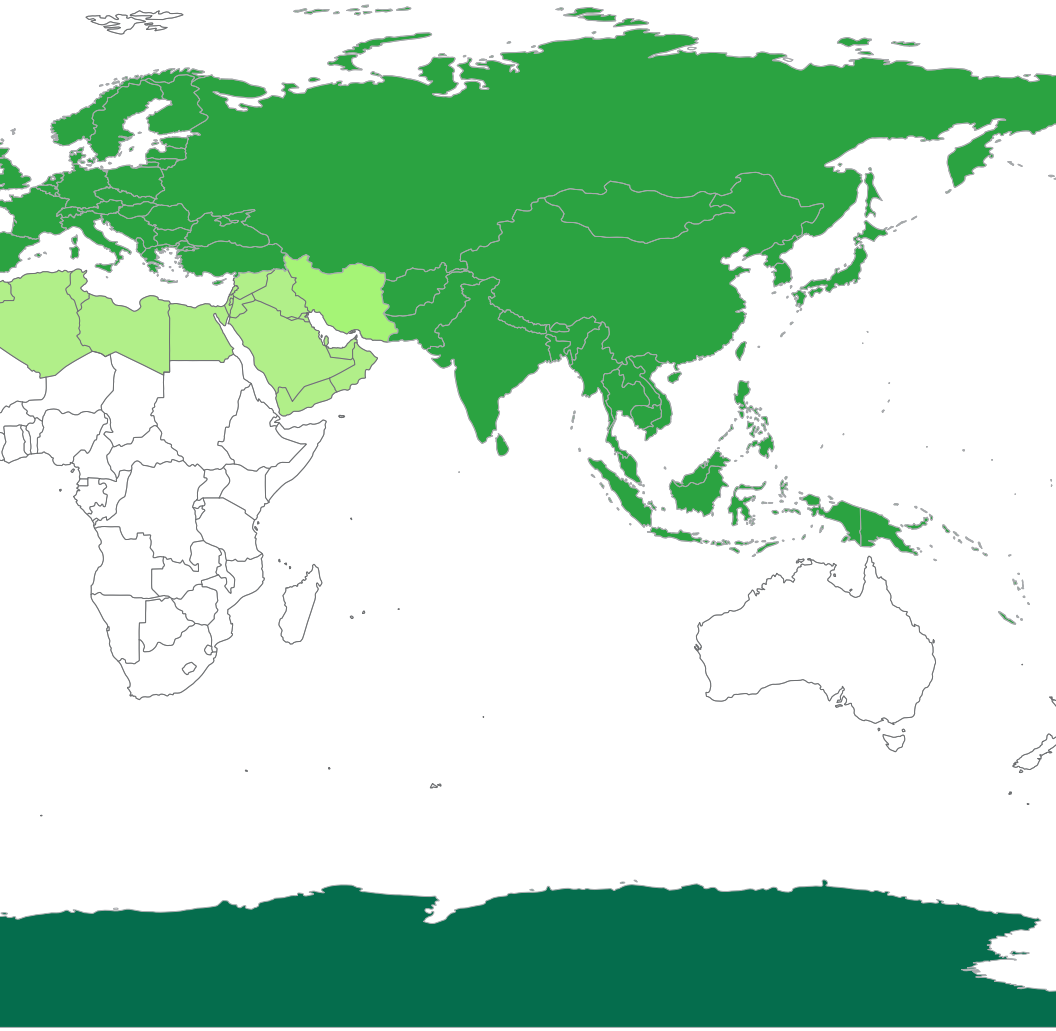
SUSTAINABLE TRANSPORTATION

AN INTERNATIONAL PERSPECTIVE



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The former managing editors of Projections were very open in sharing advice - thank you Anna Brand, Isabelle Anguelovski and Rachel Healy. I hope you will enjoy the layout of this volume, and would like to thank Marissa for designing and improving the graphic design with her ideas. - EVA KASSENS, 2009

PROJECTIONS *volume 9*

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SUSTAINABLE TRANSPORTATION
AN INTERNATIONAL PERSPECTIVE

COVER IMAGE Map courtesy of Eva Kassens; data courtesy of World Resources Institute, 2005. This map shows CO_2 emissions by transport as a percentage of emissions. The more grey the continent, the higher the CO_2 transport emissions in relation to total emission of that continent; the more greeen the continent, the lower the CO_2 transport emissions in relation to total emission of that continent.

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ROAD PRIVATIZATION AND SUSTAINABILITY

Macquarie Infrastructure Group 2008 Annual Report; modified by author.

ABSTRACT

Almost all road infrastructure is treated as a public good and seen as a governmental obligation. But roads differ from other public goods such as national defense in both non-rivalry and non-exclusiveness features. Moreover, Financing construction and maintenance of road infrastructure is challenging because in most countries, government revenues for road construction and maintenance are insufficient. Here, the idea of road privatization is introduced as a possible alternative. Although there are many political and societal hindrances in implementing this idea, its potential to solve problems in transportation is indisputable. The road owner pays the government for the externalities produced from his property (pollutions or accidents) but can make money by charging users (passing the externalities burden to users, while easing congestion and free rider problems) and because the road is privately constructed and owned, the opportunity cost of the road construction and maintenance is better accounted for. By assigning the road's property to private sectors, the supply side might become more efficient based on the transformation from a publicly subsidized market to an open market framework. The equity problem of the new pricing scheme can be partially solved with a rebate policy similar to credit-based congestion pricing (CBCP).

INTRODUCTION

The road network is a major component of a transportation system. Roads, together with vehicles and drivers and their behaviors, establish a road system. But little effort has been done to incorporate a clear framework of road ownership and the related regulations especially compared with the two other components of the system. Since vehicles and drivers have their own identity, it is easier to think about implementing policies to affect them; however, this is not the case for roads. The ownership of roads is not clearly defined and regulated. Although one counter-argument is that governments or states are the owners of roads, an unambiguous way to solve the ownership problem is to privatize roads.

About two hundred years ago, hundreds of turnpike companies operated miles of toll roads in the UK and the USA. In 1830, 1116 turnpike trusts maintained 22,000 miles of toll roads in Great Britain (one fifth of the total road system) (Jeffreys, 1949) and by 1845, 1562 toll companies had been chartered in the USA (Klein et al, 2006). The tolled roads comprised a substantial part of the economy at that time. The turnpikes were successful even though they disturbed the flow of traffic. The concept of a dedicated road fund, financed from the fuel taxes and established in Oregon in 1919, changed the balance of transportation financing from private toward public sector investment (Roth, 2006).

Privatization of transportation infrastructure has gained more attention in the recent years. The potential depletion of public financial resources due to fuel tax revenue reduction, increased in alternative fuels' consumption, and the demand for better service requires a revolution in the road infrastructure. Moreover, advances in toll collection technologies, Electronic Toll Collection (ETC) in Singapore (Uskkusuri et al, 2004), have lowered the transaction costs of revenue collection from roads.

Road privatization transforms road ownership from public to private ownership. In recent years, the long-term concession agreements or public-private partnerships (PPPs) have emerged as a potential source of significant new revenue for transportation (Ortiz et al., 2008). The transformation has been accomplished in two different ways. In the first approach, build operate transfer (BOT), a private entity is granted the right to construct, operate, maintain, and finally transfer the property to the government through an auction (Chen et al., 2007). Although some other similar methods exist, such as build own operate (BOO), all the methods can be categorized as constructed private roads. Under this approach, roads should be built by the private sector. Thus, the cost of the construction is considered in the decision making process and consequently in the revenue collection. Some examples of this approach are the Dulles Greenway (Euritt et al, 1994) and Median California State Route 91 (Sidney, 1996) in the United States, Super Highway project in China (Yang et al, 2002), and Guadalajara project in Mexico (Huang, 1995).

The second approach is leasing existing roads to the private sector for some period. Here, the

private entity only considers maintenance costs while evaluating a renting decision. However, the opportunity cost of construction is considered through bidding. In fact, if the leasing creates more revenue than BOTs, private entities only have incentives to invest in renting instead of BOT projects. Thus, the renting price of leasing contracts increases to a level which indirectly includes construction costs. However, existing infrastructure could be a great source of benefit under this approach. The first long term lease of an existing toll road in the USA was the Chicago Skyway lease for 99 years and $1.83 billion in 2004 (Ortiz el al., 2008). Another controversial example is the Indiana East West Toll Road (157 miles), which is leased for a nearly four billion dollar concession fee. Debates are ongoing about financial and public acceptance of this contract (Crowe Chizek, 2006), (Graves, 2007).

In both approaches, firms (private entities) collect money by charging tolls on their roads. Previously, it was impossible to gather tolls without disturbing the traffic flow. But with the electronic devices, it is easy to charge vehicles with little interruption, at low cost, and with high flexibility (Uskkusuri et al, 2004), (Litman, 2003). Present pricing schemes for privately owned roads are odd because they are not demand-responsive (based on the contracts, tolls are usually applied only for peak-hour periods or should remain the same for all periods of day). The road pricing flexibility, as its main strength, is almost ignored in even governmental owned congestion pricing schemes, although there are no tight price limits for the public roads.

The rest of the paper is organized as follows. The second section reviews the main problems of the road system and the methods to improve it. The third section describes public goods and discusses if roads are public goods. The fourth section reviews privatization strategies. The fifth section analyzes administrative or governmental prices against market or private prices. The sixth section reviews potential risks of privatization. The seventh section explains possible outcomes and results of privatization. The following section discusses the implementation issues aroused from few practical examples. The ninth section addresses the question of matching between privatization and sustainability. The tenth section tries to answer the question of whether privatization matches sustainability goals. The eleventh section provides an outline for privatization policy and the possible remedy for equity problems. Finally, conclusions summarize the main points.

IMPROVING ROAD SYSTEM

In general, sustainable development entails three dimensions: economic, environmental, and social sustainability or equity. With no exception, sustainable roads should provide economic efficiency, ecological stability, and social equity (Schwaab et al, 2001). Nevertheless, all the dimensions can be converted to monetary terms. Financial improvement can cover other aspects as will be discussed later. However, a sustainable policy should consider different impacts of pursuing this goal. The present trends in the road systems do not seem sustainable.

Congestion is a growing concern for road networks. The average traffic congestion costs for OECD countries account for about 3% of their gross domestic product (GDP), about $810 billion annually: this proportion is 4.4% for South Korea (Schwaab et al, 2001). Congestion also increases greenhouse gas (GHG) emissions, losses in energy and time, and criteria pollutant emissions.

Reducing vehicle miles traveled (VMT) through demand management and increasing efficiency (sending an efficient price signal) are two broad policies to address congestion or in general external costs from roads. Adding capacity is another solution on the supply side. Although additional capacity may increase demand, taking into account that VMT and GDP are highly correlated (Choo et al, 2001) (even if no causal relationships are found) supports the trend of adding capacity rather than reducing VMT. In other words, the efficiency increase through adding capacity will not only decrease our fuel consumption, pollution, and accidents by providing a better service, but also increase GDP by providing a better access to socio-economic systems. For instance, a study by the World Bank found that although a better road network increases motor vehicle usage, it can reduce GHG emissions by improving agricultural and heating practices (better access to fuels and inputs) (EU road federation, 2007). Thus, the attempts to increase the efficiency of roads might be superior to policies restricting demand-VMT. Those attempts do not restrict people's travel activity and seek to be more efficient overall. However, a combination of the two approaches can be implemented as well.

Financing is another problem in transportation systems. Not only are the funds insufficient, but they are also inefficiently allocated. Transportation costs are not passed to users in the present transportation finance structure. By including the internal costs (construction and maintenance costs) and external costs (congestion, pollution, accidents) of travel, the efficiency of roads can be increased (Schwaab et al, 2001).

ARE ROADS PUBLIC GOODS?

A common definition of a public good is "A good which once provided to one user must be provided to others in the same amount" (Public good def-a), in other words, everyone can simultaneously obtain benefits. This means that the good should be 1) Non-rivalrous (one's consumption does not impede that of others') and 2) Non-exclusive (no one can be excluded from its consumption). Do roads fit this definition? Even in non-congested conditions, each driver's entrance to a road lowers other drivers' utility by reducing overall speed. When roads become congested, one person's benefit definitely reduces that of others. Thus, they are rivalrous. This becomes worse with congestion. The second argument is that some people's consumption is much less than others' (less VMT). Some people cannot afford a car, which means roads are partially exclusive. Since the rich consume more and have higher VMT, public roads provide a kind of progressive subsidy for society, with a higher subsidy for people with higher income. This creates an inequality.

The other definition for a public good is "A good that is hard or even impossible to produce for profit" (Public good def-b). This is not true for roads anymore. A $4 billion concession fee contract for the Indiana Toll Road (Crowe Chizek, 2006), for example, shows huge profits can be gained from road infrastructure. Users' willingness to pay is seemingly high enough to compensate for the travel cost increase. This can constitute a profitable industry which increases GDP directly and indirectly.

One general conception about roads is that they are strategic goods like national defense, and should be under national control and treated as public goods. Leasing instead of selling roads complies with this conception to some extent. Government does not sell its property and applies some control levers on these roads. Thus, this relation will not be out of control.

Finally, transportation infrastructure should improve with economic growth. Considering the lack of financial resources limits this growth, there may be no other solution than at least a partial private road system. In this regard, the Public-Private Partnerships investments have grown in the transportation sector (IRF, 2007).

PRIVATIZATION STRATEGIES

A transformation from public to private arrangement can be made through different strategies and on different levels. Each strategy has unique characteristics which should be commensurate with the nature of the particular good or service under application. Three broad strategies have been used: Divestment, Delegation, and Displacement. It should be noted that each strategy can be applied in different roles of governments: Planning or paying for, or producing goods or services (Savas, 1989).

Divestment

Divestment means shedding an enterprise through selling, donation, or liquidation. Denationalization is another term for divestment. This is generally a one-time act by governments. This option is frequently used in transportation systems. The attempt to sell state-owned freight rail road to Conrail in the USA (Savas, 1989), the sale of the National Freight Corporation (state- owned trucking company) in Great Britain (Savas, 1989), the sale of the share of mass transit railway in Hong Kong (Asian economic news, 2000), and the giving away of the English Channel hovercraft ferry service to its management (Savas, 1989) are some famous examples.

Delegation

Governments can delegate different parts of a service to the private sector. Delegation can be carried out by contract, franchise (concession), grant, or mandate. This option needs a continuous role for governments (Savas, 1989). The Indiana East West Toll Road lease (Crowe Chizek, 2006), grants for operating mass transit (Rebelo, 1999), (Kwak, 2002), and concessions

of airports in China (Hooper, 2002) are of this type. Giving away roads to the real owners, the tax payers who mostly financed roads, is another hypothetical option (Carnis, 2001).

Displacement

Inadequate service due to lack of public funds will result in displacement of governmental owned enterprises with private ones. Marketization is another term used for this process. Displacement is a passive process that does not require active efforts by governments (Savas, 1989). Displacing parts of public road funds, maintenance, or even ownership with private ones such as BOO and BOT projects (Euritt et al, 1994), (Sidney, 1996), (Yang et al, 2002), (Huang, 1995), and the rapid growth of express mail services (freight transportation) by private companies show that this can be a common strategy in transportation systems (Savas, 1989).

Privatization can be done by each of the mentioned strategies or combinations of them. However, privatization should connote directionality and the related strategy(s) can be considered form(s) of privatization only when this leads to a lesser, not greater, role for governments (Savas, 1987). Public-private partnerships can be considered as other types of privatization in transportation, like the use of R&D partnerships to increase the efficiency of vehicles (Sperling, 2001). Table 1 presents some of the examples of privatization in the transportation sector.

TABLE 1. Examples of privatization in the transportation sector

STRATEGY	CASE	COMMENT
DIVESTMENT	Selling rail service in the US	State-owned freight rail road to Conrail
	Mass transit in Hong Kong	Sale of shares
	English Channel hovercraft ferry service	Giving away to its management
DELEGATION	Indiana East West Toll Road lease	75 year lease
	Rail and subway concessions in Rio de Janeiro	Initially Suburban rail for 10 years and the subway for 20 years
	Taiwan High Speed rail	Concession project
	KL Light Rail transit in Malaysia	Concession project
	BAA's airports in China	Multiple concessions through establishing a joint venture
DISPLACEMENT	Guadalajara project in Mexico	BOT- toll road
	Median California State Route 91	BOT- toll road
	Super Highway project in China	BOT- toll road- Connecting industrial cities
	Partnerships to increase efficiency of vehicles in the US	R& D Public-Private partnership

ADMINISTRATIVE VERSUS MARKET PRICES

Congestion pricing is an example of externalities pricing in transportation practices. At present, it seems possible to consider that pollution and accidents can also be included. Researchers have developed detailed models for calculating the amount of pollution from different types of vehicles at different levels of speed (congestion). The number of accidents can be determined by referring to traffic records. Nevertheless, there is no, or at least little, incentive for either users or governments to address these from the perspective of road infrastructure. Pollution and accidents are usually not attributed to the road designs and their owners. From the official's perspective, these externalities are produced by vehicles or drivers, but part of these emissions, especially congestion related emissions, and accidents may be due to the poor road-way supply. However, public roads are in most cases out of reach due to the ownership structure. This problem can be addressed by transferring the property to clear entities such as the private sector. After privatization, public officials are more willing to blame roads and their private owners for their poor services. This paradox can be called property rights paradox (Buitelaar et al, 2007).

The poor quality of transportation systems and the lack of financial resources urge the need for implementing a pricing scheme. A crucial question is about the choice between centralized-administrative or decentralized-market decision for pricing (Carnis, 2001). It is not easy to answer this question mainly because there is no widespread experience of decentralized or even centralized road pricing in practice.

Road networks can be nationalized, privatized, or a combination of these two, all of which need a clear definition of property rights (Zhang et al, 2006). Nationalized (or centralized) ownership means that governments should control roads. This can be done by imposing administrative prices. But when roads are privatized, governments do not have full control over road tolls and market forces determine the decentralized prices.

Both administrative prices imposed by the public officials and market prices in a private framework have advantages and disadvantages. One important advantage of the privatization is the probable improvements in the price signal of the system. It has been known that the unhampered price signal based on decentralized ownership is the key for correct resource consumption (Carnis, 2001). This is also true for transportation, with the exception that the price of externalities could not be internalized without intervention. Therefore, it seems that decentralized control should be applied together with some regulations or fines for transportation. On the other hand, the administrative prices mislead entrepreneurs from doing real benefit and cost analyses, which will result in a full of risk environment for investment (Carnis, 2001).

Commercialization, pricing publicly owned roads with administrative control, can only provide a partial solution to the problem based on the public ownership inefficiencies (Carnis, 2001). The

inefficiency of public ownership has been shown in different studies (Dal Bo et al, 2007), (Mises, 1983). Bureaucracy and the large size of the publicly owned firms are the main contributors to the inefficiency (Dal Bo et al, 2007). In addition, private methods cannot be efficiently combined with socialist structures (Mises, 1983). Socialist structures are problematic in internalizing not only the transportation costs but also other public expenditures. Thus, it might be better to implement those structures without private methods than to implement a hybrid structure. Carnis (2001) concluded that "To solve fully the problems associated with clearly defined and exchangeable property rights in the roads network and land, if the road network is to be subject to market discipline, it must be decentralized, not merely commercialized".

Moreover, there are some inevitable difficulties in implementing administrative prices. Officials should decide to change the price or the price scheme and different institutions involved should agree with this decision, while the strength of road pricing should be based on the flexibility of prices and their responsiveness to demand (Zhang et al, 2006). The flexibility of prices is not considered in most of the present practices, especially for road pricing; instead, fixed charges are used for different periods of day (Engel et al., 2003). Furthermore, administrative prices may threaten the privacy of users. The 10 Downing street e-petition against congestion pricing in the UK was an important signal to downgrade the idea of tracking vehicles (Richards, 2008).

Finally, either pricing method can change the balance toward the public transit as a result of higher costs of driving after introducing a new pricing scheme. In addition, the revenue from roads can be spent on public transportation development leading to a better service, and the resulting increase in demand for public transportation can smooth the traffic on roads, which leads to a decrease in congestion, gas consumption, and emissions as a secondary effect of privatization.

POTENTIAL RISKS OF PRIVATIZATION

The first and most important risk of privatization is equity. New ownership of road infrastructure causes great losses and benefits to different groups of people. Companies or individuals who spend higher proportions of their income on transportation will lose money at least in the short run. For instance, trucking companies opposed the privatization trend based on this rationale (Graves, 2007). On the other hand, road owners possibly gain a huge profit. Generally, transportation costs changes in an unclear resource-efficient manner after privatization. Some of these companies should be losers and winners; present transportation costs are far from their reasonable level (Crowe Chizek, 2006).

The possible gain of peripheral land owners is an equity issue for new road construction. But through auctioning the construction of a private road, landlords can participate and gain from their land's appreciation after the construction. The participation can be beneficial to society.

Landlords can lower the price of construction or, as a substitute, lower the toll revenue, which simply leads to less expensive services (Engel et al, 2005).

The possibility of a new monopoly (or oligopoly) formation is another important risk. The spatial restriction of road development and the possible barriers to enter the market may result in an imperfect competition. Alternative roads are restricted for any origin-destination pair, and a new competitive alternative is costly to construct and hard to allocate space for. This is accompanied by high levels of tolls (monopolistic behavior) and even over-investment in road networks. The risk of a new monopoly necessitates regulation. With regulation, a decentralized structure can outperform a centralized one by being more responsive to travel demand patterns if flexible prices are allowed (Zhang et al, 2006). Another argument against private roads is that their revenues (may) go to the private sector and shareholders rather than government. But government can charge the private companies for the externalities produced from the roads and raise revenue for other public expenses. Moreover, area residents can be the possible shareholders of private roads. Thus, the higher revenue can be justified.

Road network ownership has a vague framework. Examination of all of its aspects is essential to prevent an unpleasant outcome. This examination should consider all the parties or institutions which are involved and the associated strategies (further explanation in the "Policy Analysis" section).

WHAT ARE SOME POSSIBLE OUTCOMES?

Fundamental changes affect transportation structure through creating dramatic changes in the public roles, road way system, land use, people's behavior (driving and purchasing car), and alternative fuel usage. Government will not be responsible for the road's externalities. This leads to easier fining and charging scheme designs. In this new environment, Asset Management (AM) can play a critical role. Roads as assets of nations should be taken care of in a wise manner while privatized (Dornan, 2002).

From the road owners' perspective, interestingly, private benefits instead of private costs (costs of driving) will be the goal. But this can be dangerous for the transportation service. Social welfare is the goal, not making more profits. Regulations are essential to direct the investment to the more socially superior projects (Sperling, 2001). On the other hand, the private sector's objective to minimize costs can address internal costs (cost of construction and maintenance), and by maximizing benefits, the private sector can provide better and more efficient service to attract demand.

An indisputable strength of the private market for roads is that market levers would increase supply, constructing new roads or increasing capacity when there is a shortage and would

decrease it, closing some roads or decreasing capacity, when demand is lower than its equilibrium level. In this new environment, public roads' existence can be dangerous. Many users might shift to these roads, due to the absence of fee charges, and the congestion might become much higher than plausible levels (DeCorla-Souza 2008). As a result, it seems essential to think about the privatization of most of the roads unless worse congestion and poorer service is acceptable to some groups of people. A regime including main public roads may not be efficient, but it can provide different goods (roads) with different prices so that different classes of users can use them.

After privatization, a road network becomes a collection of substitute and complement goods. In this new environment, substitute roads compete for attracting demand while complements probably cooperate to improve their service. Generally, substitute roads are the roads on alternative routes and complement roads are the roads on the same route. This creates a competition between road owners to determine the optimized price for their roads. Interestingly, some road segments will be complements for some routes and substitutes for others. This makes prediction of the result harder. However, it seems that cooperation between road owners can help the efficiency of the network (Zhang et al, 2006). After privatization, the junctions' performance can also pose a problem unless road owners and public officials cooperate.

Privatization might result in two possible broad outcomes: an oligopoly or a competitive framework. These two are the same in providing better service than the present conditions. Figure 1 shows the transition from present conditions to two possible outcomes based on the Van Aerde model (Rakha et al, 2002), a more complicated model version of the Greenshields model (Greenshields, 1934). It should be noted that this model estimates different points of the intersection of supply and demand for each road with speed, flow, or density as variables. The left curve of the figure shows some hypothetical data which are close to average present conditions and the other two curves show two possible outcomes (speed and flow diagram).

By representing private roads and the consequent pricing regime, both the demand and supply change results in less congested roads. Rufolo et al (2008) showed that mileage fees result in reduction in driving even with the same total money gathered as the gas tax spent to drive. The difference between competitive and oligopoly outcome is based on the power of firms to change prices. In a competitive framework, firms do not have any power to change tolls (prices), so they probably try to increase the demand, maximize the traffic, and stay at the maximum flow part of the curve to increase their revenue. But the competitive behavior of roads owners is less probable (Zhang et al, 2006).

The oligopoly structure is more probable based on the spatial restrictions of roads' construction. Adding that changing routes may be time-consuming and users may not have any other options,

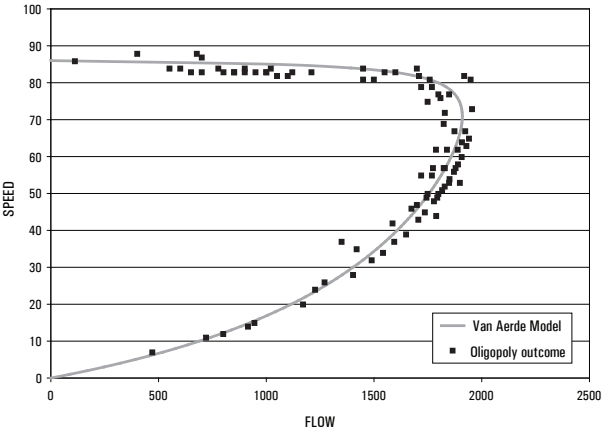
the owner can overcharge and consequently increase his/her profits and gain a monopolistic power. In addition to the spatial restrictions, land purchasing problems and high construction costs are barriers to entering the market, which may lead to a monopoly or some kind of oligopoly (Zhang et al, 2006). For several practices, the tolls are the highest in the world; the prime example is a 13-mile stretch outside Mexico City that costs $6 to use, twice the daily minimum wage in Mexico (Porter, 1997). However, charges decrease the demand for travel. Thus, both frameworks reduce congestion. The private owners try to prevent the congested part by increasing prices when demand increases. They try to sustain their revenues and decrease their maintenance costs by restricting the demand. If the demand is not restricted, the traffic flow (consumption) decreases and as a result, their revenue will decrease due to both lower demand and the poorer service.

An oligopoly, which is commensurate with less consumption- lower VMT, is superior to a competitive outcome without regulating emissions due to the higher charges required. Generally, private marginal costs instead of social marginal costs govern the transportation market (concept of externalities). To approach the social optimum, consumption should be reduced. In fact, oligopoly behavior and externalities cancel or reduce the effect of each other. It should be noted that the road owners can smooth the change in travel demands by applying different prices for different periods of the day (changes in supply).

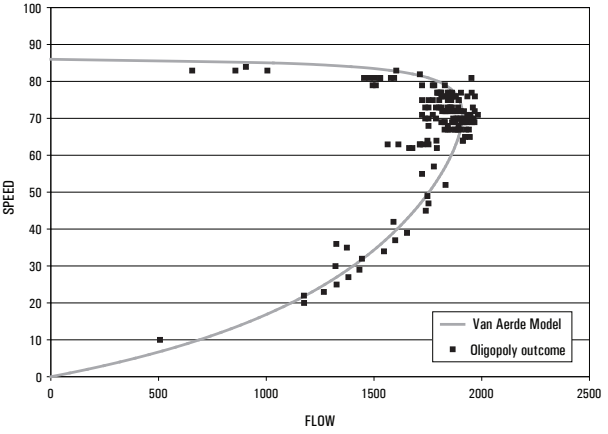
Not only can privatization decrease congestion, but it can also decrease emissions by shifting speeds to more efficient parts and decreasing travel time. The speed of approximately 80 kilometers per hour represents both maximum flow and lowest emissions including GHGs (for most of the vehicle models), which is the peak part of the model. The competitive outcome is desirable from this aspect: the target of a competitive market would be providing the service mostly at the peak point of the graph. As an example of increasing efficiency by charging, each priced lane in the median of State Route 91 in Orange County, Cal carries twice as many vehicles per hour as the adjacent toll-free lanes during peak-hours based only on a good balance of demand and capacity (DeCorla-Souza, 2008).

However, publicly owned roads are strongly accepted goods. The hardest part of implementing this policy is the essential change in people's view about the ownership. People might resist this change (Philadelphia Business Journal, 2007) not only because they prefer their stable conditions and are afraid of changes, but also because they are afraid of being worse off with the introduction of new charges. The equity issues around toll pricing can exacerbate the situation. Nevertheless, opinion surveys showed that people favor tolled express lanes against a gas tax increase (Samuel, 2005). People's satisfaction is the key for the success of the policy. This can be addressed by a Christmas Tree legislation; all should benefit from the policy (Christmas Tree Bill); CBCP in section 11.

PRESENT CONDITION



COMPETITIVE CONDITION



OLIGOPOLY CONDITION

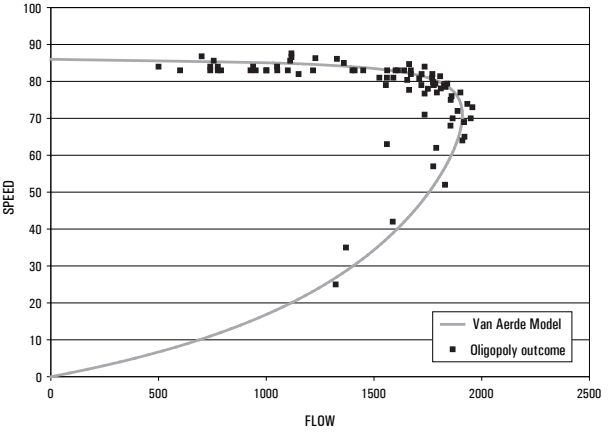


FIGURE 1. The possible outcomes of privatization.

POLICY ANALYSIS

Different parties are affected by road privatization in different ways. Buyers or renters, who try to maximize their benefit; government, who should pursue social welfare; road users, who want to minimize their costs of travel; and other related groups such as shipping companies that suffer from this change and adjacent landlords who benefit from this transition. An integrated framework of road privatization should consider them all together. There are several facts in this new structure:

Government

1. The goal of increasing social welfare does not always comply with the new owners' or renters' goal. As a result, a complete study of the necessary regulations in different scenarios is essential (Engel et al, 2002).
2. Government role changes. Government will not be responsible for roads maintenance, construction, and even emissions. The road owners will become responsible for their roads' externalities.

Private industries

3. Road owners try to maximize their benefits from roads. Their income depends both on the quantity of demand and prices charged. Roads owners are responsive to the demand, trying to price their roads to increase not only their profits (by charging effective tolls) but also the demand (by providing a better service). Both of these two objectives are neglected in the centralized-public structure.
4. A gigantic industry will be formed. Long term and stable revenue streams encourage the private sector to invest in this industry. A significant part of the industry would be formed just by leasing the existing roads. Consequently, government can make profits from an industry that is in a near breakdown condition now.
5. Some companies will substantially suffer from privatization because transportation costs account for a high proportion of their costs, and introducing this policy will increase their costs by great amounts. They may be compensated by being offered shares of the private firms running tolled roads or travel credits.
6. Landlords will benefit from their property appreciation when a new road is constructed. They can participate in the construction by purchasing bonds, or they can be taxed to maintain equity (Engel et al, 2005).

Road Users

7. Road users will probably oppose the privatization. Thus, it is important to offer them some benefits. These benefits can range from the increase in public expenditures to the direct payment

to all the people in each region based on the revenue gathered in that region. Transparency can also be an important factor for public support. However, different groups behave differently. For instance, the rich might welcome this policy because their compensated time is worth more than the price they pay. Section 11 tries to address the equity problem of this policy.

Superior to all of those facts, the transformation from the public to private ownership may result in a more efficient system; e.g. the electricity sector (Dal Bo et al, 2007). This is the main advantage of privatizing roads. This policy can represent a Pareto efficient solution. By drawing out all the transactions of money among different parties, the system will be better off because the private sector will be more efficient.

IMPLEMENTATION ISSUES

The trend of improvement in pricing technologies is an important factor driving the privatization process. A variety of pricing schemes is available: Congestion pricing, mileage-based charges, value pricing, cordon-based pricing, bridge tolls, HOT lanes and etc. Each of the schemes has advantages and disadvantages. It is not the intention of this paper to review these schemes; the interested reader is referred to Victoria Transport Policy Institute TDM encyclopedia. However, it should be noted that a satellite-based technology at an affordable cost is still not available to implement some types of the pricing schemes (Richards, 2008). Furthermore, the public is concerned about their privacy in some methods of charging. However, the charging technology, although not complete, is available (Kim et al., 2008).

Addressing public concerns is the key to the success of privatization. The public is concerned about the conflicting objectives of private owners or operators and the public goal of safe and reliable transportation. Undervaluation of facilities, use of the revenue outside the transportation sector or even outside the origin state, transparency of contracts, forgoing of non-profitable projects, operation and maintenance of facilities, and length of lease agreement are other concerns of the public (Ortiz et al. 2008).

There are some specific concerns about contract terms both for the public and private sector. For the lease agreements, the length of long-term agreements is a concern related to the ability to protect the public interest. The Chicago Skyway was leased for 99 years and the Indiana Toll Road was leased for 75 years, both of which are more than the typical length of such agreements (30-40 years). Longer term agreements are supposed to be less capable of controlling the private sector.

Another main and important concern of the public is about non-compete clauses included in some concession agreements. Non-compete clauses prevent the state and local government from adding capacity within a specified distance of the facility or otherwise paying for the

lost revenue. This can give monopolistic power to the concessionaire (Ortiz et al. 2008). On the other hand, the winner of bidding may overestimate the demand for the road at the toll ceiling, a winner's curse, since a significant percentage of drivers can choose alternative roads without guarantees like non-compete clauses (Fischer et al., 2002).

The flexibility in pricing is not considered in most of the contracts. Tolls and even their periodic increases are determined or limited prior to implementation. This will limit the concessionaire to specific, usually inefficient, price(s). The other limitation is the fixed-term franchise which has been reported as the main reason of the disappointing performance of private highways in Latin America. Most of the Latin American concessions were awarded as a fixed-term franchise, thereby creating a demand for guarantees and contract renegotiations (Engel et al., 2003). Interoperability of the entire highway network and other transportation modes is another concern (Ortiz et al. 2008). Accompanied encouragement of flex-time, telecommuting, car pool and van poll options, and provisions of high-quality transit system is required for the success of the policy (DeCorla-Souza 2008).

Radical policies like widespread privatization require strong, committed, and stable leadership. To succeed in the privatization, political establishment should provide the basic information for the public. Richards (2008) reported unwillingness to create the vision as the key to the failure of national road pricing plan of Blair administration. The Minnesota department of transportation opinion study showed that users may be more accepting of a change in funding method if the reasons are clearly explained (DeCorla-Souza, 2008).

MORE SUSTAINABLE TRANSPORTATION?

A successful development relies on "simultaneous achievement" of all the Three Es of sustainability: environment, economy, and equity (Jepson, 2001). A sustainable development should provide a better quality of life for all, now and into the future (Agyeman et al, 2003). In this regard, a sustainable transportation system focuses on providing people access to different destinations while minimizing the negative effects of transport and maximizing economic prosperity and social equity. The question is whether privatization matches these needs.

The efficiency goal of the private sector can ensure a more efficient transportation system. A better pricing signal can direct users' behavior to a more efficient use of scarce resources, including the environment. Fuel taxes are incapable of providing the required flexibility to efficiently guide this behavior. As a sign of the incapability in the US, House Bill 3946 mandates Oregon State to examine alternatives to the current system of taxing fuels (Kim et al., 2008). Nevertheless, renegotiations of concession agreements and inflexibility of charges can reduce the private sector's incentive to be efficient. Engel et al. (2003) reported opportunistic renegotiations as the main reason for the failure of the highway privatization in Latin American countries.

In addition, transformation from publicly owned to privately owned facilities, which provides clear property rights, can ease the process of emission charging. The private owner or leaser can be held responsible for the pollution produced by his/her property. Consequently, the owner will pass on the charges to the users. To avoid other externalities, the owner will automatically address/charge for traffic accidents and congestion. Thus, a more environmental friendly system is conceivable.

"Lack of cash has led virtually every state in the USA to explore innovative finance techniques" (Ortiz el al., 2008). According to the June 2006 US DOT statistics, about 50% of current highway mega projects (> $500 million) in the USA involve PPPs. Some concession agreements involve billions of dollars transactions in total (Zhang 2008). As a sad example, the collapse of I-35W Mississippi River bridge in Minnesota can be attributed to the lack of funding for proper inspection and maintenance. Officials have expressed concerns about many other bridges in the USA (Davey et al., 2007). The concession agreements have grown from the reality that transportation system needs far more money than is available because of declining fuel taxation funds (Ortiz el al., 2008). However, the potential of the private funds can be overestimated. For instance, the Latin American experience with highway privatization provided lower funds than expected because part of the public funds were diverted to bail out franchise holders in financial trouble (Engel et al., 2003).

The available funds in transportation will shrink if the transportation sector is held responsible for its GHG emissions. The nature of the transportation system, with its highly dispersed emission sources and less carbon-intensive energy substitutes, avoids efficient control of GHG emissions. The significant new revenue from PPPs can offset transportation share by investing in other more efficient sectors leading to a more sustainable life.

The main problem of privatization in terms of sustainability is related to the last E; equity. It should be noted that the current fuel taxation is unfair because such taxes are totally unrelated to the actual amount and impact of the usage. The users pay the same on a highway with low costs as a superhighway with billion dollars of costs (DeCorla-Souza, 2008). As discussed before, road subsidies (no charge on a system that should be charged) represent a progressive subsidy, a higher subsidy for richer people. Nevertheless, the public's concern about the conflicting objectives of a private owner or operator and the public goal of safe and reliable transportation is legitimate. Furthermore, a variety of groups will be affected by privatization, and some of them should be compensated for their loss. The next section introduces a possible remedy to address the equity concern.

THE EQUITY PROBLEM AND A POSSIBLE REMEDY

In spite of the advantages of pricing schemes and privatization, the process has encountered

public resistance. One main reason is the equity issues accompanied by the pricing. Opposite to the current structure -a progressive subsidy for roads- privatization might approach a progressive taxation scheme. Nevertheless, the poor are more affected by the privatization because they spend a higher proportion of their income on transportation and will pay more with higher costs. In the congestion pricing context, some studies even found that average commuters would be worse off without implementing redistribution policies (Small, 1983), (Hau, 1992). A rebate policy, credit-based congestion pricing (CBCP) (Kalmanje et al, 2004), (Kockelman, 2005), can be welfare enhancing for all the users.

Under a CBCP, drivers receive monthly travel credits in a revenue neutral approach. Users do not pay money unless they go beyond all of their travel credits. The travel credits can be in terms of money or can be traded and converted to money. The supporting argument for this approach is that roads are owned by tax payers (Savas, 1989) and the possible revenue should be returned to them (Kockelman, 2005).

However, the revenue neutral aspect of the CBCP is questionable due to the free rider problem. In the basic approach, an average driver pays nothing and the driver with high value of time pays the low income users to stay off the congested roads. But even without privatization, the charges should include externalities to force people to pay for the burden they impose on others. Thus, it should not be revenue neutral. The CBCP, equipped with the possible revenue gathering to solve the free rider problem and charge the externalities, can be used not only for congestion pricing but also for road pricing.

Clearly, no private owner will be willing to provide travel credits for the users, which means free of charge service. City or state officials should provide the travel credits through part of the revenues gathered by leasing the existing infrastructure or charging for the externalities from road owners. But the credit allocation may entail a complex and problematic role. Questions related to the boundaries of the geographic region, providing funds, and determining those entitled to the credits should be taken care of. However, this might be counter to the privatization goal. As mentioned before, privatization should lead to a lesser, not greater role, for governments.

To address another aspect of sustainable transportation, the CBCP policy has a great potential to provide an externality pricing scheme especially for GHG emissions. More travel credits can be allocated to environmentally friendly vehicles. A fuel cell car can gain more credits based on its GHGs' emission reductions. On the other hand, road owners may pass on the externality charges or fines on their roads to the users. As a similar approach, Forkenbrock (2008) proposed different charges for different vehicle classes through mileage-based charges. To set up an effective policy, a thorough study is needed to determine how to efficiently allocate travel credits and who is eligible for them.

CONCLUSION AND FURTHER WORK

Privatization of transportation infrastructure has gained increasing attention in recent years mainly due to the lack of funds in the transportation sector. Privatization can be considered as an approach to roadway sustainability. Two different aspects of privatization can help sustainability. Private participation increases funding and investment opportunities and transformation to private ownership, which provides clear property rights can help the process of environmental charging.

On the other hand, increasing the efficiency of roads through optimal pricing and optimal investment, a byproduct of privatization, can indirectly decrease the externalities produced by transportation. Transportation sector revenue increase, another byproduct of privatization, can be used to fund transit systems and other publicly owned infrastructures. Differentiating between vehicle classes can help the process of emissions reduction using a rebate policy. Further work will focus on how this rebate policy should be designed.

Although privatization seems capable of improving two of the E's of sustainability, equity issues and users' resistance are the main obstacles for this policy. With some modifications, CBCP can address the last E. However, road privatization will likely be a step-by-step process which will need time for public and political acceptance.

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