Road Pricing to Reduce Congestion, Pollution, and Injury Accidents

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Introduction

Transportation in America is facing many serious problems. Congestion on our roads results in increased transit times, which stifles economic growth through lost productivity and increased fuel consumption. In 2005, congestion caused Americans to consume an additional 2.9 billion gallons of fuel and spend an additional 4.2 billion hours in their vehicles, for a combined total economic cost of $78 billion [1].

Increased fuel consumption results in larger amounts of carbon dioxide being released into the atmosphere, which may contribute to climate change. Approximately 70% of the 20,680,000 barrels of oil consumed each day in America are used for transportation [2]. Of this, a large percentage is consumed through motor vehicles traveling our nation's highways. In an average vehicle, only 0.3% of the energy consumed goes towards moving the driver [3].

Additionally, vehicle accidents create substantial costs for the transportation system, in terms of human lives lost and economic costs. According to one study [4], the economic cost of crashes greatly exceeds the cost of congestion to society. In 2005, metropolitan accidents resulted in a total economic cost of $164.2 billion, or over twice that of congestion.

The cost of each fatal accident is over $3.2 million, while each injury accident costs approximately $68,000 [4]. Due largely to roadway safety improvements, fatalities per 100 million vehicle miles (MVM) have decreased substantially. However, the number of total yearly fatalities has remained approximately constant as motorists have increased their total miles travelled. As such, a reduction in the total number of fatalities presents an opportunity to save a tremendous amount of resources.

Americans' transportation problem is getting worse, as travel demand continues to increase much faster than capacity. Americans, until the recent spike in gas prices, have continually increased their total travelled distance, which has placed a great deal of strain on the transportation system. State Departments of Transportation (DOTs) are facing increasing challenges of providing acceptable levels of roadway service within their limited budgets. Over the last 20 years, travel in metropolitan areas has increased 105%, while the capacity of roads has only increased 45% [1].

In short, steps need to be taken to improve our nation's transportation system in such a way that congestion, pollution, and accidents are greatly reduced. Additionally, steps must be taken to make our transportation system more economically viable.

Road Pricing

One method that has the potential to alleviate the aforementioned problems is road pricing, or roadway tolls. While tolls are not a new idea, innovative applications of tolls are being developed that specifically target the problems previously discussed. In essence, the objective of a toll is to assign a true economic cost to a motorist for the use of a roadway. As demand for travel on a road increases, the price is also

increased, which in turn reduces the level of demand. In this explanation, tolls are used to reduce congestion, which is typically the aim of these systems in practice. However, as explained previously, pollution and congestion are correlated, and with simple modifications, road pricing can be used to reduce injury accidents. Several options for road pricing are presented below:

- High-Occupancy Toll (HOT) Lanes – This system features lanes which are free for users in high-occupancy vehicles (HOV), but also allows drivers of single-occupant vehicles to use the system upon paying a toll. The system provides economic incentive for drivers to carpool and offers single-occupant vehicle drivers the flexibility of high level-of-service lanes when they require it. A picture of an HOT system is presented in Figure 1.

Figure 1. HOT Lane System

- Fast and Intertwined Regular (FAIR) Lanes – This system converts a portion of the existing free-lanes on a roadway into toll-lanes. Using an electronic system, roadway users in the free (lower level-of-service) lanes are given credits that may be used to pay for future toll (higher level-of-service) lane uses. This is similar to the HOT concept, except it may provide greater access to the toll lanes for lower-income users.
- Linking road pricing and bus service has been proposed, specifically with the HOT and FAIR systems, to limit the effect of higher tolls on low-income users [5]. Widespread use of buses could also decrease the number of accidents on our roadways, as a professional driver, who is not engaging in high-risk behaviors such as drinking or talking on a cell phone, should be less likely to be involved in an accident.
- Value Pricing Program (VPP) – Value pricing refers to a system that changes the toll charged to vehicles based on congestion. In simpler systems, toll rates change at set times of the day. For example, at rush hours, the charges for roadway use increase. In more sophisticated systems, the tolls can change dynamically to reflect real-time conditions. This gives motorists an economic incentive to use the roads at less-congested times. In the 1990s, the Value Pricing Pilot Program showed that a small percentage reduction of the total road traffic during peak use can create substantial reductions in congestion [6].

The noted options are just a few of the road pricing configurations that can be used to decrease congestion on our roads. While they are specifically targeted at reducing congestion, they have the side-effect of simultaneously reducing pollution. To specifically target pollution, road pricing can be modified in several ways. For example, low-emitting and fuel efficient vehicles, alternative fuel vehicles, and motorcycles may be allowed free or reduced-charge use of HOT lanes [7]. Additionally, the following road pricing systems may be utilized:

- Vehicle-Miles-Travelled (VMT) Charges – Users are charged a fee based on how far they drive their vehicles on the roadway.
- Weight-Distance Taxes – Users are charged a fee based on how far they travel and the weight of their vehicle. This would be most beneficially applied to the freight industry.
- Smog Fees – Users are charged based on the number of traveled miles and the pollution their vehicle creates per mile [8].

These options show increasing sophistication, but also require greater implementation technology as one moves down the list. VMT charges would discourage all roadway use, which could simultaneously reduce congestion and pollution, making it ideal to more congested areas. Smog fees, which would be most difficult to implement, would also encourage users to shift to more fuel-efficient vehicles, while not necessarily requiring a decrease in vehicle-miles travelled. Thus, smog fees may be better-suited to less-congested areas, where only reduction in pollution is desired.

The ability of tolls to decrease injury and fatal accidents is unknown. In theory, accident data for roadways could be collected to determine the total cost of accidents on the roadway. Roads which show a high propensity for injury or fatal accidents could have increased tolls, the funds from which would be used to implement cost-beneficial safety improvements. Unfortunately, this may have an unwanted side effect. Research has shown that by increasing the fees on major thoroughfares, or using tolls that attempt to reduce congestion, drivers resort to using smaller and potentially less-safe roads for transport. An increase in serious accidents may result as these roads were not designed for the increased volume of traffic that suddenly uses the roadway [9]. To overcome this, tolls could be applied to low-volume roads as well, specifically in areas where the incidence of accidents is high. This revenue could then be used to improve safety conditions. As placing toll-booths on small roads is impractical, this system requires sophisticated in-vehicle, toll-tracking systems.

Implementation

New tolling technologies allow road pricing to respond to roadway conditions in real-time. Cutting-edge systems, which are being implemented in European nations, rely on satellite-based GPS technology to assess user fees. Distance travelled, demand pricing, and even emission rates can be used as criteria for assessing user fees, and the systems eliminate the need to construct, staff, and maintain toll booths, as well as the traffic slowdowns to pay tolls. While these systems require users to purchase an in-vehicle GPS unit, the systems are very user-friendly and convenient once in place [10]. Technologies such as these represent the future of road pricing.

Alternatives to Road Pricing

America must also consider raising fuel taxes. Currently, approximately 60% of federal highway spending comes from direct user fees, such as gasoline taxes or tolls [11]. Essentially, the government is subsidizing the other 40%, which encourages greater consumption. To decrease congestion on our roads, pollution created by our vehicles, and accidents on our highways, the number of vehicles on the road must be reduced. This can be accomplished through accurately pricing road use, which can be accomplished with increased gas prices. Taxes should be implemented at the federal level to prevent interstate price competition. The increase in fuel tax should be offset by a decrease in federal income tax. This reduction would leave net tax revenue unchanged while still providing a financial incentive to decrease transportation demand.

High fuel taxes have been used in Europe since the 1920s, and their effect is striking: there are 30% fewer cars per person, 30% fewer miles traveled per car, and cars get 30% better gas mileage than their American counterparts [12]. While there are many variables that contribute to this situation, the effect of higher gas prices on reducing the quantity of travel demanded is obvious.

Encouraging users to find alternate transportation presents a simple alternative to road pricing that can reduce congestion on roadways. For example, Atlanta instituted a program known as "Cash for Commuters" in which participants were paid $60 per month, for 3 months, to use an alternate form of transportation instead of driving their vehicles. One and a half years later, the study participants reported using alternate forms of transportation 2.4 days per week [6]. These results indicate that commuters currently using personal vehicles may be receptive to switching to public transportation.

Criticisms of Road Pricing

Many arguments exist against road pricing, the more important of which include:

- Users are already charged for road usage through fuel taxes;
- People do not want tolls, and they are politically difficult to implement; and
- Tolls are unfair to lower socio-economic class users;

These and other arguments pose substantial barriers to further implementation of road pricing. However, through the re-allocation of taxes mentioned above, these barriers become less formidable, and implementation may finally become a reality.

Conclusions and Recommendations

Road pricing is not a cure-all for America's transportation problems, and it is certainly not politically popular. However, it has been shown to help reduce congestion and pollution, in both theory and practice, and may also be tailored to reducing injury and fatal accidents. Innovative road pricing mechanisms have the ability to improve the long-term viability of the American transportation system

and move it in a more sustainable direction. In fact, the U.S. National Surface Transportation Infrastructure Financing Commission recently advised Congress that a national, satellite-based, distance tolling system is the best long-term solution to America's transportation funding [11]. Regardless of whether this comes to fruition, metropolitan areas should continue to implement road pricing, and even less-populated areas should consider road pricing to improve the nation's transportation system.

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