P3s in the Transportation Sector: Policy Implications

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Acronyms

CPI	Consumer price index
EU	European Union
P3s	Public–private partnerships
US	United States

Background

Throughout the world it is common for government to fund, build, operate, and maintain the road systems based on the premise that roads are public goods. Therefore, everyone uses or benefits from this investment in road network. Road networks generally consist of major highways, regional, and local roads. The focus of this chapter is primarily on major highways and potentially regional roads.

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The United States (US) Interstate Interstate Highway system illustrates a major highway network. When US President Eisenhower began the interstate highway system in 1956, which is among the largest public works project in history, its total costs were over $500 billion through 1966 when it was essentially completed. The Consumer Price Index (CPI) has increased 8.2 times since 1966, so that the value in 2021 dollars would be $4.1 trillion. The project passed the House of Representatives with overwhelming support by members of both parties (388 in favor to 19 against), while the US Senate after a conference with the House passed the bill by 89 to 1. The US Interstate Highway system is considered a major success and has been transformative to the US economy

In April 2021, President Biden proposed a $2.0 Trillion expenditure on infrastructure which was subsequently reduced to $1.2 Trillion by July 22, 2021, with a larger proposal still including social infrastructure spending. The Republicans counteroffer for traditional infrastructure was much smaller than Biden's proposal. Clearly, there are numerous factors that have changed in the intervening 65 years from the Eisenhower era to the Biden era. However, one distinct change in attitude appears to be significant. In 1956 it seemed obvious that the federal and state governments should fund and construct roads. In 2021, the Republican House of Representatives plan was based at least in part on the use of $400 billion as P3s for the transportation projects (Wilkie, 2021). This proposal seems to replace the 1956 government fully controlled and non-tolled roads by partial market based private participation. Indeed, the perception and economic theory (Musgrave, 1959; Samuelson, 1955) of what is a pure public good and whether government should produce such goods has changed and is clearly reflected in the 2021 Republican counteroffer to Biden's infrastructural government funded proposal. Indeed, P3s and privatization have been adopted by governors and mayors of both parties, like Mayors Daley of Chicago, Goldsmith of Indianapolis, Rendell of Philadelphia, Giuliani of New York City, Governor Bush of Florida, Governor Schaefer of Maryland, and Governor Daniels of Indiana.

One claimed purpose of Eisenhower's interstate highway system was for defense, to provide easier evacuation of cities in case of an atomic attack by the Soviet Union. President Eisenhower however, believed that the major purposes of the roads were economic growth, to improve highway safety, to reduce lawsuits, and to relieve congestion and less so for defense purposes (Interstate Highway System, 2021). A major funding source for the operation of the highways was a semi-user' fee, namely, the gasoline tax. In the 1950s, a direct charge on the civilian users of the highways would have involved high government transaction costs of collecting, securing, and delivering the toll revenues. It is interesting to note that President Eisenhower preferred tolls on the interstate highways, but was persuaded by the argument that except for the two Coastal regions, drivers would not be able or willing to pay the tolls. In any case, in the 1950s high transaction costs made the collection of direct user fees impractical and justified "free" use of the highways. However, from both efficiency and equity viewpoints, funding the construction, maintenance, and operation of the road should be by the users of the system.

On the production side, substituting government monopoly construction and provision by competitive private and public entities improves efficiency. From an equity viewpoint, non-users of the highways should not subsidize the users of the highways. Further, indirect users of the highways like buyers of products delivered by using the trucks, pay through the fees that are incorporated in the price of the delivered products. The gas tax was supposed to serve as a semi-user fee and pay for public roads construction and maintenance when the transaction costs were high. Indeed, the gas tax was increased from 2 cents to 3 cents per gallon at the time when the interstate highways were created. The rationale for such a tax is that the more a driver uses a road, the greater is his/her gas tax contribution for it. However, the gas tax takes the entire road system as one project. Rather, each road should be considered as an independent venture, and the construction and operation of each road should be economically sustainable.

Financing Roads

Use of gas taxes to fund roads, especially highways, has some issues. Drivers who do not use the highways do not directly benefit from them so why should they pay for them. For example, a driver may purchase gasoline in New Jersey but drive almost exclusively on highways in Pennsylvania. Drivers of older, less fuel-efficient vehicles are unjustifiably taxed more heavily for any given distance. As shown below, a significant amount of the gas tax proceeds is diverted to non-highway uses like urban mass transit systems. In addition, the gas tax is likely regressive, being borne in percentage terms more by lower income individuals. We use the US example as a general illustration on the desired model of funding highways while showing the weaknesses of the more common funding sources for highways.

The gas tax revenues are used to fund other government ventures like mass transit, law enforcement, and education. For example, between 2000 and 2019 New York and New Jersey allocated more than 33 percent of their fuel tax proceeds to mass transit (Feigenbaum & Hillman, 2020). Transfer of funds to other activities creates the possibility of "white elephants" and encourages inefficient production of such activities. Further, such transfers cause drivers to unjustifiably subsidize users of mass transit, a redistribution of income. In general, user fees are appropriate wherever the direct beneficiaries can be identified. If government choose to subsidize one group of population, it should do so directly and not through penalizing another group for that amount. Cross subsidization by drivers of users of mass transit or other services does not correct for inequity and produces unjustifiably transfer of income among residents. Again, efficient road usage requires that the marginal costs of the investment, operating, maintenance, and associated negative externalities are equal to the marginal benefits of the trip. When for a given road, user fees are set above the marginal costs and the extra revenues are diverted to other services like mass transit, the road is underused, and drivers subsidize unjustified users of mass transit. If user fees are below marginal costs, subsidization inappropriately occurs in

the other direction. The diversion is nontrivial. In the US, New York State diverts 37.5% of gas tax revenues to other state services; this is a long time practice in the US and is likely in the European Union (EU) countries (Feigenbaum & Hillman, 2020; Watson, 2019, respectively.) The gas tax in the Netherland is $3.36 per gallon, which suggests that it uses only a fraction of its gas tax revenues for roads, causing underuse of cars and roads and overuse of other services to which funds were probably diverted.

When Public–Private Partnerships (P3s) operate individual roads, competition among the private entities at least to obtain the concession is expected to yield the desired social optimum where prices are closer to cost. In providing public goods, government is expected to charge for the negative environmental externalities added to the direct average total cost. In the future when electric cars become the norm, such environmental costs will significantly diminish. Such governmental charges are appropriate only if those receipts are used either to compensate those that suffer from the pollution or are used to ameliorate pollution. Using these environmental receipts to subsidize other services yields inefficiency and unjustified equity outcomes. Again, making each road a profit unit and encouraging competition in the investment and operation of the road yields an increase in social welfare and avoids unjustified cross subsidization. The principle is that road fees are used for roads and their levels reflect direct and indirect costs, while cross subsidization of road fees and other services is avoided. This principle generally means moving as much as possible to competitive user fees for "traditional" government services that are essentially private. In today's reality of electronic technology, user fees are both easier to implement and often entail low transaction costs. Thus, gasoline taxes could become obsolete. Further, when electric cars become more ubiquitous, the gasoline tax will yield low revenue, and eventually become insignificant.

Pure public good services like national defense, air pollution control, police patrol, or disaster services are enjoyed by all residents, and each person enjoys the full magnitude of them. Thus, pure public goods are appropriately funded by the relevant government. The reason for such general ledger funding is that everyone in that society enjoys similar level of service. Still, even when pure public goods are under the responsibility of government, the construction, operation, and other related services can be contracted out to public and private entities, and produced under competitive bidding. In the case of highways, where users are identified, the direct beneficiaries should pay the average total costs.

In the second decade of the twenty-first century, as distinct from the 1950s, existing technology enables low transaction costs in collecting the tolls, while even avoiding congestion at toll booths. So, it would become efficient and equitable to set market prices where those that use the roads and enjoy their benefits pay for their use. Such prices could be adjusted to prevent congestion but at what might be considered competitive levels. User fees allow rational decisions about expanding or contracting capacity. When user fees are employed, drivers use the road until the last dollar they spend equals the benefits they gain from using the road. When the price is zero, as is still common on the US interstate highway system, the road is often over-used, often causing congestion, especially at peak times.

Conventional wisdom suggests that pricing of highways is only appropriate if a close substitute free road is available. However, if monopolistic prices could be prevented, user fees are appropriate and there is no efficiency or equity reason for general government funding to subsidize a highway. The question is how to prevent monopolistic pricing when no close substitute road is available. There are two possible solutions to this problem. One is to subject the operator of the road to the appropriate regulatory commission or agency to approve its pricing. The other is for the regulatory commission to set a price cap where prices could only be raised over time by the difference between some appropriate price index and the expected change in productivity in the highway industry. The latter method of controlling monopoly is considered preferrable since it encourages cost cutting and productivity gains and avoids the necessity for many periodic public hearings. Price caps are designed to encourage cost cutting innovations by allowing the private operator to retain the profits from improved efficiency or lower costs. By keeping prices near competitive levels, such caps and traditional rate regulation discourage entry of competing roads. Society gains greater output in the form of increased road usage compared to the usage under the higher prices without regulation. In any event, high capital costs and the advantages of incumbency make competitive entry unlikely, adding to the desirability of government regulation.

Shadow prices are suggested to reduce risks of the private participants when the latter finance the total costs of the project. Under shadow prices, the road is often offered free of charge to the users while the public partner might pay the average total costs per trip to the private partner. The objective is to maintain a free road to the drivers while minimizing risk, or possible losses, to the private partner. Shadow pricing could be criticized on both efficiency and redistribution grounds. At a price of zero, more drivers use the road than if tolls were set at average total cost. The direct and indirect users on the road are subsidized by taxpayers, and possibly even leading to "white elephants" or socially undesired roads.

A common argument in the case of high initial capital costs, like a bridge, where marginal cost is low relative to average total cost, government should build the bridge and price it at marginal cost, which is close to zero, until congestion occurs. This policy reflects the notion that taxpayers pay for the infrastructure, which is considered a sunk cost. This argument is questionable on several levels. Such an argument that encourages government to fund the bridge, or in the case of Spanish roads to shield the private partner from losses, leads to "white elephants" (Albalate and Bel-Piñana, this volume). Thus, roads where demand is low even when the roads are completed can be too easily justified by such a policy. From a redistribution and efficiency viewpoint, such a project is subsidized by taxpayers that mostly gain no benefits from the bridge rather than being paid for by direct users of the bridge who are its beneficiaries. Also, it is obvious that although consumer surplus is increased at lower prices, it is not clear that such losing roads should be built. Further, a road priced at average total cost is likely to accumulate sufficient funds to maintain the road rather than relying on the general government budget. In such a manner, under a P3 model, funds become available for repairs when needed. Obviously, as Leccis (this volume) stated about the collapse of the

Italian Morandi bridge, strict government regulation is needed for all bridges to prevent a catastrophy.

Advantages and Disadvantages of Public-Private Partnerships (P3s)

Governments often have difficulties raising funds for capital projects because of debt limitations. P3s enable private funds to be used. The role of government normally is not to conduct business activities. Partnership with private partners enables creative activities, faster adoption of technology, cheaper and opportunistic purchasing of inputs, easier use of part time employees, competitive market wages to employees, fewer restrictions from using unionized labor, and avoiding strict and costly government protocols. Experience has often shown that public monopolies act less efficiently than firms operating under competitive conditions. Government can partner with companies that specialize in particular activities and have unique knowledge that could improve the outputs and save on resources. Private partners are focused on meeting goals, increasing income and reducing costs more than government. In P3s, government shares with its private partner bad consequences rather than bearing them on its own. Also, in P3s the private partner's unique expertise could be instrumental in solving unexpected problems. When a private partner controls overall aspects of building, operating, and maintaining the road, it is likely to avoid many problems that exist when several independent contractors are involved. Significantly, P3s are more likely than government to avoid "white elephants." When government builds a road or a bridge, it is more likely to overestimate its usage, or is pressured to build it by political, interest or lobbying groups. A private partner is less likely to share in an unprofitable road.

Experiences addressed in this volume show some distinct disadvantages of P3s in roads. When a P3 concession is near the time of transfer to government, the private partner may neglect appropriate maintenance and incorporation of improved technology on the road. Government often lacks the expertise of highly paid lawyers, accountants, and engineers unlike their private counterpart. Thus, it is sometimes difficult for government to negotiate a good or appropriate contract reflecting the public interest. In particular, the private partner's experts often obtain incomplete contract that enables renegotiations to occur where the private partner benefits at the expense of the public. In addition, government incurs transaction costs to monitor P3s' contract compliances that is missing in public projects. Even though P3 contracts specify the share of each partner in case of a failure or disaster, government often ends up bearing the full responsibilities. The private partner often creates a separate corporation for this P3 or relies on high debt to bear low risk.

Small project P3s are generally preferred over one large P3. In the case of a large P3, it is advisable to break it up to a smaller number of independent P3s to reduce risk even though the costs seem higher than in the conduct of the entire project. By

so doing, more private companies are able to enter the biddings for the smaller project, increasing competition among them, and yielding close to normal returns. When a large P3 project is offered for bidding, only a few companies may respond reflecting limited competition, the likely risk is higher, and therefore government would be in an inferior position. Smaller independent projects reduce the likelihood of risk and uncertainty for the government. Notably, companies have to be large enough to incorporate sufficient activities to obtain relevant synergies (Albalate and Bel-Piñana, this volume). Another disadvantage is the higher borrowing costs of P3s relative to government. P3s sometimes require special legislation, which incurs transaction costs and increases approval time. Government needs to regulate P3s that enjoy monopoly power to prevent output restriction. A significant problem related to P3s is the possibility of renegotiation, which encourages low bids and creation of "white elephants."

Public-Private Partnerships (P3s) Versus Privatization of Roads

The question is why not have complete privatization rather than p3s. The use of Build-Operate-Transfer (BOT) or Build-Transfer-Operate or Build-Own-Operate-Transfer for highways is common where the private partner over time (usually 20–40 years) recovers its investment, enjoys normal or somewhat above normal returns, and then transfers the road to government. The greater the initial private investment, the longer is the concession period. Government often intends to allow free or reduced prices once the road is under its control. One might question the rationale for the transfer to the government. In particular, the private partner might avoid introduction of new technology and all but repairs required in the contract as the road approaches the transfer to government. The operating company might be motivated to raise or request higher prices if it operates the road for a given time while it might avoid increasing prices if it operates the road indefinitely. Also, one might argue that government should avoid operating businesses, but should promote the public interest through appropriate regulation to control monopolistic pricing or encourage competition through auctioning, among other methods.

In any event, the introduction of user fees enables the shift from full government control to more market-oriented pricing of P3s. Electronic monitoring technology achieves lower transaction costs and thereby allows user fees and makes P3s more feasible. Fully or even partial private involvement through P3s enables more efficient production, greater adoption of technology, less bureaucracy, and greater flexibility in management, purchasing, and employment, and more rigorous analysis of the economic desirability of roads. One could view the creation of P3 as a stage towards reducing government operations and moving towards privatization. For a more complete treatment of this issue, see chapter 17 of volume 1.

The introduction of P3s to finance, construct, operate, and maintain highways is designed for government to share the risks with businesses, and inject productivity, flexibility, and usage of lower cost inputs. However, experiences show that regardless of the initial contract between government and the business entity, renegotiations often occur, and the risk sharing of government dominates. Of 148 worldwide infrastructure projects analyzed, which had financial closure between 2005 and 2015 and for which data were available, 33% were renegotiated (World Bank, 2021). In Latin America and the Caribbean, 58% were renegotiated, in Northern America 40%, in the EU 28%, and in Southeast Asia 13%. The most common infrastructure segment was transportation where 40% were renegotiated. On the average, renegotiation occurred 3.6 years after financial closure. In the case of construction, renegotiation on average occurred 2.5 years into the project. The major reasons for renegotiation were increased costs of construction (21%), changing government policy (19%), and tariff issues (16%) (World Bank, 2021). The main factors that probably contribute to renegotiation are risk and uncertain events, the relative low equity of the private partner's often separate company created for the p3, the greater desire by the government versus the private partner for the project's completion, and poor contract management by the public partner. Leccis, in this volume, argued that the public partner is reluctant to revoke concessions because of the costs involved, leading to greater bargaining power for the private partner. The realistic expectations for renegotiations could motivate private contractors to submit low bids when competing for the contract. Monteiro (2015) claims that better assessment of risk and mitigation strategies in the initial contract could significantly reduce the occurrence of renegotiations. Possible obstacles that have occurred in similar such projects can be used to assess risk and enumerate the appropriate remedies should they occur. Clearly, events and conditions that are unable to be predicted could still lead to renegotiations.

An important rationale for P3s is the fact that government needs a new road or major work on an existing road but lacks the funds to do so. The private partner is aware of the situation and uses opportunities to renegotiate and improve its own position. Also, the private partner's objective is to maximize profits while the public partner's objective is to complete the road and establish or maintain moderate prices to appease voters. Private road operators usually use demand sensitive pricing to maximize profits while public road operators often maintain fixed prices during the day.

Private toll roads could be considered an alternative to both P3s and public roads. Such roads were common historically in the US and are now common in Europe. Some have been successful, and some have failed as is the case in any other business. The Dulles Greenway Road has become successful after having initially overestimated ridership. The return on equity was expected to be 11–12% in 2020 and retained earnings grew from about $ 3 billion to about $7.5 billion in the seven-year period ending on December 31, 2019 (Commonwealth of Virginia, State Corporation Commission, 2021). SR 91 in Orange County, California has also been successful. It provided four traffic lanes, two in each direction with easy access to/from it as it is in the middle of the freeway. The road has been equipped with the latest

technological devices guaranteeing travel at 65 miles an hour or tolls are returned to the consumer, and the road provides for immediate removal of disabled cars. Tolls are differentiated by the time of the day and by existing demand (Wikipedia, 2021a, 2021b).

On the other hand, some P3s have been unsuccessful. For example, the Morandi bridge, which is part of the A10 highway in Italy, collapsed in 2018 with 43 fatalities, raising questions about the desirability of P3s (Leccis, this volume.) Another failure was evident with the Southern Indiana's I-69 Project where the private concessionaire was four months late in beginning the construction and fell behind in paying subcontractors, contributing to the ultimate financial problems. The project's ultimate costs grew from $369 million to $556.2 million, a 51% higher cost, and it was completed 2 years behind schedule when the State took control over the entire project (DeGood, 2018). One could easily claim that even in business partnerships in general, it is common that some fail. The issue is clearly whether such failures are more common in P3s than in other similar businesses and whether appropriate contractual agreements could prevent their occurrences. Such a detailed study could be in order.

Private roads have some disadvantages. When a government agency operates and maintains a road it enjoys sovereign immunity in case an accident with injuries, death, and property damage (Fishman, 2009). At the same time, private roads, or even private partners in P3s are fully liable and need to carry expensive insurance. Also, state and federal road operators are not required to pay federal taxes on profits while private toll roads owners are fully taxed. Finally, government can borrow at a lower interest rate than private road operators. Thus, there seems to be a clear disadvantage for private operators of roads vis-a-vis public road, leading to disincentives to build competing P3 or private roads. However, such disadvantages are institutional, set by government procedures and are not related to the actual operation of the P3s.

Some remedies exist to overcome the disadvantaged private operators. The state legislator could grant sovereign immunity to the private operators of roads. Also, government could help the private operators to float tax exempt bonds like the Private Activity Bonds. However, nothing can or should be done with respect to the private operators' taxes, which exist for all business. Such tax discrimination discourages construction of private toll roads, which compete with existing toll free or tolled public highways. The existence of these obstacles creates uncertainty for potential private operators, leading to reduced incentives for their entry. Government's role is to prevent monopolistic power and control its pricing power. However, ceteris paribus, over time with increased population, income, and car ownership, the demand for travel on major roads increases. The supply of public roads has not kept pace, creating congestion and diminished speeds. This situation creates opportunities for P3s and even for fully private roads. In the case of roads we have determined that the public good aspect is limited, letting prices fluctuate makes better use of existing capacity. It seems that private firms more often employ demand sensitive pricing where prices change to reflect changing intensity of use and price elasticities of demand. Demand sensitive pricing on highways could eliminate

congestion, enable flow of traffic at a desired spreed, and increase the revenues generated from the travelers. This is a similar policy to varying prices over the day by restaurants, movie theaters, and even some highways (e.g., SR 91 in Orange County, California.) Allowing prices to rise during rush hours prevents congestion on the toll roads while increasing revenues. Such pricing policy may also encourage other firms to offer substitute services to the existing state or federal roads, like buses, moving belts, or special lanes on existing roads.

The Road Beyond

The basic question this book addresses is whether P3s in highways, bridges, and parking increase social welfare and their productivity in comparison to government controlled construction, management, and operation of these infrastructures. In general, P3s in highways have been successful in the world. For example, Decola-Souza and Sullivan (this volume) have evaluated P3s of US highways and concluded that such ventures generally proved successful, as did the ring roads in India, and the developers' roads in England. The chapters in this volume indicate that problems with P3s have arisen when the private partner had low equity in the P3 ventures, the stake of the public partner was higher in risk taking, when the partnership agreements were incomplete, all reasons leading to renegotiation. A clear success of P3s was in parking facilities. Matindill and Perry, in this volume, have shown that P3s for parking facilities in universities and transit stations were successful compared with public parking facilities managed by public authorities. Construction, management, and operation of such facilities are provided by companies that possess specific knowledge and experience, specific IT programs, and well-trained employees while allowing universities and transit authorities to concentrate more on their core mission. These P3s also relieve the public partners from debt issues associated with the construction.

Other factors for success revealed in this book include the size of the project. The larger in scope and costs and the longer it takes to complete the project, the greater is the extent of risk and uncertainty, and more likely is renegotiation and even bankruptcy to occur. Thus, it has been suggested that large projects might be designed as independent smaller projects even at seemingly higher costs. High initial capital cost roads that compete with free roads are risky (Villalba-Romero and Liyanage, this volume). Since the initial costs for a road or bridge are often high, annual returns that are low in the immediate years of operation could lead to low profitability or even bankruptcy when much of the funding is based on debt. It is difficult to expect an economically feasible road if it has to rely on future revenues based on the development engendered by the road (De Buen and Ortiz, this volume). Roads whose revenues are based solely on tolls and not on increased value of adjacent land and properties that the road operators own, are less likely to be financially viable (Villalba-Romero and Liyanage, this volume). Clearly, the owners of new roads that own adjacent land may enjoy capital gains attributed to their operating road that

could support the investment in the road. The unknown revenue stream is especially acute in the case for "greenfield" roads which are riskier due to the unknown actual ridership (Decola-Souza and Sullivan, this volume). A basic question is what should be the share of government in a P3 road investment. Roads provide direct and indirect benefits to the users as well as pure public good benefits to the community (e.g., encouraging development, reducing pollution) and therefore the financing should be shared proportionately by the partners (Carbonaro, this volume).

De Buen and Ortiz, in this volume, have made some important suggestions on the bidding process and its participants. The potential public partner should provide relevant information to the competing companies on the proposed project, including the expected demand and the environmental consequences. Preparation of the bid is expensive for the private companies but is expected to lead to more participants and quality bids. The costly negotiation process of P3s that is absent in public projects may contribute to better learning and overall cost reduction. Finally, long-term relationship between the public and private personnel contribute to better managed projects.

There are three alternatives in developing and rebuilding existing state and national or federal highways: public, P3s, and private ventures where the P3s may incorporate several models. We recognize the difficulties of the public option, the problems associated with P3s, and some issues with private roads and now we should evaluate and choose the preferred alternative of these three. We suggested that existing technology makes user fees possible with low transaction costs. A main thrust of P3s is the transfer of the road to complete government ownership and operation after 20–30 years and sometime even after 99 years. However, the discounted present value of net revenues of such distant years after the private option expires is very low, while any such infrastructure probably requires major rebuild after the lengthy private operation. These significant outlays also include the installation of new materials and technology that were not available when the project was initially built. Thus, there does not seem to be a clear advantage for having the road transferred to the government. Nevertheless, implementation of P3s seems to enjoy some advantages over public roads. Having private toll roads prevents both the renegotiation problems, and the lack of incentives for improvements in the last years of the concession period. Privatization of highways is likely be the preferred alternative of the three. The process of obtaining state laws to provide sovereign immunity for private roads and the cheaper financing for state governments could be incorporated in the privatization option. Clearly, investment in private roads should be treated no differently from other investments. Greater reliance on private roads seems desirable, but their use requires a change in the mindset of legislators and the public. P3s may be simply an intermediate but an important step to private highways.

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