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Road Pricing: Old Beliefs, Present Awareness and Future Research Patterns

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Abstract: The theoretical evolution of academic beliefs and practical policymakers' perceptions of road pricing (from now on rp) as an instrument of efficient and equitable allocation of resources are described and analyzed. The aim of the paper is to reconstruct the logical evolution of the theory behind rp in order to understand why there has been scarce policy impact in spite of a long theoretical tradition. In so doing I try to bring to the fore the fundamental issues that will have to be tackled by future research in order to generate consensus around this policy instrument.

The paper is structured in four parts. In the first part the fundamental issues of a typical rp model are considered. Among the most important aspects one recalls: first-best/second-best environment, short/long term analysis, homogeneous/heterogeneous time evaluation, perfect/imperfect information, efficiency/equity analysis, use/non-use of resources generated, private/public transportation provision. In the second part the characterizing parameters have been interpreted in the light of the Smeed Report of 1964 that can be considered representative of the “old belief”. In the third part the “present awareness” is expressed by the book *Internalising the Social Costs of Transport* of 1993 dealing with the problem of internalising the external costs of road transport. In the fourth part some reflections on the most promising research areas for rp implementation and acceptance are put forward. Specific research will have to be conducted concerning social acceptability and feasibility, simultaneous cost internalisation, behavioral assumptions and information and pricing interconnections.

Key words: road pricing, social acceptability

Summary: 1. Introduction, 2. Characterizing parameters of a rp model: a preliminary description, 3. Old beliefs, 3.1 How things were supposed to work, 3.2 What were the explicit and implicit assumptions, 4. Present awareness, 4.1 How are things supposed to work, 4.2 What are the explicit and implicit assumptions, 5. Future research patterns, 5.1 Feasibility and social acceptability, 5.2 Simultaneous cost internalisation, 5.3 Behavioral assumptions, 5.4 Information and pricing interaction, 6. Conclusions, 7. References.

1. Introduction

In this paper I will try, on the one hand, to trace the theoretical evolution of conception of rp as a single instrument or as part of a policy mix in the management of excess demand for private transportation within a urban area and, on the other, to assess policy makers' and citizens' perception of rp as a demand management instrument. The analysis concerning public acceptability cannot be overlooked if one believes, as we do, that "The ultimate test of whether a particular program of tax earmarking is properly viewed as an indirect form of user charging is whether those who pay the taxes approve of the program"¹.

The analysis will proceed along a scheme that (hopefully) will stimulate the emergence of the topical differences among the models that have until quite recently characterized the conceptual framework and therefore the expected use of rp and those that have evolved from them. The first-best, short-run, full information, homogeneous drivers, no alternative to private transportation, no distributional impacts, etc. scenario has evolved into a more realistic and complicated one: second-best, short and long-term run analysis, imperfect information, heterogeneous commuters, different alternatives to private transportation, distributional impact analysis etc. Two works that can be considered representative of the beliefs shared by both the policy-makers and academics in different "eras" will be compared so to confront their final recommendations on a well informed way. I will try not only to shed light on the more relevant differences that have come to the fore but also to indicate some of the more interesting research patterns for the future in order to make rp a viable and accepted instrument in the transport policy-making process.

The article is organized as follows: in paragraph two some of the fundamental aspects of rp modeling are highlighted, in the third paragraph most relevant characteristics of the Smeed Report that has been assumed representative of the "old beliefs" are described and analyzed with the aim of pointing out the necessary hypotheses on which the conclusions are based. Mirroring the third paragraph, the fourth describes and analyzes the hypotheses and conclusions derived in the book *Internalising the Social Costs of Transport*, representative of the "present awareness", setting the stage for the fifth paragraph where suggestions for future research patterns are put forward. Specific attention is paid to the problem of earmarking and of the institutional setting. Paragraph six concludes.

2. Characterizing parameters of a rp model: a preliminary description

This paragraph describes the most significant and representative characteristics of a rp model in order to confront them in paragraph 3 and 4.

Pareto optimality

The fundamental parameters to which several others are, in some way, linked is either Pareto optimality of rp implementation *strictu sensu* or the less binding potential Pareto optimality. The potential Pareto improvement criterion, usually applied in the analysis of economic externalities, is solely concerned with efficiency aspects, bypassing equity ones since unresolved interpersonal utility comparisons can be avoided. The Kaldor-Hicks compensation

¹ R.E. Wagner "Tax norms, fiscal reality, and the democratic state." In R.E. Wagner (editor), *User charges and earmarked taxes in principle and practice*, Routledge, London, pp. 10-11 , 1991.

criterion just asks for the potential capability of the gainers to compensate the losers without questioning the need for its actual occurrence. The important thing to them is that society as a whole is potentially in a better position to distribute its own resources. On the other hand, strict Pareto optimality is the discriminating factor in practical policy-making and equity issues which should be considered at least as important as efficiency ones. This last issue is of the utmost importance from the policy-maker's point of view since whereas efficiency is a constraint equity may well be an objective.

First-best versus second-best

Although from a theoretical perspective it has been considered for a long period a first-best solution for tackling congestion under an efficiency point of view there has *de facto* been little public and political support. The standard argument rehearsed since the 1920's is that congestion arises since marginal social costs of road use diverge from private costs. So if the aim is to create the most favorable conditions to get the traffic flows at the levels most beneficial to transport as a whole, we have to make road users to take account of the costs imposed by them on others, in other words we have to internalize the external costs by levying a congestion charge equal to the difference between social and private costs referred to congestion. In a second-best scenario this is not necessarily so simple since relevant changes in the evaluation procedures occur, the efficiency-equity dilemma can no longer be avoided. The optimization process becomes more intricate and the value of the signals provided by the price system outside a first-best world becomes undoubtedly ambiguous.

Short-run versus long run-analysis

Although in the seminal works of Ellet² and Dupuit³ the problem of tolling transport facilities is strictly linked to the problem of investment therefore implicitly adopting a long-run perspective. Some of the more recent literature is not always clear about the time span taken as a reference. More in detail, if one looks at the problem of congestion in a short-run perspective, existing road capacity is taken as given and the issue restricts to the calculation of the net benefit maximizing with respect to the quantity of road use; whereas, from a long run perspective, optimal road capacity and quantity of use are determined simultaneously. As Small⁴ et al. recall: "Road user charges and optimal investment, though often treated separately by policy analysts, are facets of the same problem: both are aimed at minimizing the total costs of building, maintaining, and using a road system. Although investment pertains to the initial design and construction of a road and user charges pertain to ongoing user and maintenance activities, the two are interdependent." This is so true that in the long run one has to consider other elements influencing the level of congestion and the effects of congestion tolls on rates of population growth, income growth and, of course, increases in road capacity over time in

² C. Ellet "A popular exposition of the incorrectness of the tariffs on tolls in use on the public improvements of the United States" *J. Franklin Institute*, vol. 29, pp. 225-232, 1840.

³ J. Dupuit "On tolls and transport charges" reprinted in *International Economic Papers*, (1962) vol. 11, pp. 7-31, 1849.

⁴ K.A. Small. C. Winston, C.A. Evans *Road Work. A New Highway Pricing and Investment Policy*, The Brookings Institution, Washington D.C., p. 9, 1989.

order to estimate, among other things, to what degree does lagged adjustment in the housing sector- a sector complementary with transportation in producing urban output- works as an implicit congestion toll potentially representing a second-best alternative to the toll⁵.

Fixed versus variable value of time

In the early works on congestion, the internalization of the excess time spent on the network was based on the assumption that the value of the marginal unit of time was the same for every journey⁶ whereas, in subsequent works⁷, it has been progressively recognized the inevitable variability of the value of time among travelers and there has been a critical revision of the consequences for the analysis of dropping this assumption. Further research on this issue has showed that the values of time vary widely between users of different transport modes and that the strength of income relationships is mode-dependent. While for low incomes the values are fairly similar for all modes, at higher incomes values for rail and coach users tend to diverge from those of other modes, with urban bus-users showing the lowest variation with income⁸. Further insights into a more accurate evaluation of time can be achieved by expanding the neo-classical model of consumer theory to include the time dimension bridging this theoretical basis with that of discrete choice models, and providing an interesting basis for the empirical measurement of different values of time.

Full information versus imperfect information

Most of the works on the effects of rp do not explicitly mention the quality of information available to the network users; however, the implicit assumption is that perfect information is available to all, since the time/cost minimizing driver hypothesis is usually put forward. What can plausibly be approximately true in the house-to work journeys and in any other recurrent trips is not necessarily true for others. More in detail, one can argue that in absence of full information even though the single traveler is trying to minimize the time allotment dedicated to transport, due to imperfect information, he is not optimizing his position. Some work has recently been conducted on the relative efficiency and the interaction between different information and pricing systems for the regulation of stochastic road traffic congestion⁹. This research endeavors might have particular repercussions on the acceptability of rp since they might contribute to avoid what can be defined “congestion overkill” when a poorly informed user might find himself in the very frustrating situation where he, not being aware of a certain congestion situation in a determined area of the network, involuntarily

⁵ D. Seagal, T.L. Steinmeier “The Incidence of Congestion and Congestion Tolls” *Journal of Urban Economics*, vol. 7, pp. 42-62, 1980.

⁶ A.A. Walters “The theory of measurement of private and social costs of highway congestion” *Econometrica*, vol. 29, pp. 676-699, 1961.

⁷ The path-breaking articles under this respect were: R. Layard “The distributional effects of congestion taxes” *Economica*, vol. 44, pp. 575-581, 1977 and A. Glazer “Congestion tolls and consumer welfare” *Public Finance*, vol. 36, pp. 77-83, 1981.

⁸ MVA *The Value of Travel Time savings*, Policy Journals, Institute of Transport Studies–University of Leeds, Transport Studies Unit–University of Oxford, 1987.

⁹ E. Verhoef, R.H.M. Emmerink, P. Nijkamp, P. Rietveld “Information provision, flat and fine congestion tolling and the efficiency of road usage” *Regional Science and Urban Economics*, vol. 26, pp. 505-529, 1996.

drives into it and not only will suffer an extra time loss due to congestion but will also have to pay for it since he is involuntarily contributing to it.

Charge earmarking

If one can safely assume the earmarking problem, to be, if not totally included in the potential Pareto optimality versus Pareto optimality issue, at least treated under that respect, however it deserves specific mention since it covers a specific role under the distributional side which reverberates on the potential acceptability of the whole maneuver. Since it is almost universally accepted that rp systems provoke undesirable distributional effects, in absence of a redistribution of the resources generated, it becomes of the utmost importance for equity and acceptability purposes to describe, analyze and optimize the resource earmarking process by adopting a critical position in evaluating the institutional environment in which the process takes place. In other words, conscious of the state of affairs one should wonder whether the political process can reasonably be expected to operate not only to impose charges, where they are appropriate, but also if the level of charges imposed will be correct. Once the assumptions on the motivations of public workers are considered to be the same as non-government workers, that is simply welfare maximizing, one realizes that there is a strong case for a government pricing behavior inconsistent with the normative expectations.

Public/private transportation

Another fundamental distinction that characterizes the modeling of rp effects is the hypothesis concerning the presence, status and influence of a public transportation sector. When taking into consideration the public transportation sector one cannot avoid making assumptions on aspects such as cross price elasticities between public and private transportation, effects of induced demand deriving from abandonment of private transportation, adoption of marginal cost pricing in the transport sector, etc. The simultaneous analysis of the private and public transportation sector is as interesting as complicated since it involves various aspects that have both efficiency and equity implications. Transferring a certain percentage of demand from a less (private) to a more (public) efficient mode of transportation might imply net benefits for the society if the allocation of the resources improves. One should compare the larger amount of road space dedicated to public transportation that, in a short-run context, must be subtracted from private use, with the greater efficiency in terms of space used per person transported. On the equity side one has to consider the effects both on the quota of users that were already using public transportation that might be better off if the greater demand for public transportation implies an improved service in terms of frequency, quality of the busses, new lines opened, etc, or else be worse off if public transportation is close to saturation and, in absence of new investments, the newcomers provoke the deterioration of the existing service.

It is most likely that the lower congestion fostered by rp will allow substantial reductions in operating costs for the bus companies since the service provided will be produced at a lower cost, given that less busses and less transport workers will be needed.

Other characterizing features of rp modeling

As pointed out from the outset, there is no aim of completeness or exhaustivity in this listing of rp modeling characterizing features, and therefore the previous description should be looked at as simply reflecting the Author's beliefs concerning the most meaningful parameters to be considered though there are at least four other aspects that deserve a brief description. One is the fixed or stochastic characterization of demand. This aspect involves the introduction of a probabilistic approach into the model but the essence of the results does not necessarily change. A second aspect that is to be taken into account is the network modeling method since it might influence the kind of trade-off between congestion creation and diffusion. In various models congestion is conceived as taking place in a bottleneck situation whereas in others a full network is assumed.

When assuming a long-run perspective, one has necessarily to take into consideration the secondary effects of the toll charging, since the monies levied are either channeled back into the transportation sector at large or, more directly, are used to determine a zero increase in the out-of-pocket money travelers have to pay, the indirect effects are always present. In this case the distinction between short and long-term analysis blurs and the overlapping of the adjustment process with the indirect effects becomes inextricable and both phenomena should be considered simultaneously.

Last but not least, one has to consider the varying effects of the tariff structure and methods of payment. It is widely recognized that different tariff structures -- variable or fixed-- and the methods of payment --pre or post-payment—might have a strong influence both on the perception of a rp scheme as well as on the response to equal charges.

Having chosen and described the characterizing features of a rp scheme I will try to bring to the fore the more relevant differences about the “old beliefs” models and the “present awareness” ones in order to derive some suggestions for the policy-making and to suggest new research along the “future research patterns” that look more promising in terms of better solutions to the congestion problem in accordance both to the economic principle of efficiency as well as to the political one of equity.

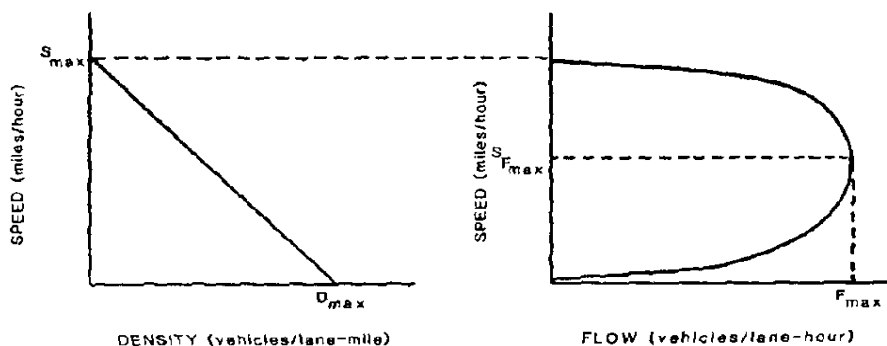
3. Old beliefs

I provide a description of how the fundamental parameters of rp modeling have been treated in the Smeed Report that is largely considered representative of a dated way of conceiving the role of rp. The main belief that imbues the role of rp relates to the necessity of a pricing mechanism to achieve an efficient allocation of road space within the urban context. The statement by William Vickerey summarizes, with words which he wrote almost forty years ago, the mainstream economist's view :”There can be no efficient solution to the urban traffic problem that does not include provision for charges on automobile use that are differentiated according to time of day.”¹⁰

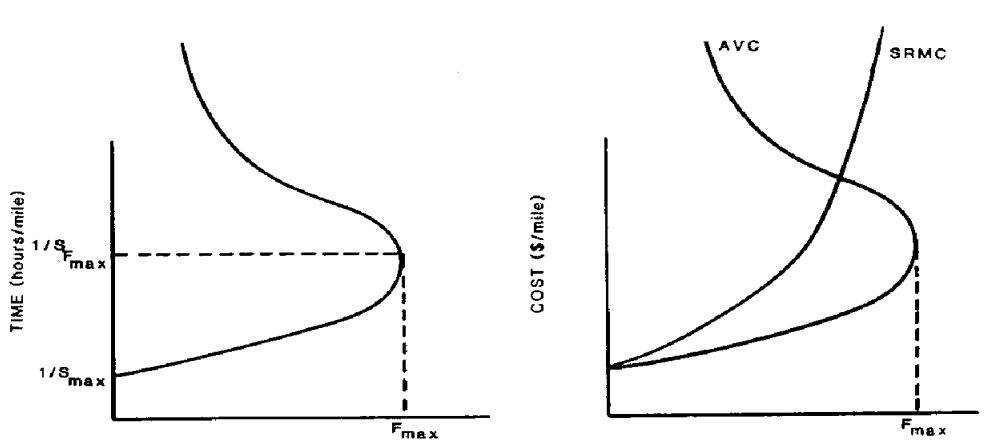
¹⁰W.S. Vickerey “General and specific financing of urban services” in H.G. Schaller (ed.) *Public expenditure decisions in the urban community*, Resources for the Future, Washington D.C., pp. 62-90, 1962.

3.1 How things were supposed to work

The statement by Vickerey represents the general belief that has guided the generation of economists who have adopted the “fundamental diagram of road traffic”¹¹ which relates volume to density showing that as the density of vehicles increases, the speed at which they travel decreases. The subsequent logical step is the derivation of the speed-flow diagram on the basis of the relationship $flow = speed * density$. From the economic point of view the most relevant relationship is that between cost per user and flow (output) since by considering vehicle operating costs variable with speed the most important effect of congestion is the cost attributable to the increased trip times.



Given the value travelers place on time, by inverting the speed-flow relationship, time per mile is obtained and by multiplying time per mile by the value of travel and adding vehicle operating costs we get the average variable cost curve and the short-run marginal cost as time consumed approaches infinity as the flow approaches capacity.



Having stated the technological underpinnings of the cost curves, in the absence of any toll the equilibrium point is determined by the intersection of the AVC and the demand curve at

¹¹ F.A. Haight *Mathematical Theories of Traffic Flow*, Academic Press, New York, p. 72, 1963.

a point that implies an inefficient use of road capacity since any traveler receives a benefit greater than what he directly pays to travel. The basic economic reasoning is that in this situation the extra cost to society, including the costs induced in terms of time losses to the other travelers, are greater than the benefit gained by the additional user. The amount by which the incremental cost differ from the socially optimal one is given by the area delimited by the short-run marginal curve above and the demand curve below. The welfare loss to society is provoked by an excessive use of the road network due to non-optimal pricing. The solution proposed to the problem is to impose a toll, equal to the congestion externality, in order to have equilibrium at the optimal social quantity¹².

This represents in a nutshell the logical construction of the argument in favor of, or one should say, explaining the necessity of a rp scheme, in order to get an efficient production (traffic flow) out of the urban road network, by internalizing the social costs imposed by excessive private transport.

3.2 What were the explicit and implicit assumptions

Even though the description of the various steps that guide us from pointing out the inefficient allocation of urban road infrastructure to charging a toll is linear and, given the assumptions, unexceptionable, one has to meditate on the fact that “The best policy to deal with urban road congestion is likely to be some form of road pricing. However, road pricing is the exception rather than the rule”.¹³ How can this be the dim reality, “As the irresistible force of increasing traffic demand meets the immovable object of fixed road space in urban areas, the benefits to be gained from intervening with congestion pricing grow greater”¹⁴?

If the reasoning is convincing and the logic adopted has no flaws one has to look at the hypotheses, implicit and explicit, chosen and verify if those are sufficiently close to reality to be an appropriate point of departure. Armed with the previously defined model characterizing parameters I will discuss the various assumptions made in the Smeed Report.

The Smeed Report of 1964, is the output of a working group instituted by Ministry of Transportation of the United Kingdom, and was intended as a preliminary analysis to verify the technical possibilities and economic implications of the adoption of a rp scheme. The general hypothesis on which the working group based its activities was that the introduction of prices linked to the use of the road network were to be accompanied by a reduction of equal amount of existing taxation so that car drivers as a group would not end up paying more that they previously did. So even if there is a conscious expectation of some welfare distribution impact there is not a specific mention or interest in its measurement. The fact that some individuals and some companies will inevitably be paying more and other less simply stimulates a recommendation concerning research on this issue to be performed at the same time when implementing any sort of pricing mechanism. Since the problem is acknowledged but with inadequate perception of its real influence on its final acceptance one notices that no distinction

¹² S.A. Morrison “A Survey of road Pricing” *Transportation research*, vol. A, n° 2, pp. 87-97, 1986.

¹³ A.A. Walters “Congestion” in J. Eatwell, M. Milgate, P. Newman (eds.) *The New Palgrave: A Dictionary of Economics*, Macmillan, London, vol.1, pp. 570-573, 1987.

¹⁴ A.W. Evans “Road Congestion Charging: When Is it A Good Policy?” *Journal of Transport Economics and Policy*, vol. 27, n° 2, pp. 209-214, 1992.

is made between potential and actual Pareto improvement since the distributional impact is on average considered small and the two concepts equivalent.

Rp is examined both in a long and short run perspective, since it is expressly mentioned that the demand management to be achieved through it should not be considered an alternative to the construction of new roads but rather an instrument to obtain a more efficient evaluation of the present network and of the roads that are about to be constructed. Rp is conceived to be instrumental to the emergence of the willingness to pay for roads and the influence on the long time changes in land use patterns are not considered even though they are relevant for assessing the overall distributional impacts of the maneuver.

The distributional issue is mentioned but not sufficiently analyzed since it is considered important only on a group level (drivers/non-drivers) and congestion charging effects are assumed to be linked to the expenditure of the resources generated. It is suggested that the resources could be allocated in the following ways: divided between the local and national fiscal levels in order to ameliorate the road network, spent to finance public transportation or simply stored. Even though distributional impact analysis is expected to be one of the most important research themes for the future it is explicitly mentioned that it does not fall within the research boundary of the Report. An explicit mention of the distributional impact is made, at the class level, when stating that car drivers were to benefit from a rp system if the resources obtained from road charging were used to reduce the tax burden of the transport sector.

A fortiori one can say that the earmarking aspect is not sufficiently analyzed even if it is recognized to be important and suggestions on its role are simply defined on a hypothetical basis.

The interaction between congestion charging and private transportation is addressed in connection with monetary evaluation of time. The monetary value attributed by a road user to a trip is the price he/she would be willing to pay to actually make it and the monetary value of the costs caused by other individuals are measured by how much they would be willing to pay to avoid these costs. The level of agreement on this estimation method of monetary values and the comparability of its results substantially depends on the acceptability of the present distribution of income and wealth among the relevant parts involved in the process and of the respect of the marginal pricing principle in the alternative methods of transportation.

No specific mention is made of cross elasticities between different modes. The issue of public transport arises again when considering the benefits related to rp. The reduction of congestion through rp will guarantee for the bus operating company a higher productivity of the bus fleet since the same number of routes will be served with less vehicles and less workers giving rise to both an investment and operational cost saving.

No specific mention is made about assumptions on the first or second best environment. Even though other policy instruments such as parking policies and fuel taxes are evaluated, the full implications of the introduction of a first best instrument in a second best world are not. As it was previously recalled concerning the treatment of public transportation, rp pricing is seen, if not completely, predominantly in isolation and therefore all the problems caused by the subsidization of public transportation and the departure from the application of marginal cost pricing to both sectors are not properly considered.

Similar fate is reserved to the evaluation of time since no explicit mention is made of

the possible problems of the estimation of its value and, more specifically, of the influence of its variability on the outcomes of the implementation of a rp scheme. It is therefore assumed that in absence of any specific mention of the time evaluation its value is considered constant and independent of the context and amount of time saved.

The same can be said about full versus imperfect information context. No mention is made of the question and is therefore assumed that full information characterizes the policy prescriptions put forward in the Report.

Finally as it is for the complementary characteristics of a typical rp scheme one as to evidence that a lot of emphasis is put on the tariff structure and on the methods of payment while practically nothing is said about network modeling if one excludes the necessity expressed for the applicability of the system to a large number of people. Secondary effects and network modeling are not deemed noteworthy. The operational requisites for the implementation of a rp scheme foresee a tariff, on the one hand, strictly correlated to the use made of the road infrastructure resource, therefore variable in different periods of the day, week, year and, in contrast with this, on the other, a tariff that should be stable, easy to be ascertained by road users before starting a trip.

4. Present awareness

In this paragraph a description is provided of how the fundamental parameters of rp modeling have been treated in the work *Internalising the social cost of transport* published in 1994 by the European Conference of Ministers of Transport which may represent, given the Authors' background and the context in which the publication comes to light, the present way of conceiving the internalising process of the social costs of transport. Among the different instruments analysed rp plays a dominant role.

What differentiates from the outset this work from the Smeed Report is not so much the general structure of the argumentation, that can be considered more or less similar in the fundamental parts, but rather the emphasis put on specific issues and the realism of certain assumptions.

One that stands out is that of the environmental costs imposed by road traffic. If there is no doubt that the problem had already been underlined in the Smeed Report, one witnesses a deeper and larger attention paid to the environmental problems caused by road transport such as atmospheric, acoustic pollution, and road accidents.

On the realism of certain assumptions, one has to say that while in the Smeed Report the distributional issue had been evidenced even though left out of the research, in this case it is the core of the debate especially when referring to the issue of social and political acceptability.

4.1 How things are supposed to work

The general model of traffic flow which specifies the congestion problem has substantially remained the same. What has changed is the weight given to the external costs arising from it and to the connected internalisation policies. Quinet rightly recalls that the “.. concept of social cost involves a degree of uncertainty, related to the decision about what constitutes the “zero level” of harmful effects in certain cases, notably for noise and air

pollution”.¹⁵ This specification concerning the extension of the concept of social cost reverberates on the social cost measures expressed in absolute terms or as a percentage of GNP. Quinet concludes that “Knowledge of transport sector social costs, ..., is gradually improving as more and better research is done. The uncertainties that remain have many causes, most of these being related to the difficulty of calculating monetary values in the absence of markets, and to our imperfect understanding of the harmful effects of transport in certain fields..”¹⁶

4.2 What are the explicit and implicit assumptions

Rather than attempting to analyze how the various parameters I intend to give an overall evaluation of the theses proposed and provide detailed accounting of the arguments put forward, when appropriate, to clarify the position supported.

As it is for Pareto optimality, one can safely assert that the policy measures are supposed to produce only potential Pareto improvements since the overall analysis is developed in a second-best world. Glancing at the table of contents one gets an impression of a greater attention paid to various social and political issues that were expressly ignored in the Smeed Report. Where Button provides a wide and well articulated overview of the internalising process of the social costs of road transport, Banister describes the problem of equity and acceptability, while Rothengatter tackles that of the obstacles to the use of economic instruments in transport policy. The economic efficiency that is sought could only come about if property rights were allocated to the resources in question. However, since external effects have different spatial/temporal influences, this has strong consequences on the exercise of the property rights influencing, on the one hand, the non-linearities expressed in the manifestations of the polluting phenomena and, on the other, their practical applicability.

The distributional effects are expressly dealt with in the paper by Banister that opens his reasoning by asserting that :”In all decisions relating to transport there are winners and losers. No policy is neutral in this respect. It can also be argued that the present system is not equitable either. The key questions to be addressed in supporting these statements are concerned with the identification and measurement of the social costs of transport. The second question is to establish who the winners and losers are, and to determine whether the costs/benefits could be attributed more fairly”¹⁷. The issue of equity is divided in three components, interpersonal, interareal and intergenerational equity. The practical implementation issues of a rp scheme and its acceptance induce Banister to conclude: “.. that even though it may be desirable to have clear economic incentives concerning the environmental costs of transport at the macro level, no major policy change is likely because of distributional implications and public reactions which occur at the micro level.”¹⁸

As for earmarking is concerned the positions taken by Button and Banister are

¹⁵ E. Quinet “The social cost of transport: evaluation and links with internalising policies” in ECMT-OECD *Internalising the social costs of Transport*, Paris, p.33, 1994.

¹⁶ *Ibidem*, p. 66.

¹⁷ D. Banister “Equity and Acceptability Questions in Internalising the Social Costs of Transport” in ECMT-OECD *Internalising the social costs of Transport*, Paris, p. 153, 1994.

¹⁸ *Ibidem*, p. 154.

divergent. In contrast to what has been sustained by Small about the capability of redressing the regressive effects through the resources generated,¹⁹ earmarking is considered, by Banister²⁰, necessary but not sufficient to redress the negative distributional impacts of rp. A substantial asymmetry between the visible and concrete additional costs imposed (tariff) and the eventual, not so clear, difficult to communicate and to accomplish, compensating actions do not provide a sufficient argument for ensuring fiscal neutrality. The earmarking issue becomes particularly relevant when, as underlined by some scholars²¹, there is a substantial fear on the policy-makers' side about the possible adverse distributional implications since it could be perceived as a substantial financial burden on the poorer sections of society. Button, on the other hand, recalls that even if the fear of regressive effects is not groundless, however the thesis put forward by Small is well founded. Button concludes that "While hypothecation of revenues from emissions charges may, for example, not conform to all theories of public finance, some degree of ear-marking may well be a necessary in concomitance to the initiation of such measures."²²

Even though the question of time is not expressly addressed, time is assumed to have different values for the different social groups. In fact Banister, while discussing the distributional impact of rp schemes, assumes that the regressive impact will be strong if some actions are not taken to strengthen public transport which, being of lower quality compared to private transportation, is used by low income classes.

The key role of public transportation in determining the impact of rp schemes is widely debated by Banister who, among the seven different strategies a household can adopt to meet rp charges places, at the first place "Switch mode from private car to public transport"²³ giving rise to a reduction in car travel. If we consider transportation a merit good, a public decision is needed on which is the most convenient way through which the service should be made available to those who need it. The final effect will be influenced by the presence of suitable public transport services. The implementation of rp schemes cannot but consider the implications an insufficient public transport network might have on its distributional effects. The subsidisation of public transport may then seem appropriate to take care of the problem even if this represents a generalised strategy.

Information is not treated as a specific issue and it is implicitly assumed to be uniformly distributed. All the drivers have a perfect information about the status of the network and if someone ends up stuck into a traffic jam it could be assumed that he has done that on purpose. This is very important since, as we will see, the nature of the tariff imposed has always to have

¹⁹ See K.A. Small "Using the revenues from congestion pricing" *Transportation*, 19, pp. 359-381, 1992 and G. Giuliano "An assessment of the political acceptability of congestion pricing" *Transportation*, 19, pp. 225-358, 1992.

²⁰ D. Banister, cit., p. 154, 1994.

²¹ See B.S. Frey, F. Schneider and W.W. Pommerehne "Economists' opinions on environmental policy instruments: analysis of a survey" *Journal of Environmental Economics and Management*, 12, pp. 62-71, 1985 and M.S. Common "The Choice of Pollution Control Instruments: Why Is So Little Notice Taken of Economists' Recommendations?" *Environment and Planning*, 21A, pp. 1297-1314, 1990.

²² K. Button "Overview of Internalising the Social Costs of Transport" in ECMT-OECD *Internalising the social costs of Transport*, Paris, p. 28, 1994.

²³ D. Banister, cit., p. 162, 1994.

a deterring and redirecting flavour and never a punishing one. Consider what might be the reaction of a driver that unintentionally ends up into a traffic jam and, on top of that, gets taxed because he's increasing congestion. The perfect, or nearly perfect, information assumption can be reasonably made for the home-work trips that make up for the great majority of congesting phenomena but does not hold for all the trips made.

The tariff structure and the method of payment issues are not expressly analysed, except when Rothengatter²⁴ recalls that "Flexible pricing strategies according to the elasticities of demand, for instance, help to divert traffic to less congested time periods, routes and modes, ..". The structure of the tariff should be variable and closely related to the external cost provoked by the action taken.

The network is modelled in a realistic way and the secondary effects are not taken into consideration as influencing the final effects provoked by rp schemes.

5. Future research patterns

Referring to the recent literature, some suggestions are in order to indicate future research patterns and to foster a wide acceptance of rp as an instrument of demand management. The path to rp implementation is presumably still quite long since the cultural revolution needed to move people from private to public transport in densely populated areas thus transforming the more basic conception of transport services has not materialized yet. Under this respect the statement Button makes concerning the important roles education and information play in changing public attitudes²⁵ is self-evident.

Two broad considerations, in a sense comprehending all the following ones, concern the need for a more empirical approach to the study of rp and consequently the strengthening of the local level approach.

Even though the debate in the literature is still somehow heated the implementation of rp schemes will ultimately depend on the answers to empirical questions such as: how many people will oppose the action, what are the realistic alternatives to public transportation, is compensation of those who lose from rp implementation feasible, etc..

Increasing economic and financial integration among different countries makes international coordination of economic policies in general, and of environmental policies especially, particularly acute, when an equal level of competitiveness of the firms located in the various states is considered desirable. However, rp represents a peculiar instrument that can be justifiable and desirable only in specific conditions (high congestion) that are not necessarily present in all the cities in the same manner. The level of problem perception is strictly linked to the spatial characteristics of the city involved and so is the type of solutions proposed. The intervention approach has to consider the local context more than the national one unless all the State is uniformly subject to the congestion problem (Singapore is an example) since the effects which the instrument will provoke are local and so should be the policy-making level.

²⁴ W. Rothengatter "Obstacles to the use of economic instruments in transport policy" in ECMT-OECD *Internalising the social costs of Transport*, Paris, pp. 113-151, 1994.

²⁵ K. Button, cit., p. 28, 1994.

5.1 Feasibility and social acceptability

The actual theory about rp is accepted and the divergences in the literature concerning the desirability of the implementation of rp schemes revolve around empirical problems such as: distributional effects, earmarking of the resources, methods of payment, etc. A recent article “The Social Feasibility of Road Pricing”²⁶ may be a good departing point for the analysis of the practical issues to be considered when inquiring the acceptability and feasibility of rp. Although the optimal congestion charge, allowing all drivers have identical valuation of all economic variables except for the marginal willingness to pay for making a trip, will ensure a potential Pareto improvement since only the Regulator will be in a better situation and everybody else will be worse off if there is no redistribution of the resources collected. There is evidence in the literature that, given these assumptions, negative redistributive effects may be greater than the efficiency gains attainable²⁷. However these conclusions rest heavily on the assumptions made concerning the identical evaluation of the economic variables like, for example, time and money. These assumptions are quite strong when considering income and value of time that may well, or surely will, be different among drivers. If non intervention is taken as a benchmark two considerations are in order: intervention being regressive, deteriorates the conditions of the poor, on the other hand, one has to wonder whether “the progressive incidence of welfare losses from unregulated congestion provides a sound basis for leaving this inefficiency in existence”²⁸. Given these premises, that lead to assume that congestion charging can be mostly beneficial for those drivers that have a high marginal utility of time and a low marginal utility of income, the study by Verhoef, Nijkamp and Rietveld investigates “the factors that determine the respondents’ opinions on road pricing”²⁹ The results of the study are that there is a potential social desirability for rp based on the gains drivers obtain in terms of reduced travel times even though they result somewhat reluctant to pay for the morning commute to work. A recursive analysis has brought to light that the most important elements in determining the responses are the financial transfers associated to rp and consequently its redistributive impacts. The responses have been various and among the most frequent one recalls: rescheduling, new job and residence search in the long run, increase use of public transport when and where available, carpooling and trip abandonment too. Even if these responses do not allow for quantified demand elasticities it is reasonable to assume that the influence of rp could be substantial.

5.2 Simultaneous cost internalisation

Another important attempt that has been made in the ECMT-OECD book is that of

²⁶ E.T. Verhoef, P. Nijkamp and P. Rietveld “The Social Feasibility of Road Pricing. A Case Study for the Randstad Area ” *Journal of Transport Economics and Policy*, pp. 255-276, September 1997.

²⁷D. Seagal and T.L. Steinmeier “The location tax as an alternative to the congestion toll”, Urban Planning Policy Analysis and Administration, Discussion Paper D77-1, Harvard Department of City and Regional Planning, 1977 and S.F. Borins, “Electronic road pricing: an idea whose time may never come” *Transportation Research*, 22(A), pp. 37-44, 1988.

A.W.Evans “Road Congestion Pricing: When Is It a Good Policy?” *Journal of Transport Economics and Policy*, 26, pp. 213-243, 1992.

²⁸ E.T. Verhoef, P. Nijkamp and P. Rietveld, cit., p. 256, September 1997.

²⁹ *Ibidem*, p. 258.

considering rp effects on various external congestion costs simultaneously. This approach is quite innovative since it introduces the issue of cost correlation induced by congestion. Historically rp has been conceived as an instrument to tackle the problem of congestion alone. However, excessive road use, especially in urban environments, induces several other costs among which one can recall increased fuel consumption, greater polluting emissions, atmospheric and acoustic, accidents and visual intrusion. The interrelations among the various forms of external costs and their correlation with traffic congestion has not been sufficiently analyzed probably due to the difficulty in quantifying them and in understanding their reciprocal influences³⁰. One of the debated problems is, for example, that even if congestion provokes a larger number of accidents, their relative cost can be assumed to be lower than average due to the reduced speeds so to make controversial the final evaluation of its impact on society. Johansson³¹ makes an interesting attempt along the alley of the simultaneous internalization considering time losses along with fuel consumption and emissions, even though he explicitly ignores distributional and uncertainty considerations. Speed is considered the fundamental interconnection among these three external costs and his work aims at estimating the level of charges that should be imposed in order to achieve an optimum level of external costs. He concludes that “.. indirect external effects of transportation may constitute important non-negligible elements in an optimal pricing schedule”³² and demonstrates, explicitly underlying the highly stylized characteristics of the theoretical model used, that the optimal road charge can be defined as a function of the current speed rather than as a function of the traffic flow.

5.3 Behavioral assumptions

If the problem of congestion is widely viewed as one of, or even, the most important issue in metropolitan areas, and substantial research endeavors have been conducted on how to cope with congestion no viable solution is in sight. The large literature on the subject has predominantly assumed a specific set of behavioral assumptions about responses to policy measures, such as the effect of changes in the level of service or pricing on mode choice, which do not consider the range of the possible adaptation strategies.

However, individual's views and responses on efforts aimed at reducing congestion can be quite different from policy-makers' and planners' ones so that the internalising process can ultimately be thwarted. The policy-makers can gain a lot by comprehending how road users, specifically, and transport “consumers”, at large, view the situation they are confronted with. Novaco, Stokols and Milanese³³ state that :”Individuals pay for congestion in terms of out-of-

³⁰ These considerations are confirmed by the work of Quinet (see E. Quinet, cit., 1994) where a good survey of the different studies performed to quantify the various external costs is reported. The attempts made in the quantification of the external costs of road transport are always aimed at single forms of costs and results are reported on the studies dealing with the quantification of the interrelation among them.

³¹ O. Johansson “Optimal Road-Pricing: Simultaneous Treatment of Time Losses, Increased Fuel Consumption, and Emissions” *Transportation Research*, vol. 2, n° 2, pp. 77-87, 1997.

³² O. Johansson, cit., p. 86, 1997.

³³ R.W. Novaco, D. Stokols and L. Milanese “Objective and Subjective dimensions of travel impedance as determinants of commuting stress” *American journal of Community Psychology*, vol. 18, n° 2, pp.231-257, 1990.

pocket costs, loss of time and some additional maintenance costs resulting from slow 'stop-and-go' traffic conditions. Among the non monetary costs are stress, a need to coordinate activities and, possibly, some health effects". It is often assumed that individuals will act according to a superior law of social welfare whereas it should be clear that individuals will react in a way that, given the constraints, will best suit them. Therefore only by acquiring a deeper knowledge of the people's travelling decision process one will be able to field policies capable of producing the desired results. Different approaches to tackling congestion have been adopted throughout the years and, if an increase in the infrastructure was considered necessary in the sixties, later on the stress was on improving the management of the available infrastructure, and subsequently in the late seventies transport systems management, aimed at the reduction of drive-alone attitudes, were considered necessary. It is now believed that the inevitable next step must be altering human behavior when confronted with congestion. The relevance of the behavioral test, aimed at forecasting whether or not the measure about to be implemented will act in the desired action, is assuming a new and more important role. Salomon and Mokhtarian underline that "The assumptions that are (often implicitly) incorporated into congestion-mitigating policies seem to be part of the reasons for the relative lack of success in reducing congestion. The following assumptions seem to be particularly incongruent with current understanding of travel behavior: 1. Assuming fixed travel demand and ignoring the possible materialization of latent demand; 2. Assuming that the travelers are cost minimizers rather than utility maximizers; 3. Assuming that only a limited choice set is available to the individual, and consequently that the addition of an option is likely to have a significant effect, and; 4. Assuming that responses to demand-management techniques are similar to those of supply side measures."³⁴ Growing transportation costs are imposed by rising levels of congestion therefore stimulating various forms of response. The key to effective policy-making derives from the understanding of the response mechanism which is often complicated and cumbersome. Future research in this direction will have to investigate with deeper attention the implications of the dynamics of the decision process as well as the incidence of costs and benefits of behavioral adjustments.

5.4 Information and pricing interaction

Another research vein that will presumably have great relevance in the near future is the one investigating the possible interaction of road information systems and pricing schemes. As it has been previously mentioned, rp schemes got to be perceived only as traffic redirecting and reducing instruments and never as traffic "punishing". The distinction may seem subtle but it is extremely relevant if one considers the different reactions drivers might have. If the driver is well informed and willingly decides to take, for example, a shorter but probably congested route will perceive the tariff as a traffic reducing inducement to him as to everybody else, whereas on the other hand, if he/she unexpectedly ends up into a traffic jam he/she will feel that he/she is not only paying in terms of time lost but, on top of that, he/she is unjustly punished by being subjected to a tariff. The reactions and the willingness to lobby against the implementation of the pricing scheme in this second case would probably be much stronger

³⁴ I. Salomon and P.L. Mokhtarian "Coping with congestion: understanding the gap between policy assumptions and behavior" *Transportation Research-D*, vol. 2, n° 2, pp.107-123, 1997, in part p.109.

than in the first one. Verhoef, Emmerink, Nijkamp and Rietveld in a work on this issue remind that :”As is the case for any market, efficient pricing of road usage only yields its desired optimal effects if individual choices are based on perfect knowledge of the prevailing price and quality of the ‘good’ to be purchased”³⁵.

The second best alternatives to rp, such as parking policies, fuel tax differentiation, and so on, even though have obtained great attention, cannot achieve an appropriate tariff discrimination, that is needed to induce an optimizing behavior, when the people it is aimed at have different marginal utilities of time and income just to cite the two most relevant differences that might occur. If the literature has so far addressed the issue of information provision and congestion charging as separate issues, it is time to consider the possible interactions among these two forms of demand management, especially since technological evolutions for the implementation of both actions seem to converge quite quickly. Once you know how much congestion is located around a specific vehicle and you are able to charge a on-board-unit a tariff in real time you would be almost simultaneously able to give the driver detailed information concerning the general status of congestion around him. The relevance of these interactions between information diffusion and road charging is confirmed by the conclusions of a more recent work by Emmerink, Verhoef, Nijkamp and Rietveld³⁶ where the welfare effects of various kinds of information (perfect, imperfect and no-information) dissemination on two groups of drivers (informed and uninformed) are examined. Given the assumption of linear link travel cost and demand together with that of the homogeneity of travelers except for their willingness to pay to make a trip, these scholars conclude that the provision of either perfect or imperfect information guarantee strict Pareto improvements.

6. Conclusions

In this paper I have tried to trace the evolution of both the academic and political-making understanding and use of rp as an instrument of congestion calming and traffic management taking the Smeed Report as a starting point and confronting it with the ECMT-OECD report on *Internalizing the social cost of transport*.

The conception of the role of rp have changed quite substantially as the paper has shown, however, given the limited implementation of rp schemes, some specific research issues have been suggested in order to achieve a greater social acceptability of the instrument. Among the most promising research fields I recall: education and changing of public attitudes towards pricing mechanisms, analysis of people’s responses to rp and of rp models behavioral assumptions, analysis of external costs interactions and their charging, rp and road information systems correlation, and international cooperation.

The mistrust policy-makers demonstrate in adopting potentially regressive rp schemes is not only well founded on purely electoralistic grounds but also has a deeper economic justification. It has for long been assumed that cost-benefit analysis should be simply dealing with adding up the total money costs and benefits regardless of whom receives them.

³⁵ E.T. Verhoef, R.H.M. Emmerink, P. Nijkamp and P. Rietveld, cit., p. 507, 1996.

³⁶ R.H.M. Emmerink, E.T. Verhoef, P. Nijkamp and P. Rietveld ”Information policy in road transport with elastic demand: Some welfare economic considerations” *European Economic Review*, vol. 42, pp. 71-95, 1998.

Harberger³⁷, with reference to this aspect, argued that it could be considered one of the “three basic postulates” of applied welfare economics. However, even if one accepts the compensation test as a criterion for measuring welfare change, it has been demonstrated that not only the summation of total money gains and losses does not, in general, provide sufficient evidence for passing these tests, since positive net money gains may be observed even when compensation is not possible, and yet politically legitimate, but the opposite might happen too. The question therefore inevitably becomes one of incorporating interpersonal comparisons concerning the marginal utility of incomes of various groups into the policy decision process, “... the justification for ignoring the distribution of gains and losses cannot be based on hypothetical compensation as a welfare criterion”³⁸. The final decision concerning the distributional weights lies in the hand of the politician after the economist has produced the effects of alternative sets of distributive weights proposed by the politician.

Given these considerations, the efficiency-equity trade-off becomes an even more complicated problem. This is even more so if we analyze this issue with the tools of microeconomics from a general equilibrium point of view and introducing a distinctive flavour of second-best modeling. The greatest challenge second-best modeling has brought to the first-best conception, within the standard neoclassical tradition, concerns the essence of welfare economics i.e. its first and second theorems. The separation between efficiency, requiring that agents’ plans are coordinated in a market-like manner, and equity, reached through income transfers, allowing a separation between the final distribution of welfare from the distribution associated to the ex-ante distribution of endowments and rights and the ex-post price structure, is no longer possible. One can mention several reasons why this cannot be considered acceptable and realistic, but among them the most relevant, for our purposes, are: “limited commitment and the losses due to time inconsistencies”³⁹ as stressed in the macroeconomic literature when describing the inability of Government to commit to policies, and bureaucratic or political failures. These considerations lead us to a further one concerning the fundamental assumptions of societal rule-making and the political structure of the economy. The political structure of the economy in the neoclassical interpretation stems from three basic assumptions that can be summarized as follows: neutrality of property assignments, irrelevance of command and control, efficiency of market exchange which, taken together imply a conceptual separation of distributional, political and allocational concerns. However it can be demonstrated that the neoclassical model can only produce the expected results when there is agreement between the parties concerning the relevant property rights and when this agreement can be costlessly enforced. These assumptions hardly adapt to the congestion problem especially if one considers the high transaction costs one would incur in organizing a market for the exchange of rights to travel in different roads in various times of the day. Abba

³⁷ C. Harberger “Three Basic Postulates for Applied Welfare Economics: An Interpretative Essay” *Journal of Economic Literature*, vol. 9, pp. 785-797, September 1971.

³⁸ R.W. Boadway “The Welfare Foundations of Cost-Benefit Analysis” *The Economic Journal*, pp. 926-939, 1974.

³⁹ R. Guesnerie “The genealogy of modern theoretical public economics: From first best to second best” *European Economic Review*, vol. 39, pp. 353-381, 1995.

Lerner⁴⁰ has observed that, as it seems to be for neoclassical economics :”An economic transaction is a solved political problem”.

⁴⁰ A. Lerner “Th economics and Politics of Consumer Sovereignty” *American Economic Review*, vol. 62, pp. 258-262, May 1972.

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