FROM FREE TO PRICED INFRASTRUCTURE: U.S. ROADS AND THE INVESTMENT PUBLIC-PRIVATE PARTNERSHIP

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February 17, 2014

ABSTRACT

Much of microeconomics focuses on price system operation since prices are critical for allocating the demand for and the supply of goods and services. However, the use of major U.S. infrastructure assets remains un-priced (or “free”). Moving to priced provision has redistributive effects that can halt its implementation. Despite severe environmental harms from un-priced transportation infrastructure, economists have offered surprisingly few strategies for addressing such objections, even though pricing creates additional wealth that can help compensate potential losers. We describe a novel approach that relies on basic property laws to enhance the appeal of shifting from un-priced to priced road transportation services. Pricing of previously free road services allows value embedded in that infrastructure to be released. Value can be realized immediately through upfront concession lease payments offered by private operating companies in exchange for receiving the toll revenue from newly priced roads. We propose preserving a portion of the added wealth generated by pricing in a public permanent fund and distributing dividends from the fund’s investment income to the infrastructure’s citizen-owners. Dividends mitigate the redistributive effects of pricing and thus facilitate its adoption. Permanent funds are currently used in Alaska, Alberta, Texas, Norway and many other jurisdictions to preserve natural resource wealth. They can be innovatively applied to encourage road pricing, which mitigates a variety of environmental harms.

¹ We are grateful to numerous workshop and seminar participants at the University of British Columbia, the University of Minnesota, Cornell Law School, the Cornell Department of Policy Analysis & Management, American Enterprise Institute, APPAM’a 2013 Fall Research Conference, and the Property and the Environment Research Center, for helpful comments and suggestions. We are grateful to the Ohio Department of Transportation for assistance with data.
I. Introduction

Much of modern microeconomics focuses on price system operation. Prices are viewed as effective in allocating the demand for and the supply of goods and services (Perloff, 2012). However, large portions of the U.S. economy provide vital services that remain “free” or un-priced. The most significant example is the infrastructure service provided by America’s extensive system of roads, bridges and tunnels. That infrastructure provides the service of safely transporting a car, truck, bus, or motorcycle from one point to another. The U.S. road system is large, extending some 4 million miles. It includes about 46,000 miles of Interstate System highways, which carry the bulk of its traffic (U.S. Department of the Interior, 2014).\(^2\) It is valued at roughly $2.5 trillion (Winston, 2013). That extensive network is largely un-priced or, in the case of roads, un-tolled.

Unfortunately, the lack of variable road pricing for that service creates a host of demand- and supply-side problems. On the demand side, traffic congestion creates severe environmental problems. Roughly a third of America’s carbon dioxide emissions are due to moving people or goods and about 80 percent of those emissions come from cars and trucks (Barth and Boriboonsomsin 2009). Traffic congestion wasted 2.9 billion gallons of fuel in 2011 (Texas A&M Transportation Institute 2012) and generated about 56 billion pounds of additional carbon dioxide (CO2) emissions, or 380 pounds per auto commuter, that year. There is increasing evidence that such emissions are harmful, particularly from diesel fuel (Sydbom 2001). The overall financial cost of congestion in 2011 was $121 billion, or about $818 per U.S. commuter (Texas A&M Transportation Institute 2012).

Congestion imposes large social costs in addition to lost time and fuel. Babies developing near congested traffic have worse health outcomes (Currie and Walker 2011) while longer commutes are

\(^2\) For brevity, we refer to the entire system of U.S. state roads, interstate highways, county roads, local streets, and the associated bridges and tunnels simply as the “road system.”
associated with more obesity and higher divorce rates (Lowrey 2011). Traffic congestion also has negative effects on productivity. Prud'homme and Lee (1999), for example, show that lower levels of congestion allow for a larger effective labor market, 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 (Texas Transportation Institute 2010).

Un-priced road infrastructure services also create severe supply-side problems. The gravest may be the lack of stable revenues to fund the system. Currently, revenues from state and federal fuel taxes are declining as vehicle fuel efficiency improves and since annual vehicle miles traveled, which had been increasing for decades, began to decline after 2004 (Puentes and Tomar 2008). A shift into alternative fuels such as natural gas and electrics also reduces revenue. Moreover, the federal and most state fuel taxes are levied on a per-unit basis and are not inflation indexed.

Unstable revenue is a timely concern because many segments of the U.S. road system are past their original design lives and suffer from years, and sometimes decades, of deferred maintenance (American Society of Civil Engineers 2012). 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 (The Road Information Project 2001). Other funds for maintenance and expansion, such as general funds, are limited. This creates a considerable 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 (National Surface Transportation Policy and Revenue Study Commission 2006).
Transportation facilities are publicly owned assets; pricing of existing un-priced capacity is inherently a political decision.\(^3\) To make road pricing widely appealing, a broad group of citizens in the controlling jurisdiction must realize benefits from MBUF adoption. We here describe a new approach, which we call an investment public-private partnership (or IP3), to enhancing the political acceptability MBUFs. We estimate potential dividends generated by an IP3 approach using data from the Columbus, Ohio, metropolitan area. Assuming full pricing of the Columbus road network, we find that the IP3 approach would generate household dividends similar to those offered by the Alaska’s Permanent Fund.

This study offers three important but underappreciated insights: (i) Pricing the use of transportation services that are presently free liberates latent economic value (in the form of unrealized consumer and producer surplus) currently trapped in those assets; (ii) That latent producer surplus can be best realized through competitive bidding among firms on the basis of the largest upfront lease payment to operate the asset; and (iii) A portion of that newly realized value can be invested in perpetuity through a permanent fund that generates income for all citizen-owners of the asset. Investment income from the permanent fund helps encourage citizen-owners to support the pricing necessary to release the asset’s latent economic value. We discuss reasons to move to a priced road system in the next section.

We describe the IP3 approach in Section III and suggest several steps in its implementation. In Section IV, we review the benefits of this approach, emphasizing its advantages relative to other approaches to enhancing public support for MBUFs. We show how an IP3 enhances the political feasibility of pricing existing un-priced transportation capacity, and discuss several U.S. precedents for this approach. We also address several common objections to this proposed use of concession

\(^3\) Legal title to various road facilities rests with the relevant jurisdiction. The entire Interstate Highway system, for example, is owned by the states in which each segment resides. State roads are similarly state owned, while city streets are owned by the relevant municipality.
lease proceeds. Section V examines reasons why an IP3 is preferable to the traditional approach of utilizing only tax-exempt municipal bond debt to finance infrastructure. 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. Moving to Priced Road Infrastructure Services

Transportation economists have long argued that shifting to a system of variable per-unit-traveled road prices, or mileage-based user fees (MBUFs) would address the above problems (Vickery 1969; Vickrey 1992; Walters 1961). MBUFs assign a price for the use of road infrastructure, much like per-unit charges in other utilities. Examples include per-kilowatt charges for electricity, per-minute of telephone use, or per-gallon of water. MBUFs allow motorists to know the true social resource costs of their decisions, and thus help regulate traffic flows during periods of peak demand. MBUFs encourage travelers to choose the alternative that best suits their individual needs when road prices are high. That includes options such as bus, transit, carpooling, moving closer to work, telecommuting, or biking (Parry and Bento 2001). In addition to reduced emissions, increased efficiency of the available road created by MBUFs is important because of rising resistance to new and wider highways arising from environmental and NIMBY concerns (Samuel 2007).

On the supply side, MBUFs produce facility-specific revenue that, over a wide range of traffic volumes, increases with intensity of facility use. This is analogous to the revenue produced by prices charged for other utility services that fund those systems. MBUF-generated revenue is independent of improvements in vehicular fuel efficiency and less subject to the vicissitudes of the political process than is allocation of fuel-tax revenue. By providing such funding, MBUFs ameliorate U.S. road infrastructure’s endemic deferred maintenance problem. This is beneficial because regular
maintenance reduces the production of concrete and other materials necessary for road reconstruction. The production of concrete creates large amounts of CO2 (U.S. Energy Information Administration, 2006). Writing in an unpublished paper in 1951 or 1952, Milton Friedman and Daniel J. Boorstin stressed the importance of road pricing by noting that:

... at first glance, it seems hardly possible that this apparently trivial problem of how to charge people for the highway services they use is a key to the whole problem of how to plan and pay for better highways; yet it is just that. This fact cannot be too strongly emphasized. It is a key not only for a system that would involve operation of roads by private enterprise but equally for the present system of public operation. Should a particular road be built? How should it be built? How should it be financed? Should an existing road be maintained, improved, or allowed to deteriorate? If we could charge directly for the service of the road, we could answer those questions—whether under private or public ownership—in the same way that we now decide how many automobiles should be manufactured, what kind of automobiles should be manufactured, how their production should be financed, whether a particular model should be discontinued, and so on. In short, road pricing and congestion pricing would yield important benefits on both the demand and supply sides of the transportation sector (Roth 1996).

Moreover, MBUF-produced revenue can attract more financing than traditional tax-exempt municipal bonds to finance infrastructure. This includes privately provided equity capital introduced through public-private partnerships (PPPs), as well as privately issued debt. PPPs are contractual agreements between a public agency and a private sector entity that allow for greater private participation in the delivery and financing of transportation projects (U.S. Department of Transportation, 2014). By including performance-based penalties and rewards, PPPs facilitate enforcement of a regular maintenance schedule that reduces the scope for deferred maintenance (Geddes 2011; Winston 2010; Engel, Fischer and Galetovic 2009).

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4 Tax-exempt municipal bonds have often been used to fund transinfrastructure in the U.S. There are several reasons why that option is unrealistic for our proposal. First, the tax-exempt municipal bond market is relatively small because the tax exemption appeals only to wealthy investors and is not valuable to those who do not pay U.S. muni income tax. Second, it is not clear that municipal bond covenants would allow the revenue from bond sales to be used in the manner we propose. Third, there have been proposals to cap or eliminate the federal tax exemption interest income from municipal bonds (Lambert 2014). This would make their use as a financing mechanism less appealing.
Importantly, MBUF revenue increases with motorists’ willingness to pay for use of the facility. Private investment flows toward higher NPV projects; PPPs thus encourage investment dollars to flow where value is highest to customers, as in other industries where output is priced and private participation is substantial (Council of Economic Advisers 2007; Day 1998; Hau 2006; Holtz-Eakin 2003). Conversely, private investment is less likely to participate in low-revenue projects unless they are subsidized, which reduces the chance that scarce investment dollars will be spent on non-economic “white elephant” projects (Engel, Fischer and Galetovic 2006; Sadka 2006).

The key to improved road policy is transitioning to MBUFs. Although it is often feasible to price new transportation capacity and to price existing transportation capacity in certain limited cases (such as converting high-occupancy vehicle (HOV) lanes to high-occupancy toll (HOT) lanes), substantial barriers to pricing existing transportation capacity remain. There is a small but growing multi-disciplinary literature on strategies for enhancing public acceptance of MBUFs. Small (1983, 1992) and Mohring and Anderson (1994) stress that wise use of new toll revenue is critical for public acceptance. Small (1992) suggests using a portion of the new revenues for tax reductions and rebates in the relevant region and the remainder for regional transportation improvements. King, Manville, and Shoup (2007) argue for giving new revenues to the jurisdictions (e.g. cities and towns) through which newly priced freeways extend. Gulipalli, Kalmanje, and Kockelman (2008) analyze what they call credit–based congestion pricing. They suggest rebating back to motorists toll credits equal to average monthly usage. This implies that motorists who use the road more than average pay for that added usage, while those who use it less can bank or sell credits. Arnold, Doan, and DeCorla-Souza (2012) suggest enhancing public acceptance by increasing motorists’ travel choices. They suggest converting the right shoulder of a highway into a new general purpose lane while converting the left

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5 This is in contrast to the extensive literature examining privatization strategies converting the ownership of a firm from government to private, i.e. privatization (see e.g. Megginson and Netter 2001). This literature examines industries where output is already priced.
lane into a high-occupancy toll (HOT) lane. There are other innovative approaches involving toll revenue “recycling” in which toll revenues are rebated back to motorists (Parry and Bento 2001; Kockelman and Kalmanje 2005).

III. The Investment Public-Private Partnership

A basic tenant of property law is that asset owners possess the right of fructus, which is to retain the fruit, produce, profit or increase from a thing (Garner 2009).6 Most U.S. transportation infrastructure assets are citizen-owned, which implies that the relevant jurisdiction’s citizens have a right to asset-generated income.7 This is analogous to the right that a steel mill or electric utility’s owners (shareholders, in the case of a publicly traded firm) have to the income those assets produce. Although it is seldom recognized, this is also true of infrastructure assets. A critical contribution of our approach is explicit recognition of citizen-owners’ frutus right to income produced by transportation assets.

A second key element of our approach is greater private-sector participation in the form of public-private partnerships (P3s). In a P3, the private partner provides the public entity with an upfront cash payment in return for the right to collect toll revenue from a newly priced transportation facility. The private partner is charged with operating, maintaining, and renovating the facility for the lease’s duration according to its terms. The contract enumerates the precise performance standards by which a facility will be operated. Such contracts typically include strong incentives linked to clear performance metrics. Maintaining roadways according to a strict schedule, for example, can be rewarded, and failure to do so penalized.

6 See Geddes and Nentchev (2013) from which this discussion borrows.
7 An exception to infrastructure citizen-ownership is the Ambassador Bridge that connects Detroit, Michigan with Windsor, Ontario. The bridge is privately owned.
Our concept couples the benefits of the P3 approach with an innovative funding arrangement that benefits directly the citizens of the region in which the P3 is implemented. Under an IP3, payments generated from P3 concession fees are deposited into a public permanent fund owned by the citizens of the jurisdiction where the newly priced infrastructure is located. Those citizens have a legal claim to the value generated by their infrastructure. Households receive an annual dividend paid out of the permanent fund’s investment income.

In contrast to exhaustible resources, roads can be re-concessioned (and new lease payments obtained) over time. As the balance of the fund’s investment proceeds are reinvested and as roads are re-concessioned, the fund’s principal grows, providing ever-greater annual income to taxpayer-owners. An IP3 as applied to roads is superior to preserving wealth from natural resources in a permanent fund.

Although this is a choice variable for government, we propose investing the majority of concession fee payments into the permanent fund. The portion of upfront concession lease proceeds not invested can be used to renovate and expand the existing infrastructure network. Like any utility, the system becomes sustainable through variable user fees that fund the network. MBUFs network respond to changes in the demand for road services while guiding investment into (and out of) segments.

We term this an investment public-private partnership because it preserves forever the latent value of an infrastructure asset that is realized through pricing. By better recognizing the taxpayer-owner claims to facility-generated value, this approach helps clarify the difference between an asset that remains nationalized (citizens can assert a well-defined right) and one in which citizen-owners possess well-defined property rights, but where title remains with the public sector. We refer to these as “publicized” assets in that some rights of the public are well recognized.
It is important to recognize how publicization of infrastructure assets differs from privatization or nationalization. Privatization conveys asset title to a private party, perhaps through an initial public offering of shares. Nationalization assigns asset ownership to all of a jurisdiction’s citizens. However, no individual or subgroup of citizen-owners has a recognized claim to the use of the asset in question or to income it generates. Therefore, basic elements of property rights, do not exist.

Recognizing citizen-owner rights helps clarify who holds legitimate claims to infrastructure assets, and thus to the toll revenue they generate. For example, the Interstate Highway system is owned by the citizens of the states in which those highways are located. The same is true of state roads. It is not necessary to privatize assets to better recognize citizen-owner rights.

An example illustrates that citizen property rights in infrastructure assets already exist. A basic of property rights is transferability. In 1990, the state of New York sold the Cross-Westchester Expressway (part of I-287) to the New York State Thruway Authority for $20 million (equal to about $35 million in 2013). The New York State Thruway Authority issued roughly $350 million in bonds to buy I-287, with the balance of the bond proceeds to improve the New York State canal system and the Tappan Zee Bridge (Grasso 1994). Facility title was conveyed to the Thruway Authority because it had to hold title as security for the necessary bonds. The fact that title to a transportation facility was transferred indicates that taxpayer-owner property rights to infrastructure have been recognized explicitly. The IP3 approach represents a step forward because it clarifies and formalizes such rights, while allowing value embedded in infrastructure assets to be realized.

This proposal is also innovative in that it utilizes a public permanent fund to legally protect value released by pricing transportation infrastructure in perpetuity. Because the fund exists forever
and its principle is legally protected, wealth deposited into the fund is sheltered from dissipation stemming from political spending pressure.

To better clarify our approach, we next describe several steps necessary for its implementation. But before it is implemented, the relevant transportation authorities must decide—with extensive public input—if the approach is appropriate for their regions. This implies careful consideration not only of the efficacy of area-wide variable road pricing, but also a permanent fund to accumulate principal for citizen-owners and to distribute dividends. Public IP3 sponsors may wish to also carefully consider the distribution of upfront concession lease proceeds between permanent fund investment and current expenditures, as well as the regulation of details of the P3 through the concession contract. The public sponsors must then carefully and thoroughly explain the IP3 concept to the infrastructure system’s citizen-owners and other groups.

The next step is to determine the structure of the IP3 concession contract. P3 contracts govern the relationship between the public project sponsor and the private partner for the contract’s duration. It is crucial that the public project sponsor carefully consider contractual structures before soliciting bids. An important consideration is the initial MBUF level and allowed rates of increase over time. Other key contractual issues include desired levels of service, how those service levels are measured, standards for maintenance and expansion, and how performance is incentivized using contractual rewards and penalties. Linking toll increases to inflation, for example, creates an inflation-protected revenue stream that is likely to attract greater upfront concession payments, and thus larger payments to residents from the permanent fund. Caps on tolls are helpful in controlling market power, but are also important in structuring a P3 that will attract private capital.
Concession lease length is also critical. Infrastructure owners (citizens) may view relatively short leases more favorably if they provide the public project sponsor with added flexibility. Shorter leases also increase competition by allowing rebidding to occur more often. They are also likely to increase the IP3’s political feasibility if the public views long leases skeptically. However, if the leases are long enough to meet certain tax rules, they have the benefit of allowing private sponsors to expense depreciation. This raises concession value and upfront concession payments which allows for larger subsequent annual dividend payments to citizen-owners. Potential public-sector project sponsors may wish to seek expert advice to facilitate their decisions regarding P3 contractual structure.

The third step is for the public sponsor to announce a request for qualifications to attract and screen qualified bidders for IP3 leases. Bidders may include a road operator and a financier coordinated through a legal entity created specifically for the purpose (a SPV) of bidding on, financing, maintaining, and operating the network or facility in question. This step involves all of the standard approaches used to assess potential bidders.

Subject to preset contractual lease terms, the bidder offering the largest upfront concession payment is awarded the contract. As with lease length, such bidding ensures that infrastructure owners receive the most value for income created by their assets, which results in the largest possible annual dividend. Competitive concession bidding effectively converts producer-side value generated by road pricing into an upfront payment. Once the winner is selected and the lease agreement concluded, the majority of the concession payment is used to capitalize the citizens’ permanent fund (FN-70%?). The remainder 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 road network or with additional transportation options, or both.
The fourth step is to capitalize the public permanent fund. The public sponsor of the IP3 must determine the legal structure of the permanent fund and how to best insulate its capital from short-term spending pressure. The APF, for example, is protected in that state’s constitution. The sponsor may wish to borrow from other successful, permanent funds models from around the world. This step is central to the IP3 because citizens must have confidence that the fund’s principal will be protected from political pressure for immediate spending. The permanent fund preserves wealth in perpetuity since the fund’s principal is never spent. The fund invests in a diversified portfolio of stocks, bonds, currencies, real estate, and in infrastructure itself. Such basic, transparent capital commitments help to protect the fund, in addition to any legal protections it may enjoy.

The fifth step is to price road use using variable MBUFs, and begin facility operation under the private operation. Once a private road operator has been identified, the network can be variably priced, and the toll revenue stream generated. The concession contract governs the system’s operation. The road system is then operated much like a utility where contracts address key issues as market power, asset maintenance, and service quality.

An array of alternative approaches can assist in MBUF implement, such as gradual phase-ins and “premium service” lanes that may serve to enhance pricing’s appeal to the public. Premium lanes are variably priced to ensure the motorist a certain, guaranteed minimum speed between two points on the road segment. Along with premium lanes unpriced (or more moderately priced) “standard” lanes are available. Though not examined in detail here, such approaches could be usefully adopted alongside MBUFs using this approach.

The final step is to ascertain the likely size of annual dividend payments. Dividends are paid out of annual investment income. The public sponsor is responsible for establishing the method by
which annual dividends are calculated. Fortunately, a number of established models can guide these decisions. The formula used to calculate the APF dividend may provide a model. IP3 sponsors may also wish to emulate Alaska’s approach to determining eligibility for annual dividends.

Because the fund exists in perpetuity, income grows as new facilities are added to the priced network and as existing facilities are re-concessioned. Some permanent funds, including Alaska’s, choose to reinvest a portion of their investment income back into the fund. Through these steps, the IP3 utilizes private infrastructure investment to provide households with an annual payment to offset the cost of adopting variable MBUF pricing. This enhances public support for adopting variable road pricing.

IV. Benefits of the Investment Public-Private Partnership

The IP3 approach combines the benefits of adopting MBUFs with those created by a legally protected permanent fund and with private participation in infrastructure operation and maintenance. At its most basic level, utilizing an IP3 to price transportation facilities provides additional, investment for aging, congested transportation facilities in an era of tight public budgets. Incorporating a permanent fund into this model provides taxpayer-owners with access to income generated by road pricing, granting them a tangible stake in accurately pricing, properly maintaining, and efficiently operating their transportation infrastructure.

Protecting wealth through a permanent fund is also important because taxpayer-owners recognize that, under current organizational arrangements, revenue from newly tolled roads may be diverted for non-transportation purposes. For example, revenue initially raised to meet principal and interest payments on bonds issued to build a bridge may still be collected but diverted for other non-transportation purposes long after those bonds are paid off. Such diversion is also a concern for gas
tax revenue, and is a long-standing problem. For example, the Washington State Good Roads Association reported that more than $10 million of gas tax revenue was diverted to other purposes in the 10 years between 1933 and 1943 (Washington Secretary of State’s Office, 1944).

Diversion is also a problem for natural resource wealth, as the APF’s history suggests. The APF was formed because Alaskan natural resource wealth from North Slope oil reserves was quickly spent by the state after its discovery in 1968. As one commentator described:

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 (Anderson 2002).

The APF was created in response to the “frenzy of public spending,” to help preserve the value inherent in natural resources for future Alaskan citizens. The APF is protected in the Alaskan constitution, which requires that at least 25 percent of the revenue from oil and gas sales or royalties be placed into the fund. Investment income generated by the fund is then used to pay an annual dividend to all Alaskan taxpayers.

Another example is Canada’s Alberta Heritage Savings Trust Fund, which is used to preserve wealth generated by Alberta’s vast bituminous sand (or “tar sand”) deposits. The fund initially received 25 percent of Alberta’s nonrenewable resource royalties. That fraction was subsequently increased to 50 percent. As of December 31, 2012, the fund was invested in stocks, bonds, real estate, and alternative investments and had approximately $16.4 billion under management (Alberta Heritage Trust Fund 2013). Similarly, Norway has been depositing 100 percent of the revenue from its nonrenewable resources into its permanent fund.
The IP3 approach may seem like a radical departure from existing policy. However, several U.S. brownfield PPPs provide precedents for an IP3, although they occurred on tolled facilities.\(^8\) The brownfield lease most similar in concept is the (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. That was the largest fee even offered for a U.S. toll road concession. 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.

Unlike the IP3, the Pennsylvania lease would have directed investment income to transportation spending in the state rather than to cash dividends. Concession proceeds would have been invested through the state’s pension fund rather than through an independent permanent fund. Although related, the IP3 has several advantages over this approach. Because citizens would not have directly received 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 as in Alaska, which increases its independence from political pressure.

The second related 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). The state

\(^8\) A brownfield PPP refers to leasing an existing transportation facility. It is often contrasted with a greenfield PPP, which is enlisting private assistance in designing and constructing a new facility.
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 (Anderson 2002).

The third illustrative brownfield lease is the Chicago Skyway. 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 Infraestructuras 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 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 relatively 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 huge by international standards (Foote and Bel 2009), which may be due to the relatively security of property rights and contractual enforcement in the United States (Daniels and Trebilcock 1996).

V. The Role of Private Participation

We next show why private participation is critical to the success of an IP3. In general, private participation can be broken down into several key 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, and because our focus is on pricing systems that are already built.

One consideration that applies to several potential private roles is competition through competitive bidding. Competitive bidding to provide a service is impossible without private competitors. Bidding reduces the cost of offering a variety of critical services, including facility financing, operation and maintenance. Competition promotes social welfare, since it encourages firms to operate efficiently, to focus on customers, to adopt new technologies, and to innovate (Geddes 2011). 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 may be subject to tort liability for failing to maintain facilities to certain standards, thus heightening their incentives to properly maintain and operate the facility.

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 next examine the effects that an IP3 is likely to have in practice on an actual road network using measured traffic flows from Columbus, Ohio. We combine traffic data provided by the Ohio Department of Transportation (ODOT) for the Columbus, Ohio metropolitan area with financial information from large P3 projects around the country. We find that adopting the IP3 approach in Columbus would significantly reduce traffic congestion. The approach would provide the taxpayer-owners of Columbus infrastructure with an annual dividend payment of between $150 and $1,900 per household annually, depending on the structure of the permanent fund and the method of dividend payouts.

Columbus is appropriate for this analysis for several reasons. First, it is a major metropolitan area (as well as the state capital). The estimates are likely to apply to other cities with similar size and road structure. Second, Columbus exhibits non-trivial levels of traffic congestion during peak times, and detailed traffic flow sensor data were available for the metro area. We can thus reasonably
estimate likely congestion reductions from road pricing. Moreover, comprehensive traffic data from this region allow us to estimate dividends assuming that all major highways and arterials are priced. This reduces the scope for traffic diversion onto non-priced facilities. Third, the relevant geographic area lies entirely within one state, which reduces (but does not eliminate) jurisdictional complications, such as disputes over the right to toll revenue.

Several key assumptions underlie our revenue estimates for an IP3 in Columbus, Ohio. Pretoll traffic demand was based on 2010 traffic volume and traffic composition data. We relied on demand elasticity estimates from an extensive Singapore study of congestion pricing to account for motorists’ responses to tolling (Olszewski 2003). It considers the changing of routes, driving times, and transportation modes (city buses, for example) in response to tolls. Singapore’s public transportation options are more extensive than those in Columbus, giving motorists there more alternatives to priced roads. As a result, Singapore’s elasticity estimates generate relatively conservative toll revenue estimates. We assume (conservatively) that elasticity rises by 50 percent in the third year of tolling as motorists adjust over time, which is consistent with prior literature (Matas and Raymond 2003).

We modeled three initial toll rate scenarios: low, medium, and high. The low-toll scenario is based on a “value-added” tolling concept. Under this approach, tolls are set to generate revenue sufficient to fund road improvements, such as renovation, operation, and maintenance work. The demand-management aspects of this approach are limited however. It is analogous to a cost-of-service approach and leads to a low net present value (NPV) of future cash flows with correspondingly low annual dividend payments to households. Under this approach, we applied $0.05/0.15 (cars) and $0.12/0.20 (trucks) for off-peak/peak per-mile driven rates, respectively (Poole 2011). Because such tolls are very low, they are unlikely to significantly reduce congestion. The approach provides a useful baseline estimate.
For the high-toll scenario, we applied toll rates used on Northern Virginia’s Dulles Greenway. This scenario uses $0.31/0.37 for cars, $0.68/0.81 for light trucks, and $0.99/1.17 for heavy trucks for off-peak/peak per-mile rates, respectively. Early morning and late evening hours are free due to limited traffic. We assume that toll rates increase 2.5 percent annually, which is the expected long-term annual inflation rate as measured by the Consumer Price Index (Federal Reserve Bank of Philadelphia 2012). The medium toll-rate scenario is the arithmetic average of the high and low toll scenarios.

To estimate road renovation and maintenance costs, we utilized data from the 2011 financial reports of four major toll-road infrastructure projects: (1) Indiana Toll Road; (2) Ohio Turnpike, (3) Pennsylvania Turnpike, and (4) West Virginia Turnpike (Statewide Mobility Partners LLS and Subsidiary 2010, Ohio Turnpike Commission 2010, Pennsylvania Turnpike Commission 2011). This resulted in average annual per-lane-mile maintenance and construction costs of $46,295, which we inflate annually using the construction-cost inflation forecast (Ohio Department of Transportation 2011, Oregon Department of Transportation 2013). Administration costs were $60,913, which we assume would not change significantly over the lease’s duration. Capital costs were $131,698, which we assume would increase annually at the rate of the Consumer Price Index.

Under these assumptions, our model produced the estimated concession payments (discounted net cash flows) reported in figure 1. We report estimates using six possible concession lengths (between 5 and 40 years) as well as the three toll-rate scenarios. This results in a total of nine concession payment estimates. Discount rates of 3 and 7 percent (which is standard) were used. These estimates offer a sense of how lease payments vary when utilizing best practices for conducting cost-benefit analysis on infrastructure investment projects (Oregon Department of Transportation 2011).
Figure 1 suggests wide variation in expected concession payments depending on the assumptions used.

FIGURE 1 ABOUT HERE

**Estimating Dividend Payments.** As noted, we recommend that the majority of the upfront concession payment be placed into the permanent fund. To be conservative, we base our model assumptions on 60 percent of the upfront payment committed in this manner. Each region can adjust this proportion to match its specific circumstances and preferences to maximize the appeal of road pricing.

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 (U.S. Census Bureau 2012). We use an average annual expense ratio (total operating expenses divided by net assets) of 0.24 percent, which is the APF’s average over the last four years (Alaska Permanent Fund Corporation 2009). The expected annual rate of return on investment for our model fund is the mean of the 5 percent target rate of return (ROR) and the 10.34 percent historical annualized ROR over the long run of the APF.

We consider two different investment fund approaches, which result in different annual dividend estimates. Under the APF approach, taxpayer-owner dividends (calculated using the Alaska Permanent Fund Corporation formula) are covered with only dividends and capital gains from investing the protected principal. Additional amounts are added to the principal and reinvested each year, which results in dividends that increase over time. This is due to both re-concessions and principal growth.

The second approach relies on depleting the principal to pay higher current dividends. Under this approach, dividends and operating expenses are covered using funds from both principal and investment proceeds. Dividends are determined to ensure that the principal is fully depleted by the
end of the concession period. The principal is replenished after the next lease. This approach generates higher annual dividends in the short term, but lower annual dividends once the principal in the public permanent fund has sufficient time to mature. As Figure 2 indicates, dividends from the APF approach will exceed the declining-principal approach after about 30 years.

We assume 60 percent of concession fees are deposited into the fund to ensure conservative estimates; dividends are higher if a greater fraction of concession lease payments is placed in the fund. Figure 2 indicates that dividends will be twice as large in the early years under the declining principal approach. Nevertheless, the annual dividend from the IP3 permanent fund approach using a 15-year lease compares favorably with the $878 dividend for 2012 from the APF (noting that the APF dividend is per person rather than household, as in our estimates).

FIGURE 2 HERE

Figure 2 also suggests that dividends are likely to increase substantially if the assumed concession length is increased to 20 or 25 years. Given other relatively long US brownfield leases (99 years for the Chicago Skyway and 75 years for the Indiana Toll Road, for example), estimates based on such lease lengths are reasonable.

**Improve in Traffic Conditions from Congestion Pricing.** A key goal of annual dividend payments is to allow infrastructure citizen-owners to capture some of the social value created by adopting variable road pricing, or congestion pricing. Congestion-based pricing, in which tolls rise to moderate demand, is a crucial aspect of the IP3 that leads to improvements in traffic conditions. We assess traffic congestion using standard highway level-of-service (LOS) grades. The Highway Capacity Manual lists the following levels of service:
A = Free-flow operations at about 90 percent of free-flow speed.
B = Reasonably unimpeded operations at about 70 percent of free-flow speed.
C = Stable flow, restricted maneuverability, operation at about 50 percent of FFS.
D = Substantial increase in delays due to high traffic volume.
E = Significant delays, average travel speed of 33 percent (or less) of FFS.
F = Extremely low speed, excessive queuing.

We calculated LOS grades for each major road in the Columbus area using the Highway Capacity Manual instructions and Columbus road capacity data (Ohio Department of Transportation 2013). We observed improvements in traffic flows over the duration of the modeled concession as reported in Figure 3. Figure 3 suggests that an IP3 in Columbus would result in large and relatively rapid reductions in traffic congestion. We predict a trend of moderate further improvement in traffic conditions in following concession years. This suggests that, by implementing MBUFs, the IP3 approach is likely to substantially reduce traffic congestion in the Columbus metropolitan area.

FIGURE 3 HERE

VI. Summary and Conclusions

We suggest an innovative approach for improving public acceptance of road pricing through mileage-based user fees. 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 numerous advantages relative to current proposals to increase citizen support for road pricing.

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 MBUFs would address many of those problems. MBUFs would regulate demand, thus reducing traffic congestion while
generating new revenue. However, the adoption of MBUFs on existing capacity is politically difficult to implement. Recent literature has focused on offering proposals to enhance the public acceptance of variable pricing of existing transportation facilities.

Our approach to enhancing public acceptance of variable road pricing is based on the Alaska Permanent Fund model. The APF exists in perpetuity and pays a substantial annual dividend to all Alaskan residents. The APF approach can be used in other contexts to protect the large upfront payments realized from road concession leases from excessively rapid spending. 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 facilitates MBUFs 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. Moreover, the IP3 offers 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. Because the IP3 provides a fixed annual payment in perpetuity, it will be substantial help to those on fixed incomes, such as retirees. 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.

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 created 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 “commons” problems associated with
infrastructure. We leave the exploration of such issues for future work.
References:


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Estimated Concession Payment (Scenarios for Toll Rate, Discount Rate, and Concession Length)

Source: Authors’ modeling.
Figure 2

Annual Dividend Amounts Per Household for All Concession Length Scenarios

**APF Approach**—perpetual, increasing dividends

**“Declining Principal” Approach**—constant dividends, paid only during concession

Note: This assumes a medium toll-rate scenario and a 7 percent
discount rate. Source: Authors’ modeling.

Figure 3

Level-of-Service Grades from Congestion Pricing of Columbus, Ohio

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Note: Detailed calculations of concession NPV, dividends, and LOS grades are available from the authors. Source: Authors’ calculations.