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Implementation of Electronic Road Pricing in India (ERP)

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Abstract— **The traffic congestion problem is a frequent issue for the residents of metropolises of India which is proving to be costly to the individual and society. It results in the loss of productive hours, environmental pollution, wasted fuel and adverse health effects. Although expanding the capacity of transportation systems and stimulating the public transportation may gradually decrease the traffic congestion, they cannot completely solve the traffic congestion problem. By selectively charging the road users at busy times and places, road pricing offers a method of restraining the usage of vehicles on the road networks and is potentially more equitable and more efficient than the main alternative policy option, restraint of car ownership. The main aim of this paper is to check the feasibility of implementing Electronic Road Pricing(ERP) in India.ERP not only reduces traffic congestion, but takes away the necessity of toll booths and also provides an alternate source of income for the Government of India.**

I. INTRODUCTION

Road pricing is an instrument that takes direct charges for the use of roads. Road pricing is economic and useful too. It serves three purposes:
1) Manages the tax to travel demand
2) As an bonus to guide more efficient investment judgments
3) As an income of public revenues, e.g. Roads can be financed and for public transport.
The implementation of road pricing can be done in many ways, including [1] (VTPI, 2010):
Road tolls: charge paid for riding on a certain roads (usually fixed)

Congestion pricing: a charge depending on the level of traffic in a certain areas (usually varies)
Cordon fees: a charge applied in particular areas, e.gDistance-based fees: a charge based on the number of miles travelled
Toll booths or vehicle passes are usual methods to gather the road fees, and have been used for hundreds of years in countries around the world. A strong disadvantage is the discomfort to the user, as the vehicle has to stop for paying the charge in the toll, possibly adding to traffic. Electronic road pricing (ERP) aims to reduce the discomfort to the user, as well as providing more flexibility as to the level of the charges. ERP methods include (VTPI, 2010):

Electronic tolling, which bills a fee to the users while crossing a point on the road;
Optical vehicle recognition, it uses an optical system to charge the user;
GPS(global positioning system), which tracks the location or place of the vehicles and charges based on the distance driven by the vehicle.

II. FEASIBILITY OF TECHNOLOGY AND OPERATIONAL NECESSITIES

The largest obstacle for ERP is probably political and public acceptance, particularly before implementation. In regular vehicle users are considering themselves worse off when charged for something previously perceived as being free of charge. In addition, there may be much general distrust in government agencies resulting in a fear that the instrument only serves to increase public revenues. In developing countries car drivers are often a small but rich and politically influential minority, rendering political support difficult. However in cities where initial public acceptance was low, acceptance has been found to increase after its implementation.
To secure public support and successful implementation of road pricing or congestions the following issues needed to be taken into account:

- Clear communication about reasons behind this policy and the benefits to society, including congestion reduction and public health benefits;
- Implementation of complementary policies such as flextime, ride sharing and parking fees, public and non-motorized transport ;
- Transparent decision about the road pricing, and

based on public trust;
- Variable but predictable fees based on the level of congestion;
- Convenient system, which is easily understood by the user;
- Protection of privacy of the user;
- Development of 'knowledge culture' among politicians and professional on alternative pricing mechanisms, based on systematic transport policies and analyses;
- Use of public ERP revenues for public and non-motorized transport.

In relation to the political and public opposition against ERP systems, questions of equity are frequently raised. The impact of ERP on equity, that is the costs it imposed on various income segments of society, is a matter of debate. However, although there may be equity issues related to road pricing, it is believed that the instrument can be designed intelligently so as to minimize those impacts, including reduced charges and reducing other taxes for low-income groups. Equity concerns often raised in developed countries were found to play a smaller role in Latin American cities.

III. STATUS OF TECHNOLOGY

Electronic road pricing which uses electronic or optical tolling is a mature technology. Roads, one of the last non-priced utilities, are overused. They compete with other modes of transport yet, when saturated, detract significantly from social, environmental and economic outcome. Effectively pricing road usage is a significant task and may be extremely complicated to implement. Nevertheless, potentially suitable models have been proposed that could raise sufficient revenue for infrastructure expenditure, be revenue neutral and improve congestion on our roads. Technology is not the issue, nor is funding – The key problem is one of community acceptance because of the inevitable debate about "winners & losers". Even if consensus could be achieved, application is likely to take considerable time.

Without broad community acceptance, introduction of a electronic road pricing scheme may never happen.
Through the introduction of an aggregated transport account, users will be provided with adequate information to understand their total cost of transport. Such an integrated account would enable consumers to easily compare mode choice outcomes and monitor their individual transport expenditure. An amount that currently represents over 17% of total Australian household expenditure [18]. Furthermore, a transport account aggregator could provide benefits to consumers through better prices for services, bundled transport offerings and discounts for optimal transport choices. Ultimately users could elect to participate in optional road pricing arrangements and have visibility into actual costs through the use of the aggregated account thus paving the way for acceptance of broader road pricing schemes.

Fig 1: Traffic jam in metropolises

All potential road pricing models are likely to involve alterations to existing taxation systems as well as an appropriate measurement of the value of roads to the economy and an approach to dealing with varying circumstances (e.g. rural versus urban city).
A successful road pricing strategy will need to:
- Raise sufficient revenues for infrastructure investments and maintenance
- Be revenue neutral or better to satisfy Treasury
- Reduce congestion
- Be technically easy to implement
- Address equity concerns

IV. POTENTIAL OF ERP

Pricing in theory and practice -This section gives us a basic overview of the principles behind road pricing and looks at case studies of electronic road pricing in practice. This is by no means an exhaustive review of the performance of charging patterns worldwide, but, as discussed below, the ability of charging to have a substantial impact on congestion is checked.

How charging works-As mentioned above, current charges do not properly address the variable costs for driving, including external effects on the environment and the effect vehicles have on slowing down other traffic. Thus, electronic road pricing attempts to internalize those costs for the driver. Whereas congested roads previously went under-priced, now, the price paid by drivers will more accurately reflect the cost of using the road. As a result, drivers who do not value the ability to travel on that road at that time will not drive on it, and the road will become less congested. The drivers who are willing to pay will enjoy a reduction in their journey times as well as a 'toll road bonus' - more reliable travel through decrease variation in journey times.

Drivers who are not willing to pay a price will either:

- Drive at a different time
- Change place one wants to go
- Change routes to the same destination
- Change modes of transportation
- Decides not to travel

With these in mind, it is important to note possible unintended effects of changing the price (or tolls) of a road. Drivers who change to different routes may cause congestion on smaller roads they are diverted too. This diversion, as well as excessive changes in place one wants to go (or route, for that matter) can harm businesses or local areas in common. Which decision a driver makes will depend on the alternatives available, so these must be considered while implementing a charging scheme.

The reason congestion pricing based precisely on roadway congestion is more accurate and efficient than time-of-day pricing is that it approximates the marginal external cost imposed by drivers more closely than time-of-day pricing, which uses the average borderline external cost imposed by drivers over a given time period (during peak periods, for example). In order to better understand this difference, imagine a large group of friends meeting for an expensive dinner and, in order to decrease the bookkeeping, the bill is divided evenly amongst each friend (as in time of-day road pricing). Since each individual friend could not lower the group bill significantly by ordering less, there is reason for too much consumption. If, however, every individual friend is charged according to the amount of food he orders (as in direct congestion pricing) there is logic for self-restraint.

Of course, there may be sacrifices in simplicity or lower operating costs in return for using a pricing scheme like this. Thus, the exact benefits between different methods should be weighed against the relative costs of implementing them. Private sector involvement -Another new technique in road investment and management is the use of private sector financiers and operators in place of traditional contracting methods. Though controversial, there is evidence of several benefits to private sector involvement in providing both priced and un-priced roads. This section explores three benefits - efficient operation, risk transfer, and access to private capita - as well as risks that arguably should be addressed to protect the 'public interest'.

V. CONTRIBUTION TO SOCIO-ECONOMIC DEVELOPMENT AND ENVIRONMENTAL PROTECTION:

In order to move to a high capable transport system, a collection of strategies is required, can be also called the Avoid-Shift-Improve method, this

1. Stops or reduces the need for unwanted travel (Transport Demand Management),
2. Shifts private vehicle use to more capable modes
3. Reduces the environmental pollution.

ERP is considered an important and effective instrument in the 'Avoid' plan, i.e. reducing the growth in travel demand, while also helping for a modal shift. Vehicle use has been sensitive to tolls, with price ranging from -0.1 to -0.4 for urban highroads, i.e. a price increase of 10% results in reduce of 1-4% automobile use. The encroachment is moreover highly case specific, and may depend on factors such as the type of toll, the accessibility of options and on user (consumer) choices. Estimates for encroachment of road pricing on vehicle trips vary on a wide basis, from 3% to 15%. However even the total demand for travel is damaged, road pricing could increasingly reduce traffic if only a small amount of total traffic changed from peak to off-peak with estimates for several places in the range of 10% to more than 30% (VPTI, 2010; Pike, 2010). In

Singapore, the ERP has reduced road congestion by 25,000 vehicles in peak times, and increased road speeds by 20%. Bus travel also increased. By decreasing travel demand, the benefit's are

1. Traffic reduction, i.e. travel time reduction
2. Reduction of greenhouse gas
3. Air quality gets improved
4. Increased road safety while driving

VI. FINANCIAL REQUIREMENTS AND COSTS TOP:

Different perspectives can be used to look at ERP among them cost and benefits are shown in Table 1. Though the cost of investment of ERP equipment is high, the ratio of cost-benefit to the government is always positive –depending on the level of user fees (Pike, 2010). A Jakarta government used a study for ERP indicates a 4 years payback time (Dalkmann, 2010).

VII.

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Table 1: Costs and benefits of ERP to governments and users or society:

	Benefits	Costs
Government	Increased revenues	Investment and system operation
Users / society	Reduced travel time Better air quality Increased road safety	Increased vehicle travel costs

In Stockholm and Santa Clara County in California time savings were shown considerably to exceed the operating cost. In London and Stockholm no such differences were found both in economic growth and retail sales inside and outside the electronic road pricing perimeter.

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