Strategies to Promote Sustainable Transport Pricing

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Abstract

India as a developing country has been one of the fastest growing economies in the world. The impact of high economic growth is seen in sectors like transportation and automobiles. The theories of microeconomics establish a direct and positive relation between increase in GDP and per capita income with per capita consumption. The rise in disposable income indicates more opportunities for an individual to pursue his personal needs like owning a luxurious vehicle which affects their travel behaviour and indirectly discourages the use of public transit. India holds the position of 4th largest car manufacturer in the world (Indian auto, 2018). Although increase in vehicle ownership indicates growth in the economy, its negative impacts cannot be ignored. The negative externalities (e.g. congestion, vehicular emission, noise pollution, accidents, light pollution, road damages) generated by use of private transit creates significant economic loss to the country. A World Bank study released in 2016 revealed that India lost more than 8.5% of its GDP in 2013 due to air pollution.

The paper seeks to identify through a study of various international examples the best practices and soft policy measures for incorporating external social costs into the price paid.The need of the hour is to develop a mechanism which can internalize the external cost of transport for urban private vehicle users to minimize its use. Pigovian tax is one such measure which can be applied to bring equity within the transport sector, ex-Congestion pricing and eco-tax. The study tries to incorporate the external cost of transport for private vehicle users through policy measures and develop a mechanism to estimate it.

Keywords: Pigovian tax, Externalities, Bid rent curve, Economic sustainability

1 Introduction

1.1 Background

In India, the number of vehicles used increased from 0.3 million in 1951 to 58.3 million in 2001-02. About half the vehicles are concentrated in 39 metropolitan cities. Growing urbanization in India has led to a rapid increase in vehicular pollution. The exposure to toxic vehicular pollution has worsened in India due to staggering pace of motorization. As per a study conducted by the Center for Science and Environment,

the number of registered vehicles has gone up 700 times from 0.3 million in 1951 to 210 million in 2015. The air pollution from vehicles in urban areas, particularly in big cities, has become a serious problem. The pollution from vehicles is visible through symptoms like cough, headache, nausea, irritation in the eyes, various bronchial and visibility problems. Transport pricing has always been sought after to solve various traffic associated issues across the world.

1.2 Research Problem

Increase in urbanisation has led to a constant rise in the number of motor vehicles plying on roads in large cities all across the world. This has had an impact on human health, environment, pattern of urban development, road conditions, and safety. The growth process in developing countries like India is putting an increasing pressure on urban transport systems. Use and ownership of motor vehicles continue to grow at a rate that is higher than the growth rate of population. The study conducted by WHO (World health organization) in 2018 shows that about 90% of the world's population is exposed to dangerous levels of pollution and 14 of the world's 15 most polluted cities are in India.

Vehicle ownership growth rate of 15% to 20% per year is common in some developing countries. In India, the total number of registered motor vehicles has increased from about 0.3 million in 1951 to 230 million in 2016; recording a growth rate of about 10.7% annually. The share of cars, jeeps and taxis in the total number of Registered Motor Vehicles was 13.1% for 2016. The total share of buses for the same year was 0.8% (Ministry of Road Transport and Highways, 2015-16).

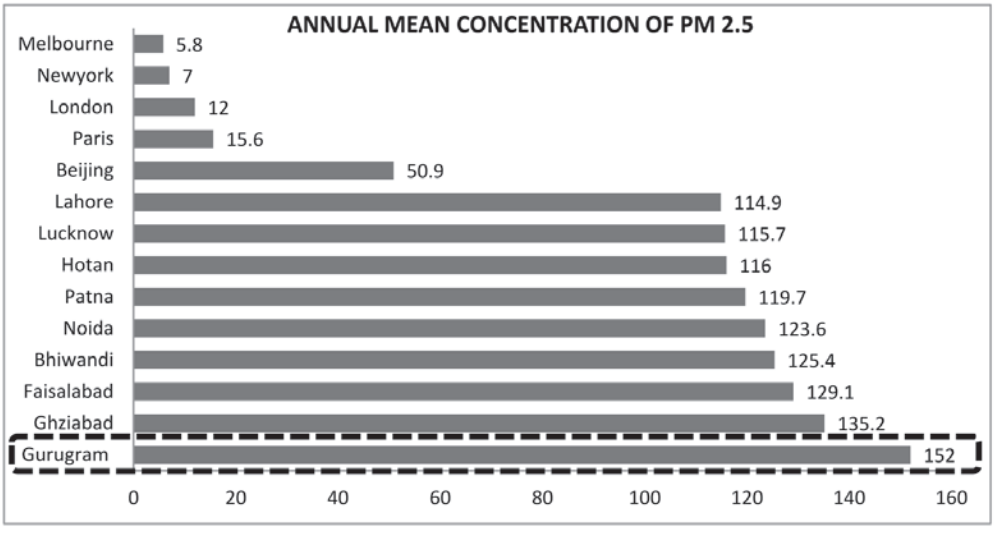
According to a study by Uber, Indian commuters take 1.5 times longer to travel a given distance in peak hours compared to travel time during non-peak hours. Traffic congestion during peak hours in four major cities (Delhi, Kolkata, Mumbai and Bangalore) accounted for a loss of Rs 1.5 lakh crore a year. Ironically, India's current road transport costs ignore these externalities and are less than valid costs. The NUTP (National Urban Transport Policy) 2014, highlights the need to design the roads according to its users rather than the number of vehicles. The need of the hour is to develop a mechanism which can internalize the external cost of transport for urban private vehicle users to minimize its use. As per a report by WHO, Global Burden of Diseases, 2017 air pollution in India is responsible for as much as 3,85,000 deaths in 2015. This highlights the need to focus on external factors also that are responsible for loss of life.

1.3 Site Selection and Justification

The area under study was identified from 100 most polluted cities in India. The cities that exhibited 15 percent rise in Air Quality Index and displayed a noise pollution level of 65 DB (As per standards laid down by CPCB) during peak hour and above were then shortlisted from the list of mapped cities. As per WHO, in 2018 Gurgaon was identified as the most polluted city in the world.

Zone	Permissible noise level standards in the daytime (dB)	Permissible noise level standards at night (dB)
Industrial zone	75	70
Commercial zone	65	55
Residential zone	55	45

The population of Gurgaon was 8, 79,000 in 2011 with a growth rate of about 74% from 2001 and population density of 2608 persons per square kilometer. According to the Census of India 2011, 33% of the households in Gurgaon own a car and 43% own Two-wheelers. The overall PCTR (Per Capita Trip Rate) for Gurgaon was noted to be 1.55 with a motorized share of 1.08 as per CMP (Comprehensive Mobility Plan of Gurgaon) and the average trip length was found to be 8.1 km per person per day.apped cities.



2. Literature Review

2.1 Sustainable Transport Pricing

Transport pricing refers to the method of payment that is paid in exchange of use of transport infrastructure and services. It is also a system that directly charges motor vehicle users for the use of road or associated services. Road pricing is used as a tool to alleviate the problems and challenges of urban road transport and improve efficiency.

Sustainable pricing of any product or service like transport can be defined as a condition that ensures sustainable development of the sector under study. Sustainable development refers to the ability to meet the present needs without compromising the ability to fulfil future requirements.

There are three major aspects associated with sustainable development- (a) Financial Sustainability (b) Social Sustainability; and (c) Environmental Sustainability. Financial sustainability requires that the total value of product be realised through the set price. It calls for efficient allocation of scarce resources. Social sustainability requires special focus due to inability of pricing arrangements to take into account the market conditions that hinder the capacity of certain sections of society to have access to certain resources. It requires that prices for basic necessities like food, transport, water etc. be based on equity considerations. In order to ensure equitable access to all resources, social sustainability lays emphasis on regulation of prices. Environmental sustainability targets conservation of scarce resources and prevention of degradation of natural capital like water bodies. (Sengupta, 2001)

With rising population and urbanisation levels, cities are constantly growing and creating added demands on transportation network. With increasing disposable income levels, private car ownership has shown a considerable rise which has resulted in rising pollution levels in cities. Transportation sector for movement of goods and people makes increased use of motor vehicles which degrades the environment by increasing the use of fossil fuels. The fuel combustion results in release of various harmful pollutants in the surroundings. The prices of fuels however do not take into account the premium on scarcity of resources, neither the harm caused by the emissions. Uninhibited or uncontrolled use of natural resources had caused depletion of natural resources. The absence of monetary regulation makes nature readily available for use and also dumping.

An externality refers to any activity that affects and impacts others but the person responsible for it, for example emissions through a non-compliant vehicle will have immediate effects on people travelling behind it and not the person sitting in the vehicle. The carbon emissions will further add to the existing Greenhouse Gases and thus cause an increase in average temperatures leading to long term harm to everyone. Such externalities, if monetised and reflected in prices can help in optimal utilisation of resources and alter the depletion pattern. Thus, there is a need to alleviate free access to nature and monetise the costs of externalities to reduce environmental degradation and improve quality of life.

Since transport is the backbone of a city and its growth and economy, its sustainability becomes essential. For sustainable development of the sector, it becomes imperative to base its social cost by internalising costs of externalities of pollution, congestion, etc. The costs of externalities can be internalised or included in total social costs by Pigovian tax, a tax that is charged on any good or service which creates negative externalities. The basic objective of the tax is to make the price of good or service equal to the marginal social cost and thus ensure more efficient allocation of resources.Marginal social cost refers to the sum of private cost (owner's own costs) and external cost (effects borne by people other than the user). For example, the cost of manufacturing a car that includes the costs of buying inputs, land for a car plant, and other costs of operation implies the private cost for the manufacturer. In the process of car manufacturing, water or air is also polluted which an external cost is borne by others in the absence of the manufacturer not paying for this external cost or including it in the price of the car. The cost of producing an additional unit of output of a good or service refers to marginal cost.

MARGINAL SOCIAL COST= MARGINAL PRIVATE COST + MARGINAL EXTERNAL COST

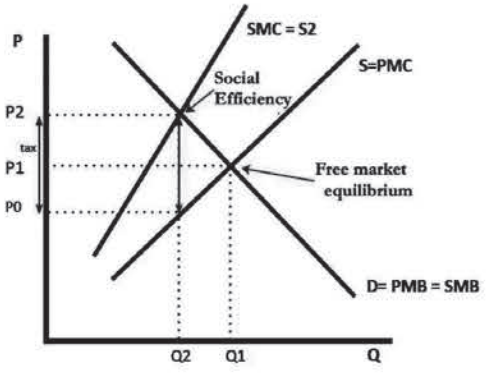


Figure 2-1Pigovian Graph

- In a free market, the equilibrium will be at Q1 – where D=S. At the output calculated, there is social inefficiency.
- At Q1, the social marginal cost (SMC) is greater than the social marginal benefit (SMB) – there is overconsumption.
- If the government places a tax equal to the external marginal cost, then consumers will be paying the full social marginal cost. (SMC)
- This will reduce the demand from Q1 to Q2 and this will be socially efficient because at Q2 (SMC=SMB)

2.2 Why Public Transport

The use of public transport has various benefits associated with it not only for the national economy but also to individual health, finances and quality of life. Public transportation is essential for ensuring urban sustainability. Use of public mode of travel reduces carbon emissions and footprint thus making cities more healthy and liveable. It also enhances accessibility and provides equitable access to transport facilities to all economic sections of society. A large number of benefits are found to be associated with the use of public transport. It is economically beneficial to the community, is healthy due to reduced emissions, reduces congestion and allows better and equitable use of available road space, helps to bring down monthly household expenditure, promotes social relations and is safe and equitable.

2.3 Best Practices

- **Congestion Pricing in London**

The cordon pricing scheme makes use of an automatic number plate recognition system. It consists of cameras at all entrances, pavement markings and signage at streets. Registration of vehicles is done automatically through cameras that take photographs of number plates (Provonsha, 2017).

- **Electronic Road Pricing in Singapore**

The scheme is designed in such a way that it responds to congestion in real time. The system detects the vehicle type, congestion on route at specific times and then deducts a variable fee from the smart card fixed in the vehicle passing through the congested route. The ERP scheme was launched in 1998, replacing a cordon pricing scheme that was first implemented in 1975 (Provonsha, 2017).

- **British Columbia's Carbon Tax**

The mechanism includes putting a carbon tax on purchase and use of fossil fuels since they account for approximately 70 percent of greenhouse gas emissions. The mechanism helps in reducing carbon emissions by encouraging low fuel consumption and thus promoting sustainable economic development (Provonsha, 2017).

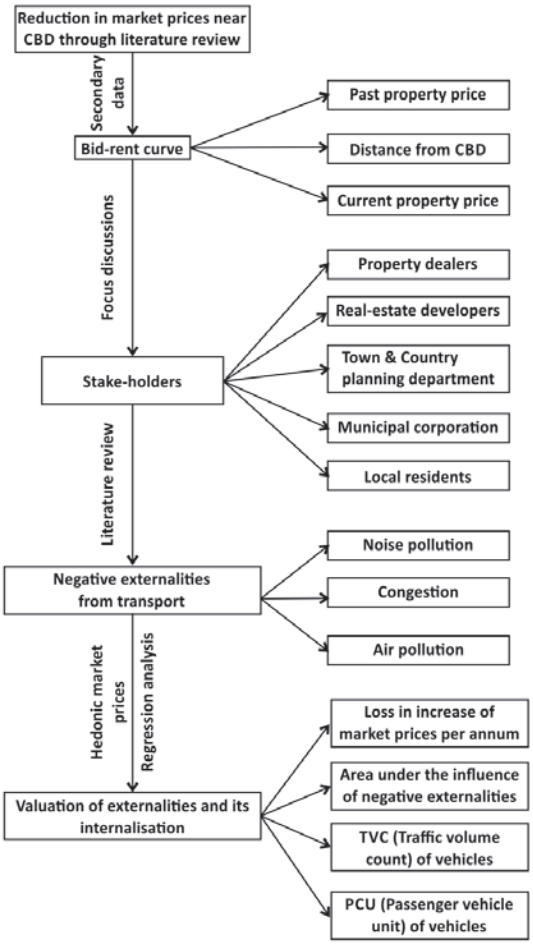
3. Methodology

The current study will help in assessing the impact of externalities caused by private vehicles using hedonic market price method. The bid rent curve is plotted and used to assess the change in market prices with increasing distance from CBD. The shift in curve is assessed and the external factors responsible for

the same are identified. This was done through interviews and discussions held with various stakeholders like Development Authority, Town and Country Planning, Real Estate developers, property dealers and local residents. As per the group discussions conducted by various stakeholders, it was found that negative externalities from private transport, specifically at peak hour are the foremost reason for the declining property prices.

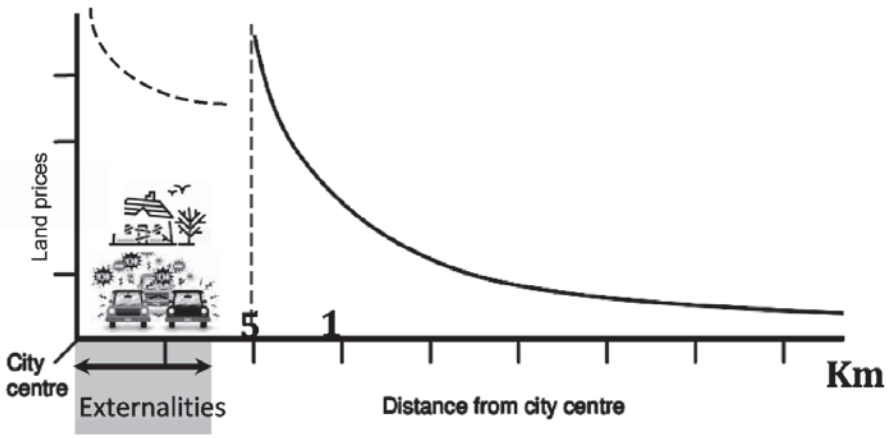
The loss in property value due to negative externalities from private vehicles is evaluated using the market rates with increasing distance from the CBD and the difference is calculated. The loss in increase of property value per annum is then multiplied by the area under the influence of externalities and the final amount achieved from the above calculation is thus assumed to be the monetary loss which the residents have to bear. To internalize the external cost, a toll based mechanism is designed which considers the size of vehicle based on its PCU (Passenger Car Unit). The amount of loss in property is then divided by the total number of vehicles plying on roads during the peak hours. PCU value of vehicles passing in front of the residential area is used. The study considers private vehicles as the main cause for producing negative externalities. This is because the per capita emission rate, per capita space occupied on roads that further leads to congestion and per capita noise emitted from private vehicles was found to be significantly higher as compared to that of public transport.

3.1 Study Approach



4. Analysis and Findings

The bid rent curve for mono centric cities shows decreasing land value over distance from the city center. In the case of Gurgaon, the price of land shows a dramatic slump, depending upon the distance from the city center. The land prices in the city centre are lower than in the next ring which is contrary to the general notion that land is most valuable in the centre. The major reason for this is the poor environmental quality, vehicular congestion, high noise levels and carbon emissions. The price of the land then again escalates and reduces as one moves away from CBD due to reduced externalities caused by transport.



Distance from CBD

For a selected CBD in case study area, price per square feet were plotted against distance from CBD. According to figure 2, the price of land just in the immediate vicinity of the selected CBD showed a decline up to a distance of 2.5 to 3 km due to the impact of negative externalities from current mode of travel. The land price after a distance of 3 km again shoots up and forms a conventional Bid-rent curve. This highlights the loss of land values caused by external factors like noise, congestion, pollution etc. in localities close to CBD. And thus emphasize the greater need to shift to more efficient modes of transport like buses.

The price per square feet for different dwelling units in a residential property were evaluated. It was found that the flats that face park were priced higher than those facing roads. A price difference of about 15 lakhs to 20 lakhs was obtained. In discussion with developers and residents, it was found that more people prefer park facing houses rather than road facing and thus the higher price. This shows that proximity to roads reduces willingness to live there and causes a decline in property prices due to the effect of factors like congestion, noise and air pollution. The change in prices for two similar residential properties over a time period were evaluated, the one close to CBD was priced lower than the one far away from it within a distance of 3 km.

4.1 How Equitable is Current Transport System in Gurgaon

As per the Comprehensive Mobility plan for the city of Gurgaon, the current modal share of the city is in favour of private transport the 31% of it is constituted by cars and 43% by two-wheelers. The average trip

length is 16 km, 10 km, 9 km, and 7 km for bus, car, two-wheeler and auto respectively. The amount of fuel consumed per capita for a bus use is 11.25 times lower than that of a car user which shows the externalities caused by use of public transit. A bus caters to 3 times more trips than that of a car and yet consumes less fuel highlighting its efficiency, as the average occupancy is 65 for bus, 2.8 for auto, 2 for car and 1.3 for two-wheelers. A bus consumes 4.5 times less fuel than that of a bike and 5 times less than an auto. A bus makes 2.7 times more trips than a bike and 5.5 times more trips as compared to an auto. (Integrated Mobility Plan for Gurgaon Manesar Urban Complex, 2010)

Fuel consumed				
Mode of Travel	**Bus**	**Car**	**Two wheeler**	**Autos**
Total kms driven/day	49720	140120	203400	58760
Mileage	5	11	40	13
Total fuel consumed/day (in liters)	9944	11916	5085	4520
Value fuel consumed/day 000' (in INR)	775632	893700	381375	339000
Fuel consumption/person for average trip length	0.04	0.45	0.17	0.19
Value fuel consumed/person for average trip length	3.12	33.75	12.24	14.25

5. Research Gap

The prices taken for study depend on one time data since trend for the same was not available. The effects of externalities have thus been evaluated on the current market rates only.

6. Implications

The population growth in the country is significantly visible with the growth of the automobile sector and vehicle ownership per capita. To bring equity in the transport sector it becomes important to introduce policy measures and tools like pigovian tax that take into account the external cost and inspire more people to shift to public transport. The internalization of external cost in private transport is imperative so as to shift the current road pricing system in favour of public transport users.

The difference obtained in land values due to externalities as visible through bid rent curve should be borne by travellers passing through the area during peak hours. Practices from international case examples if implemented can take into account the external cost and thus encourage minimised use of private transport. This will help reduce carbon emission and exhausts from fuel combustion.

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