# PRIVATE INVESTMENT AND ROAD PRICING: THE PUBLIC-IZATION OF INFRASTRUCTURE ASSETS

R. Richard Geddes[1]
Associate Professor
Department of Policy Analysis and Management
Cornell University
251 Martha Van Rensselaer Hall
Ithaca, NY 14853
rrg24@cornell.edu

Dimitar N. Nentchev
Research Assistant
Department of Policy Analysis and Management
Cornell University
251 Martha Van Rensselaer Hall
Ithaca, NY 14853
dnn5@cornell.edu

**September 11, 2013**

**ABSTRACT**

Private infrastructure investment in the United States is often viewed as providing an alternative financing method given a revenue stream from a transportation facility rather than as creating new revenue *per se*. However, private investment in the form of upfront concession lease payments for newly priced roads can be used to enhance the public appeal of road pricing, thus generating substantial new revenue from existing transportation facilities. Our new approach uses the value embedded in U.S. infrastructure that is released through pricing to make that pricing politically feasible. We suggest preserving a portion of the wealth generated by road pricing in perpetuity through a *permanent fund,* which is one type of public trust fund. Permanent funds are currently in use in Alaska, Texas, Norway and many other jurisdictions to preserve natural resource wealth. Following Alaska, we propose that investment income from the fund be used to provide an annual dividend payment to all households within the newly priced region. We refer to this approach as an investment public-private partnership, or IP3. The IP3 has several advantages relative to current proposals to increase citizen support for road pricing. It ameliorates the agency problem between citizens and their elected representatives that are exacerbated by the free cash flows that road pricing generates. It also creates direct citizen-stakeholdership in transportation infrastructure, which increases public support pricing. The Alaskan experience suggests that this approach can also reduce income inequality, create higher personal income, and mitigate the effects of recessions.

## I. Introduction

The network of roads, bridges, and tunnels that form the backbone of the U.S. transportation system is one of the nation's most valuable assets. The 4-million-mile road system, with roughly 46,000 miles of interstate highways, is valued at about $2.5 trillion (*1*). Yet the system suffers from major ongoing problems on both its demand and supply sides. Traffic congestion is a severe demand-side problem, particularly in urban areas. In 2010, congestion wasted 4.8 billion hours of travel time and 1.9 billion gallons of fuel (*2*). One estimate put the annual overall cost of traffic congestion to the U.S. economy at $168 billion (*3*). Congestion imposes large social costs in addition to lost time and fuel. Babies developing near congested traffic have worse health outcomes (*4*) while longer commutes are associated with more obesity and higher divorce rates (*5*). Traffic congestion also has negative effects on productivity. Prud'homme and Lee (1999), show that lower levels of congestion allow for a larger effective labor market size, which means that businesses can better locate the workers they need. Congestion is also worsening over time, as annual hours of delay per peak-time traveler increased 136 percent between 1982 and 2009 in the nation's fourteen largest urban areas (*6*).

The system's supply-side problems are also legion. Revenues from state and federal fuel taxes that support the system are declining as vehicle fuel efficiency improves and since annual vehicle miles traveled, which had been increasing for decades, leveled off in 2004 (*7*). A shift into alternative fuels such as natural gas and electrics also reduces revenue. Additionally, many segments of the system are mature relative to original design standards and suffer from years, if not decades, of deferred maintenance (*8*).  Thirty-two percent of America's roads are now in poor or mediocre condition, and driving on such roads costs motorists $67 billion in additional operating costs and repairs annually (*9*). Funds from other sources for maintenance and expansion, such as general funds, are limited due to the fiscal constraints facing many states and localities, including borrowing limits, creating a gap between available revenue and the investment necessary to keep the system in a state of good repair. According to one estimate, available funding for U.S. highways alone would fail to cover investment needs by between $139 and $172 billion per year over the next decade (*10*). Recent federal transfers from general revenue into the Highway Trust Fund highlight the current system's instability as a funding source (*11*).

Transportation economists have long argued that a shift to a system of variable vehicle miles traveled (VMT) charges would address many of the above problems (*12*, *13*, *14*). VMT charges assign a price for transportation services, which allows motorists to know the true resource costs of their decisions, and thus help regulate traffic flows, particularly during periods of peak demand. Variable pricing encourages travelers to choose the alternatives for economizing on road space that are most appropriate for them, such as bus, transit, carpooling, moving closer to work, telecommuting, biking, etc. rather than encouraging the use of a specific alternative mode (*15*). Increased road use efficiency from VMT pricing is also important because of rising resistance to new and wider highways arising from environmental concerns (*16*). On the supply side, VMT charges generate facility-specific revenue that – over a range of traffic volumes—increases with the intensity of facility use. VMT revenue generated is also independent of improvements in vehicular fuel efficiency, is more stable and less subject to political decisions compared to fuel tax revenue, and can be used to fund transportation maintenance and improvements.

Revenues from VMT charges can also be used to attract financing in addition to traditional tax-exempt municipal bonds. This includes private risk (or equity) capital introduced through public-private partnerships (PPPs), which is a focus of this article. The U.S. Federal Highway Administration's Office of Innovative Program Delivery states that, "Public-Private Partnerships (PPPs) are contractual agreements formed between a public agency and a private sector entity that allow for greater private sector participation in the delivery and financing of transportation projects." PPPs have been utilized to deliver infrastructure projects in many countries, including Australia, Canada, the United Kingdom, France, Italy, Portugal, and Spain, among others (*17, 18, 19, 20, 21*).

By including performance-based penalties and rewards, PPPs facilitate enforcement of a regular maintenance schedule that reduces the scope for its deferral (*22, 23, 24*). Because revenue from VMT charges increases with motorists' willingness to pay for facility use, PPPs encourage investment dollars to flow to the highest-value projects, as in other industries where output is priced (*25, 26, 27, 28*). Conversely, private investment will not participate in low-revenue projects without subsidies, which reduces the likelihood that scarce investment dollars will be spent on "white elephant" projects (*29, 30*). VMT charges coupled with private participation result in an approach similar to that for other utilities in the United States where customers pay a per-unit price to a private provider. Examples include electricity, telecommunications, natural gas and many water utilities.

Although it is often feasible to price new transportation capacity and to price existing transportation capacity in certain cases – in particular by converting high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes – substantial barriers to pricing existing transportation capacity remain. Concerns often focus on the equity effects of instituting road pricing since transportation spending absorbs a larger fraction of the budget of low-income households. Small (1983), (1992), and Mohring and Anderson (1994), stress that the use to which toll revenue is placed is critical for public acceptance of road pricing (*31, 32, 33)*. Research has focused on how the use of revenue generated by congestion pricing affects its political acceptability, and innovative approaches have been offered. Small (1992) suggested using a portion of the new revenue for tax reductions and rebates in the relevant region and the remainder for regional transportation improvements (*32)*. King, Manville, and Shoup (2007) argue for allocating net revenues generated by congestion pricing to the jurisdictions (e.g. cities and towns) through which newly priced freeways extend (*34)*. Gulipalli, Kalmanje, and Kockelman (2008) analyze credit–based congestion pricing, which addresses equity issues by providing monthly allocations for motorists to spend on congestion tolls (*35)*. Arnold, Doan, and DeCorla-Souza (2012) suggest enhancing motorist's travel choices quickly by converting the right shoulder of a highway into a general purpose lane while converting the left lane into a high-occupancy toll (HOT) lane (*36)*. There are other innovative approaches involving toll revenue "recycling" in which toll revenues are rebated back to motorists (*15, 37*). This literature suggests that it is insufficient to state the social benefits of variable pricing in mitigating congestion in order to gain its public acceptance.

Because transportation facilities are public assets, the pricing of existing un-priced capacity is inherently a political decision. To make facility pricing politically rational, a broad group of citizens in the relevant jurisdiction must realize benefits from its adoption. Research increasingly suggests that traffic congestion imposes social costs over a wide geographic area (4, 5). The wide distribution of benefits from variable pricing through an IP3 is consistent with that evidence.

Importantly, U.S. infrastructure assets are citizen-owned, which implies that citizens of the relevant jurisdiction have a property right to income generated from those assets. We outline a new approach to using congestion-pricing revenue to address holdups in the implementation of that pricing. The pricing of currently un-priced transportation facilities combined with private sector participation via PPPs releases substantial economic value embedded in those infrastructure assets. We suggest that a portion of the value released by pricing be protected in perpetuity through a public permanent fund where dividends are distributed to the citizens who own the infrastructure.

Experience in preserving natural resource wealth using permanent funds suggests that this approach is feasible. We refer to our method as an investment public-private partnership or IP3. Through an IP3, a public permanent fund is capitalized with concession lease payments paid by a private partner. The private partner operates the newly priced transportation facility, such as a road, bridge, or tunnel. Annual dividend payments from the fund are distributed to all households in that jurisdiction. Such universal dividend payments are progressive in that they represent a larger share of income for poor families, so an IP3 reduces income inequality.

The IP3 challenges the view that private investment is a mechanism to raise financing given an existing revenue stream (i.e. funding) rather than a method of generating new revenue. By bolstering public support for road pricing, an IP3 allows new revenue to be raised on an existing un-priced facility and its underlying value to be realized. We are unaware of any conversions of major un-priced U.S. transportation facilities to priced facilities, suggesting that exploration of innovative policy proposals is warranted.

We proceed as follows. In the next section, we describe the IP3 approach and the permanent fund model in detail. In Section III, we review the benefits of this approach, pointing out its advantages relative to other approaches to enhancing public support for road pricing. We show why an IP3 improves the political feasibility of pricing currently un-priced transportation capacity. We also address several common objections to this proposed use of concession lease proceeds. Section IV reviews similar, instructive transactions in the United States. Section V examines reasons why an IP3 is preferable to the traditional approach of utilizing tax-exempt municipal bond debt backed by toll revenue. Section VI presents a financial model using data from Columbus, Ohio to estimate likely revenue, and thus dividend payments, stemming from an IP3. Section VII summarizes and concludes.

## II. The Investment Public-Private Partnership

The concept at the center of the IP3 approach is the public permanent fund. Similar to a trust fund, a permanent fund preserves wealth in perpetuity since the fund's principal is never spent. A public permanent fund is one type of U.S. sovereign wealth fund. It is a public fund because it is citizen-owned. Such funds have been used successfully in North America to preserve natural resource wealth in Alaska, Texas, and several Canadian provinces (*38*). The largest U.S. examples are the $38 billion Alaska Permanent Fund, which is particularly relevant for our proposal, and the $25 billion Texas Permanent School Fund.

The Alaska Permanent Fund is a semi-independent corporation created by the Alaskan constitution of 1976. Alaskan natural resource wealth in the form of North Slope oil reserves was quickly spent by the State after its discovery in 1968. As one commentator describes:

> In 1968, nine years after statehood, Atlantic Richfield pumped the first oil from Prudhoe Bay, beginning a new boom cycle. The following year the state held an auction for oil leases, and in a single day collected $900 million, at a time when the state budget itself was barely over $100 million. This shower of riches sent Alaska into a frenzy of public spending, particularly on capital projects. From 1961 to 1981 state general fund expenditures grew at an average annual rate of 22 percent, from $45 million to over $3 billion (75).

In response, the Permanent Fund was established to help preserve state wealth into the future and to protect it from political pressure for immediate spending. The Alaskan constitution required that at least 25 percent of the revenue from oil and gas sales or royalties be placed into the Permanent Fund. Investment income generated by the fund is used to pay an annual dividend to all Alaskan citizens. Similarly, the Texas Permanent School Fund was created in the Texas Constitution of 1876. It was capitalized by sales, trades, leases and improvements to lands set aside for that purpose. Investment income generated is used to fund schools. Texas also has a Permanent University Fund created in the Constitution of 1876 to support the state's universities.

We next enumerate several key steps in the implementation of an IP3 using the public permanent fund model. We suggest that a jurisdiction utilize an IP3 only after extensive public education, comment, and input. Once it has decided that the IP3 approach is appropriate for that jurisdiction, the public-sector project sponsor must choose the appropriate area, facility, or system to be variably priced and subsequently leased through a concession. The benefits of implementing congestion pricing are likely to be greatest in congested areas because the welfare gain from managing traffic flows and raising revenue for maintenance and expansion are higher in those regions. However, the U.S. experience with brownfield PPPs (i.e. PPPs on existing facilities), suggests that large concession payments can also be obtained from facilities with substantial uncongested portions. Project sponsors may also wish, at least initially, to avoid networks that cross jurisdictional lines to reduce coordination problems across those jurisdictions. They may also wish to complete initial IP3s on relatively small regions where administrative costs are lower.

The project sponsor must also determine what fraction of lease proceeds will be deposited into the permanent fund and what fraction will be utilized to invest in the region's transportation system. This is a critical decision, since larger deposits into the permanent fund will increase the dividend while reducing resources available for improving transportation within the region. The sponsor should also consider how quickly the transportation system, including alternative modes or system expansion can be implemented or improved, and how that schedule conforms with implementation of pricing. We view the adjustment of this fraction as a way of optimizing the public appeal of an IP3 to the jurisdiction in question.

The public sponsor must also carefully consider concession contract terms. They will govern the relationship between the public project sponsor and the private partner for the duration of the concession. A key consideration is the range of initial usage prices or VMT charges, which is affected by congestion levels and other factors, as well as its rate of increase over time, which may be capped at some clearly specified rate, such as the consumer price index. Other key contractual elements include desired levels of service, required maintenance and expansion, and how those aspects of performance are incentivized through the contract. Linking toll increases to inflation, for example, creates an inflation-protected revenue stream that is likely to attract larger upfront concession payments.

Lease length is also critical. The public may view relatively short leases favorably if they provide the public project sponsor with added flexibility and increased competition, thus increasing the political feasibility of the IP3. Longer leases have the benefit of allowing the private sponsor to expense depreciation, thus raising concession value and upfront payments, which allows for larger subsequent dividend payments. Another critical aspect of the concession contract is appropriate oversight and enforcement throughout its life, which may necessitate the creation of a new Office of Infrastructure Stewardship or a similar public group to oversee contract compliance. That office would serve as an explicit infrastructure “trustee” with responsibility for ensuring that the infrastructure was maintained, operated, and expanded in accordance with contractual terms.

Once details of the concession contract are determined, the public sponsor announces a request for qualification (RFQ) to attract and screen qualified bidders. Bidders are likely to be a consortium of a road operator and a financier coordinated through a legal entity created for that purpose. Project financing, in which non-recourse debt is backed by revenues from the leased facility, is typical (see, e.g. 76). The RFQ also allows the project sponsor to gauge interest in the lease and to assess the likely number of bidders.

Subject to lease terms, the winning bidder is selected based on maximum concession payment. Such bidding ensures the largest upfront payment and thus annual dividend payments. It effectively monetizes economic rents available from congestion pricing. Once the winner is selected and the lease agreement completed, the majority of the concession payment is used to capitalize the fund. As per the decision above, the remaining portion is used to improve transportation in the same area or corridor as the newly priced network or facility, providing motorists using priced facilities with either an expanded facility or with additional transportation options.

The facility is then priced and operation begins under the concessionaire. There are today an array of suggested approaches to assist the implementation of congestion pricing, such as gradual phase-ins and “premium service” versus standard lanes that may serve to enhance its public appeal (*39*). Although we do not examine them in detail here, we believe that such approaches can be usefully incorporated into an IP3. Concession payments are then deposited into a permanent fund that is invested in perpetuity in a diversified portfolio. That portfolio may include infrastructure as an alternative investment, thus recycling concession wealth back into newly priced facilities.

The final step is to ascertain the likely size of annual dividend payments and determine which households will receive them. Dividends are paid out of wealth generated by the fund's investment income. That income will increase with concession payments as additional facilities are leased over time. Because the fund exists in perpetuity, income will also grow as facilities are re-leased. The impressive growth of the Alaska Permanent Fund is a case-in-point. The IP3 therefore utilizes private infrastructure investment to provide households with an annual payment in order to offset the cost of and thus the public resistance to adopting variable facility pricing.

**III. Benefits of the Investment Public-Private Partnership**

We next discuss benefits offered by the IP3 approach relative to other recent proposals to increase public support for congestion pricing. We are unaware of extant proposals for the pricing of currently un-priced capacity that incorporate private participation through a PPP, or through the use of a public permanent fund, to improve acceptance of pricing. Our basic permanent fund approach is separable from private participation however. For example, the government could rely on tax-exempt municipal bonds backed by toll revenue generated by newly priced facilities to capitalize a permanent fund, effectively preserving the economic value realized through pricing without private financing or operation. We view this separability as an added benefit of the core IP3 concept. However, we believe that private participation in those capacities is critical for the success of an IP3, and review several reasons for including private participation below.

There are discussions of important benefits of private participation, such as clear performance standards and the transparency of risk, available elsewhere so we do not discuss them here (*10, 23*). Those are in addition to benefits flowing from the variable pricing that the IP3 facilitates *per se*. We here discuss only benefits arising from what we view as the IP3's core innovations, which include the public permanent fund model and the universal dividend payment.

*The IP3 lowers agency costs between citizens and elected representatives*.

Potential agency problems between a jurisdiction's citizens and their elected representatives are an important policy issue that has been recognized in multiple disciplines (*40, 41*). Such problems are exacerbated by large cash flows generated by newly priced transportation facilities. The agency problems created by large uncommitted cash streams, or "free cash flows," have long been recognized as a concern in the corporate governance literature focused on publicly traded, privately owned firms (*42*). The institutional arrangements, or governance structures, surrounding revenue stream use are critical in ensuring that value generated from facility pricing is used in principals' best interest, i.e. in citizens' interest. Evidence of transportation investment that is sometimes poorly directed is consistent with taxpayer-elected representative agency concerns in this sector (*43*). Agency problems are likely to arise for both the use of new revenue streams and for lump-sum payments generated by concession leases.

The use of a public permanent fund reduces opportunities for using value realized through pricing to fund projects that may have short-term political appeal but are not be socially cost beneficial. Additionally, fund balance *transparency* and fund *performance* (as well as straightforward comparison to standard performance benchmarks, which are aided by internet access), are likely to reduce citizen-representative agency costs associated with principal preservation.

A second channel through which agency costs are reduced by the IP3 is through clarification of citizen's role as the ultimate owners of transportation infrastructure. Under an IP3, households may readily observe the value they hold in a public permanent fund and receive dividends based on that value. Such clarification encourages households to take a greater interest in transportation infrastructure maintenance and operation, since the size of future concession payments depends on such efforts. The permanent fund approach therefore allows the value created by road pricing to remain under citizens' control while still insulating it from political spending pressures.

A third channel for mitigating agency costs is by improving the allocation of transportation infrastructure investment. By facilitating variable road pricing, the IP3 generates critical price information that indicates where investment dollars are of greatest value to motorists. Which projects are self-funding and which are not becomes more transparent. This improves the transparency of any subsidies necessary to support non-self-sustaining projects that may be desirable to complete a transportation network.

*The IP3 and equity in road pricing*

The effects of road pricing on equity are an important area of research. A key element of the IP3 is that it enhances income equity. The IP3 generates an annual dividend payment for all households. Such a payment represents a larger fraction of annual income for low-income families by definition. By releasing value embedded in infrastructure, the IP3 reduces income inequality without taxation, but instead by generating net wealth. In addition to low-income families, it is also beneficial to those on fixed incomes, such as retirees.

The IP3 approach also enhances intergenerational equity by utilizing contractual enforcement mechanisms to ensure that network value is preserved and is a well-maintained asset that can generate dividends in perpetuity. It allows principal value to increase through compounding and through additional leases. Because public permanent funds effectively increase national savings, they counteract the intergenerational impact of accumulated government deficits and debt. As a result, they improve a state's bond rating, and thus lower its debt costs.

By increasing public support for road pricing, an IP3 generates the initial capital necessary to create a permanent fund. Deposits into the fund are of course not limited to road concessions. Once the fund is created, it offers the institutional structure to accept additions to the fund's principal from any source regardless of origin. That is, additions to the permanent fund need not come exclusively from infrastructure. If, for example, a state creates a permanent fund from concession lease revenue, it could add to the fund's principal using revenue generated from natural gas leases or from other occasional revenue sources.

Moreover, as the Alaskan example illustrates, a permanent fund also creates benefits through higher personal income, higher employment, and mitigated recessions due to the regularity of dividend payments (*38*). Because the Alaskan economy is dependent on crude oil and other resource prices, the legislature hoped that the fund's principal and dividends would sgrow to be sufficient to help diversify the Alaskan economy (*38*).

*The use of concession lease payments for transportation infrastructure*

A possible criticism of the IP3 involves the proposed use of lease proceeds. It is sometimes argued that using proceeds to create a permanent fund unnecessarily sequesters economic value that should be spent, either immediately or over time, on transportation infrastructure. As noted above, the IP3 makes explicit the property rights that citizen-owners currently possess in transportation infrastructure. The citizens of the relevant jurisdiction are the owners of its transportation infrastructure, and therefore have a right to benefit from value monetized through an IP3 lease. Capitalizing a citizen-owned permanent fund with that value makes citizens' property rights in infrastructure explicit. This enhances citizen's stewardship of those assets.

A related criticism is that it is inefficient to monetize the value of infrastructure through a PPP and to then establish a permanent public trust fund to pay back dividends when toll revenue could be directed to citizens directly. The IP3 approach, however, requires that the true value of public infrastructure assets be revealed through bidding in the way that competitive offers for a home reveal its true value. Just as a farmer who has stored an old-but-rare car in her barn for decades may not appreciate its value, or properly maintain it, until it is valued (or priced) by an expert, citizens will not properly value a transportation facility – and are thus unlikely to maintain it – until its worth is realized through a lease. We view *value revelation* as an under-appreciated benefit of private participation in the transportation sector.

Although we believe that some portion of lease payments must be spent on current projects to generate political support for such a major institutional change, requiring that all lease payments are spent on transportation minimizes citizens' ownership stake in transportation assets. A similar point applies to revenue recycling proposals. A basic component of any property right is the right to capture asset-generated income (74). Just as the shareholders of a corporation have a legal claim to its profits, citizens have a rightful claim to the income stream generated by their transportation assets. The jurisdiction's citizens and its transportation facility customers – truckers and motorists – are distinct (but likely overlapping) groups. To channel asset-generated income to motorists alone is to conflate citizen-ownership with customer-ownership. If facility property rights including the right to capture asset-generated income do in fact rest with customers, this suggests instead the mutual ownership form, such as a mutual investment fund or insurance company.

In addition to property rights, our permanent fund/cash dividend approach is grounded solidly in microeconomic theory. It relies on the conclusion that, because cash is fungible, it is preferred by recipients to benefits yielding the same monetary value but that must be received in the form of a specific good. Economics texts typically demonstrate this by comparing the utility created by cash compared to food stamps in assisting the needy (72). It is therefore unlikely that citizens would receive greater utility from increased investment in transportation than from the set of goods they could purchase with cash.

To the extent that cash generates greater support from citizens than pre-determined spending, proposals mandating lease proceeds be used for transportation may in fact never result in road pricing, and thus not produces lease proceeds. We do not suggest that the entire concession payment be distributed in the form of upfront, lump-sum cash payments. Citizens are likely to view such a payment as part of transitory rather than permanent income, with a resulting high marginal propensity to consume from that payment. Value distributed in this manner may be spent quickly. The IP3 instead preserves infrastructure value in perpetuity while allowing citizens to receive cash payments out of investment income. Such payments are likely to be viewed as part of citizens' permanent income, with a higher associated marginal propensity to save. We next discuss several brownfield leases in the United States that serve as precedents, and that hold lessons for, the implementation of an IP3.

## IV. U.S. Precedents for the IP3

U.S. brownfield PPPs on already-priced facilities – two completed and one nearly completed – hold lessons for the use of IP3s in the United States. The brownfield lease most similar in concept is the proposed, but ultimately unsuccessful, lease of the Pennsylvania Turnpike. In May 2008, a group of investors led by Spanish toll road operator Abertis and a Citigroup infrastructure fund offered the Commonwealth of Pennsylvania a concession fee of $12.8 billion for a seventy-five year lease of the 537-mile tolled Pennsylvania Turnpike, which was the largest concession fee even offered for a U.S. toll road lease. To put the bid in perspective, it represented over one-fourth of the federal government's entire annual highway construction budget for 2008. Of the $12.8 billion fee, $2.3 billion would have been used to pay off existing turnpike debt. The net fee received by the state would then have been invested through the state's pension system that was (prior to the 2008 financial crisis), estimated to yield annual income of about $1.1 billion.

The Pennsylvania lease, unlike the IP3, would have directed investment income to transportation spending in the state rather than to cash dividends. Concession proceeds would have been invested in the state's pension system rather than through an independent permanent fund. Although closely related, the IP3 has several advantages over this approach. Because citizens would not receive infrastructure-generated investment income, it is less likely that the lease would have enhanced their perceived stake, and therefore their stakeholder-ship in, transportation infrastructure. The IP3 would also invest proceeds with a semi-independent public corporation, which increases its independence from political pressure.

The second illustrative transaction is the brownfield lease of the Indiana Toll Road. In 2005, the State of Indiana issued a request for proposals for a seventy-five-year concession lease. The winning offer was for $3.8 billion from the Indiana Toll Road Concession Company

(ITRCC), a joint venture between Cintra and Macquarie. The state committed to using proceeds to fund a ten-year transportation plan known as Major Moves, which would support about two hundred projects around the state. The Indiana Toll Road lease differs from the Pennsylvania lease in that concession proceeds would not be invested in perpetuity but would have been spent over that ten-year period. Indiana citizens would not receive direct dividends and thus may not have developed the degree of attachment to the program offered by the IP3. Notably, program attachment was a major goal of Gov. Hammond who initiated the Alaska Permanent Fund (75).

The third instructive brownfield lease is the Chicago Skyway concession. This was the first modern lease of an existing U.S. toll road. In March 2004, the City of Chicago issued an RFQ from bidders interested in leasing the Skyway for a ninety-nine-year term. The high bid of $1.83 billion came from a partnership of Cintra Concesiones de Intrastructures de Transporte S.A. (Cintra) of Madrid, Spain, and the Macquarie Infrastructure Group of Sydney, Australia, which cooperated to create the Skyway Concession Company LLC. Annual toll increases are capped at the greater of 2 percent, the rise in the Consumer Price Index, or the increase in U.S. gross domestic product per capita.

Lease proceeds were used in several ways: $825 million to pay off both outstanding Skyway and city debt; $500 million to create a reserve fund that will produce about $25 million annually for the city; $325 million invested in an annuity; and $100 million for a variety of projects, such as homeless shelters, facilities for senior citizens, and libraries. The Skyway lease was criticized partly because of the latter non-transportation uses of concession lease proceeds. Although we have not studied those entities in detail, proceed use for a reserve fund and an annuity are consistent with the spirit of an IP3 in that they are invested in real assets and generate investment income. The use of investment income from the Skyway reserve fund differs from our approach in that dividends are not distributed to citizens in cash.

One notable aspect of U.S. brownfield concessions is the large concession lease payments realized, in some cases on facilities exhibiting a modest amount of traffic congestion, and where congestion prices are not used. The payments are large by international standards (77), which may be due to the relatively security of property rights and contractual enforcement in the United States (78). We next discuss the advantages of including private participation relative to relying on tax-exempt debt to raise an upfront payment against the revenue stream.

## V. The Role of Private Participation

One criticism of the IP3 approach is that private participation is unnecessary. In this section, we show why private participation is instead critical to the success of an IP3. Private participation can be broken down into several roles, including facility financing, design, construction, operation, and maintenance. We do not here focus on design and construction because the private sector has long been involved in such infrastructure roles in the United States through traditional design-build projects.

One consideration that applies to several potential private roles is competition through competitive bidding. Competitive bidding is impossible without private competitors. Bidding reduces the cost of providing a variety of key services, including facility financing, operation and maintenance. Competition is a critical force for promoting social welfare, since it encourages firms to operate efficiently, to focus on customers, to adopt new technologies, and to innovate (*22*). Competition is critical for IP3 success because it is the force that converts profits from congestion pricing into financial resources to capitalize the public permanent fund. Competition is also important in more traditional roles such as the design and construction of any necessary renovations or expansions of the leased facility.

Private participation ameliorates the serious problem of deferred facility maintenance. The private partner is contractually obligated to maintain the facility according to pre-determined, transparent, enforceable standards. Standards can be defined in terms of desired outcomes, such as the timing and quality of maintenance, rather than through the level of input use. Private partners are thus incentivized strongly to maintain facilities. Moreover, private partners can be subject to tort liability for failing to maintain facilities to certain standards, thus heightening their incentives to properly maintain and operate the facility.

An important private partner role is supplying financing given the stream of toll revenue from newly instituted pricing. Critics note that revenue from newly priced roads could instead be used to generate an upfront payment using tax-exempt bond debt serviced by toll revenue (i.e. toll revenue bonds). There are several reasons why private financing is preferable to a tax-exempt-bond-only approach. First, the inclusion of equity participants allows for an additional, more risk-tolerant type of capital to be included in infrastructure financing. Bonds are an inherently conservative method of finance that promise only fixed repayment of principal plus interest to bondholders. Because payments are fixed, bondholders receive no additional return if a project performs well. Their focus is therefore on minimizing default risk. A bond-only financing arrangement by definition provides no “equity cushion” to shield bondholders from potential losses, so they demand other security. Bondholders require that the debt-coverage ratio—the percentage by which revenues generated by an asset must exceed debt payments—to be relatively high. To obtain an investment-grade rating, municipal bonds typically must have annual revenues between 25 percent and 100 percent above the cost of annual debt service (73).

This gives bondholders the financial cushion that equity risk capital would otherwise offer, but also mechanically limits the amount of capital that can be raised using bond financing for given toll revenues. Moreover, increasing municipal bond debt may be unappealing at a time of unprecedented state and local budget constraints, as exemplified by debt downgrades as well as high-profile bankruptcies in Stockton, California, Central Falls, Rhode Island, and Jefferson County, Alabama, among others.

Equity investment raises more capital from a given revenue source not only through the added supply of funds to which it has access, but also indirectly through the financial cushion it offers bondholders, which facilitates a lower debt-coverage ratio. The greater tolerance for risk associated with equity investment also allows for less conservative forecasts of revenue growth, and a greater upfront value for households (72). In sum, private partners supply risk capital and competition that maximizes the size of the upfront concession payment, and thus the amount that can be placed into the permanent fund.

This is consistent with U.S. experience. It was estimated that the Chicago Skyway lease, which generated a $1.83 billion toll concession fee, would have supported only about $800 million under traditional bond financing (*16*). The effects of brownfield leases are also reflected in improvements in bond ratings after lease completion. For example, Moody's Investor Service upgraded Chicago's bond rating as a result of its improved fiscal position to the highest level in twenty-five years. Similarly, the Indiana brownfield concession led Standard & Poor's to upgrade that state's debt rating to AAA. The rating will save the state millions of dollars in interest payments over time.

Finally, to the extent that bonds are backed by general revenues, or that toll revenue bonds benefit from an implicit taxpayer guarantee, the use of those bonds exposes taxpayers to financial risk. Taxpayers effectively become uncompensated equity holders, or the residual claimants, in the project. They provide not only capital but also the service to society of bearing that project's risk (*44, 45, 46*). The cost of providing such risk-bearing services is opaque, however, since taxpayers are unable to charge for it explicitly. That service's cost is therefore un-priced. The transference of certain risks inherent in infrastructure projects (often referred to as "risk transfer") onto private investors is a frequently stated benefit of private participation. However, the *transparency* of the true social cost of providing the risk-bearing service offered by its pricing has, to our knowledge, never been articulated.

We next describe a model using traffic data from Columbus Ohio that allows estimation of the probable size of the upfront concession fee payments, and thus the size of the annual household dividends for that area. We first discuss the main inputs into our model and then the estimated concession fee outcomes.

## VI. Estimation of IP3 Concession Fees

We here attempt to provide rough estimates of the likely size of the up-front concession payment under an IP3 approach. We do so by calculating the net present value (NPV) of new cash flows from leasing the major highways and arterial roads of Columbus, Ohio for concession lengths of 5, 10, 15, 20, 30 and 40 years. We chose Columbus, because it is a major metropolitan area (as well as the State capitol), because it exhibits non-trivial levels of traffic congestion during peak times, because detailed traffic flow sensor data were available for that metro area, and because the geographic area in question lies entirely within one state, which reduces jurisdictional complications. Moreover, the detailed traffic data from this region allows us to assume that all major highways and arterials are priced, thus reducing the scope for traffic diversion onto non-priced facilities. Our financial model offers revenue and cost projections for each year of the concession. Our pre-toll traffic count data are from 2010.

We relied on several basic assumptions to model expected toll revenue from an IP3 in Columbus. Pre-toll traffic demand was based on highly detailed traffic volume and composition data for Columbus (*47, 48, w*e are very grateful to the Ohio Department of Transportation for assistance with these data). To account for changing traffic demand over time in response to tolling in Columbus, we relied upon elasticity estimates from an extensive Singapore elasticity study on congestion-pricing of several major urban expressways (*49*). The Singapore study adjusts for re-routing, re-timing and changing modes of transportation. Singapore's public transportation options are much more extensive than those in Columbus, leading to greater substitution into other modes in response to tolling. Singapore is thus likely to exhibit a higher price elasticity of traffic demand than Columbus. The application of Singapore elasticities to Columbus results in relatively conservative toll revenue estimates. Consistent with prior literature, we conservatively assume that elasticity rises by 50 percent in the third year of tolling (*50*).

We modeled three scenarios for initial toll rates: low, medium, and high. The low toll scenario is based on the value-added tolling concept. Under this approach, tolls just offset the cost of the added value to motorists -- renovation, operation and maintenance work. This implies that revenues beyond those costs will be limited, which leads to a low NPV and concomitantly low dividends under this scenario. We applied $0.05/0.15 and $0.12/0.20 off-peak/peak per-mile rates to cars and trucks accordingly (*51*). We realize that this approach is likely to provide limited congestion-mitigation benefits, but include it to provide a baseline estimate.

For the high scenario we applied toll rates from the Dulles Greenway in Virginia. Those rates reflect not only maintaining/operating costs for the facility, but also multiple social costs created by motorists – congestion, environmental, and health externalities, among others (*52*). We here used \$0.31/0.37, \$0.68/0.81 and \$0.99/1.17 off-peak/peak per-mile rates for cars, light trucks and heavy trucks, respectively. Early morning and late evening hours are toll free under this scenario due to limited traffic during those times (*53*). We assumed that toll rates will increase annually by the expected long-term annual inflation rate as measured by the Consumer Price Index (CPI), which is 2.5 percent (*54*). We take the medium toll rate scenario to be the average of the high and the low.

Regarding costs, we utilized the 2010 financial reports of four major toll-road infrastructure projects in the USA - Indiana Toll Road, Ohio Turnpike, Pennsylvania Turnpike, West Virginia Turnpike (55, 56, 57, 58), to obtain average per-lane-mile operating costs. This resulted in maintenance and construction costs of \$30,082, which we inflate annually using the "construction cost inflation forecast" (60, 61). Administration costs were \$49,232, which we assumed to have negligible to no change over the concession period. Capital costs were \$83,138, which we again assume increase annually at the rate of the CPI.

Using the above assumptions, our model generates the NPV estimates reported in Table 1. We report estimates using six concession lengths (5 through 40 years) as well as the three toll rate scenarios for a total of nine NPV estimates. Calculations are conducted utilizing discount rates of six and eight percent to provide a sense of how lease payments vary. Table 1 exhibits wide variation in lease payments.

**TABLE 1: Estimated Concession Payments under Alternative Discount Rates and Concession Payments**

| Duration of concession | High toll rates (low discount rate) | Medium toll rates (low discount rate) | High toll rates (high discount rate) | Medium toll rates (high discount rate) |
|---|---|---|---|---|
| 5 yrs | $3,480,978,099.40 | $2,229,935,489.09 | $3,301,987,601.40 | $2,115,358,615.81 |
| 10 yrs | $5,924,403,899.96 | $3,783,498,599.08 | $5,419,621,969.48 | $3,461,858,594.04 |
| 15 yrs | $7,590,208,484.96 | $4,833,235,849.72 | $6,738,743,540.81 | $4,293,184,779.72 |
| 20 yrs | $8,698,995,724.31 | $5,524,670,728.84 | $7,541,441,957.85 | $4,793,784,529.49 |
| 30 yrs | $9,898,748,564.57 | $6,259,343,314.36 | $8,308,483,688.45 | $5,263,679,243.15 |
| 40 yrs | $10,399,226,725.13 | $6,555,436,777.24 | $8,576,238,829.60 | $5,422,181,383.03 |

Note: For the low discount rate scenario we use a 6 percent base discount rate plus a factor to reflect future uncertainty that starts at zero in the first year and rises to 4.1 percent in year 2051. For the high discount rate scenario we use an 8 percent discount rate with the same adjustment factor.

*The estimation of dividend payments*

We assume that the majority of the upfront concession payment is placed into a permanent fund. We utilized 60 percent for the purposes of our estimates, recognizing that one of the advantages of an IP3 is that this proportion can be adjusted to the specific circumstances of the region in which it will be applied. As per the above discussion regarding the Alaska Permanent Fund (AFP), we assume that the concession payment is used to capitalize a fund that invests in a safe, highly diversified portfolio, and that investment income is used for covering operating expenses and to pay annual dividends to all 318,454 Columbus households (*62*). We used the average annual expense ratio (total operating expenses divided by net assets) of the Alaska Permanent Fund over the last 4 years – 0.24 percent as a measure of fund expenses (*63, 64, 65, 66*). The expected annual rate-of-return on investment for our model fund is the average of the five percent target rate of return (ROR) and the 10.34 percent historical annualized ROR over the long run of the APF (*67, 68*).

We applied two different investment fund approaches that result in different estimates for the annual dividend. Under the APF approach, dividends (calculated using the APFC formula) and fund operating expenses are covered only with the proceeds from investing the protected principal. Additional amounts are added to the principal and reinvested each year, which results in perpetually increasing dividends (*69*). The second approach relies on declining principal. Here, dividends and operating expenses are covered with funds from both principal and investment proceeds. Dividends are calculated so that the principal is fully depleted at the end of the concession period. This creates higher annual dividends, which are distributed only for the duration of the concession. The principal is presumably replenished after the next concession.

**TABLE 2. Estimated Annual Dividends per Household under the IP3 Lease**

| Concession Length Scenario (years) | Year of the concession | APF Approach - Dividend ($) | "Declining Principal" Approach - Dividend ($) |
|---|---|---|---|
| 5 | 1 | $ 158 | $1,036.01 |
| | 10 | $ 200 | n/a |
| | 20 | $ 298 | n/a |
| | 30 | $ 443 | n/a |
| | 40 | $ 660 | n/a |
| 10 | 1 | $ 265 | $1,034.33 |
| | 10 | $ 343 | $1,034.33 |
| | 20 | $ 511 | n/a |
| | 30 | $ 760 | n/a |
| | 40 | $ 1,130 | n/a |
| 15 | 1 | $ 338 | $1,025.97 |
| | 10 | $ 438 | $1,025.97 |
| | 20 | $ 652 | n/a |
| | 30 | $ 970 | n/a |
| | 40 | $ 1,444 | n/a |
| 20 | 1 | $ 387 | $1,014.19 |
| | 10 | $ 501 | $1,014.19 |
| | 20 | $ 746 | $1,014.19 |
| | 30 | $ 1,109 | n/a |
| | 40 | $ 1,650 | n/a |
| 30 | 1 | $ 438 | $989.97 |
| | 10 | $ 568 | $989.97 |
| | 20 | $ 845 | $989.97 |
| | 30 | $ 1,257 | $989.97 |

| | | | |
|---|---|---|---|
| | 40 | $ 1,870 | n/a |
| 40 | 1 | $ 459 | $971.03 |
| | 10 | $ 595 | $971.03 |
| | 20 | $ 885 | $971.03 |
| | 30 | $ 1,316 | $971.03 |
| | 40 | $ 1,958 | $971.03 |

Note: Table 2 assumes a medium toll rate scenario and a 6 percent discount rate, with rate increasing over time.

We use 60 percent of concession fees deposited into the fund to ensure conservative estimates, but dividends would be higher if a greater fraction of lease payments were placed in the fund. Table 2 suggests that there is almost a 2-to-1 tradeoff between dividend size across the two approaches, where principal can be preserved at the expense of annual dividends. Nevertheless, the $626 annual dividend from the Columbus IP3 permanent fund approach using a 15-year lease compares favorably with the $878 dividend for 2012 from the Alaska Permanent Fund (keeping in mind that the APF dividend is per person rather than household, see http://pfd.alaska.gov/). Table 2 also suggests that dividends are likely to increase substantially if the assumed concession length were increased to 20 or 25 years. Given the relatively long lengths of other U.S. brownfield leases (e.g. 99 years for the Skyway and 75 years for the Indiana Tollroad), analysis based on longer lease length is reasonable.

*Improvement in traffic conditions from congestion pricing*

We next consider the effects of the IP3 on traffic congestion. Congestion-based pricing, in which tolls rise to reduce demand, is a crucial aspect of the IP3 that leads to vital improvements in traffic conditions. We calculated level of service (LOS) grades for each Columbus road, using the Highway Capacity Manual instructions (*70*) and Columbus road capacity data (*71*). We observed the improvements in traffic flows over the duration of the modeled concession as reported in Table 3 below. Table 3 suggests that there are large, and fairly rapid, reductions in traffic congestion as a result of the adoption of an IP3 in Columbus. A trend of moderate further improvement in traffic conditions was observed in following concession years.

**Table 3: Level-of-Service Grades from Congestion Pricing of Columbus, Ohio**

**TABLE of Hourly LOS grades**

*Periodical view of road 33 (Columbus, OH) projected traffic conditions*

| Time of day | pre-toll | IP3 | | | | |
|---|---|---|---|---|---|---|
| | 2010 | 2011 | 2020 | 2030 | 2040 | 2050 |
| 0:00 | A | A | A | A | A | A |
| 1:00 | A | A | A | A | A | A |
| 2:00 | A | A | A | A | A | A |
| 3:00 | A | A | A | A | A | A |
| 4:00 | A | A | A | A | A | A |
| 5:00 | A | A | A | A | A | A |
| 6:00 | B | A | A | A | A | A |
| 7:00 | F | D | C | C | B | B |
| 8:00 | F | C | C | B | B | B |
| 9:00 | C | B | B | A | A | A |
| 10:00 | B | A | A | A | A | A |
| 11:00 | C | A | A | A | A | A |
| 12:00 | C | B | B | A | A | A |
| 13:00 | C | B | A | A | A | A |
| 14:00 | B | A | A | A | A | A |
| 15:00 | B | A | A | A | A | A |
| 16:00 | C | A | A | A | A | A |
| 17:00 | E | A | A | A | A | A |
| 18:00 | C | A | A | A | A | A |
| 19:00 | A | A | A | A | A | A |
| 20:00 | A | A | A | A | A | A |
| 21:00 | A | A | A | A | A | A |
| 22:00 | A | A | A | A | A | A |
| 23:00 | A | A | A | A | A | A |

Note: To provide a context for LOS grades, "A" = free-flow conditions with unimpeded maneuverability; "F" = extremely low speeds, high delay, extensive queuing (*63*). Detailed calculations of concession NPV, dividends and LOS grades are available from the authors.

## VI. Summary and Conclusions

The United States faces a severe set of policy problems on both the supply and demand sides of its transportation system, including traffic congestion, unstable revenue sources, and inadequate funding, among others. Many policy analysts believe that adopting a variable vehicle-miles traveled charge would address many of those problems. A variable VMT fee would regulate demand, thus reducing traffic congestion while generating new revenue. However, the adoption of VMT fees on existing capacity is politically difficult due to implement. Recent literature has focused on offering proposals to enhance the public acceptance of variable pricing of existing transportation facilities.

We here offer an approach to enhancing public acceptance of variable road pricing based on the Alaska Permanent Fund model. The APF exists in perpetuity, pays a substantial annual dividend to all Alaskan residents. The APF was adopted in response to a "frenzy of public spending" that occurred after the discovery of large oil deposits there. The APF approach can be used in other contexts to protect the large upfront payments realized from road concession leases from excessively rapid spending, thus reducing principal-agent costs between citizens and their elected representatives. Based on microeconomic theory, annual cash dividends combined with a public permanent fund are likely to increase public acceptance of road pricing. We stress the flexibility of the IP3 approach, which allows it to be adjusted to the needs of the jurisdiction in question.

The IP3 approach has a number of benefits. It facilitates variable VMT pricing by allowing citizens of the relevant jurisdiction to benefit from the value released by that pricing. It both regulates demand for the use of those facilities and generates new facility-specific revenue that can be used to renovate and expand those facilities as needed. Infrastructure use will thus become more sustainable. Second, it provides an equitable solution to the problem of facility pricing by recognizing that all citizens are owners of a jurisdiction's infrastructure, and should receive some of the value from lease payments. Third, because the IP3 provides a fixed annual payment in perpetuity, it will be substantial help to those on fixed incomes, such as retirees. It will also reduce income inequality because everyone gets the same payment fixed payment. Finally, there are a number of social benefits generated by the inclusion of private participants, which we discuss in detail above, such as increased citizen-stakeholdership in and attachment to transportation infrastructure. The Alaska experience supports this view.

There are several extensions of the IP3 approach that we do not examine here. For example, after a certain period of time, shares in the public permanent fund could be made tradable so that households can "cash out" of the fund if they so wished. This would create a price for shares of the fund, and would allow for more concentrated fund ownership (such as by large institutional investors), which may help to overcome potential free-rider problems in the monitoring of infrastructure investment, operation, and maintenance, thus reducing possible common pool problems associated with infrastructure. We leave the exploration of such issues for future work (79).

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