Who Can Reduce Traffic without Building more Roads? A Comparative Analysis of the Cost-Benefit Debate Around the Proposed Congestion Pricing of Roads in Delhi

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Traffic congestion is one of the biggest problems facing policy makers in cities the world over. Conventional wisdom dictates that building more roads is a way to reduce congestion but this is rarely the case. This is so because the price of availing the resource, namely road space, is zero and hence, motorists tend to demand far more than the optimal. In the present paper, I have gone over the concept of 'congestion pricing', the theoretical solution to this problemandhave attempted to analyse why its implementation has been so patchy even though economists have been advocating it for ages. This issue has been gathering force in India ever since the proposal to introduce a congestion fee of one hundred and fifty rupees for vehicles entering the central districts was made. I have looked at the major cities around the world which have tried using congestion pricing as a solution; more particularly the model of congestion pricing proposed in Delhi. I have argued that the major cities which attained reasonable success at congestion pricing had certain pre-conditions which werefulfilled before they introduced congestion pricing. While on paper the theory of congestion pricing is sound enough to be considered, the pre-conditions which I have distilled from the theoretical and comparative analysis may be evaluated by policy makers looking to introduce congestion pricing. The lack of fulfillment of said pre-conditionsin Delhi would mean that even the

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simple congestion pricing model would have limited to adverse effects on the level of congestion. In my opinion, important lessons from the comparative analysis need to be internalized before Delhi can introduce congestion pricing.

"As a nation we are increasingly stuck in traffic… Traffic congestion has increased rapidly in urban areas where growth in volume of motorists has risen faster than growth in roadway capacity"[1]

I. Introduction

Traffic congestion has been, and continues to be, a massive problem in almost all major cities around the world. Congestion not only hampers the quality of life when people lose time but it also disrupts supply and delivery schedules of businesses and companies.It acts as a hindrance to general flow of commerce[2] and also leads to noise and air pollution. Because the price of availing of the service, namely road space, is zero, motorists tend to demand more and more until the supply extinguishes. For this problem, the economically sound solution of introducing a cost on the motorist for the externality which he creates for his fellow motorists has proven to be difficult in context to implementation due to various reasons. Of the major cities around the world which have tried their hand at congestion pricing, three cities grab the maximum public attention—London, New York and Singapore. While there have been unqualified successes like in Singapore, there have also been cases where implementation has failed like in Hong Kong or shelved like in Edinburg and New York.

With the objective to ease the congestion problems being faced by the traffic in the city, the Municipal Corporation of Delhi recently announced that a congestion fee of one hundred and fifty rupees would be charged for entry into certain central areas of the city. In the present paper, Iwill combine the social, political and economic angles to the traffic congestion problem which is faced in every major city around the globe. In my opinion, it is important to look at the social and political ground realities in light of the fact that in spite of there being clinching economical evidence favoring some manner of congestion pricing, congestion pricing of urban roads have been limited to a handful of cities with varying degrees of success. The nature of this work is mainly to analyze the success and failure of congestion pricing using three case

1 Tirza S. Wahman, *Breaking the Logjam: The Peak Pricing of Congested Urban Roadways Under the Clean Air Act to Improve Air Quality and Reduce Vehicle Miles Travelled,* 8 Duke Envtl. L. & Pol'y. Forum 181-183, 181-208 (1998). (Wharman is talking of induced demand in simplistic terms, the formal expression of which can be found in Part III of the paper).

2 Gregory B. Christansen, *Road Pricing in Singapore After Thirty Years,* 26 Cato J. 71 (2006); *See also* Lior Jacob Strahilevitz, *How Changes in Property Regimes Affects Social Norms: Commodifying California's Carpo ol Lanes,* 75 Indiana L.J. 1231, 1231-1296 (2000).

studies—Singapore, London and New York; and then try and use this data to understand whether the proposed Delhi congestion tax is feasible or not.

In the first part of the paper, the nature of the resource which is in question is analyzed with a view to understand the problems associated with taxing the same. Part II of the paper summarizes the theoretical problems with conventional methods of decongestion while proving that the economics in favor of congestion pricing is well established. In Part III, I have addressed the non-economic arguments leveled against congestion pricing which mainly deal with equity and political questions. Parts IV and V deal with the practical considerations around congestion pricing. While Part IV looks at other major cities which have implemented congestion pricing, successfully or otherwise, Part V attempts to apply lessons from those experiences in analyzing the model proposed in Delhi and suggests certain changes to the same. It must be noted that this paper does not attempt to improve or test the economic logic behind congestion pricing; instead, it explores which among the various models of congestion pricing employed all around presents the best chance of decreasing traffic congestion in Delhi. The paper is also limited in its analysis of various electoral calculations which enter policy making while a tax of this nature is introduced.

II. Nature of Road Space

A. Public Good?

In order to analyze road space management policy, it is important to look at the nature of the good concerned at *status quo*. Public roads are generally managed by the government. Also, it is seen that access to most roads is unrestricted and free. Arguably, road space is a public good under low levels of usage.[3] A public good has two main distinguishing features: It exhibits non-rival consumption i.e. the usage by one individual does not affect the usage by other individuals and it also exhibits non-exclusive consumption i.e. once the supply of the good is set in motion, individuals cannot selectively be prevented from using it. While it is uncontested that public roads are non-exclusive in nature[4], it is clear that non-rival consumption does not apply in case of roads being congested. Congestion is a classic case of externality. As long as the roads are relatively uncongested, the traffic flow is unhampered by the addition of one extra driver. With congestion, quality of service delivered (of the road space) declines as individual drivers only take into account their out-of-pocket expenditure and the time delay they suffer.They do not take into account the

3 Daphna Lewinsohn-Zamir, *Consumer Preferences, Citizen Preferences and the Provision of Public Goods*, 108 Yale LJ 377 (1998).

4 There are no bars on anyone on entering public roads in India, keeping in mind that tolled roads are a sort of congestion pricing.

time delay they impose on other drivers (ignoring other externalities of congestion such as air and noise pollution) which adds to the vicious cycle of congestion. Clearly, road space is not an out and out public good;instead, according to Gillette and Hopkins, it can be better described as 'congestible public goods'[5]. It is basically an open-access resource that generates negative externalities at higher levels of usage[6], which arise because commuters do not take into account the difference between the visible cost and the actual total cost.[7]

B. The Problem with Externality

The main crux of the problem with *status quo* is that users externalize certain costs associated with the use of roadways.[8] Externalizing the costs leads to inefficient allocation of resources; in this case, road space. Road space is not allocated to those who value it the most but is allocatedin a rather haphazard manner—on the basis of time and effort depending on a rule of 'first capture'[9]. Because of the externalities and inefficient allocation, the road space is overused, much like the classic case of the 'tragedy of the commons'[10].

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5 P. Gillette, Clayton & Thomas D. Hopkins, *Federal User Fees: A Legal and Economic Analysis*, 67 BU L. Rev. 795, 802 (1987). *See also* Johansson, Borje & Lars-Goran Mattsson, *Principles of Road Pricing, in* Road Pricing: Theory, Empirical Assessment and Policy, 9-10 (1995). (They argue that there can be two ways to judge whether road space is a public good or not, which is immaterial to policy analysis of roadspace. Instead, it is more pertinent to note that there is a distinction between capacity and potential capacity of a road. Since a chain is only as strong as its weakest link, road space should be judged at full potential capacity which makes it a public resource since it is not necessarily rivalrous; for example, fire-brigade services).

6 Even at low levels of usage, there are certain externalities such as air and noise pollution which are unavoidable. Note that, in theory at least, this paper does not attempt to solve the problem associated with such externalities because the researcher believes that they are different problems with differing solutions. This is because the problem with the pollution externality is that there is an externality associated with driving in general and not the use of a particular roadway even though decrease of pollution may be a positive effect of the model analyzed in this paper. *See* Craig N. Oren, *Getting Commuters Out of Their Cars: What Went Wrong?*, 17 Stanf. Envtl. L.J. 201, 141-207 (1998). ("traffic congestion and air pollution are entirely congruous problems, and so have different solutions", "trip reduction for the sake of congestion relief largely takes the form of shifting employee trips out of a narrow peak period").

7 This is a recurrent theme which we will return to in the later sections of this paper.

8 Shi-Ling Hsu, *A Two Dimensional Framework for Analyzing Property Rights*, 36 U.C. Davis L. Rev. 838, 813-893 (2003). (" When highways become congested, joint use fails in that allocations of use are not necessarily made in an economically efficient manner").

9 Jonathan Remy Nash, *Economic Efficiency* v. *Public Choice: The Case of Property Rights in Road Traffic Management,* B.C. L. Rev. Volume 49, 687 (2008); See generally *Pierson* v. *Post,* 3 Cai 175 (NY Sup Ct 1805).

10 Garrett Hardin, *The Tragedy of the Commons*, 162(3859) Science 1243 (1968). (Hardin describes the nature of overconsumption when the benefits of consumption go to the consumer while the costs are borne by the entire group to an extent that the resource is extinguished).

It is clear that road space is a valuable resource, access to which is not determined by the money one pays. In such a scenario where a valuable resource is offered at below market price, it is seen that a shadow market develops in some other form of effective currency.[11] This effective currency is usually time and effort. This explains the long queues outside ration shops (or fair price shops) where food grains are offered below market price by the government. Since the grains are not being charged at market value, people expend an alternate form of currency, i.e. their time and energy, by standing in the queue to buy the food grains.

In the case of roadways, the effective currency at present is time.[12] Commuters who can access the congested road space are the ones who are willing to drive at that particular level of congestion.[13] The question that is important at this juncture is why *time* is an inefficient basis to allocate road space. A person who is willing to pay a considerable amount of money to use a particular roadway might not finally end up using it because he may not be willing to invest that amount of *time* to use the roadway. Instead, people who value their time less are willing to use the said roadway even though they value the roadway less than the first individual.[14] As such, allocation on the basis of time-cost is not efficient.

The second problem is that because costs can be externalized, there is always a tendency to over-consume; like in the phenomenon described as the tragedy of the commons.[15] Even though the society would be better off as a whole if everyone consumed till an optimal limit, the individual has an economic incentive to over-consume because he does not bear the costs of usage. Road-space, being an open access resource, suffers from this same problem of costs being externalized. When an individual considers whether to use a certain road or not, he *perceives* certain costs while deciding the trade-offs between the costs and benefits of using the road. If this perceived cost does not reflect the actual cost of the trip, then he will definitely be bound towards making inefficient decisions.

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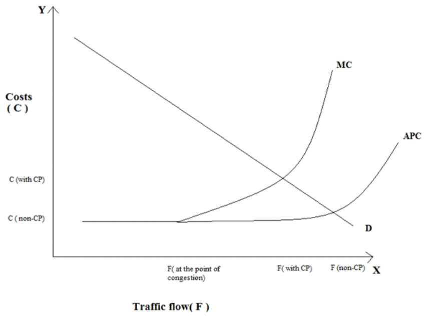
11 Gary S. Becker, The Economic Approach to Human Behavior 6 (1976). (Becker describes "office waiting time for physicians" as "one component of the full price of physician services").

12 Lewis M. Fulton, Robert B. Noland, Daniel J. Meszler & John V. Thomas, *A Statistical Analysis of Induced Travel Effects in the U.S. Mid-Atlantic Region*, 3 J. Trans. & Stat. 1, 1-14(2000).

13 *Id*.

14 Robert G. McGillivray, *On Road Congestion Theory*, Urban Ins., 2-3 (1974).

15 Jonathan Remy Nash, *supra* note 9. (Note, however, that the distinction between common property and open-access resource has not been made by Hardin which has been pointed by later scholars. Nevertheless, the general principle holds true).



The graph above illustrates the point outlined before. The demand curve *(D)* for road-space is negatively sloped because the costlier it is to drive to a longer distance, the fewer people will drive. The Average Perceived Cost *(APC)* curve depicts the perceived cost of a trip to the commuters while Marginal Cost *(M)* depicts the actual marginal cost. The MC and the APC curves are identical before the road gets congested, i.e. at low levels of usage.

The point where MC curve intersects the demand curve shows a lower level of congestion (F) while levying a higher cost C. In the absence of internalization, however, equilibrium is at the point where APC curve intersects the demand curve which shows a higher level of congestion and the costs of the externality are not attributed to the commuter himself. These results are in consonance with the arguments framed earlier.

III. The Economics of Congestion

The first question that any policy maker has to answer while he is putting forward a model of road pricing is why or how road pricing is better than conventional means of reducing congestion. The more obvious and commonsensical methods of reducing congestion pricing are to build more roads, build alternate means of transport, etc. In the present section, the researcher will show how congestion pricing makes more economic sense than other conventional methods and as such build a theoretical framework for addressing the issues which arise subsequently. The second question that this section answers is whether roads can be decongested using the other conventional method of taxation (which excludes congestion tax). The argument espoused in this section is that taxation cannot be treated as an alternative to congestion pricing; it is, rather, a supplement to the same.

A. The Problem with Building More Roads

The most commonplace method to decongest roads is to build more roads. Not only is it the most traditional, but as Jay Dilger argues, it is also the most attractive option for politicians because of a wide variety of reasons which include the *prima facie* commonsensical nature of the solution.[16] This question is significant because in India and most other countries, infrastructure of transport facilities is primarily a function taken up by the government. This question will be addressed in the next section which analyzes the role of public choice in the face of glaring economic inefficiency. However, contrary to common sense, building of more roads or new roadway capacity is not the solution to this problem because of a host of reasons.

The first problem with building more roads, especially in cities crippled by a general space crunch, is that it is extremely expensive, complex, and controversial and wrought with numerous social and political considerations.

Secondly, another manner of decongestion through increasing capacity is to build mass transit systems such as more railroads. Pickrell, in his study of rail transit projects in the United States, argues that it is ineffectual because the number of motorists who switch to rail is negligible compared to the new users of the railroad.[17] Also, a cost per trip analysis of the former motorists who had switched to rail revealed that to attract motorists in numbers enough to reduce congestion, the quantum of subsidy the railway authority offers would be financially unfeasible.[18]

Thirdly, there are certain advantages of private roadway transport with reference to the taste and preference of the city residents—which are difficult to change overnight. In view of the layout of certain cities such as Delhi, private roadway transport is simply convenient. It is also true that in India, price hike of fuel notwithstanding, both two-wheelers and four-wheelers are becoming cheaper by the day and as such it is getting difficult to dis-incentivize.

Fourthly, 'building out'[19] as a strategy is inherently flawed because researchers on transportation dynamics have identified three paradoxes which render increasing roadway capacity ineffective and in certain cases, even counter-productive—even if new roadway and mass transit construction is assumed

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16 Robert Jay Dilger, *TEA-21:Transportation Policy, Pork Bare Politics and American Federalism,* 28 Publius 49, 50 (1998).

17 D.H. Pickrell, *Urban Rail Transit Projects: Forecast* v. *Actual Ridership and Costs,* U.S. Department of Transportation, Transportation Systems Center, Cambridge, Massachusetts (Oct. 1990), http://www.debunkingportland.com/docs/Pickrell(no_text).pdf.

18 *Id*.

19 Richard Arnott & Keneth Small, *The Economics of Traffic Congestion,* 82 Amer. Scien. 446,446-455 (1994).

to be cheaper.[20] This has mostly to do with induced demand, latent demand and mispricing of congestion. Induced demand essentially means that when a new road is built to reduce the load on existing roads, it attracts new users more than the users of the existing roads and soon enough it is just as congested as the existing roads.[21] Latent demand is the phenomenon by which we do not see the actual demand on a crowded route, say Route A, because of people's decisions as affected by the existing congestion (For example cancellation of trips during rush hour or use of mass transit system). The actual demand is seen when another alternate route, say Route B is opened up which is less congested to begin with.[22] Mispricing is the problem with the present system of charging motorists—it does not internalize costs[23] of congestion. Because motorists do not pay for the externality that they impose on their fellow motorists (in this case the externality being loss of time among other things), they make socially inefficient choices which lead to the failure of conventional de-congestion policies.[24]

To understand how a combination of these factors act in ensuring that there is no improvement in congestion with increase roadway capacity, let us consider a series of possible situations.

In the first scenario, which is called the *Pigou-Knight-Downs* paradox (also called the 'fundamental law of traffic congestion'[25]), let us assume that 1000 commuters between two cities can choose between two routes, a direct route via a narrow bridge (Route 1) and a second more circuitous but wide road (Route 2).[26] The first route takes 10 minutes to commute with zero traffic but rises linearly with the ratio of traffic flow (F_1) to bridge capacity (C_1). Capacity is assumed to be at the traffic flow at which speed is reduced to half of the speed at zero traffic. Travel time is defined by the following equation, 10 minutes + extra time, if the road is congested. $\{T_1 = 10 + 10\,(F_1/C_1)\}$ Let us assume that Route 2 takes 15 minutes.

There are certain obvious assumptions like that every commuter chooses the route which takes the least possible time.

$$T_1 = 10 + 10\,(F_1/C_1),$$

$$T_2 = 15,$$

$$F_1 + F_2 = 1000$$

[20] *Id.*
[21] *Supra* note 5, at 7-8.
[22] D.H. Pickrell, *supra* note 17, at 447.
[23] D.H. Pickrell, *supra* note 17, at 451-455.
[24] D.H. Pickrell, *supra* note 17.
[25] D.H. Pickrell, *supra* note 17, at 451.
[26] D.H. Pickrell, *supra* note 17, at 448.

Possibility 1: When $C_1 < 2000$

And $T_1 = 10 + 10 (F_1/C_1) = 15 = T_2$

Then, $F_1 = ½ C_1$ and $T_1 = T_2 = 15$

The traffic flow over the bridge(Route 1) adjusts to ½ C_1, so travel time on both routes stays stagnant at 15 minutes.

Possibility 2: When $C_1 > 2000$

$F_1 = 1000$ and $F_2 = 0$

Then, $T_1 = 10 + 10000/ C_1$

Taking $C_1 = 2500$, then $T_1 = 14$minutes and as $F_2 = 0$, it is clear that no one is using Route 2.

As seen in the mathematical expression outlined above, increasing the capacity of the bridge to any value less than twice the traffic flow has no effect on the travel time of commuting on Route 1. It is seen, however, that if $C_1 > 2000$, i.e. when the capacity is more than traffic flow, the travel time decreases linearly. It may also be safely assumed that increasing the capacity beyond twice the traffic flow is not economically feasible and zero usage of Route 2 represents inefficient usage of resources. The implications of this paradox are manifold. Firstly, it is clear that increasing the bridge capacity to a feasible quantum (twice the traffic flow or 2000 in our example) has no effect on anyone's travel time. In other words, the new capacity generates its own demand.[27] Secondly, measures such as mass transit and carpooling would not work in decongestion because they would be subject to the same limit i.e. as long as there is any traffic on the Route 2, there will always be a latent demand for the increased bridge capacity and the travel time remains at 15 minutes. The main point of this paradox (or in any attempt to increase roadway capacity) is that the actual cost of the trip is not internalized. For any trip, there are two costs; social cost and private cost. The private cost is the cost borne by each individual commuter. The social cost is the private cost plus the cost of the externality that the individual imposes on other fellow commuters, i.e. the loss of time. During peak hours or times of congestion, the social cost always exceeds the private cost. As is clear from the assumption with which we started out, commuters choose the route which imposes a lower cost on them, i.e. a lower private cost. Subsequently, the equilibrium that is reached in this model is one in which the private costs across the two routes are equalized. This leads us to the conclusion that if instead of the equilibrium being reached by equalization of private cost, the commuters were distributed by the equalization of social cost, the paradox would disappear. This

[27] D.H. Pickrell, *supra* note 17, at 449.

is precisely what congestion pricing seeks to achieve, that is to internalize the social cost of the trip which would lead to a congestion free equilibrium.

The second paradox is a modification of the above paradox and is called the *Downs-Thomson* paradox wherein the new route is a railway line which is privately operated. The train line works on the principle of increasing returns with added flow, because quality of service increases with more commuters using it. Using similar mathematics, it is found that increasing road capacity leads to more congestion.[28] Expanding road capacity decreases the people travelling on train and thus leads to decreased quality of service on the train. At equilibrium, both road and rail services are worse off. This is because the new capacity generates *more* than its own demand. [29] One reason for the same is that instead of just an external cost being imposed, there is an extra benefit being created by each commuter on the train. As Mohring demonstrated in his study, this is a common feature of all mass transit alternate models wherein both the individual transport and the mass transport suffer and as such this investment could be used in improving the existing roadway infrastructure.[30]

The third paradox is the *Braess* paradox which deals with a hypothetical road network wherein a new shorter link road (Route 3) is added which at zero traffic conditions is faster than both the existing routes (Route 1 and 2). Braess showed that adding the new link route actually makes everyone's travel time go up because the model allows people to choose the fastest route without taking into consideration the costs(of slowing the others down) that they impose on their fellow commuters.[31]

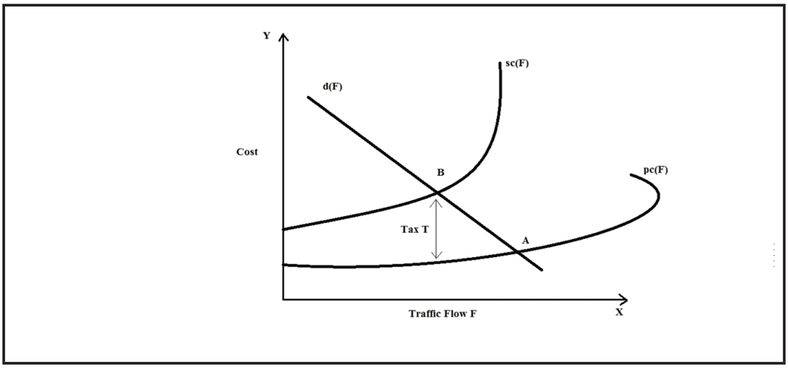
It is clear from the above illustrations that the primary problem with conventional increase of roadway capacity is that it is destined to fail (except in extreme limiting cases which are, in any case, unfeasible) because they are unable to internalize the social cost and the equilibrium reached as such is inefficient. This is precisely what congestion pricing aims at doing, i.e. internalizing the social cost.

B. Congestion Pricing in Theory

In calculating the congestion price, one must find a way to put a price on the externality. This is done by assuming an identical monetary value on every minute of travel time and multiplying it by the total number of minutes

[28] D.H. Pickrell, *supra* note 17, at 448.
[29] D.H. Pickrell, *supra* note 17, at 450.
[30] D.H. Pickrell, *supra* note 17, at 449. (Mohring delved into a detailed study of mass transit systems, which included the formulation of a model of bus line taking into account various factors such as road speed, frequency of service and time taken to get off and on).
[31] D.H. Pickrell, *supra* note 17.

travelled. In the graph below, for the purposes of simplicity, out-of-pocket costs, as well as the other costs of congestion such as pollution, have been ignored. The private cost, denoted by *pc(F)*, signifies the cost to the individual commuter and on multiplying *pc(F)* by flow *(F),* we get the total cost at any point. Then we look at how much the total cost increases when the flow is increased by one unit. This value would be the social cost {*sc(F)*= private cost + external cost} that is imposed by the extra added commuter on the existing commuters.



In a scenario without congestion pricing, the equilibrium is at point A where the benefit to the commuter for every trip is equal to his private cost. On taking into consideration the nature of road space[32], it is clear that too many trips over and above the optimal number are taken because the existing model does not internalize the *total cost* of each trip.[33] Introducing a congestion tax *(T)* would then move the equilibrium to the optimum point B which takes into account the social cost and thus prevents overuse of the road space. The quantum of tax (*T)* is simply the vertical distance between the social and private costs at optimal equilibrium B i.e. equivalent to the external cost. With congestion charge in place, the private decision making will now take into consideration the social cost of the decisions and as such the social equilibrium will be naturally maintained. Equilibrium at Point B represents decongestion. The principle behind the model of congestion pricing, as seen above, is of equalizing social cost instead of private cost and allowing private decisions to come to a social optimum.[34]

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32 As explained in Part II of the paper, the nature of roadspace is arguably like a public good with qualifications.

33 Tirza S. Wahman, *supra* note 1, at 196.

34 D.H. Pickrell, *supra* note 17, for a formal mathematical solution as to how this logic is applied to solve the *Downs-Thomson* and the *Knights-Pigou* paradox.

C. Is Congestion Pricing Fair?

Even though it is clear that congestion pricing makes more economical sense than increasing roadway capacity, building more roads is still the dominant governmental response -notwithstanding the present policy of the Delhi government to introduce a congestion pricing cordon. In this section, the researcher will look at the reasons why building out is a more popular option even though economists have laid down a strong theoretical foundation over the course of nearly three decades.[35] Secondly, this section also looks at the competing thought processes and the non-economic arguments which have been directed against congestion pricing.

Economic efficiency favors congestion pricing but increasing capacity remains the more popular option of the government. This is due to a host of reasons. Firstly, the political groups that form the government do not usually go against the general sentiment of their voting populace. The electorates are mostly comprised of people who believe that new roadway construction will lead to alleviation of congestion problems. This erroneous belief is due to two reasons; assumption of rationality of all involved and lack of information about costs to all involved.[36] Also, such building projects lead to the generation of ample new short-term employment which serves both the voting populace (since it provides short-term jobs for them and boosts local economy[37]) and the political actors who have something to show for their trouble when it comes to reelections. Essentially, this becomes a political question and increasing roadway capacity serves all except the fundamental purpose for its existence, de-congestion.[38]

Of the arguments that are leveled against congestion pricing, the most convincing one pertains to equity. It is said that once congestion pricing is introduced, the poorer sections of the society are driven off the streets. Since congestion pricing allocates the road space to those who value it the most, it is argued that private transport will soon become the sole domain of the economically affluent. It is true of any policy that everyone cannot be made better off at one stroke. Welfare must be prioritized to those who need it the most and some such people will be worse off for a gain in benefit across the board. In fact, if we consider every individual only in their roles as commuters, then this argument is valid. It is so because as commuters, *everyone* is made worse off because they are made to pay tax if they want to use the road space or not. However, if we consider that every commuter is a citizen first and that he has already paid road taxes irrespective of the amount of road space he used, the

35 R.H.M. Emmerink, Information and Pricing in Road Transportation 3 (1998).

36 *Id.*, at 37.

37 William W. Buzbee, *Urban Sprawl, Federalism, and the Problem of Institutional Complexity*, 68 Fordham L. Rev. 57, 80 (1999).

38 Jonathan Remy Nash, *supra* note 9.

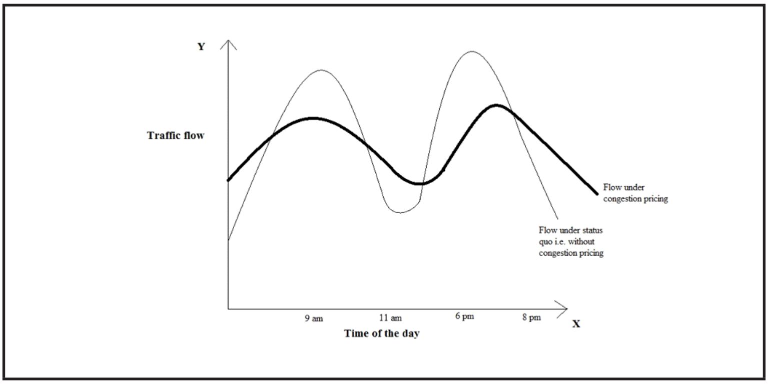
argument falls flat. Detractors of congestion pricing fail to appreciate the absolute lack of equity in the present taxation structure and also that congestion pricing taxes are levied on a person only for what he uses. Lump sum road taxes, on the other hand, charge for roads which may not even be practically usable due to congestion. Clearly, congestion pricing is farthest from inequity in the present circumstances because instead of driving the less-affluent off the streets, the tax firstly de-congests the roads and secondly allows for improved public transport facilities which will work much better in a de-congested framework.

Another argument against congestion pricing, pertaining to how the taxes from congestion cordons are used, is the trust deficit which exists between people and the government. In layman terms it is argued that since people do not trust the government when it comes to usage of the tax collected, they tend to favor methods to increase capacity over congestion pricing. Ideally, the taxes collected should be used for better collection procedures and public transport system in order to provide alternatives to individuals who are unwilling to pay the congestion fee. The trust deficit argument is an argument that should be directed not against the nature of *policy;* instead, against the nature of *polity.* Trust deficit problem can be an exception found in a particular democratic government but it cannot be used as a general argument against all such democratic governments. This is so because removal of the trust gap through periodic elections is the very foundation on which a democracy is built. Other minor arguments are that toll collection and calculation of distance travelled per car is prohibitively expensive to implement. How such a belief is erroneous is elucidated in the next section of the paper; it deals with case studies which show that congestion pricing is a viable and long term solution.[39] Congestion pricing would ensure that the local economy (for that matter even the wider economy) ticks over smoothly because of alleviation of the wide plethora of problems associated with congestion, as has been discussed earlier.

There is one final consideration which states that congestion pricing, in its attempt to spread out trips evenly across twenty four hours, misses the point of concentrating economic activity. The argument is that there is sufficient economic logic in not only aggregating economic activity within specific geographical zones but also in having a common schedule or concentrating working hours within specific zones. The benefits that accrue from such commonality in time and space far outstrip the costs which might be a consequence of the same. It should be noted that the objective of congestion pricing is not to perfectly even out the traffic flow but to link prices with traffic flow so that the extremes of peak hour traffic which push congestion above a

[39] *See* Michael H. Schuitema, *Road Pricing as a Solution to the Harms of Traffic Congestion*, 34 Trans. L.J. 81, 96 (2007).

critical point are evened out by small shifts of time of travel. This is clear from the graphical illustrationon the next page.



IV. Congestion Pricing in Practice

This part of the paper looks at the practicality of introducing congestion pricing in various scenarios by looking at certain case studies and also analyses whether Delhi is suited for such a regime.

The neo-classical economists were the first to look at the problems of transport congestion when they studied various forms of market failure.[40] Dupuit[41], Pigou[42] and Knight[43] worked on the theoretical aspects of roadway congestion in the 1920s.[44] William Vickrey brought forward the theoretical aspect to a practical grounding for the first time in 1952.[45] Vickrey suggested congestion pricing methods in New York's subway system but it remained largely unimplemented.[46] R. J. Smeed also submitted similar proposals to the U.K. government but not much attention was granted to them.[47] Finally, it was Singapore which first adopted a holistic congestion pricing system based on the

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40 Jonathan Baert Wiener, *Global Environmental Regulation: Instrument Choice in Legal Context*, 108 Yale LJ 677, 677-799 (1999).

41 J. Dupuit, *On the Measurement of the Utility of Public Works*, 8 Annales Des Ponts Et Chaussees (1844).

42 A.C. Pigou, The Economics of Welfare 63 (1920).

43 F.H. Knight, *Some Fallacies in the Interpretation of Social Cost*, 38 Q.J. of Econ. 582, 584 (1924).

44 Pigou and Knight were instrumental in proposing the *Pigou-Knight-Downs* paradox which forms the main part of the theoretical background for the formal expressions of problems of congestion. This has been discussed in detail in the earlier sections.

45 William S. Vickrey, *The Revision of the Rapid Transit Fare Structure of the City of New York*, Literary Licensing LLC (1952).

46 William S. Vickrey, *Pricing in Urban and Suburban Transport,* 53 The Amer. Econ. Rev. 452-465 (1963).

47 *See generally* R. J. Smeed, Road Pricing: The Economic and Technical Possibilities (1994).

recommendations of Allias and Roth to the World Bank. Singapore, to this day, remains one of the foremost success stories of congestion pricing.[48]

A. Singapore

For a period of three and a half decades now, Singapore has been successfully implementing congestion pricing in its most sophisticated forms to achieve enviable results. Indeed the data speaks for itself. In 1976, the government of Singapore introduced a one dollar (or three Singaporean dollars) charge for entering into the central business district (CBD) during rush hours, i.e., from 7 am to 9:30 am. Very soon, there was a 73% reduction in usage of private cars within the restricted zone, a 30% increase in carpooling and a doubling in bus usage.[49]

The question that is important for policy makers to ask is how this was made possible.

With a population of four million people, Singapore began to feel the pangs of congestion in the early 1970s. Measures that were initially taken included increasing of import duty on motor vehicles and also of registration fee of new cars. When these measures failed to have an impact on the traffic volume, the cordon congestion tax on the CBD was proposed and implemented in 1976. Traffic volume reduced by 50%, instantly. Shortly, restricted hours were introduced in the afternoon as well. Over the years, the government took a slew of measures to improve the system from a rudimentary cordon tax to a sophisticated Electronic Road Pricing system (ERP). The ERP basically uses an In-Vehicle Unit (IU) attached to the windshield of a car to calculate the miles travelled in a congested area and deducts the amount from the commuters account. Such a system has obviously made cordon taxing obsolete to an extent.

Also, technological advancement has made it possible to avoid certain spillover effects of congestion pricing. Initially, it was seen that the neighborhoods outside the CBD were increasingly congested as drivers parked out of the restricted zone to avoid the fee. The government responded by putting up signs to warn commuters that waiting on those roads was illegal and in such cases, fines would be levied using surveillance cameras.

As impressive as the implementation of these measures was (and, in fact, unprecedented anywhere else in the world), it was also evident that it is was not financially feasible to have all roads which had a tendency to be congested

[48] Tirza S. Wahman, *Breaking the Logjam: supra* note 1.

[49] *Reducing Congestion: Congestion Pricing has Promise for Improving Use of Transportation Infrastructure,* GAO-03-735T (2003).(Statement for the Record of Jay Etta Z. Hecker, Director Physical Infrastructure Issues).

to be installed with ERP (or cordoning earlier). The Singaporean government came up with a novel solution wherein they limited the number of cars with a concept of a Certificate of Entitlement (COE). A COE is a legal right to own, register and use a vehicle for a period of ten years. This COE is distributed via a uniform price sealed auction policy and as such owning a car becomes prohibitively expensive. This system works in perfect complement with the congestion pricing system to ensure a decongested city.[50]

The third measure taken by the government was to use the considerable funds from congestion pricing to improve mass transit to an unprecedented level of efficiency and penetration even though the initial intention of the government was not to collect revenue, but decongest instead. In the long run, it is seen that congestion pricing has been a good investment for the government in that it has not only decongested but also shown sizeable revenue returns.[51] Combined, these measures have ensured that a city like Singapore with a population of more than, say, the state of Houston does not suffer from traffic congestion.

B. New York

New York, with a population of 8 million, and expected to grow by a million by 2030, is one of the cities worst affected by congestion pricing. In 2000, a facility based, semi-cordon congestion pricing system was introduced on the George Washington Bridge, Lincoln Bridge and Holland Bridge among others. The scheme consisted of increasing the normal four dollar charge to a five dollar charge during peak congestion hours of the morning. This scheme fell flat on its face. In one year, the flow had decreased a mere four percent during the afternoon and close to seven percent in the morning. One reason for such a failure was the obvious inability of the tax to successfully allocate people into various time slots based on their willingness to pay. In 2008, a legislation proposing to introduce full cordon pricing in New York's Manhattan district and other central business areas was defeated in the New York State Assembly. Political questions (such as those discussed in the earlier sections[52]) held sway over a sound economic model[53] and congestion continues to rise to this day in New York.

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[50] Jonathan Remy Nash, *supra* note 9, at 86.

[51] Jonathan Remy Nash, *supra* note 9, at 83.

[52] *See* R.H.M. Emmerink, Information and Pricing in Road Transportation 3, 37 (1998).; William W. Buzbee, *Urban Sprawl, Federalism, and the Problem of Institutional Complexity*, 68 Fordham L. Rev. 57, 80 (1999).; Jonathan Remy Nash, *Economic Efficiency v Public Choice: The Case of Property Rights in Road Traffic Management,* B.C. L. Rev. Volume 49, 687 (2008).

[53] Sam Schwartz, Gerard Soffian, Jee Mee Kim & Annie Weinstock, *A Comprehensive Transportation Policy for the 21st Century : A Case Study of Congestion Pricing in New York City*, 17 NYU. Envtl. L.J. 580, 580-607 (2008).

C. London

The case study which is most relevant to the object of the present paper is the study of London's congestion pricing. In 2003, London introduced a fourteen dollar congestion price for driving and parking in certain central avenues bounded by the Inner Ring Road[54] from 7 am to 6:30 pm.[55] Under the scheme, residents of the area paid 10% of the tax and it excluded commercial and public utility vehicles and most importantly *vehicles which ran on alternative fuel.* This move ensured not just decongestion but also incentivized behavior which imposed lesser externalities. The manner of toll collection was also innovative, for there are no toll booths surrounding the area. Instead, payments were made either before hand or before midnight of the day during which the usage had occurred by a variety of payment options such as retail outlets, telephone, text, internet, etc. Payments were enforced by surveillance cameras which notedlicense plates by a technology called automatic number plate recognition.[56] After the introduction, traffic volume had decreased by 20% and average traffic speed had increased by 22%.[57] Such significant success had come with one negative for the government;revenues had come nowhere near as high as Singapore's.

V. Answers for the Delhi Model

Recently, the Municipal Corporation of Delhi announced that a congestion fee of one hundred and fifty rupees would be charged for entry into certain central areas of the city along with a one-time urban transport tax with a view to reduce the number of cars in the city.[58] This twin tax is a part of the government's 12th Five Year plan targets. As expected, these proposals have been the subject of some scrutiny in recent times. Political opposition is building slowly, which securely will gain strength when the move finally comes close to being implemented. In light of the above case studies, one might draw conclusions about the present proposal and judge its potential efficacy.

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54 Jonathan Leape, *The London Congestion Charge*, 20 (4) J. of Econ. Pers. 161, 157-176 (2006). (The area covers only eight square miles which roughly adds up to just 1% of the total area of Greater London).

55 *Central London Congestion Charging,* RoadTraffic-Technology.com, 10-3-2013 http://www.roadtraffic-technology.com/projects/congestion.

56 Sam Schwartz, *supra* note 54, at 163. Automatic number plate recognition has a 85-90% success rate on first pass and this increases with every pass. To pass through the restricted zone, every car has to pass by multiple cameras.)

57 *Road Pricing: Driven to Radicalism*, The Economist, (June 9, 2005) *available at* http://www.economist.com/node/4061102.

58 Dipak Kumar Dash, *Rush Hour,* Times of India, 13-9-2012, at http://epaper.timesofindia.com/Default/Scripting/ArticleWin.asp?From=Archive&Source=Page&Skin=-TOINEW&BaseHref=CAP/2012/09/13&PageLabel=11&EntityId=Ar01101&ViewMode=HTML.

Firstly, the Singapore experience shows that for a successful incremental congestion pricing regime, there must be certain ingredients which must be added in the right chronological fashion. Detractors of the pricing in India would point to the fact that cars are rather inexpensive in India and even so in Delhi, where there is a big market for used cars as well.[59] This is true in the sense that even in London, it is seen that barriers to entry of new cars complement congestion pricing. The government should keep the quantum of the 'urban transport tax' high enough so as to make the purchase of new cars sufficiently difficult. The second and the more important difference from the Singapore model is the development of the public transport system. Even though Delhi boasts of a state of the art underground railway system, other alternate modes must be developed while making the existing mass transit systems more reliable, penetrative and cheap. An initial cordon pricing system followed by more extensive measures as and when the revenues start flowing is surely the correct and viable policy as has already seen in the case of Singapore. Higher petrol and diesel tax, as advocated by some sections, would not work because while it might discourage driving in general, it would not take into account a commuter's willingness to pay on the basis of time and place. Also, another reason why existing hot lanes or special reserved lanes have not succeeded or will not succeed is that in such a case the policy makers attempt to decide *for* the commuters without having real time information as opposed to congestion pricing where every commuter takes the decision based on his willingness to pay which results in much lower deadweight loss.

Secondly, there are policy decisions yet to be made regarding the efficacy of the proposed tax –for instance, the manner of tax collection. Archaic methods such as toll booths cannot work in such a system because in an attempt to reduce congestion during rush hours, it will end up *increasing* congestion. Again, ERP technology as used in Singapore is too expensive, at least during the initial stages. As a solution, the researcher would point to the measures taken in London to collect and enforce taxes through a combination of diverse paying options (such as internet and text messages, etc.) and surveillance cameras to identify non-payers.

Thirdly, the proposed model exempts commercial and public vehicles but does not incentivize non-externality-imposing behavior such as using alternate fuel. While a ban on auto-rickshaws running on diesel was possible in order to introduce LPG powered auto-rickshaws, such an option is not viable for private vehicles. The best way to tilt the balance towards cleaner fuels is by exempting cars running on such fuel from congestion charge. Problems with vehicular emissions in Delhi are well documented and the success of such incentives has already been seen in the London case study.

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59 Certainly cars in India are inexpensive compared to Singapore where a Honda City costs nearly $50000 as against $16000 in India.

Fourthly, the lesson from the failure of the New York congestion pricing is twofold. Firstly, a tax of one hundred and fifty rupees may be too little if one considers the type of commuters who enter the central districts of Delhi. These are mostly wealthy executives, businessmen and professionals for whom one hundred and fifty rupees is a slight speck on the out-of-pocket costs such as petrol and car maintenance. The significance of political questions should not be underestimated. Lack of political visibility of congestion pricing and extreme lobbying by disinterested sections of the government leads to a moderate model of congestion pricing to be shelved in New York. To ensure that congestion pricing does not become a weapon of vote-bank politics and remains a long term solution, this must be taken into consideration and publication of information about congestion pricing to the general public must be taken up in earnest. In the absence of consideration of the above, public choice will continue to diverge from economic efficiency.[60]

Fifthly, there is a possibility of a constitutional challenge to the proposed congestion tax under Article 19(d) of the Constitution of India (which grants all residents the right to move around the country without restriction); something that policy makers should consider before framing the legislation/policy which gives final effect to the proposed model of taxation.[61]

To sum up, it is clear that Delhi needs to at least introduce a pilot program on congestion pricing in the central districts of the city provided that certain pre-conditions are met. The problem with the implementation of congestion pricing is summed up very succinctly by an economist when he says, "It has been a commonplace event for transportation economists to put the conventional diagram on the board, note the self-evident optimality of pricing solutions and then sit down and wait for the world to adopt this obviously correct solution. Well, we have been waiting for seventy years now… why is the world reluctant to do the obvious?"[62] Public choice dictates that the general populace will always be hostile to a charge for a resource which was previously free. As such our policy makers must base their decisions on not just economic concerns but on social and political realities as well.

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[60] Shi-Ling Hsu, *supra* note 8, at 675.

[61] An analysis of such a challenge is beyond the scope of the present paper.

[62] Piet Rietveld & Erik T. Verhoef, *Social Feasinilities of Policies to Reduce Externalities in Transport, in* ROAD PRICING, TRAFFICK CONGESTION AND THE ENVIRONMENT (Kenneth J. Button & Erik T. Verhoef eds., 1998).