however, the risk allocation depends on whether profit or revenue is shared. The private partner is fully exposed and partially exposed to operations and maintenance risk under revenue-sharing and profit-sharing, respectively.
[62] Various types of earnings-sharing mechanisms have been used in the regulated telecommunications, electricity (27 states plus DC), natural gas (13 states) and water industries (New York state only). *See* Sappington, David E.

Sharing can be achieved when the private partner remits a contractually-defined proportion of revenue or profits to the government; risks are shared, rather than wholly allocated to one party or the other. In its simplest form, the government and private party share revenue in the same contractually-determined proportions at all revenue levels; the graph below illustrates an example where the project sponsor receives 20 percent of gross revenue.[63,64]



A risk-sharing contract should be flexible enough to provide investors and public sponsors with a set of acceptable risk-return tradeoffs over a range of uncertain future demand. In particular, a sharing contract can balance 1) the investor's willingness to share a portion of the project's upside potential in return for getting some downside risk protection, with 2) the sponsor's willingness to provide a degree of downside protection in exchange for a share of the project's

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M. and Dennis L. Weisman. "Price Cap Regulation: What Have We Learned from 25 Years of Experience in the Telecommunications Industry?" *Journal of Regulatory Economics* 38, no. 3 (2010): 227-257; and The Brattle Group. "Alternative Regulation and Ratemaking Approaches for Water Companies," September 30, 2013. http://www.nawc.org/uploads/documents-and-publications/documents/NAWC_Brattle_AltReg_Ratemaking_Approaches_102013.pdf (accessed March 8, 2015).

[63] While not depicted in the graph, a proportional revenue-sharing model in which the government bears downside risk will require the public sector to share in losses by making payments to the private party.

[64] Revenue-sharing arrangements can be more complex. The term sheet describing anticipated contract terms for the State Highway 183 Managed Lanes project to increase capacity and relieve expected congestion pressures, calls for revenue to be shared between the private partner and the Texas Department of Transportation according to applicable percentages for a given range of Toll Revenues. In the example, a 20 percent assumption is used for simplicity. *See* Texas Department of Transportation. 2012. *SH 183 Managed Lanes Project – Toll Concession Public-Private Partnership Agreement Term Sheet, SH138 Managed Lanes Project*. https://ftp.dot.state.tx.us/pub/txdot-info/dal/sh183_managed/rfq/terms.pdf (accessed March 12, 2015). Also *see* page 7 of *Overview of Public-Private Partnerships for Highway and Transit Projects: Testimony Before the Transportation and Infrastructure Committee Panel on Public-Private Partnerships*, United States House of Representatives. 113th Cong. 2014. http://transportation.house.gov/uploadedfiles/2014-03-05-bass.pdf.

upside gain. In a contract negotiation, both sides take positions based on their own forecasts of demand and project performance; an effective contract will allocate risks and returns in a way that is acceptable to both parties.

Sharing contracts can allow for both parties to share in project upside and downside. For example, if the project performs better than expected — by exceeding a negotiated threshold rate of return — the contract may call for the partners to split that portion of the return above the threshold in pre-determined proportions. Similarly, if the project performs worse than expected — the rate of return falls below a negotiated threshold — the contract may specify that each partner absorbs part of the shortfall. Contracts may therefore involve sharing of returns below a lower threshold, above an upper threshold, or as we emphasize in this section, both.

How do sharing models work?

For illustration, we discuss two types of profit-sharing models. Similar revenue-sharing arrangements have been used in road and transit PPPs in Europe, Latin America, and Asia.[65]

Proportional sharing of high and low returns

Sharing contracts can insulate both parties when demand deviates substantially from initial forecasts by allowing the private partner to retain all profits in a central range of the rate of

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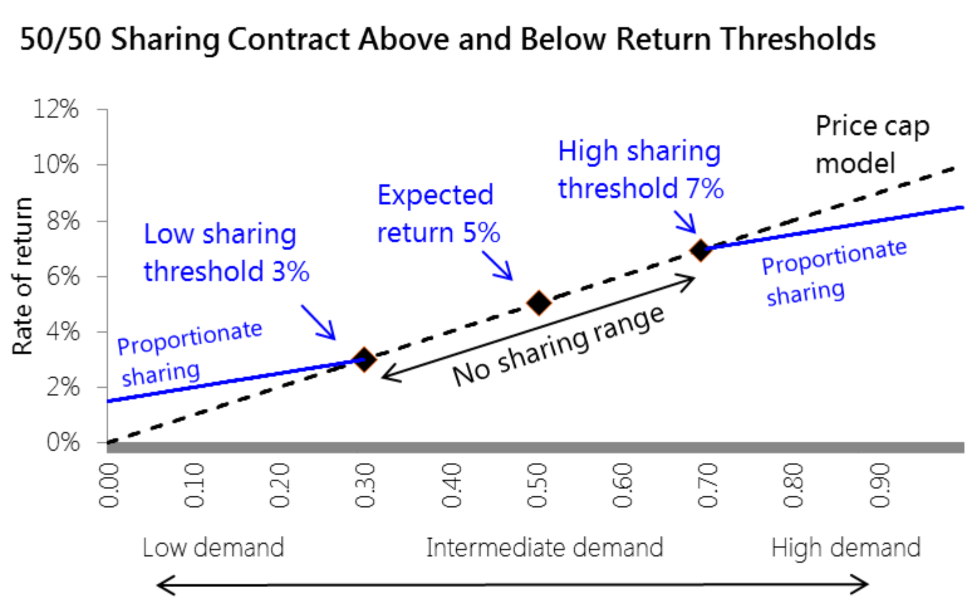
[65] Variations of sharing are used in a number of countries. On Federal Trunk Roads in Germany, approximately 20 percent of toll revenue is allocated to the toll operator for operating the electronic toll charging system, while the remaining 80 percent is allocated to enhancing federal transport networks. *See* Böger, Torsten R. "PPP Projects in Germany." Presentation at Konference om OPP med fokus på transportsektoren, May 27, 2014. http://www.toef.dk/file.php?name=/files/OPPHorten/Torsten%20B%20VIFG.pdf (accessed March 9, 2015). London Underground PPP contracts specify the allowable rate of return on equity and allow for a review of outputs and prices every seven and one-half years, including an extraordinary review if costs become significantly out of line with baseline assumptions. *See* Stern, Jon. "The Role of the Regulatory Asset Base as an Instrument of Regulatory Commitment." *European Networks Law & Regulation Quarterly* 2, no. 1 (2014): 15-27. and Bolt, Chris. "Regulating by Contract and License – The Relationship between Regulatory Form and its Effectiveness." Presentation at University of Bath School of Management, Bath, UK, March 20, 2007. http://www.bath.ac.uk/management/cri/pubpdf/Occasional_Lectures/19_Chris_Bolt.pdf (accessed March 11, 2015). The concession contract for the A28 Toll Motorway in France provides for revenue-sharing between the concession company and public sponsor, equal to 8 percent initially and growing to 18 percent when cumulative cash flows reach contractually determined thresholds. *See* Goavec, Jean-Yves. "The A28 Toll Motorway – An Innovative Approach to Financing." Presentation at European Transport Conference, Strasbourg, France, August 10, 2003. http://abstracts.aetransport.org/paper/index/id/1577/confid/9 (accessed March 12, 2015). Public authorities in Chile, Colombia and Korea have various forms of shared revenue risk according to ranges of revenue, e.g. if revenue rises above a threshold the concessionaire compensates the public authority (and conversely). *See* Vassallo, Jose M. "Traffic Risk Mitigation in Highway Concession Projects – The Experience of Chile." *Journal of Transport Economics and Policy* 40, no. 3 (2006): 359-381.; Irwin, Timothy. "Public Money for Private Infrastructure – Deciding When to Offer Guarantees, Output-Based Subsidies, and Other Fiscal Support." Working paper, The World Bank (2003). http://elibrary.worldbank.org/doi/pdf/10.1596/0-8213-5556-2 (accessed March 12, 2015).; and Kim, Yong-Seong. "Public and Private Partnerships in Korea." Presentation at the Third Session of the United Nations Economic Commission for Europe Team of Specialists on Public-Private Partnerships, Geneva, Switzerland, April 19, 2011. http://www.unece.org/fileadmin/DAM/ceci/ppt_presentations/2011/TOS_PPP3/5.3_Yong-Seong_Kim.pdf (accessed March 12, 2015).

return, corresponding to the most likely outcomes, while permitting profit-sharing outside that range. Consider a contract where the private partner retains all profits within the 3 to 7 percent range, but the government project sponsor shares 50-50 in any return shortfall below 3 percent or any returns in excess of 7 percent, as illustrated by, the graph below.[66] The upward-sloping dashed black line represents the rate of return under a pure price cap model, in which the private sector takes on all of the demand risk; the solid blue lines represent the private sector return above and below the negotiated return thresholds. The private partner keeps *all* of the return between the negotiated thresholds of 3 percent and 7 percent (the "Intermediate" demand range) and assumes all of the demand risk. In this range, in which there is no sharing, the contract operates like a pure price cap model. The incentives for cost efficiency and exposure to operations and maintenance risk are the same as in the price cap model.[67,68]



In both the "Low" and "High" ranges, demand risk, incentives for cost efficiency and exposure to operations and maintenance risk are qualitatively the same as in the rate of return model.[69] If

[66] By return, we mean: [revenue – (operations & maintenance expenses + depreciation + taxes)] /fixed assets. In a rate of return model, fixed assets would essentially correspond to the rate base.

[67] Since the price cap is constant within a given year, the extra revenue produced by an increase in demand along the x-axis, e.g. one additional vehicle on a toll road translates into a higher rate of return on the rate base, which is shown on the y-axis. In this simplified example, costs are also assumed constant during the year.

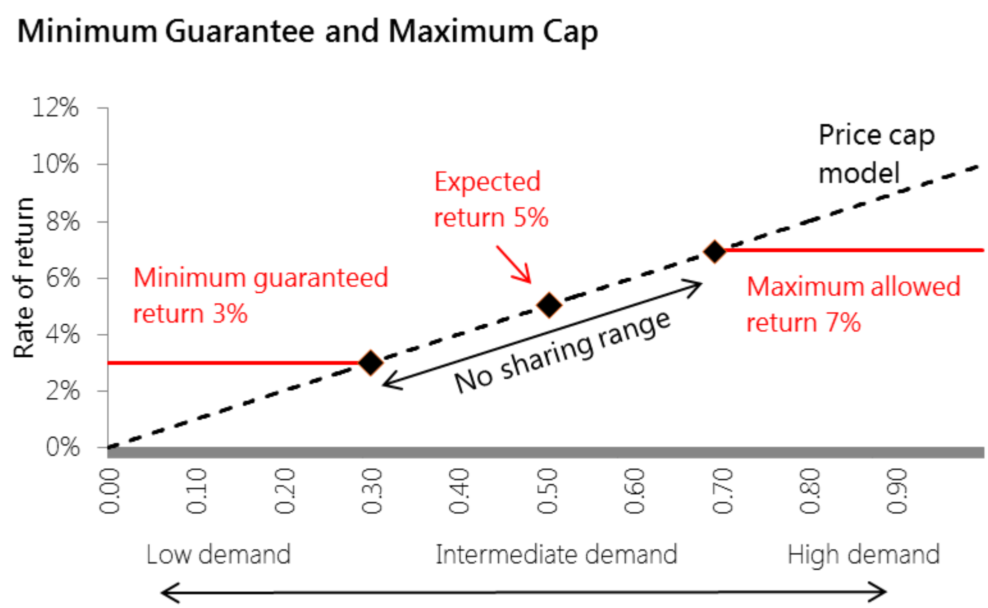
[68] Engel, Eduardo, Ronald D. Fischer, and Alexander Galetovic. "The Basic Public Finance of Public-Private Partnerships." *Journal of the European Economic Association* 11, no. 1 (2013): 83-111.

[69] In the Low and High ranges, the closer the blue line is to the dashed black line, the more efficiency incentives and risk exposures resemble the price cap model, while the closer the blue line is to the horizontal, the more incentives and risk exposures resemble the rate of return model with very frequent (i.e. instantaneous) price adjustments. If there is a demand shortfall, for instance, and a price increase is implemented to reestablish the rate of return *along the blue line*, the size of the required price increase will be smaller than otherwise, because the allowed return in the Low range is less than three percent. As a result, the public sector still has exposure to demand risk, but the magnitude of the exposure is reduced compared to the rate of return model.

demand falls into the Low range, the private firm will absorb just half of the shortfall between the 3 percent threshold and the actual rate of return, experiencing the return illustrated by the solid blue line. The government will either compensate the private partner for half of the shortfall below 3 percent either by raising taxes, issuing public debt, or reallocating funds from other public uses, or it may allow the private partner to adjust prices quickly to raise the rate of return in future periods. The PPP contract would stipulate whether returns outside the no-sharing range would be addressed with payments between the project sponsor and private partner, with price adjustments, or a combination.[70] Similarly, if demand reaches the High range, the private firm will share half of the return above 7 percent with the project sponsor, such that the retained return increases less steeply, as illustrated by the solid blue line. The private partner will pay the government an amount equal to half the return above 7 percent, which the government may use to make public investments in other parts of its regional economy, lower taxes, or retire debt. The contract may also call for the price to be adjusted going forward.

Minimum profit guarantees and maximum profit cap

PPP contracts can also be structured to provide complete downside protection to the private partner in exchange for a limit on the upside. Consider a contract that provides the private partner a minimum guaranteed return of 3 percent and a maximum return cap of 7 percent, as illustrated by the graph below. The upward-sloping dashed black line again represents a pure price cap model in which the private partner bears all of the demand risk; the solid red lines represent the private partner's minimum and maximum allowable returns at the negotiated return thresholds.



[70] A PPP contract could use payments to adjust for the past shortfall and price increases to prevent future shortfalls; alternatively, it could call for price adjustments large enough to compensate for the past return shortfall and prevent future shortfalls.

As in the previous example, the private partner keeps all of the return between the negotiated thresholds of 3 percent and 7 percent (the Intermediate demand range) and assumes all of the demand risk. In the no-sharing range, the contract operates like a pure price cap model without any sharing, and incentives for cost efficiency and exposure to operations and maintenance risk are the same as in the price cap model. However, in both the Low and High demand ranges, demand risk, incentives for cost efficiency, and exposure to operations and maintenance risk also match the rate of return model.

Compared to the 50-50 proportional sharing model discussed above, the *magnitude* of the subsidy to the private partner or payments to the project sponsor are larger. If demand falls into the Low range, the private firm will avoid the *entire* shortfall between the 3 percent threshold and the actual rate of return, earning the return illustrated by the lower solid red line. To cover this shortfall, the government will compensate the private firm for the entire shortfall below 3 percent by raising taxes, issuing public debt, or reallocating funds from other public uses; depending on the terms of the PPP contract, it may also allow the price to be increased quickly to prevent future shortfalls. If demand reaches the High range, the private firm will receive a constant return of 7 percent. The private partner will pay the government an amount equal to the entire return above 7 percent, which the government may use to make public investments in other parts of its regional economy, lower taxes, or retire debt. The PPP contract may also call for price reductions to bring future returns into the 3 to 7 percent range.
Which contractual form is most attractive to investors and project sponsors will depend on risk appetites and return expectations. Relatively risk-averse investors or investors with low confidence in the demand forecasts may be willing to accept a maximum return cap in exchange for being fully protected if returns are much lower than expected. Investors who are willing to assume greater risk and are more optimistic about demand may prefer the first contract because it offers higher return potential in exchange for less protection on the downside.

Summary

Sharing models retain the private partner's financial incentive to increase profits while aligning the interests of government and investors. Moreover, for greenfield projects ― where demand projections are most uncertain ― sharing the impact of large forecast errors reduces the risk of contract renegotiation. Arrangements that include sharing when returns fall below contracted rate of return thresholds would partially insulate the private firm from the demand shortfall, reducing the risk that the project company enters bankruptcy or seeks to renegotiate to avert bankruptcy.

Sharing models can also protect the project sponsor and local stakeholders against underestimation of demand or large rate increases by the private partner. If demand is much higher than expected, the government will receive revenue that it can deploy to make other investments, lower taxes, or retire debt. The benefit of the shared revenue to the government and its constituents should reduce the government's incentive to renegotiate. Similarly, the sharing of returns above an upper threshold will dampen the private partner's incentive to raise prices to a level that would drive returns above the threshold.

IV. Conclusion

Realizing the potential benefits of PPPs for taxpayers — including lower costs, better service quality and faster project delivery — depends on allocating project risks to the party best able to manage them. Arguably, demand risk is the most important source of uncertainty affecting the financial viability of an infrastructure project in which user volume determines the private partner's compensation, particularly in the case of new build, or "greenfield" projects, for which no history of use exists.

We introduce three incentive structures for PPP contracts that may benefit both public sector sponsors, by creating value for taxpayers, and private investors, by generating attractive returns. Applying principles from the regulation of privately-owned energy and telecom infrastructure to PPP projects in which the private partner assumes temporary control of the infrastructure, the proposed approaches are designed to broaden the scope for PPP negotiations that voluntarily incorporate some of these features into PPP contracts. This process can help to create options attractive to investors and sponsors with risk preferences and return expectations not accommodated by more commonly used models. By aligning investor and sponsor interests, these incentive structures have the potential to increase the number of PPP deals and increase the odds of the projects' long-term success.