Urban Travel - Intra or inter - Modal Competition?

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ABSTRACT

1. The concrete problems of urban travel have led certain countries to introduce the deregulation of public transport. The recent advances in economic analysis (e.g. the theory of contestable markets) have no doubt got something to do with these policies. There is no doubt that these analyses are relevant, and they show interesting openings for research into a greater efficiency in public services, and therefore urban public transport. But we believe that they turn their back on an essential and prerequisite question - that of the organisation of the competition between individual transport and public transport.

2. Specially in urban areas, it is today pertinent to situate the question of the competition between the private car and public transport with relation to pricing. In France, decades of policies strongly influenced by the choice of the automobile, have eluded this problem which is one of the principal preoccupations of researchers and deciders. The interrogations have largely been centred on the urban growth of transport supply with the very legitimate aim of sticking closer to demand. However, if pricing is not taken into account, along with the phenomena of subsidies which often accompany it, the configuration of the supply systems is oriented. Through its action on demand, pricing acts on supply by improving or deteriorating the perspectives for profitability. " Snowball " effects can then mean that a slight under-pricing leads to the domination of one particular mode of transport. These effects have notably been brought to light by certain analyses in recent network economics.

3. In order to illustrate this analysis, we use the example of the city of LYONS (France) to show that there is a certain under-pricing of automobile travel. This presentation is based on a detailed analysis of the automobile externalities, its costs of use, and the receipts which public authorities get from it. Secondly, we go on to study a certain number of urban travel policies carried out in Europe (France, Great Britain, Switzerland, Italy) and are thus able to illustrate this " snowball effects ". On the other hand, in the cities, notably in Switzerland, where the supply has been contained, this supremacy has been considerably tempered. Once again, the volontarist action on public transport has not been sufficient to reduce the use of automobile, as can be observed in France.

INTRODUCTION

1. The transport problems in urban centres invite us to examine all the recent contributions of economic theory (Lorenzi, 1994). The deregulation or privatization of urban public transport in certain countries has, for example, been inspired by the theory of contestable markets. Interesting as they may be, we believe that these solutions are not able to deal with the problem as a whole. Apart from anything else, they come up against the limits of those sunk costs particularly for certain segments of public transport supply (heavy in situ proprio mode).

2. It is then necessary to underline the system dimension of urban travel. Within this system, there is a real competition between the automobile and public transport. A very considerable number of difficulties, such as congestion, environment, and to a certain extent the drift in the costs of public transport, derive from the poor regulation of this competition. This paper deals with this central issue.

3. Firstly, thanks to developments in network economics, we will illustrate some of the elements of the logics which are at work in transport systems (I). These analyses suggest that even minor changes in policy can lead, through network and system effects, to a considerable modification in the competition between transport modes. We then try to assess the under-pricing of the private automobile in urban area (II). Other aspects of urban travel policy are relative to the developments in supply. Using certain key indicators, we analyse the comparative effects of certain urban travel policies developed in Europe (III).

THE SYSTEM DIMENSION OF URBAN TRAVEL

NETWORK EXTERNALITIES AND NETWORK PRODUCT

4. In the sense of network economics, the network product is a product for which " the satisfaction of the user or consumer is linked to the larger or smaller number of other users " (Lorenzi, 1994). We can also speak of products with demand externalities. Since the utility of the product increases with the number of users, the cost or the private advantage of the additional user (supposedly reflected by market interactions, like the price) is different from its social cost or advantage. There are numerous examples notably in the field of telecommunications (telephone, Minitel, or more recently, Internet).

5. The network product examples are no doubt very variable. There is, however, a general principle which is the association between the infrastructures with public product properties (supply and/or demand indivisibility) and one or more complementary products, often depending on a competitive supply. The network

product then refers back to a composite whole made up of products in a situation of strict complementarity, each of them being able to depend on different allocation logics. The network can, however, be understood from the dominant product in the chain of complementarities. Another important point has been brought out. By the biais of the public goods, the network products often call upon the intervention of Public Authorities. They can then be integrated into policies which characterize the fields which they cover. Since the Public Authorities are responsible for the supply of some public product, they can thus follow the macro-economic objectives which lie outside these fields.

6. It must also be noted that the analysis of network products cannot be fundamentally distinguished from the use of the traditional concepts of public economics. It has recourse to the notion of externalities, but instead of calling upon the negative externalities (such as congestion), it throws light upon the product whose characteristic is to produce positive externalities. We can therefore easily believe that for some very high levels of consumption, congestion can become more important than the positive demand externalities.

7. But the network can also be defined by positive supply externalities, referred to as indirect demand externalities. This is the case, for example, of the automobile, which, from this point of view at least, can be considered as a network product. For instance, the generalization of a make of automobile allows the consumer to find spare parts and competent sole agents more easily, when he needs to have his automobile repaired (Perrot, 1994). More generally, considering the probable properties of car manufacturing (the highly oligopolistic activity could point to a form of scale economies), the generalization of the good has enabled high gains in productivity to be obtained, partially for the benefit of the consumer. Thus, the positive supply externalities, or again indirect demand externalities, originate in the adaptations of the supply system which intervene in reaction to the increasing demand of the network product.

8. It is therefore this principle of positive supply externalities which is at the origin of the idea of an automobile network product. Direct demand externalities are rarer and somewhat negative (congestion of the road infrastructures). For G. Dupuy (1975), the generalization of automobile can essentially be explained by the fall in the prices of the second-hand market and the development of credit sales. In the light of these few notions on network economics, the fall in the price of second-hand automobiles can be analysed as one of the rare demand externalities linked to the automobile network product, and the development of credit can be seen as a supply externality (in this example we can see that the supply system linked to the network product is to be taken in its widest acceptation).

SYSTEM EFFECTS

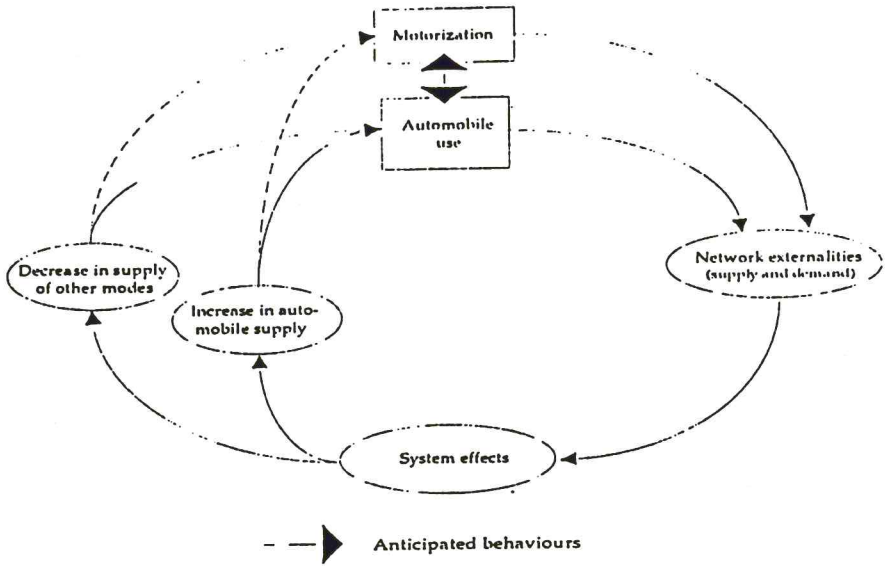
9. A system can be made up of several network products in a substitution relationship. As far as transport is concerned, specially in the urban areas, the supply externalities, if not demand, inside the automobile mode, have considerably transformed the conditions of attractiveness of the competitive modes, and then the demand on these other segments. As a consequence, the conditions of profitability for supply (operating of the transport services, profitability for the infrastructure investments, if not indeed the manufacture of rolling stock) have been affected. On the other hand, the profitability of product and services linked to the automobile network product has been improved. It is no doubt difficult to designate the processes described above using the terminology of externalities, even if it is probable that they have been reinforced by interactions depending on such an analysis (for example, the congestion externality of the automobile on public transport). On the other hand, it is possible to refer to these processes as (supply) system effects.

10. In France, these system effects are also at the origin of the progressive domination of the automobile mode in urban travel. In the nineteen fifties and sixties, the urban travel policies were highly oriented towards the use of automobile, and were accompanied by a progressive regression in the supply of public transport (fall in the service level, in investment, if not indeed de-investment). While the gains in productivity in the automobile industry generated either decreases in prices, or quality improvements, we can legitimately presume that the rarefying of the transport supply in the other modes encouraged the possessing and use of the automobile.

NETWORK EXTERNALITIES, SYSTEM EFFECTS AND SUPPLY POLICIES

11. Network externalities and system effects can then lead to snowball effects (Perrot, 1994), all the more so as these cumulative processes can be reinforced by anticipations on the future development of technologies. This aspect is linked to the high level of irreversibility imposed in the choice of technology. This leads consumers to make decisions with reference to the way they anticipate the future expansion of the network.

12. By underlining these cumulative phenomena, we can better perceive the importance which supply policies can have on the development of the transport modes. They do not only act directly by modifying the comparative costs and the utility which the users give to each mode of transport, but they provide the signals to users. Figure 1 illustrates this phenomenon using the example of the automobile generalization.



13. These developments lead us to examine two aspects of supply policies in the field of urban travel: on the one hand, pricing, and on the other hand, the developments of physical supply. These two aspects are in actual fact linked. For example a considerable development in road infrastructures could under certain condition be seen as a mean to subsidize individual mobility. Firstly, we will try to assess the under-pricing of automobile. Such a situation would be liable to amplify the snowball effects already mentioned. Secondly, we will try to look for some illustrations of these snowball effects thanks to a comparative analysis of several urban travel policies across Europe.

EVALUATION OF PRICING OF THE AUTOMOBILE IN URBAN AREAS

FIELD AND METHOD OF EVALUATION

The Price Standard

14. The notion of price, a fortiori the notion of the real price, is by no means clear. We will use the micro-economic theory of prices, in its first best traditional version, and taking into account its extensions to an economy with externalities. We believe that this is the only operative theory to answer the question. A part from the question of its theoretical relevancy, which we will not go into here, the price standard takes into account the costs, notably the external costs, for which there may be considerable disparities between the automobile and public transport, which may indeed reflect certain interactions between the two modes. Such disparities and interaction must then be taken into consideration in the framework of system competition and appear in the prices. Our evaluation will therefore be based on the marginal social cost principle.

15. The evaluation does not take parking into consideration. Within the framework of system competition, such a parti-pris is not satisfactory, (there is a

considerable disparity between the automobile and public transport). However, this is a methodological necessity which results from time and data constraints (notably the calculation of the opportunity cost for the space immobilized by parking is difficult). Furthermore, we wish to offer a low assessment of the under-pricing of individual travel, if such should turn out to be the case. We can then think that the fact of not taking parking into account conforms with this perspective. The valorizing of an opportunity cost for parking space would probably lead to overall costs which would be higher than overall receipts. This would amplify the under-pricing.

What travel?

16. The field of investigation is car travel in urban areas. Our evaluation is then founded on five methodological principles.
1 - The territory is the Lyons conurbation (as defined by the CO.UR.LY. - Communauté Urbaine de Lyon), which is France's second conurbation by size (over 1 million inhabitants), after Paris.
2. The time base is one year (1990).
3. Traffic and energy consumption are the principal material for this evaluation. This data was obtained from a study carried out by EUROPLAN (1992), for the COURLY, for The European Commission (DG VII), and for Rhônalpénergie. As far as traffic is concerned, this study uses data from a traffic assignment model, called DAVIS, developed by INRETS (Institut National de la Recherche sur les Transports et leur Sécurité - French National Institute for Research on Transport and Safety). The traffic data has been rectified so as to include transit traffic and traffic on secondary roads, both of which the DAVIS model does not account for. The EUROPLAN study uses the work of INRETS to calculate energy consumption.
4. The travel considered goes somewhat outside the field of investigation mentioned above. It may include some movements of goods, as a result of the taking into account of the Light Product Vehicle Traffic - marginal as it may be.
5. The price standard leads to the distinguishing of peak and off-peak periods. The use of the DAVIS model imposes a dividing up of traffic according to this distinction, which is nonetheless imperfect. Urban travel during off-peak periods is obtained thanks to a matrix adjusted on peak hour and rectified (but with the maintenance of origins/destinations of peak hour). This is a limit imposed by the data available.

Evaluation of costs

17. In agreement with our price standard, the notion of marginal social cost takes the following components into account:
1. The cost of maintaining the quality of the service rendered by the road network (the construction of the infrastructures is not paid for by the user but

the financing comes from taxation *. It covers: maintenance, minor road-works, operating costs linked to traffic, notably civil service, including the police.
2. The environmental cost: noise, pollution (local, regional and greenhouse effect), insecurity (cost assessment of the dead person, or the injured person; material and corporal damage not compensated for by private insurance).
3. The cost of congestion imputed to public transport (loss of time suffered by users and extra operating cost due to congestion).
4. The cost of private automobile congestion (losses of time suffered by users of private automobiles). The valorization of this cost of congestion is, however, founded on the investment expenditure which it would be necessary to program to maintain fluid traffic. We can in fact show mathematically that, in the hypothesis of an optimal investment program, there is an analogy between, on the one hand, the marginal cost of congestion measured through the loss of quality (here the value of the time lost by other users), and, on the other hand, the marginal cost of production of the infrastructure in order to maintain a constant quality of service. The hypothesis of an optimal investment program is highly theoretical. But the idea of valorizing the cost of congestion through the expenditure which would be necessary for the infrastructures is empirically interesting. We know that congestion maintains pressure on the development of road supply.

18. The marginal reasoning is translated by using assessment of the unit costs per vehicle-kilometre (VK), evaluated according to the mean cost method, but by modifying them according to the distinction between off-peak and peak hours. This distinction can have two consequences:
- either the disappearance, at off-peak hours, of some of the above components of the social cost (e.g. the cost of congestion),
- or the valorizations which are different from the off-peak to the peak hours, such as, for example, the environmental costs. Concerning noise and insecurity we supposed compensated effects ¤ . Unit costs have therefore been retained as being unvarying. As far as pollution is concerned, the theoretical hypothesis considers that the marginal cost is higher at peak-hour, because of the increase in consumption and emission which is on a par with the decrease in speed. However, the confrontation to empirical data furnished by the DAVIS model leads us to abandon theses hypotheses.

19. Mean costs which vary with the distinction between peak and off-peak hours only grossly reflect the evaluation of a marginal social cost. But from the data available, only the mean costs can be known today.

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* (except for the cost of congestion, Cf. this component of the marginal social cost below)

¤ (e.g. for insecurity, the higher level of accidents in a congested situation can be compensated for by their lesser degree of seriousness. On these questions, however, empirical studies are not available to support the theoretical hypotheses)

20. Principally because of the different methodologies in the estimations of the environmental externalities, it is necessary to envisage several evaluation scenarii. We will propose four - two of which we will refer to as minimalist; the other two belong to a durable development approach:

- minimalist approach 1 tallies with unitary cost estimations amongst the lowest to be found in the literature in France, and which come from various sources. Crozet et al. (1992), notably, restate the cost brackets and make a certain number of these low estimations available to us. As far as the cost of private automobile congestion is concerned, however, we have rectified the estimation so as to take into account only travel (or VK) to which such a cost may be imputed (peak hour). This principle is maintained for the four scenarii,
- minimalist approach 2 retains the estimations resulting from a transport accounting study, already updated over a certain number of years, in the Ile-de-France region (Greater Paris conurbation). Certain components of the social cost not being valorized, we therefore retain those of minimalist scenario 1,
- the European and Swedish scenarii are principally different from these two by higher assessments of the harmful effects of pollution and the updating of the costs of insecurity (newly proposed standards which could well be adopted in the near future in France, notably for the evaluations of transport investments). The European scenario considers the pollution standards proposed by the European Community, specially for the 30 ECU tax per tonne of CO2 emitted. The Swedish scenario retains the taxes introduced in Sweden for various emissions. These various scenarii are presented in Table 1 below.

Table 1: UNIT COSTS ACCORDING TO THE DIFFERENT SCENARII

Components of the marginal socia cost *(in 1990 FFR per VK)*	Minimalist Scenarii		Durable Development Scenarii	
	Minimalist 1	Greater Paris accounting study	European Scenario	Swedish Scenario
Invariable off-peak/peak hours				
Roadway quality	0,13[2]	0,1281	0,13[2]	0,13[2]
Noise	0.0067[3]	0,091	0,091	0,091
Insecurity	0.0352[4]	0,0352[4]	0,1075[5]	0,1075[5]
Pollution	0,12[6]	0,091	European standard[7]	Swedish standard[7]
Variables peak hours only				
Private automobile congestion	0,3005[8]	0,3005[8]	0,3005[8]	0,3005[8]
Public Transport congestion	0,13[9]	0,0851	0,13[9]	0.13[9]

1 After RATP-STP (1992).
2 After The Nation's Transport Accounts (INSEE-OEST).
3 After Crozet *et al.* (1994).
4 After Crozet *et al.* (1994). Very low standards (e.g. 1.86 million FFR for the human value).
5 After Crozet *et al.* (1994). Higher standards (e.g. 3.26 million FFR for the human value).
6 After Crozet *et al.* (1994).
7 They are proposed in FFR per gramme for the various types of pollutants.
8 18 billion francs considered as the annual expenditure in order to maintain urban traffic fluid (expenditure recommended in the 11th plan - see COMMISSARIAT GENERAL DU PLAN (1993) -applied only to VK in situation of congestion.
9 After SOFRETU-CETUR (1994).

Evaluation of receipts

21. The receipts can come from two sources:
- specific transport taxation *,
- taxation on oil products.

22. The link between these receipts and the transport pricing is by no means perfect. Some of them may come from tax destined for the production of public goods, without any specific affectation to transport, or even for the redistribution of riches. Furthermore, the price standard retained obliges us to consider the receipts which are strongly linked with, (or proportional to) the carrying out of travel, as are the costs referred to above. However, since we wish to provide the lowest assessment possible for under-pricing, we have decided to retain these receipts as a whole. A certain number of corrections do, however, have to be made.

23. As far as taxation or motor fuels is concerned, just like the taxes levied on tobacco and alcohol, its specificity correspond to the payment of a price as a counterpart for a revealed cost (here, for example, we can think of the covering of road infrastructure expenditure). The tax on motor fuels cannot, however, be considered overall as the payment of a transport price. In France, this notion is besides put forward by most of work aiming at the assessment of transport pricing. Other economic sectors (industry, tertiary - residential, agriculture) also bear the cost of taxation on petroleum products (albeit less heavy). We could believe that, in this way, they are also priced for the environmental externalities which they emit in their consumption of oil products. But over the last few years, these other sectors have made considerable efforts to reduce their consumption and the emission of the resulting pollutants. The result is that the taxes on oil products which are also levied on other economic sectors are nearer, for example, to a rarity tax on petroleum resources, which cannot therefore be compared with the costs listed above. We will therefore subtract the taxes levied on other economic sectors from the price represented by taxation on motor fuels. It is validly represented by the TIPP (Domestic Oil Product Tax) rate on domestic fuel and also includes taxes which go to funds other than the General Budget[¤] (Support Fund for Hydrocarbons, French National Petroleum Institute etc.). Nevertheless it is necessary to add the VAT (Value Added Tax) which is paid on the TIPP to the TIPP itself. Our calculations led to the results in Table 2.

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* (taking into account the travel retained, this specific taxation includes the tax on private automobile insurance, the automobile registration certificates, the motor vehicle tax, the company employee fleet vehicles tax, and the driving licences tax)

¤ These taxes are minimal compared with TIPP - 1 and 2% of TIPP.

Table 2: RECEIPTS PER TYPE OF MOTOR FUEL

	Receipts in French Francs 1990 per litre consumed
Standard Grade	3,03512
Leaded Super Grade	3,21111
Unleaded Super Grade	2,79634
Diesel Fuel	1,45967

24. It is very difficult to assess specific transport taxation. We have estimated it using the data supplied by the nation's transport accounts, by comparing what specific taxation brings in, with taxation on motor fuel. The receipts for specific taxation more or less tally with 30% of those brought in by motor fuel taxation, after our rectification. This leads us to an evaluation of 30% of the price paid as motor fuel taxation.

THE RESULTS

Table 3: BALANCE SHEET FOR COSTS AND RECEIPTS IN URBAN TRAVEL (Lyon Conurbation, 1990)

In millions FFR 90	Minimalist scenario 1	Greater Paris accounting study	European scenario	Swedish scenario
Costs	off peak : 1104,12 peak : 1738,50 Total : 2842,70	off peak : 1322,08 peak : 1654,54 Total : 2976,62	off peak : 1718,68 peak : 2250,46 Total : 3969,14	off peak : 2019,33 peak : 2478,19 Total : 4497,52
Receipts	off peak : 1314,16 peak : 1126,98 Total : 2441,14			
Costs/Receipts	off peak : 0,9 peak : 1,5 Total : 1,2	off peak : 1 peak : 1,5 Total : 1,2	off peak : 1,3 peak : 2 Total : 1,6	off peak : 1,5 peak : 2,2 Total : 1,8

25. The conclusions of these evaluations can be resumed by the following points:
1. Although the theoretical price standard retained (marginal social cost) submits the empirical evaluation to a certain number of summary methodological choices, we believe this standard is particularly relevant in the perspective of system competition. Furthermore, the same type of methodological difficulties would arise in other theoretical choices.
2. Our methodological options have been guided by the desire not to overestimate costs, nor to underestimate receipts. In this way, the under-pricing indices above could be compared with lower boundary markers for estimations per interval. We must not forget that parking is not taken into account, and that the valorizing of an opportunity cost for the immobilized public space could increase costs considerably. In the same way, taxation as a whole, including specific taxation which could partially be considered as duty, has been retained as receipts.

3. After these first two remarks, we can highlight a significant individual travel under-pricing. Without distinguishing peak hours from off-peak, we can estimate that the cost/receipt ratio is at least 1.5 (central value of the interval defined from the lowest and highest evaluations). If we only consider the peak period, this ratio is at least near to 2.
4. Over and above this cost/receipt imbalance, we can note that the structure of transport receipts stands out from the price logic; therefore from the principle of regulation of supply and demand. This can notably be seen in the fact that a considerable part of the receipts comes from fixed taxation, as well as in under-pricing in all the scenarii envisaged, at peak hours.
5. If we consider the minimalist scenarii, despite their appearing less and less " realistic ", we can consider the under-pricing as being slight, if significant. However, even a slight under-pricing is liable to unbalance the conditions of system competition considerably, because of the network externalities and system effects. It can be objected that such a reasoning would require the measurement of the pricing of public transport travel. We believe, however, that an under-pricing of public transport travel is not in a position to lead to the same network and system effects as the automobile does.

COMPARATIVE ANALYSIS OF URBAN TRAVEL POLICIES

26. We have set out the hypothesis that, within the framework of system competition, there may be network and system effects which tend to lead to a progressive domination of one particular mode of transport, by triggering off snowball phenomena. Using an example, we have established automobile under-pricing, and we can suppose that this will reinforce these snowball effects. We will now show, through a comparison of urban travel policies in various European countries, that even a high level of public transport supply does not appear sufficient to face up to a high level of use of the automobile. At most, it enables the fall in the use of public transport to be done away with, thanks to transfers usually due to walking or the use of two-wheelers. Such a result is not a formal demonstration of the snowball effect, but we believe that it does not go against our hypothesis, and we can go as far as to give the first illustrations of this, even if they still have to be validated. In any case, whether this requires an explanation by network and system effects or not, a result which is important for the question of system competition, remains. The development of public transport supply would not appear as being alone able to increase the use of this mode of transport.

SOME METHODOLOGICAL POINTS

27. In order to present this comparison, we have selected a certain number of European conurbations which have clearly contrasted policies, which can be caricatured as follows:

- France: (Lyon, Grenoble, Montpellier): offer the user the free choice of his mode of transport;
- Great Britain (Cardiff, Liverpool): deregulate urban transport;
- Italy (Bologna): ban automobile access to the city centre;
- Switzerland (Bern, Zurich): master the use of the car and promote public transport.

Our presentation, however, will be principally centred on the French and Swiss cities.

28. Even if these policies and the respective market parts of the different modes are highly contrasted, our analysis presents numerous methodological limits. The analysis of the policies in these different conurbations (Bonnel et al., 1994) was carried out in a cross section fashion. It is not therefore possible for us to bring formally to light any specific amplifying effect of the supply policy which would require a dynamic analysis in time series.

29. It is necessary to draw attention to the problems of comparability posed by this type of analysis. If we have tried as much as possible to have simple, and in principle, commonly used indicators, their definition and method of measurement can vary in certain cases from one country to another. Furthermore, the local geographical, urban, demographic economic etc. contexts are quite clearly different. This is notably the case concerning the density of the different cities or indeed the respect of regulations between a German-speaking Swiss city and cities such as Bologna and Montpellier. Finally, the administrative limits are not homogeneous from one country to another. These limitations oblige us to be prudent in interpreting the results.

30. In order to make the presentation and the reading of the data easier, we have grouped them together in Table 1 in Annexe.

CHARACTERISATION OF URBAN TRAVEL POLICIES

31. We are now going to present the major features in the policies which have been introduced, through a sectorial approach, and we will deal with the overall analysis of the urban travel system in our conclusion.

Private automobiles

32. The policy introduced in German-speaking Switzerland is very different from those carried out in the other countries. For twenty years now, the two local authorities have undertaken to master the supply of roads. The measures have been taken progressively with the agreement and even at the request of the population through referendums. They are part of a coherent whole which includes:
- the dividing up of roadways: the roadway is progressively divided out among the different uses: private automobile traffic; public transport; two-wheelers;

pedestrians. This dividing out is generally done according certain priorities to other modes than the automobile and can go as far as certain reductions in capacity for automobiles at intersections. These reductions reach 30% in certain parts of Zurich. In Bern, the " Transyt " traffic regulation system gives buses priority and adapts green-light time to private vehicles depending on the state of traffic on exit from the intersection, in order to maintain traffic fluid. This equipping also concerns left-hand turns in intersections which may be banned when they perturb the progression of public transport;

- the canalizing of traffic: the objective of this action is to canalize the flow of internal transit inside the conurbation along certain roads which are specially planned for it. This actually means that there is a traffic plan which bans traffic from crossing certain areas of the city. It is possible to access these zones, but the traffic plan automatically brings the driver back to his departure point;
- the protection of residential areas or the " moderation " of traffic: in these areas the speed is limited to 20 or 30 kph. To see to it that these regulations are respected without the introduction of repressive measures, the road-layout has been completely re-thought. In this manner, the order of priorities is completely reversed - pedestrians and two-wheeler users have priority over automobiles. The total road space is thus available for all users;
- the diversion of external transit traffic: this is obtained by the construction of ring-roads or re-routings.

33. Italy has adopted a different approach since it desires to reduce the use of the automobile. We are no longer dealing with an incitative action, but rather with a coercitive one which uses bans. There are two types of measure:

- " the ban " on driving in the city-centre: this decision was taken in Bologna in 1986. It has been relatively well accepted by the population, more than 50% of which approved it in a referendum. It consists in banning access to the city centre at certain times of day (between 7 a.m. and 8 p.m. in Bologna) except for certain categories of user (residents, people who have their own parking spaces, officials ...). Since overall this measure is well respected by the population, it has produced significant results on automobile traffic in the " ban " zones. In Bologna, the number of vehicles entering the zone has been reduced. In 1989, 78% of travellers entering the " ban " zone did so by public transport, only 11% used a private automobile.
- " alternating traffic ": this consists in allowing automobiles whose registration plate ends in an even number to use their vehicles on even days of the month and conversely for those with number plates ending in odd numbers. This method for the management of automobile traffic was introduced as the result of Government anti-pollution legislation in 1992. It is turning out to be more and more inefficient because of the non-respect of the regulations. Moreover, bi-motorization increased considerably as a result of this measure.

34. These bans are accompanied by a higher tax on motor fuel than in the other countries. Its price is the highest of the countries studied. The gap is even more significant if we retain as indicator the ratio of price of super grade petrol against public transport fares.

35. As a result of the LOTI (Loi d'Orientation des Transports Intérieurs [French Legislation for the Development of Inland Transport]), Grenoble, Lyon and Montpellier wish to guarantee the right to transportation. The English cities also preach for the free choice of the mode of transport in the name of economic market efficiency. They thus use automobile traffic management means which are much more flexible, such as the introduction of specific traffic plans, the use of technical traffic regulation tools in real time. They try to divert transit traffic thanks to the construction of new ring-roads. Moreover, certain cities in France have decided to envisage the infrastructure toll, by contracting out the construction and running of new highways, in order to be able to make the road investments desired.

Parking

36. The public supply/number of inhabitants + number of jobs ratio is an interesting indicator for situating the level of the supply of parking. It enables us to evaluate the importance of the pressure on parking. The available data indicates that France is the country which has the most abundant supply. Nevertheless, it is also the country which has started to build the largest number of car-parks, to the contrary of the other countries. In Lyon, almost 10,000 car parking spaces have been made available in the car parks which have been built in five years in the city-centre, while at the same time the number of roadway parking spaces has only been marginally reduced. What is more, the standards of town planning oblige builders to provide a certain number of parking spaces for every new building constructed, whether they be for offices or for residential use.

37. Switzerland's policy is quite the opposite. The two cities are trying to attain a certain level of stability, or even to reduce parking supply, whether it be public or private, through town planning standards. Zurich has gone as far as to ban the construction of parking spaces when new buildings are put up in certain city-centre areas. Everywhere else, they authorize a maximum number of parking spaces, with extremely severe town planning standards for offices (1 space for 10 employees). Zurich has also succeeded in doing away with 10,000 parking spaces throughout the city over the past few years. This restrictive policy, from the quantitative point of view, is accompanied by pricing and limiting the length of parking with a view to there being no competition with public transport investments. Contrary to the fears most commonly expressed, these measure would not seem to have done any harm to the economic, commercial or entertainment vitality of the Zurich city-centre.

38. There is, however, one axis along which all the cities join up, with the exception of Cardiff and Liverpool, and that is that they all try to create car parks which will encourage drivers to leave their cars for public transport on the outskirts of the cities.

Public transport

39. Once again, the public transport policies enable us to isolate the Swiss cities from their other European counterparts. The supply is abundant and largely used by the population. Contrary to French cities, they have been able to maintain their tramways. There is no doubt that the network is less modern than that of Grenoble, but it serves the conurbation much better and stretches well out into the suburbs. In Zurich a suburban rail network using existing tracks reinforces the supply in situ proprio. Bern is considering creating the same type of network.

40. This well structured network is complemented by bus lines. The two Swiss cities therefore have an abundant supply with a high quality of service, even if they do not have the most modern technology, which France loves to develop. The different indicators which we have chosen illustrate this. The two cities have the highest ratio of seat kilometre per inhabitant. The operating speed is up amongst the best. Frequencies are particularly high, and even at off-peak periods or at night, the Swiss user knows that he will not have a long wait. This is probably one of the most remarkable aspects of the Swiss quality of service, and is not to be found on any other network. On the other hand, fares is rather higher than in the other countries. It is designed to call upon the loyalty of users of public transport with highly competitive season tickets, notably the yearly subscription rate. When this abundant supply is put together with the restrictive policies for the use of the private automobile, the result would appear to be bearing fruit if we examine the ratio of the number of trips per year and per inhabitant.

41. The supply is much lower in all the other cities and is situated at a comparable level considering the size of the conurbations: from 2,900 to 4,900 seat kilometre per year and per inhabitant. The operating speeds are also lower than in Switzerland. On the other hand, if use is comparable in the French and English cities, it is lower than in Bologna. Thus, the efforts undertaken since the middle of the seventies by the French cities to develop the supply of public transport are comparable with those undertaken in the other cities studied, except for the Swiss cities. These efforts have not enabled the very high level of use of German-speaking Switzerland or Bologna to be attained.

CONCLUSIONS

42. The comparison of the levels of supply and use of public transport highlights a certain relation between these two variables for the city studied. The higher the supply, measured in seat kilometre per year per inhabitant is, the more intense is the use, measured by the number of trips per year and per inhabitant. However, a finer analysis would seem to show that frequentation does not only depend on the level of supply. Thus, if we exclude the Swiss cities from the comparison, public transport in Bologna are used more than in other cities, for an approximately equivalent supply. In Switzerland, the use of public transport is, on average, three times greater , and the modal part of automobile trips decreases notably, going from approximately 80% in the other cities, to 50%. Nevertheless, the level of supply of public transport is only twice as high in Switzerland as in all the other cities. The quality of service differential in public transport would not seem to be able alone to explain such differences in the modal parts.

43. It is then possible to complete the explanation by the link which can be found between the mastery of roadway and parking supply , whether it be in Switzerland or in Italy, and the smaller market part of the private automobile. On the contrary, the countries where policies still favorize automobiles, (as in France), are also those where this mode dominates included in city-centres, where the supply of public transport gives the best service.

44. Even if these observations on a certain number of conurbations do not really represent a demonstration of the existence of snowball phenomena, they indicate a certain supremacy of the policy concerning the use of the automobile, almost independently of what has been done in public transport. If we refer to the graph concerning snowball effects, we can clearly see the influence of the developments of automobile supply in sequence. including the interposition of anticipations. We can then hypothesize that when roadway and parking investments are maintained, snowball effects which are favourable to the automobile continue, and may even be reinforced by automobile under-pricing. The inefficient development of the supply of public transport could well go to prove this (although our analyses are cross section ones, we can legitimately suppose that the cities studied have almost unanimously carried out ambitious public transport policies). The choices as far as parking is concerned could constitute an important factor for these snowball effects. Such choices are highly structural for the city and its inhabitants. The decision to offer parking spaces in new buildings, as well as to construct car parks, engage the future and could be interpreted as important signals by users and which would be dependent upon an analysis in terms of network economics (anticipation of the size of the network). In order to be validated, these hypotheses would, however, require real analysis in time series.

45. These analyses encourage our belief that competition within the urban travel system is also to be found between transport modes. The example of Great Britain shows that the development of intra-modal competition inside the public transport is not really liable to develop the use of this mode - quite to the contrary. (cf. box in annexe). This analysis does not put into question the justification of deregulation or intra-modal competition (which will not be gone into in this paper). It simply illustrates the necessity to investigate this question through the analysis of the overall travel system, and thus of inter-modal competition.

Table 1 : Characteristics of urban travel in eight European towns

Conurbations / Indicators	BERN 1990	ZURICH 1990	LYON 1990	MONTPELLIER 1990	GRENOBLE 1990	CARDIFF 1991	LIVERPOOL 1991	BOLOGNA 1992
socio-economic characteristics								
Conurbation	Bern region	Zurich agglo	COURLY	District	SIEPARG	South Glamorgan	Merseyside County	Bologna agglo
. Number of towns	?	100	55	15	23	2	5	?
. Area (km²)	250	600	500	194	212	420	660	230
. Number of inhabitants	300 000	936 000	1 200 000	282 000	371 000	390 000	1 400 000	485 000
. Density (inhab/km²)	1 200	1 560	2 400	1 450	1 750	930	2 100	2 100
Central city								
. Area (km²)	52	90	50	57	19	120	110	140
. Number of inhabitants	134 000	360 000	400 000	208 000	160 000	280 000	450 000	395 000
. Density (inhab/km²)	2 500	4 000	8 000	3 650	8 800	2 300	4 100	2 820
. Number of jobs	135 000	360 000	270 000	104 000	170 000	150 000	310 000	260 000
. Nber of inhabitants/Nber of jobs	0.99	1.0	1.48	2.00	0.94	1.87	1.45	1.52
Market share car (on car + public transport)								
. *Average per day (%)*	52	50	80	86	81	73	75	63
- Centre/centre (%)	25	35	57	79	75	60	61	55
- Centre/outskirts (%)	45	65	62	79	75	?	?	65
- outskirts/outskirts (%)	85	85	88	91	90	?	?	80
Car								
Motorization per 100 inhabitants	38	39 (Canton 45)	42	50	38	36	34	50
Price per litre of high-grade petrol in FFR. (exchange rate at date indicated)	5.00 (Aprii 1992)	5.00 (April 1992)	5.20 (September 1992)	5.20 (September 1992)	5.20 (September 1992)	4.90 (April 1993)	4.90 (April 1993)	7.50 (May 1992)
Parking in city centre								
Public supply	2 500	3 500	24 000	14 300	12 000	9 600	17 300	2.060 (pay-parking)
- on street	1 100	1 800		5 600	9 500	2 900	4 000	+ ? (free parking)
- off street	1 400	1 700		8 700	2 500	6 700	13 300	?
construction under way or to be built	0	0	10 000	8 700	?	?	?	
Private supply	1 300	6 500	non disposable	?	8 000	5 100	9 200	?
Nber of public car parking spaces/ nber of inhabitants + nber of jobs	0.071	0.044	0.205	0.28	0.20	0.17	0.27	?
Public Transport								
Seat kilometre supply/year/inhabitant	6 200	7 800	3 800	2 908	2 900	4 600	4 900	4 000
Commercial speed (km/h)	20	24	Bus : 17; Underground : 28	15	18	train : 22	train : 24	15
Frequency (main network lines) minutes								
Peak hour	3/4	6	2.5/10	6/15	4/10	10/30	10/15	?
off-peak hour	6	8	5/20	8/20	7/12	30/45	15/40	?
Nber of km of bus lanes	?	40.8	40	21.2		2.5	2 (forecast)	40
Price single ticket/price litre high-grade petrol	1.4	2	1.35	1.15	1.25	1.16	1.09	0.8
Number of trips per year per inhabitant	505	470	182	115	140	110	150	278

Sources: P. BONNEL, S. DEMANGET, J. L. RABILLOUD, B. THOME, 1994

The British law of deregulation - Transport Act 1985

Five principal measures:

- the granting of licences for the running of local passenger transport is done away with,
- the role of the Passenger Transport Authority is considerably reduced. It gathers the characteristics of the lines which are run by private companies, provides information for users, calls for tenders for the non-profitable services,
- cross subsidies are thus done away with. It is possible to subsidize a non-profitable service, but there must be a call for tenders,
- the obligation for cooperation between local and interurban networks imposed by the law of 1968 disappears,
- the National Bus Company is divided up into as many separate companies as it had subsidiaries which were sold off separately.

The objectives which were aimed at and the results (for the whole of England and Wales):

- development of competition. The increase in the number of operators and the number of tenders submitted would appear to show that competition exists between the operators,
- increase in demand. This objective would not seem to have been attained. While the number of buses x km increased by 20% between 1986 and 1992, the number of passengers fell by 22%,
- reduction of costs. The costs fell considerably per seat kilometre. On the other hand, they were virtually stable if we retain the passenger transported as the ratio. The reduction in costs is principally due to the use of mini-buses and cut-backs in salaries,
- fare cuts. The fares increased by 32% without taking inflation into account,
- decrease in subsidies. They went down from 500 million pounds in 1986 to 340 million in 1992.

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