PASSENGER TRANSPORT IN BRAZILIAN CITIES:

SOME OBSERVATIONS[1]

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I - Introduction

Short distance, i.e. daily, passenger trips to work, to school, to services, are an essential element of both quality of life and economic efficiency. In a country like Brazil, where 81% of the population lives in "cities", urban transport is therefore a key dimension of economic welfare and development of the entire country.

In the past decade, the World Bank has been active in urban transport lending in Brazil. It focussed on suburban trains in six large cities. A central government enterprise called CBTU owned and operated suburban trains in these cities (and in few smaller ones as well). These rail networks, which were in a very poor shape, were losing patronage –and money. The Federal government decided to "decentralize" them to State governments. This could only be done after they had been rehabilitated and in some cases expanded. It was also hoped that at least some States could at a later stage privatize these networks. The World Bank assisted this rehabilitation cum decentralization process, emphasizing the need for integration of rail transport with bus transport, and the need for cooperation between States and municipalities. Loans of about 600 billion $ were granted to that effect.

The program developed as planned. The Federal government contributed an equivalent amount of money. Decentralization has been achieved for the two most

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important networks, Sao Paulo and Rio de Janeiro. One of them, in Rio, has been privatized. Decentralization is about to be achieved in Belo Horizonte and Recife. It is in process for Salvador and Fortaleza.

The purpose of this paper is not to look backwards and to "evaluate" this CBTU project. It is to look forward, and to try and analyze passenger transport issues in Brazilian cities, with a view to facilitate future policy dialogue and lending.

Note that this paper refers to transport in Brazilian cities rather than to urban transport in Brazil. This plural is not accidental. It is meant to emphasize the great disparities that exist between the various cities of the country. Table 1 illustrates this point.

Table 1 - Distribution of Trips by Mode, Various Brazilian Cities; Recent Years

	Walking (%)	Bus (%)	Train/metro (%)	Car (%)
Sao Paulo (17.7)	34	23	11	32
Rio (10.5)	15	60	5	19
Belo Horizonte (3.8)	47	36	2	16
Salvador (2.8)	29	53	1	14
Fortaleza (2.6)	38	36	1	17
Vitoria (1.2)	35	34	-	22
Teresina (0.7)	31	33	-	21
Cuiaba (0.6)	56	25	-	15

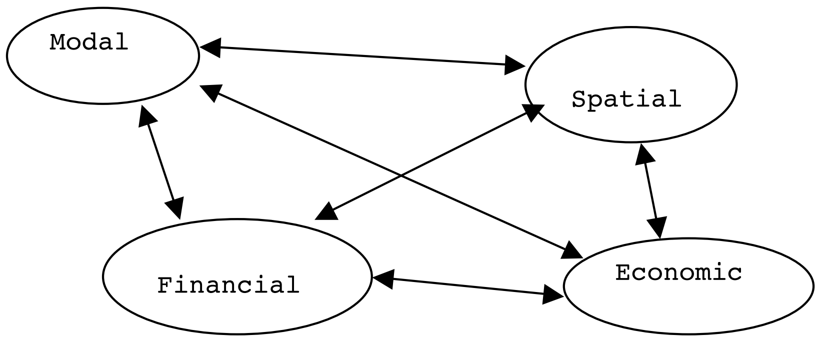
Source: For Rio: Secretaria de Transportes do Estado do Rio de Janeiro. 2000., p. 21; for other cities: GETU-SEDU
Notes: The numbers between parentheses are the population in millions; % given refer to trips; because the length of trips varies with the mode, a distribution of passenger-km by mode would yield different results; it is not sure that the data can easily be comparable between cities.

In all countries, there are differences between various cities, as a result of differences in income, in geography, in history. But nowhere are these differences as great as in Brazil. The cities of Table 1 could easily belong to different countries. Consider the two megacities of Brazil, for instance. Private car transportation, which plays a minor in Rio, plays a major role in Sao-Paulo. This means that generalizations about "urban transport" in Brazil must be made with great prudence.

This paper will focus on four distinct yet interrelated issues: the economic dimension of the problem, the spatial dimension, the financial dimension, and the modal dimension. Figure 1 suggests that each of these dimensions has an impact upon the three other ones.

Because of this systemic nature of the problem, these dimensions can be dealt with in just any order.

Figure 1 - Systemic Nature of the Problem



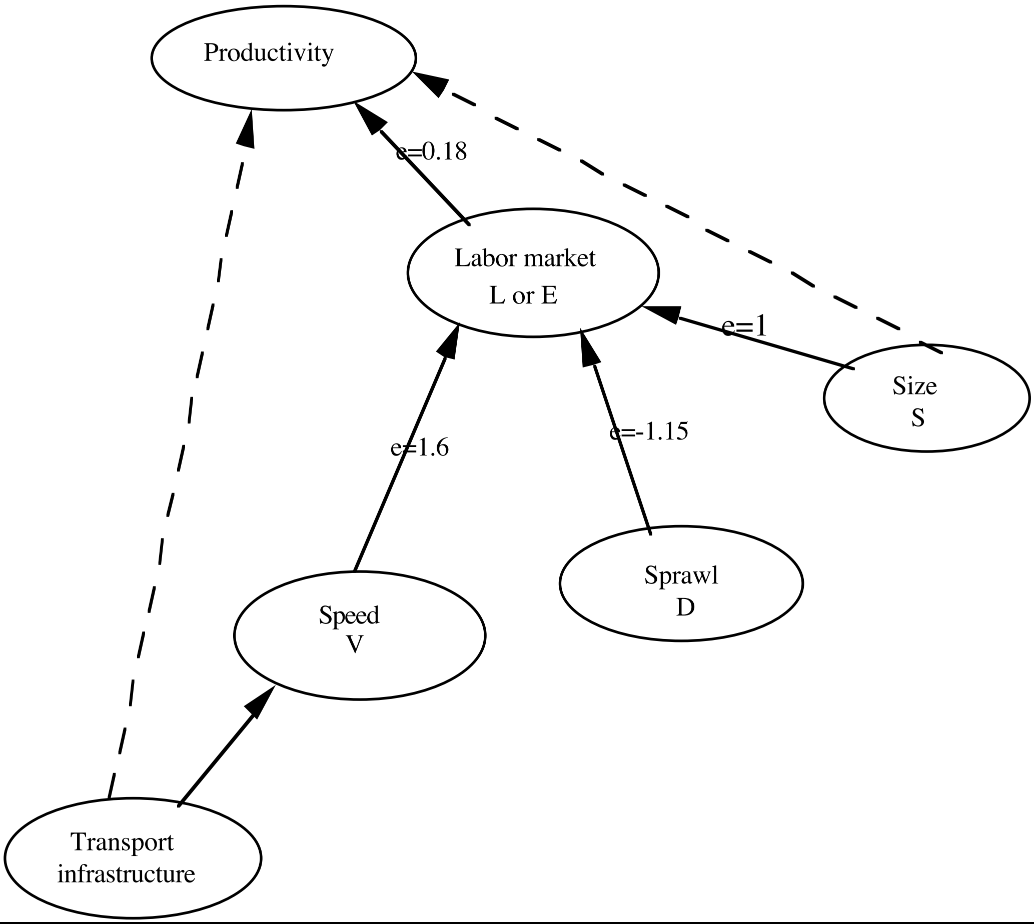
II - Economic Dimension

A "good" urban transport system can contribute to economic welfare and growth. A key notion to explore this relationship is the *effective size of the labor market* for a given city. Consider a city with 1,000,000 jobs and workers (assuming away unemployment, for the sake of simplicity). From the viewpoint of workers, the effective size of the labor market will not be 1,000,000 jobs. Workers living at one end of the city do not have access at a reasonable cost in time and money to the jobs located at the other end of the city; for these workers, the effective size of the labor market may be only 500,000 jobs. For other workers, located in the center of the city, the effective size of the labor market will be higher, perhaps equal to 900,000 jobs. This size can be calculated for each zone of the city. An average can be calculated for the entire city, weighting the size of each zone by the number of workers in each zone. From the viewpoint of workers, the average effective size of the labor market in our city may thus be equal to 700,000 jobs. A similar calculation can be made from the viewpoint of enterprises. It will show that the effective size of the labor market is equal to, say, 800,000 workers. Prud'homme and Lee (1999) present estimates of the effective size (or sizes) of the labor market for Paris, London, Seoul, Pusan, Daegu, and 23 French cities.

These estimates are contingent upon the precise definition given to "access at a reasonable cost in time and money". In the study just quoted, only the cost in time was considered. For London, Paris, and the three Korean cities, calculations were made for 45 and 60 minutes; for the 23 French cities they were made for 20, 25 and 30 minutes. In practice, the precise definition does not matter very much for analysis and comparisons over time or space. If the effective labor size of Paris at 60 minutes is larger than that of London (which is the case), this will also be true, and very much in the same proportion, for the effective labor size at 45 minutes, or at 90 minutes. In the case of Brazilian cities, however, "access at a reasonable cost" should consider money as well as time. It should mean something like: access in less than 90 minutes and less than 1 R.

The notion of effective size of the labor market is useful because it can explain the productivity of cities, and be explained by characteristics of cities, including urban transport characteristics. It is therefore a link between urban transport and productivity. This is illustrated in Figure 2.

Figure 2 – Efficiency of Cities



First, the effective size of the labor market of a given city is a determinant of the productivity, and hence the output, of that city. It is easy to see why. The larger the effective size of the labor market, the greater the probability that a given enterprise will find exactly the workers it needs, and the greater the probability that workers will find exactly the jobs they want. A larger labor market makes it possible to better adjust the supply and the demand of labor. This better "matching" of workers and jobs is a source of efficiency. Available data supports this reasoning. Everywhere in the world, the productivity of larger cities (that have, as a first approximation, larger labor markets) is higher than that of smaller cities. This is also consistent with the idea that transport infrastructure in an area increases productivity in that area. The analysis conducted on 23 French cities fully verifies this hypothesis. It even yielded an elasticity of productivity to effective size, equal to about 0.18. When the effective size of the labor market in a city increases by 10%, the productivity (and output) of that city increases by nearly 2%.

Second, the effective size of a labor market is a function of the total size of the city considered, of the relative location of jobs and homes in the city (of sprawl), and of the speed at which workers move from home to job in that city. This is self-evident. It is also borne by the empirical analysis conducted on the French cities, that also yielded elasticities. These elasticities are given in Figure 2. When trip speed increases by 10%, the size of the labor market increases by 16% —and consequently productivity and output increase by nearly 3%.

This suggests that much is at stake with urban transport in Brazil. Lowering transport costs and improving transport speeds will, all other things equal, enlarge the effective size of the labor markets, and hence increase output. The entire society would benefit from such an increase. Lowering transport costs for workers can be done by subsidizing transport demand (as done presently by the Vale Transport system), or transport supply (as done, for instance, by the French *versement transport*). It would have the same impact as transport investments or regulations that would increase the speed at which workers can commute to jobs. This might include improving rail and metro transportation, facilitating intercommunal cooperation to avoid changing buses, the substitution of slow buses by faster vans, the creation of dedicated bus lanes, the construction of new roads or the enlargement of existing roads, and a modal shift from the slow mode (public transportation) to the faster mode (the automobile).

Obviously, the elasticities estimated on the case of French cities cannot be uncritically applied to Brazilian cities. Similar studies linking the effective size of the labor market to productivity in Brazilian cities would be required to determine the elasticity of productivity to effective size.

Secondly, the concept of effective size of the labor market could be utilized to simulate the impact of various policy measures on one or several cities. By how much does the Vale Transport system increases the effective labor market size (relative to what it would be in the absence of vale transport)? By how much do the vans increase the effective labor market size? By how much did rail investments increase this size? By how much does a 1 percentage point increase in the share of automobile increase the effective labor market size? The results of such simulations would make it possible to compare the benefits of these various policy measures. A knowledge, or even an order of magnitude, of the productivity/labor market size elasticity would make it possible to estimate the economic benefits of these measures.

III - Spatial Dimension

Balkanization

In Brazil, as in most other countries, most economic and social agglomerations consist of many distinct communes or municipalities. This is illustrated by Table 2, that indicate, for the so-called "metropolitan regions", the number of communes. Note that the design of these metropolitan regions is old, and that in some cases, it can be argued that the reality of economic and social linkages extends beyond the metropolitan region borders.

Table 2 - Number of Municipalities, Metropolitan Regions

Metro region	Number of municipalities
Sao Paulo	38
Belo Horizonte	23
Curitiba	23
Porto Alegre	22
Rio de Janeiro	18
Recife	13
Salvador	9
Fortaleza	8
Natal	5

When municipalities did not have much power and income, this balkanization of economic and social agglomerations did not matter much. The Federal government (or to a lesser extent the State government) had enough muscle to design and implement policies that made sense for the entire agglomeration. This is much less the case by now. The 1988 decentralization reform has given municipalities income and power as well as elected mayors. Each municipality of an agglomeration is therefore tempted to maximize its own interest at the expense of the interest of the entire agglomeration.

Three basic demographic trends are relevant for a discussion of urban transport in Brazilian cities. They are well known, but nevertheless important.

Population Growth Decline

The first one is the decline of the rate of population growth in the entire country, which is illustrated by Table 3.

Table 3 - Population Growth Rates, Brazil, 1960-2000

Census period	Population growth (% per year)
1960-70	2.89
1970-80	2.48
1980-90	1.93
1990-2000	1.63

Source: INGE

There is every reason to expect this trend to continue. One of the two sources of urban growth, namely the growth of total population, is therefore diminishing. So is the other source, the rural to urban migration movement. This movement is about exhausted, since 81% of the population lives in cities. In the future, on average, cities will see their population increase at a rate of 1%-1.5% per year. Some cities, obviously, will grow faster than others, but for one agglomeration growing at 3% per year, there will be another agglomeration growing at 0% per year. If all other things were constant (which is not the case), the pressure on urban infrastructure, including urban transport infrastructure, would not be as great as it has been in the past decades.

Medium-sized cities

The second trend is that medium-sized cities grow faster than both large and small cities. Most of the data (particularly preliminary data from the 2000 population census) we found was by municipality, not by agglomeration. Some of the data on the high growth of medium-sized "cities" presented in the press is in fact relative to the growth of municipalities located in the suburb of larger agglomerations. A more serious analysis of the 2000 Census would be needed on this matter. Nevertheless, two points can me made with some certainty. One is that the two megacities grow more slowly than other agglomerations. Over the 1961-91 period, Sao Paulo metropolitan region grew at an annual 1.45% rate, and Rio at a modest 0.77%. This is below the average rate of natural growth in the country. Clearly, the population of these megacities is no longer increasing very rapidly. Second, the population of rural areas and of small cities (which are municipalities) is often declining or stagnating. It follows that the population of medium-sized cities, between 200,000 and 2,000,000 inhabitants, is presently increasing rapidly. Table 4 provides some data, for the 1991-96 period, for a number of "urban agglomerations".

Table 4 - Population Growth, Center and Periphery, Selected Agglomerations, 1991-61

Agglomeration	Pop.1996 agglo (in k inhab.)	Growth agglo (% per year)	Growth center (% per year)	Growth periphery (% per year)
Sao Paulo	16,667	1.45	0.40	3.09
Rio	10,532	0.77	0.26	1.36
Belo Horizonte	3,829	2.00	0.70	3.72
Porto Alegre	3,291	1.43	0.40	2.12
Recife	3,258	1.10	0.73	1.37
Salvador	2,776	1.59	1.28	2.87
Fortaleza	2,639	2.36	2.13	3.00
Curitiba	2,348	3.43	2.34	5.44
Goiania	1,416	3.30	1.72	7.90
Sao Luis	941	2.80	2.32	5.35
Natal	921	2.21	1.57	3.89
Londrina	775	1.71	1.55	1.89
Joa Pessoa	773	2.07	2.00	2.24
Florianopolis	543	1.79	1.21	2.38

Source: SEDU-GETU 2000, vol. III, p. 11

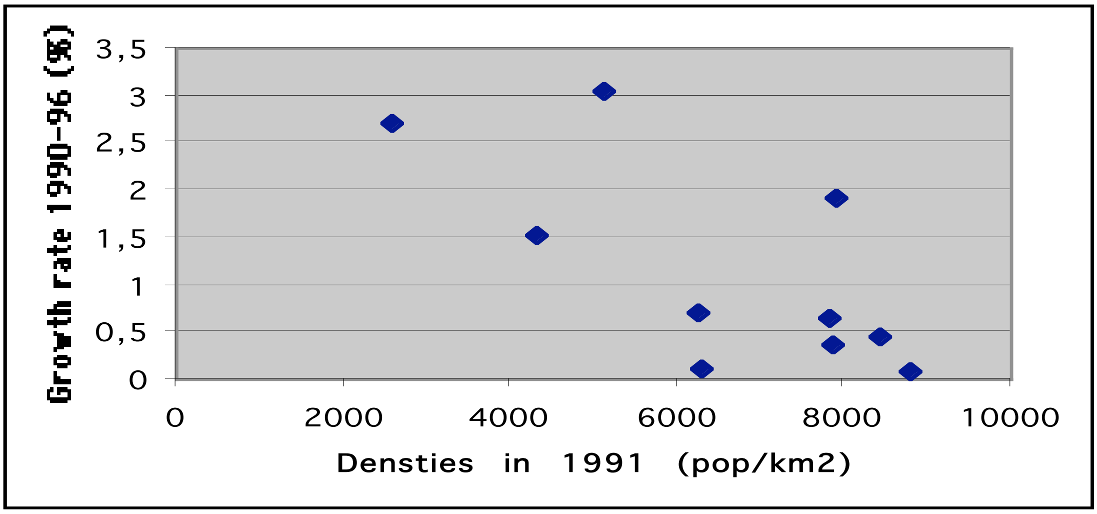
Suburbanization

Table 4 also illustrates a third major trend, the suburbanization of Brazilian cities. In all agglomerations, the population of the periphery increases faster, and often much faster, than that of the center. Not much can be made of differences between cities, because there is no certainty that the definition of the "center" is the same in every agglomeration. But the general trend is very clear. city centers grow slowly or stagnate in many Brazilian cities. We failed to find data on changes in employment location. But there are some reasons to expect it to follow similar patterns. Traditional industry, often located in city centers, has declined, and new industries tend to locate in suburban areas (as, for example Fiat in Belo Horizonte or Renault in Curitiba). Many of the jobs in the service sectors follow customers. Supermarkets are generally located in suburban areas.

A similar dispersion pattern can be observed within central municipalities. This is well documented on the case of Rio municipality. The population of this large (5.5 million inhabitants) municipality is about constant. But the eastern part of the city, the traditional center (which happens to be, incidentally, the part of the city where the subway lines are located), is either loosing population or stagnating. What little growth there is in Rio municipality only takes place west of a Sao Corrado-Anchieta line.

At the level of each agglomeration, therefore, there is a clear evening out of densities process that is taking place. Growth is inversely related to densities. This is clearly illustrated in Figure n, on the case of Belo Horizonte. In this agglomeration, as elsewhere, there is no growth, or even a negative growth, in central areas with high population densities. And population increases where densities are low. To put it otherwise, the slope of the density gradient diminishes. There are reasons to expect this trend to continue.

Figure n - Growth Rates as a Function of Population Densities, Belo Horizonte, Ten Zones



There is no simple and convincing explanation of this Brazilian sprawl. We do not know whether it is being led by enterprise location or by household location. The desire of many households to have more indoors and outdoors space must have played a role. The lack of safety in city centers also. The need to be near roads or highways for goods transportation must have induced some businesses to chose suburban locations. The changing industry-mix must have facilitated the process. Except in Sao Paulo, the share of private car trips is so small that it is difficult to blame the automobile for the suburbanization movement.

We could not find hard data on the distribution of trips between center-t-center trips, suburbs-to-center trips, and suburb-to-suburb trips. But it is clear that the relative importance of the first type declines and that of the third type increases. In Belo Horizonte, for instance, the most rapidly developing "destination zones" are not in the city center, but in the South, in a first ring area; and the most rapidly developing "origin zones" are in the East, in a second ring area. The relative importance of East-South trips is bound to increase.

Transport Implications

All these features and trends have important implications for transport patterns and policies.

As more and more people live in more and more powerful suburban communes, the need for integrated transport (as well as urban) policies at the agglomeration level increases. A sound transport policy for an agglomeration cannot result from 20 transport policies conducted by independent and often competing municipalities. In many cases, bus transportation remains regulated and managed at the municipality level, preventing (or making more difficult) intercommunal bus trips. This makes intercommunal bus trips more costly and more time consuming. As the effective size of the labor market model described above shows, this reduces the effective size of the labor market, and with it the productivity of the city. This clear case of spillovers provides a justification for some higher level government (State of Federal) intervention. It highlights the need for some agglomeration level institution or some "forced" coordination.

Urban transport problems in Brazil are more acute where they can most easily be solved. Transport demand increases where and when people (and to a lesser extent jobs) increase. Because population increases are less than in the past, and because they do not take place in the very large cities, transport demand should be easier to meet. This is not to say that it will be easy. Transport demand is also a function of income, and should grow with the growth of income. The population of many large cities continues to increase. Much remains to be done. But the perspective is no longer that of a frightening exponential growth of transport demand in Sao Paulo and Rio.

The evening out of densities will make urban transport more important. Sprawl, as shown in the labor market size model, reduces the productivity of cities – unless it is compensated by more efficient transportation.

This evening out of densities also creates a challenge for public transport. Public transport, and even more so rail transport, is most efficient for high-density areas. As more and more people will live and work in suburban areas, the share of suburb-to-suburb trips will increase, and become dominant in certain agglomerations. Public transport is notoriously inefficient to serve such trips. A dense city with public transport may be efficient. A spread out city with automobiles may also be efficient. But a spread out city with only public transport will not.

IV - Financial Dimension

The economic cost of passenger transportation in Brazilian cities, as elsewhere, is high. Although we have no hard data on that, it probably represents 10-15% of household income —not counting the cost of time involved. A number of taxes and subsidies are associated with urban transport.

Private Automobile Contribution

Private —that is automobile— transportation does not seem to be subsidized. On the contrary, it seems that urban road building and maintenance expenditures are not very high, and that they are more than covered by specific taxes on fuels and vehicle ownership[1]. In all likelihood, private car trips in Brazilian cities provide a net benefit in terms of public finance.

It does not follow that they provide a net benefit in terms of economic welfare. It could be that the externalities associated with these car trips outweigh the financial benefits (this issue is briefly discussed below). It could also be that the congestion externalities imposed by car users upon other car users are not optimal, and would justify some form of congestion pricing, for the benefits of car users. It is nevertheless important to note that, in terms of financial sustainability -in terms of "fiscal burden"- the marginal private car trip seems to subsidize public coffers, not be subsidized by them.

Public Transport Subsidies

Public transport, by contrast, is subsidized. The main subsidizing mechanism, for both buses and trains, is the Vale Transport (VT), to be discussed subsequently.

Buses also benefit from some tax relief, the magnitude of which we could not estimate. In a few cases, bus companies receive relatively small operating subsidies

[1] We did not collect hard data on this important issue that deserves more than ou more or less informed guesses.

(about 10 million $ in Sao Paulo, for instance). Bus companies, or rather bus sellers, also obtain subsidized loans from BNDES, a public bank, that make loans for the purchase of buses at a concessionary rate which is about 20 percentage points below the market rate. With a portfolio of such loans for 830 M Reais, this amounts to a subsidy-equivalent of about 80 million $ per year. Non VT subsidies for buses are therefore relatively minor.

The same cannot be said of trains and metros. They benefit from large capital subsidies. Indeed, the entire World Bank project, described in Table n, is a capital subsidy to trains and metros for more than 1,600 million US $, including the Brazilian counterparts. Assuming an opportunity cost of capital of 10% and a depreciation rate of 7%, this amounts to a subsidy-equivalent of about 270 million $ per year.

Table 5 - Publicly Financed Investments in Suburban Trains in Brazil, Recent Years

	World Bank (in M$)	Federal Government (in M$)	State & Local Governments (in M$)	Total (in M$)
Sao Paulo	126	155		281
Rio de Janeiro	128	145		272
Belo Horizonte	99	98		197
Salvador	150	40	56	246
Fortaleza	85	298[a]	52	435[a]
Total	689	837	108	1634

Source: SEDU-GETU 2000, vol. II, pp. 44-45
Note: [a]Including an Eximbank loan of 268 M$.

BNDES concessionary loans represent an additional subsidy-equivalent of about 140 million $ per year.

Train and metros also benefit in several cases from operating subsidies. The CPTM, the Sao Paulo suburban train company, received in 1999 a subsidy of 107 million $ (lower than in 1998, when it was 147 M $). Suburban trains in Rio, which have been privatized, are not subsidized, but they are presently losing money. In Belo Horizonte, the operating deficit of the metro/train, and the associated subsidy, are reported to be about 10 million $ per year. All in all, urban rail transport, which is heavily concentrated in a few cities, and entirely dominated by Sao Paulo and Rio, receives annually the equivalent of more than 500 million $, in addition to the benefits it derives from the VT.

Just as in the case of private automobile, this does not necessarily mean that such subsidies are not economically justified. It could be that economic activity in Sao Paulo and Rio would be stopped or significantly reduced in the absence of rail transport, and that the economic benefits are greater than the costs. One should note, however, that these subsidies are borne by Brazil at large, whereas the benefits accrue predominantly to Sao Paulo and Rio —although it can be added that Sao Paulo and Rio contribute generously to the Federal budget, and that they would contribute less if they were less prosperous.

Description of the Vale Transport (VT) System

The main subsidy to public transport is associated with the VT. This ingenious mechanism created in 1985 functions as follows. Every employer deducts 6% of each employee's wage and provides him/her with transport tickets for his/her journey to work and back. In most cases, this means 22 days x 2 tickets per day, or 44 VT. When the employee needs two tickets per trip (because he/she has to take two buses, or a bus and a train), the employer will have to give twice as many VT. In some extreme cases, the employer may have to give three times as many VT. These cases are not infrequent. In Rio, 11% of trips require at least one such transfer (Aquino 1996); for business trips, the share is likely to be higher. In Sao Paulo, 31% of public transport trips, in 1997, imply one or more transfers (ANTP 2000, p. 9). Obviously, employees with higher wages can opt out of the system.

Let us focus, for the sake of simplicity, on the most frequent case, in which each employee receives at the beginning of the month 52 VT, which are accepted by public transport companies for one trip. Let Wi be the daily wage of employee i, P the price of a public transport trip, the daily cost Ci to the employer for employee i is:

$$Ci = 2*P - 0.06*Wi \qquad (1)$$

Table 6 indicates the value of Ci as a function of Wi, and what it represents in relation to Wi, when Pi is equal to 1 Real (about 0.5 $), a representative public transport cost. It shows that the VT costs about 1.6 R to the firm who hires an employee paid 1 Minimum Salary, and that this represents 27% of his/her salary. These numbers diminish rapidly when wages increase. For wages equal to 3 Minimum Salaries, the VT represents a cost of nearly 1 R to the firm, but only 5% of wages. Beyond 5 Minimum Salaries, employees have no interest in asking for VT. When and if the employee needs 2 tickets per trip, formula (1) becomes:

$$Ci = 4*P - 0.06*Wi \qquad (2)$$

In that case, the cost to the firm is increased by 2 R in all cases. The cost of VT amounts to as much as 60% of wages in the case of wages equal to 1 Minimum Salary.

Table 6 - Cost of VT as a Function of Wages

Wage (in Min Sal.)	1	2	3	4	5
Wage (in R/day)	6	12	18	24	30
Cost to the firm (R/day)	1.6	1.3	0.9	0.6	0.2
Cost to firm (in % of wage)	27	11	5	2	ε

Note: Calculated with a public trip price of 1 R, in the case when the employee only needs 1 ticket for each trip.

The VT system is organized and managed under the responsibility of State or municipal governments. In Rio, for instance, it is under the responsibility of the State. In Sao Paulo and Belo Horizonte, it is under the responsibility of the various municipalities. In each case, there is a "selling agency" for the enterprises of the jurisdiction concerned. This selling agency may be a private bank, or a clearing house operated by the (State or municipal) government itself or by a syndicate of bus companies. At the beginning of the month, private enterprises purchase the number of VT tickets they need from the selling agency. Private enterprises then give these tickets to their employees. These employees pay with these VT tickets the trips they make on public transport companies. At the end of the month, public transport companies bring back VT tickets to the selling agency or its bank, and get money in exchange. (In reality, things are a little more complicated, because what each public transport company gets is not based on the fares and VT it has collected, but on its "costs". There is therefore, in each jurisdiction a second clearing house, independent from the VT clearing house, which compares for each company gains and costs, and pays or is paid the difference. But this is immaterial for the functioning of VT, and can be ignored here). This system is represented in Figure 3.

Figure 3 - Formal Operation of VT System

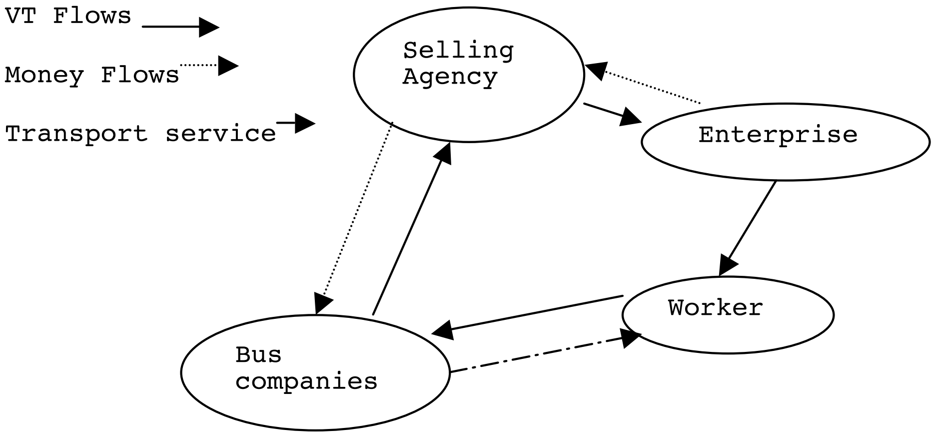


Figure 3 describes the legal, or formal, procedure. In practice, however, the system is widely evaded, and is characterized by important illegal leakages. A significant number of the people who receive VT tickets do not give them to bus (or train) companies in exchange for a trip. They prefer to sell them, as a discount, on a well organized and not really much hidden black market. Some of these workers will prefer to walk, or to bicycle, or to car pool to work; others will simply take the bus or the train without paying. Let us assume that the price of a public transport trip is 1 R. The price at which the worker will sell his VT will be lower, and something like 0.8 R. What will the purchasers do with their VT purchased at 0.8 R? Three main uses can be identified.

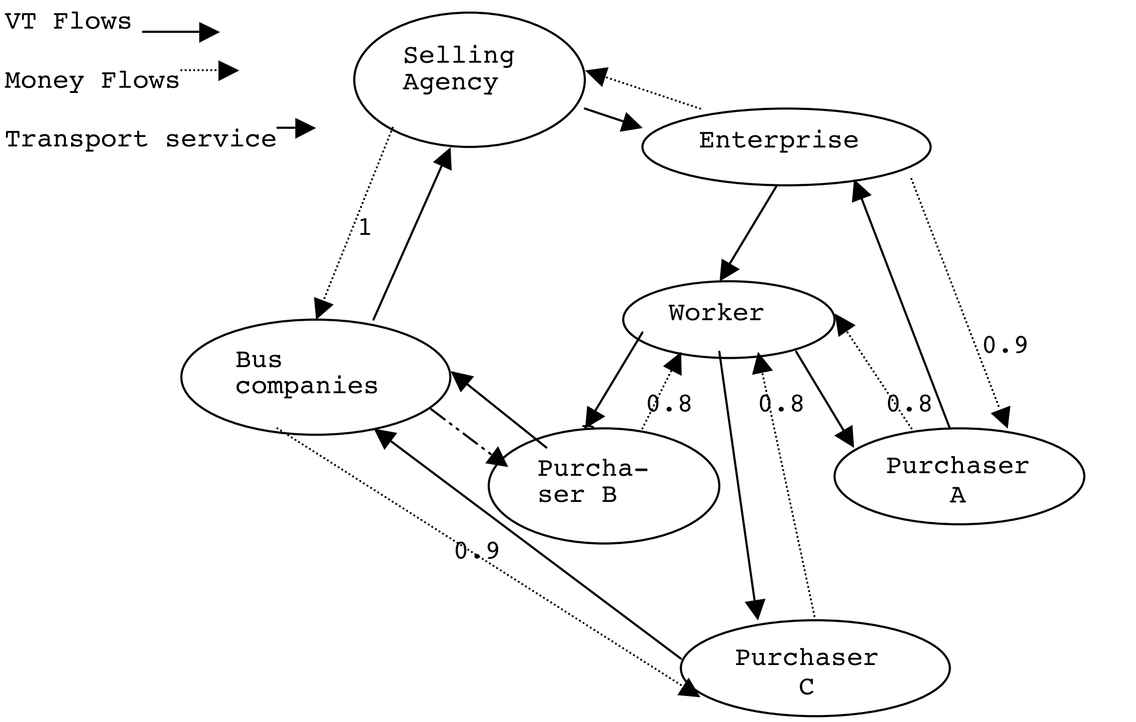
Some purchasers (Purchasers A) will sell their VT to enterprises, at a price higher than 0.8 R and lower than 1 R, for instance at 0.9 R. Enterprises are not allowed to do that. But if they do, they obtain the VT they must give to their workers at a discount, and make a benefit. Purchasers also make a benefit.

Other purchasers (Purchasers B) will use their VT for a trip on a public transport company. Purchasers B pay in effect 0.8 R for a trip, instead of 1 R. The public transport company does not need to know whether the VT that pays for the trip is a first hand or a second hand VT.

Yet other purchasers (Purchasers C) will sell their VT tickets to public transport companies, here again at a price higher than 0.8 R and lower than 1 R, for instance at 0.9 R. Public transport companies, who are of course not allowed to do so, will take these VT tickets to the selling agency and obtain 1 R in exchange. Here again, both Purchaser C and public transport company make a profit of about 0.1 R on each VT ticket.

Figure 4 illustrates these illegal or informal uses of VT. The relative importance of these informal uses is not known (to us), but it is said to be important. Perhaps one third or one-half of VT handed over to employees are not used by the recipients, and follow one of the informal routes.

Figure 3 - Informal Operation of VT System



The first purchaser is not necessarily the one who uses or sells the VT as described above. VT change hands. The first purchaser may sell it to someone else, who will use it as money, untill a final purchaser behaves as Purchaser A, B or C. In principle, the life of a VT is limited to one month. VT tickets are issued at the begining of the month, and redeemed at the end of the month. The black market value of a VT changes over the course of the month.

Burden of VT

We can use Table 6 above to estimate the amount of the subsidy in selected cities. About half of public transport trips are reported paid by means of VT. Assuming that most of the wages (of workers who benefit from VT) are in the 2-3 Minimum Salary Range, the cost of VT to the firms is about 1 R per worker, ie about 0.5 R per VT ticket —or more when the public transport fare is higher than 1 R. Actually, the average salary of workers benefiting from VT is probably higher than 2-3 Minimum Salary; taking this into consideration would lower our estimate. On the other hand, the calculation presented in Table 7 assumes that workers receive only 2 VT per day; correcting from the fact that some receive 4, or even 6, would increase our estimate. Assuming that this two effects cancel each other out, Table 7 gives a gross order of magnitude of the VT subsidy: about 700 M$ for the three larger cities of the country, something close to 1 billion $ for Brazilian cities as a whole. These numbers are in line with the claim made in Sao Paulo that Sao Paulo Metropolitan Region enterprises pay about half the total of VT.

Table 7 - Cost of VT in 3 Large Cities, 1999

	Sao Paulo	Rio	Belo Horizonte	Total
Public transport fare (R)	1.15	1.00	1.00	-
Public tr. trips/day (M)	10.47	8.80	2.05	21.32
VT/day (in M)	5.23	4.40	1.02	10.66[a]
Cost/day[a] (in M R)	3.40	2.20	0.51	6.11
Cost/year[b] (in M R)	823	532	123	1,478
Cost/year (in M $[c])	392	253	59	704

Notes:[a]Calculated from Table 6; [b]Assuming 242 days worked; [c]Assuming 1 $ = 2.1 R; aThis number, corresponding to 2,300 M VT/year is coherent with the number of 231 M VT/month in March 1999, corresponding to 2,800 M VT/year, given in SEDU-GETU 2000, vol. II, p. 49.

Who bears the cost of the VT system? The VT is paid by enterprises. But it is considered as a tax deductible expenditure. The marginal rate of corporate taxation is 35% (40% for banks). A little more than 35% of the VT is thus borne by the Federal government in the form of tax income forgone. In that sense, the VT amounts to a Federal subsidy of about 400 M$ per year to urban public transport.

The rest is borne by enterprises —that is shifted to consumers (in the form of higher prices), to employees (in the form of lower wages) and to capitalists (in the form of lower profits). In the end, the VT is borne by all Brazilians, in a manner grossly proportional to their consumption.

It is interesting to note that an increase in public transport fares leads to a more than proportional increase in the VT paid by enterprises. Sao Paulo, for instance, is about to increase the fare level from 1.15 to 1.32 R, a 15% increase. This will mean an additional bill of enterprises of about 100 M $, a 25% increase over the present bill[1]. This local decision will cost the Federal government some 35 M $ per year.

Negative Impacts of VT

It is easy to criticize the VT system. The system has indeed several perverse or negative effects. At least six criticisms can be formulated.

(i) As a tax paid (for 65%) by enterprises, VT increases production costs, and affects negatively national competitiveness, all other things equal.

(ii) As mentioned above, VT imposes tax expenditures upon the Federal government, for about 400 M$ per year. What is worse, these tax expenditures can be increased, or decreased, by locally taken decisions about public transport fares. The system therefore limits the room for national fiscal management and policies.

(iii) The VT implies some unintended redistributional effects: from non-wage earners to wage earners; from rural areas (with little public transport) to urban areas; from the informal sector to the formal sector.

(iv) The VT increases disproportionately the cost of unskilled labor, as shown in the last line of Table 6. While this may appear desirable, it reduces the demand for unskilled labor and rejects some workers out of the formal labor market and increases unemployment. There must be firms ready to employ some people at 6 R/day who prefer not to employ them at 7.6 R/day.

(v) The system induces firms to discriminate against workers located too far away from work and having to take more than one public transport trip. The law in principle obliges firms to pay their employees the full public transport cost of their journey to work. Having to chose between one worker who needs one VT to come to work and one worker who needs two, many firms will select the first worker –who may not be the most efficient, nor the most deserving. This behavior is illegal, but difficult, not to say impossible, to prevent.

(vi) The VT system is costly to administer. The selling agencies and/or the banks they hire to print and

[1] 0.17 per trip x 5.23 M trips benefiting from VT per day x 242 days per year, divided by 2.1 R for 1 $. As a matter of fact, the cost will be higher because some workers who did not benefit from VT when fares were 1.15 will now ask for this benefit.

sell VT, and then to collect VT tickets (and check for potential forgeries) operate at a non negligible economic cost. The time cost for firms involved in purchasing and distributing VT is not negligible either.

(vii) The VT is widely evaded. Some types of "evasion" do not matter much. This would be the case of the evasion described above as Purchasers B evasion, in which the VT ticket is used to buy a public transport trip. The person transported is not the worker who received the VT, but everybody is better of as a result of the evasion: the worker who obtained money in exchange for his VT, Purchaser B who is buying a trip at a reduced fare, and the bus company who sees the demand for its services encouraged by the system. But the same cannot be said of the other types of evasion. In these cases (Purchaser A and C cases), the demand for public transport is not sustained at all, since the VT is not utilized to pay for a trip. The system amounts to an increase in wages of 0.8 R plus illegal income of 0.2 shared between the purchasers, the enterprises and the public transport companies —not to mention the local regulators whose tolerance of illegal practices by enterprises and bus companies is not always disinterested. In addition, illegal practices tend to degrade statistics. Estimates of the patronage of bus companies are based on tickets sold and on VT sold. Inasmuch as some VT are not obtained by bus companies in exchange for a trip, published numbers overestimate patronage, by perhaps as much as 10-15%[1]. One can add that this uncertainty does not facilitate a fair sharing of public transport income between bus companies, and opens the door to dubious practices.

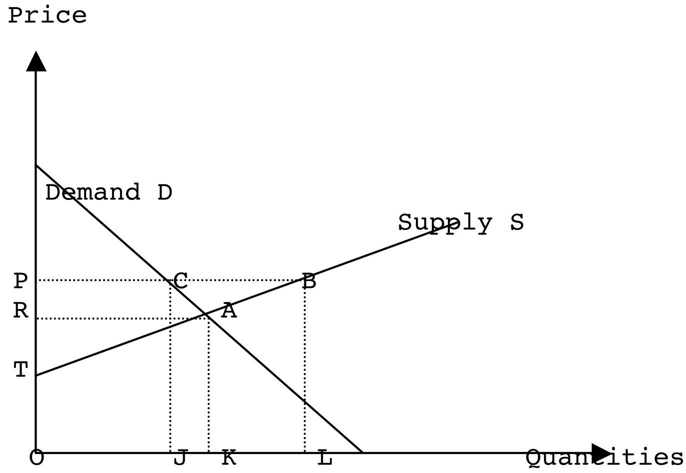
Benefits of VT

On the other hand, the VT system has major advantages, for public transport companies, for low-wages earners, and for the productivity of cities.

(i) The VT subsidizes public transport by increasing the demand for public transport. According to published data, the VT nearly doubles the demand; the true increase is probably around 80-85%, but it is nevertheless substantial. In a perfectly competitive system, this would affect producer and consumer surplus as indicated in Figure 4.

[1] In principle, a comparision of origin-destination data with patronage data should produce a more reliable estimate of this overestimation.

Figure 4 - Impact of VT on Producer and Consumer Surpluses



In the absence of VT, the demand for public transport would be represented by curve D. The supply curve is assumed to be S. There would be an equilibrium in A, with K people paying a price R. This price is lower than the prevailing price P, paid by J people. The VT moves the equilibrium to the right, up to B, with JL people using VT to travel (with JL about equal to 0.8 0J). What is the impact of VT on surpluses? The producer's surplus that would have been TAR in the absence of VT is now TBP: it has increased by PBAR. The consumer's surplus (of the people who pay their fare), that would have been RAD in the absence of VT is now PCD: it has diminished by PCAR. The net welfare gain is equal to ABC (=PBAR-PCAR).

This analysis shows that the VT increases both prices and volume of activity of public transportation. It decreases the number of people who pay the full public transportation price. The resulting increase in volume activity is therefore not as large as one might think, but there is nevertheless a sizable increase. This increase in activity increases the producer's surplus. However, a large part of this increase is eaten up by a decrease in the consumer's surplus of non-subsidized public transport users. The net gain, and even the gain of public transport companies, are relatively small in relation to the total amount of the cost of VT to enterprises (JCBL in the language of Figure 4).

In the less than perfect competitive world of public transportation in Brazil, things are probably slightly different. For suburban trains and metros, where marginal costs are probably lower than average costs (at least when capital costs are included), an increase in volume most probably increases profitability –or decreases losses. For bus transportation, with prices a function of costs plus a margin of profit, an increase in volume also means an increase in profits, particularly for the more efficient bus companies. In addition, as we have seen, the VT puts much of the burden of price increases on the back of VT paying enterprises, and reduces the impact price increases normally have on demand. This partly "guaranteed demand" probably exerts a pressure on price increases rather than on cost cuts.

Nevertheless, it can be argued that subsidizing the demand for public transport is better than subsidizing public transport supply. A significant share of subsidies directed to public transport supply, as in the case of the French *versement transport,* is captured by bus companies in the form of higher wages, higher profits and lack of efficiency efforts. The rest results indeed in lower public transport fares. But supply subsidies lower the cost of all trips, including the leisure trips of the rich, whereas VT subsidizes the most worthy trips the working trips of the poor.

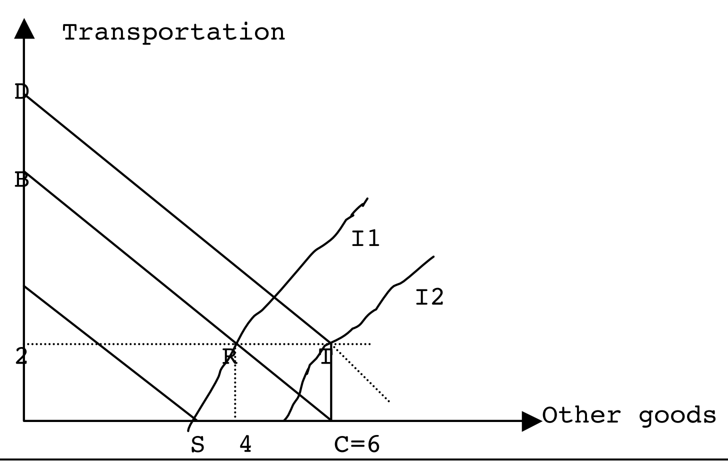
(ii) The VT system benefits mostly low-wage earners. It is basically progressive. It is true that the progressivity of VT is not perfect. The very poor, who have no job at all, do not benefit from it. People who are self-employed, or employed in the informal sector, even when they have the same income level as working poor in the formal sector, do not benefit either. Some of the people that should be targeted by subsidies are therefore not aided at all by the VT –unless one can argue that VT favors economic development and thus also benefit the very poor. Not many people in the lowest income quintile benefit from VT. But many people in the second quintile do benefit from it, for something like 30% of their income. Some people in the next quintile are also aided, for much smaller amounts. And nobody in the remaining higher quintiles gets anything out of it. There are not many public expenditures for which this can be said.

(iii) The VT system significantly increases the effective size of the labor market. For low wage earners located far away from their work, the cost in time and money of commuting to work would represent such a large share of their wages (30% or more, as shown in Table 6), not to mention 2 or 3 hours per day, that it is not worth working. These people are out of the labor market area of these firms. Similarly, these firms are out of the labor market areas of these people –which is indeed restricted to the places that can be accessed on foot.

This can be illustrated with the help of indifference curves, as in Figure 5. Let us consider a worker with a budget constraint who has to choose between two goods: transportation, and other goods. The shape of indifference curves Is is quite different from the familiar shape of indifference curves for a consumer who has to choose between two ordinary goods. This is because the consumption of transport, unlike that of any other good, produces in itself no utility, but rather a disutility. Let us assume that one trip costs 1 R (a realistic assumption), and that the unit price of other goods is 1. Our worker finds a job at 6 R per day, which implies two trips at 1 R each per day. He faces a budget constraint BC. He will maximize his utility by locating in R, consuming 2 units of transportation and 4 units of other goods. He will be on indifference curve I1. But one sees that our worker would be equally well off if he were at point S, consuming 0 unit of transportation and S (with S about equal to 3.5) units of other goods. For him a formal job paid 6 R implying a trip far away from his home is no better than an informal job near home providing about 3.5 R per day. If he manage to obtain more than 3.5 R near home, our worker will not take the formal job.

What does VT does for our worker? It moves his budget constraint form BC to DTC. Our worker will now maximize his utility by locating in T, consuming 2 units of transportation and 6 units of other goods. He is now on indifference curve I2, which represents a much higher level of utility than I1.

Figure 5 - VT and Worker's Utility



All things considered, it is not easy to pass a judgment on the VT system. Its drawbacks and failures are serious. But its benefits are massive. It incorporates millions of low wage workers into the job market, for their own benefit, and for the benefit of the economy at large. It should not be abandoned altogether. It could be modified and improved.

A much talked about modification is the introduction of "smart cards". Each worker would be given a personal magnetic card at the beginning of each month, to be used to pay for public transport trips. This is likely to reduce some of the present "leakages" and illegalities in the system. Not too much should be expected from it, however. The smart card will not be costless. The ingenuity of frauders is infinite, and they will probably find ways of frauding smart cards. Finally, some of the leakages are welfare improving; closing them will harm some workers, for no clear benefit.

A second possible modification would be to increase wages by the amount of the VT. This is already done for Federal government employees and school teachers, who receive in cash a "transport bonus" instead of a VT. The present progressive nature of the VT could be retained. This measure would greatly simplify the system, thus limiting some of the fraud associated with it. It would be neutral relative to the location of households. But it would work against formal public transport companies, that would lose the partial monopoly they have on work trips of VT recipients.

A third modification would be to extend the VT system to some non-work trips of the poor, such as trips to find a job, or trips to health or education centers. The great advantage of this measure is that it could be targeted to the non-working poor, who are often the poorest, and who do not benefit from the present VT system. The difficulties are that such a system would be costly, and difficult to administer.

V - Modal Dimension

The desirable relative importance of modes varies obviously from city to city, as a function of size, densities, income, and infrastructure heritage. It nevertheless calls for some comments.

A first issue, which is surprisingly not commented at all in Brazil, relates to the desirable importance of the automobile, and of road construction in urban areas. As a matter of fact, in practically all policy documents "urban transport" is synonymous with "urban public transport" See for instance SEDU/GETU 2001). The dominant view –constantly repeated– is that there are strong negative externalities associated with private car use, and consequently that the first objective of policy should be to reduce private car use as much as possible. The less cars, the better. This "priority to public transport" means (i) less road space for cars, (ii) more taxes for cars, and (iii) more expenditures on public transport.

This is a non sequitur. The existence of automobile-related externalities does not imply that less automobiles should necessarily be better. These externalities should be assessed, and compared with the benefits associated with automobile usage, with a view to determine the optimal level of auto usage. In certain cases, this level might indeed be lower than the present level. But in other cases, it will be higher than the present level, and reducing the present level will definitely be sub-optimal. More consideration should therefore be given to the costs of automobility, and to its benefits.

Costs of Auto Usage

Everybody keeps repeating that congestion levels in Brazilian cities have become unbearable. It is quite obvious that cities like Sao Paulo —the third most populated agglomeration in the world— or Rio -a city with more than 10 million people, and a complicated geography of mountains and shoreline— do not constantly operate under free flow conditions. It is also obvious that people hate to be slowed down as they drive, and resent "congestion" very much. A cold look at traffic conditions, however, suggests that the magnitude of "congestion" in Brazil is seriously exaggerated by popular opinion.

Before looking at the data, two general points can be made.

The first is that congestion is a pervasive phenomenon that occurs as soon as there are more than a few people on a given road. It is not undesirable in itself. Roads are not built to be near empty, and free flow condition is likely to reflect overinvestment. For a given road, there is an optimal level of congestion. This optimal level of congestion varies over the course of time with the demand for the road. An important question is: how far are we from this optimal level, and how important is the price that society pays for not being at this optimal level.

The second point is that what matters is not congestion, but the speed, or rather the speeds, at which people travel in a city, as explained in section II of this paper. Some of the kilometers driven are driven at a speed of 60 km/h, other at a speed of 20 km/h. There is a distribution of kilometers driven by speed, that gives a good idea of traffic conditions in a city. It is always dangerous to reduce a curve to one point. If it were to be done, it is probably the median point that would be the most meaningful: the speed such that half the kilometers driven are driven at a higher speed. To focus on congestion is to focus on the tail of the distribution, and it does not give a good idea of the distribution.

The much-quoted data on "extreme congestion" in Brazilian cities seems to originate from one single survey, conducted by IPEA, a respected research institute and ANTP, the public transport lobby (IPEA/ANTP 1998, IPEA/ANTP 1998a, Vasconcellos et al). Data was collected on speed, density and flows for cars and buses on 1,600 "links" in 10 different cities. The length of links varied from 300 m to 3 km. The links were not chosen in a random fashion, but selected as the *most congested links* in each city. The time periods retained for measurements were not random either, but were the *most congested moments* of the day, the morning and evening peak. The study produces data on road usage on the one hand, and on "congestion" and its costs on the other hand.

The picture that emerges from the data on road use, however, is not that of gridlock, as can be seen from Table 8.

Table 8 - Average Speed at Peak Hour on Most Congested Links, Ten Cities, 1998

	Cars Morning Peak (km/h)	Cars Evening Peak (km/h)	Buses Morning Peak (km/h)	Buses Evening Peak (km/h)
Sao Paulo	27	17	17	12
Rio	23	26	17	18
Belo Horizonte	26	23	16	16
Recife	28	23	18	14
Porto Alegre	29	28	22	20
Brasilia	45	44	28	27
Curitiba	26	22	21	19
Joao Pessoa	29	27	19	18
Juiz de Fora	38	31	22	22
Median	27.5	25	18.5	18

Source: IPEA 1998, p. 33

Traffic speeds seem unrelated to city size. The median speed is 26.5 km/h for cars and 18.5 km/h for buses. These are not particularly low numbers for urban links, characterized by many crossings and traffic lights, and of course, for buses, many stops where people exit and board. But these numbers grossly underestimate true "average" or median speeds in Brazilian cities. They refer to the most congested links at the most congested hours. Admittedly, a large share of total kilometers driven are driven in these conditions. But many kilometers are also driven on other types of roads, at other moments of the day – at much higher speeds. The true median speeds in Brazilian cities are well above 30 km/h for cars and 20 km/h for buses.

The study offers another indicator of road usage: the average ratio of volume to capacity, by type of road. Volume and capacity are flow concepts (and are measured in car-equivalents per hour. It distinguishes between three types of roads (expressways, arterial I, arterial II, collectors). Capacity is defined as 525 car-equivalents multiplied by the width of the road in meters, and reduced to take account of green lights. A bus is taken to be equivalent to two cars. The results (IPEA/ANTP 1998a, p. 45) are quite striking. Volume to capacity ratios for expressways, at the morning peak hour, range from a low 34% in Rio to a high 77% in Sao Paulo. For arterial I types of road, the ratio varies from 0.26 in Juiz de Fora to 82% in Sao Paulo. For arterial II types of roads, it ranges from 0.29 in Juiz de Fora to 58% in Sao Paulo. At off peak hours, these ratios would of course be lower. On average, even at peak hours, roads are not full in Brazilian cities. As the authors of the study indicate, "stretches of roads with very high volume/capacity, that create congestion, remain diluted in the general average" (IPEA/ANTP 1988b, p. 44). In principle, a given volume/capacity ratio can be produced by two different speeds, corresponding to the two parts of the speed-flow diagram. In the lower part of the curve, a low volume/capacity is an indicator of a high congestion. This case, however, appears not to be envisaged by the authors, and it seems that we are always on the upper part of the curve.

The mission members made about 50 urban trips in four cities, to and from airports, hotels, meeting places. This does not constitute a very representative sample, but it is nevertheless worth noting that none of these trips met a serious traffic jam.

The IPEA/ANTP study then continues by estimating "congestion" and its costs. It distinguishes between four types of roads (expressways, arterial I, arterial II, collectors) and three levels of road demand (defined in relation to a volume/capacity ratio). For each of these 12 cases, the study postulates an ideal, or acceptable speed, or travel time. Congestion is defined as the difference between this ideal situation and the actual situation.

A first indicator of congestion is offered in the form de "delays", expressed as a share of actual travel time, for both cars and buses. These delays are decomposed in delays due to traffic lights and to congestion in the case of cars (for buses, see below), and appear in Table 11.

Table 11 - Delays Incurred by Cars, by Cause of Delays, Most Congested Links, Evening Peak Time[a], Eight Cities[b], 1998

(Delays, in % of travel time)

	Traffic lights	Congestion	Total
Belo Horizonte	30	6	29
Recife	15	17	33
Porto Alegre	21	8	30
Curitiba	30	4	35
Brasilia	6	2	8
Campinas	23	6	29
Joao Pessoa	21	2	23
Juiz de Fora	17	0	17

Source: IPEA/ANTP 1998 p. 16 (or IPEA/ANTP 1998a p. 36)
Note:[a]Data is also available for the morning peak hour; delays are less important at the morning peak hour; [b]Data for Sao Paulo and Rio is not given ("Available data produced numbers inconsistent with reality")

Delays due to congestion do not appear very important, except in the case of Recife. In all cases, except Recife at the evening peak hour (but not at the morning peak hour), delays due to congestion are much less important than delays due to traffic lights.

Other indicators of congestion are offered in the form of time "lost" in congestion. The so-called time lost is the difference between the actual time on the one hand and the ideal time (taking into account the number of traffic lights) on the other hand. The study arrives at the much quoted figures of 250 millions hours lost per year for car passengers and 256 millions hours for bus passengers. Table 10 puts these number in perspective, by relating them, for the cities of the IPEA/ANP study, to the total number of hours spent in transportation.

Table 12 - Time Lost in Congestion as a Share of Time Spent in Urban Transport, Ten cities, 1998

	Car transportation			Bus transportation		
	Time Lost (M h/year)	Time Spent (M h/year)	Lost/ Spent (%)	Time Lost (M h/year)	Time Spent (M h/year)	Lost/ Spent (%)
Sao Paulo	198	1205	16	118	2696	4
Rio de Janeiro	33	499	7	80	2480	3
Belo Horizonte	6	115	5	40	8	
Six other cities	13	303	4	18	1212	2
Ten cities	250	2122	12	256	6888	4

Sources: Time lost is from IPEA/ANTP 1998, p19; for Sao Paolo and Rio time spent for each mode was estimated by multiplication the number of passengers/day by 300 days and by the average time by mode (as indicated in Table 13 below); for Belo Horizonte, the number of passengers per day was multiplicated by 300 days and by an estimated 25 minutes for cars and 50 minutes for buses; for other cities, a ratio of bus trip per inhabitant was computed on a sample of cities and multiplied by the number of inhabitants; car transport time was estimated to be 25 minutes and bus transport time to be 50 minutes.

The 500 millions hours lost in congestion for 10 cities sounds impressive. A closer look, however, shows two things. One is that time "lost" because of congestion —as defined in the study— in Brazil is largely a Sao Paulo phenomenon. The other is that this time represents a relatively small share of time spent in transportation: about 2-4% for bus transportation, and 4% to 16% (in Sao Paulo) for cars. When one considers that time lost is time lost in relation to a reasonable, but nevertheless arbitrary, ideal situation, this does not appear like an unbearable situation that deserves to become the foundation of all transport policies.

Everybody keeps repeating that congestion has reached unbearable levels in Brazilian cities, and that the costs of auto usage can no longer be tolerated. When pressed for data, analysts and policy-makers quote what appears to be the only serious study of the issue. However, a cold look at the data on which this study is based suggests a very different picture. There are obviously some worrying congestion episodes, particularly in Sao Paulo —the third largest world city— and in Rio. But they are the exception rather than the rule.

Benefits of auto usage

Just as the costs of auto usage are exaggerated, the benefits of auto usage are minimized. In most cases, they are not even minimized, they are simply ignored.

Auto usage produces gains in time. Total (i.e. including access time) travel speeds by automobiles are generally much higher than public transport speeds. Not only are vehicle speeds higher, but private car trips generally save the access time (at origin and destination) and the waiting time inherent to public transport —which can be and are extremely important. Table 13 provides data on transport time by mode for Sao Paulo and Rio.

Table 13 - Transport Time by Mode, Sao Paulo and Rio; Recent Years

	Walking	Train	Metro	Bus	Auto
Sao Paulo, 1997, average					
Travel time	nd	85	75	55	23
Access time	-	14	20	13	2
Total time	nd	99	95	68	25
Rio, 1995, peak time					
Travel time	17	76		54	35
Access time	-	8		8	5
Total time	17	80		62	40

Sources: For Sao Paulo, Vasconcelos in ANTP 2000, p. 13, from an O-D survey; for Rio, Aquino 1996, from a 5,100 households survey.
Note: Access time data for Rio is suspect.

This data must interpreted with care. Transport time reflects both the speed and the length of trips. Train trips are probably longer than other trips, and differences in transport time do not quite reflect differences in speed. Nevertheless, in Brazil —as elsewhere— private automobile is a much faster mode than public transportation. In Sao Paulo —probably an extreme case— 37.6% of all public transport trips take more than 2 hours. This makes private car, in spite of all that is said about congestion, is a major time saver. It is the main reason why all the people who can afford a car, do it, and why motorization rates increase[1].

Obviously, the benefits of car usage only accrue to the people who own and/or use a car. This excludes the very poor. Car ownership and usage, however, is not limited to the very rich. Table 14 gives the number of automobiles per households as a function of income in Sao Paulo.

[1] This is presumably also the reason why the headquarters of CBTU (the suburban train company, the one which is being decentralized) are located in an elegant suburban area of Rio that can only be accessed by automobile.

Table 14 - Car Ownership as a Function of Income, Sao Paulo Metropolitan Region, 1998

Monthly Income (in $)	Share of pop (in %)	Auto per household
<240	20.8	0.14
240-480	28.1	0.31
480-900	26.6	0.60
900-1800	17.2	1.07
1800	7.9	1.69

Source: ANTP 1999, p. 92

Less than 15% of the people living in very poor households (the lowest quintile) have access to a car, but this ratio rapidly increases with income. It reaches 60% in the 5th to 7th deciles. One should note, however, that these numbers refer to the richest Brazilian city, and that they would be lower in most other metropolitan regions.

A second benefit of auto usage is fiscal. Private cars, as mentioned above, are net contributors in terms of public finance, whereas public transportation is subsidized. The more people shift from public transportation to private cars, the better for public finance, and vice versa. This is of course not the only consideration that should prevail in policy making, but it is an important one that should not be ignored.

Road v. Rail Policies

In the past years, public policy has heavily favored rail transportation over road transportation, as well as public transportation over private transportation. Most investment subsidies have been directed at trains and metros. The VT, as an operation subsidy, benefits rail transportation nearly as much as bus transportation.

Plans for the future are also focussed on rail transportation, and very little seems to be envisaged for road construction and maintenance. At the Federal level, planned government expenditures targeted to urban transport for the 2,000-2,003 period amount to 3,900 M R for trains and metros as opposed to 140 M R to roads. This is a ratio of 28 to 1 in a country where the ratio of metro and train transport to road transport in cities is about 1 to 50. This amounts to spending over one thousand times more per rail passenger than per road passenger. At the local level, policies are similar —although not as extreme. The State of Sao Paulo has prepared a detailed and impressive "integrated urban transport plan (PITU) for 2,020" for the metropolitan region, with an identification and cost estimates of required investments. Table 15 contrasts the distribution of projected investments with that of traffic. It shows that rail traffic, representing about 12% of passenger trips is to get 80% of investments.

Table 15 - Traffic & Projected Investments, Sao Paulo, 2,000-2020

	1997 traffic (%)	Projected investment (%)
Trains & metros	12	80
Roads	88	20[a]
Buses	29	
Automobiles	48	
Vans	1	
Total	100	100

Source: Calculated form: Government of the State of Sao Paulo 2000, pp. 15 & 31
Note: [a]Road investments in general benefit both bus and car transportation, most of the proposed "road investments" appear to be for bus transportation only.

There might be a case for such a disproportionate allocation of resources. But the case should be made, and not rest on vague references to road externalities. And it should also be made by independent analysts, not merely by representatives of the public transportation lobby[1]. In large and dense areas, rail transportation is a must. Its comparative advantage is greatest for heavy flows of people. But it is not clear that presently metro and above all train lines meet that criteria. Table 16 indicates the average daily traffic on the rail networks.

Table 16 - Traffic of Urban Rail Networks in Brazil, 1998

(in passenger per day per km of track)

	Trains	Metros
Sao Paulo	44,000	240,000
Rio de Janeiro	10,000	42,00
Belo Horizonte	28,000	
Porto Alegre	42,000	
Fortaleza	6,500	
Salvador	1,800	
Natal	500	

Source: Calculated from ANTP, *Anuario Statistico Dos Transportes* 1998, as: (yearly passengers x by average length of trips) divided by (365 days x length of tracks)

With the notable exception of the Sao Paulo metro, these daily traffic flows are surprisingly low. Any road with three lanes x two, or even two lanes x two can and do accommodate such traffic flows with private cars, and a fortiori buses. It is true that these numbers are

[1] Practically all the information available emanates from ANTP. The State of Sao Paulo Secretary fo Metropolitan Transport is simultaneously chairman of ANTP.

averages, and that flows on some parts of the rail networks are bound to be much higher. It is also true that these numbers reflect both supply and demand, and that the supply of train transportation has greatly improved in recent years (thanks to the massive investments that have been made), and that patronage is increasing.

On the other hand, the demand for urban transport is changing, and these changes do not favor rail transportation. The evening out of densities in Brazilian agglomerations, the slower growth of the two megacities, not to mention the increase in motorization rates, suggest that the demand for mass transportation on suburb to center corridors will not increase very fast in the future. It will increase significantly in certain cases, for sure, and these increases might justify additional rail investments. But in many other cases, traffic is unlikely to increase sufficiently to justify heavy rail investments.

The real challenge of urban transport in Brazil is in meeting the transport demand generated by new urban patterns and income levels. The most important increases in demand will be for suburb to suburb trips, for non work purpose trips, for faster and more comfortable trips. This demand will better be served by road transportation. Brazilian cities need more roads. The present quasi exclusive focus on rail, that implies a neglect or road construction, runs the risk of a serious misallocation of resources.

Bus v. Car Policies

Roads are used by cars and buses alike. The present proposed policies are systematically anti-automobile. What is envisaged is (i) to reduce the road space allocated to private cars, (ii) to increase auto usage taxes, and (iii) to make car parking more difficult by prohibition of taxation. The idea is that by increasing the cost (including the cost in time) of automobile usage, automobile users will shift to public transportation. This strategy is unlikely to succeed, but it will have a high cost.

The advantages of the private automobile in time saved, in safety and in comfort are so great, and are increasing so rapidly because of changes in income and urban patterns, that the strategy will have limited success. Reducing road space allocated to automobiles will obviously increase congestion[1]. Halving the speed at which automobiles drive will in most cases not suffice. Someone who has to chose between a 20 minutes car trip and a 60 minutes public transport trip will continue to use his/her car even if it takes 40 minutes to drive, and probably even it if takes 60 minutes. Only a handful of car drivers will shift to public transportation. All the present car users will be penalized. Either they shift to public transportation as a result of these repressive policies, and they are by definition worst of. Or else they continue to use their cars, but they now spend more time and money because of these repressive policies. In Sao Paulo, these car users are as numerous as all public transport users.

Public transport users, it can be argued, will gain, if the road space taken away from cars is given to bus lanes. This can only be true of bus users, not of train and metro users. Bus trips represent only about 70% of car trips in Sao Paulo, but a much larger ratio in other cities. Buses do ride faster in exclusive bus lanes. The gain, however, is not always as large as is often expected. This is because driving time is only a fraction of the total time of a bus trip. Access time, waiting time, traffic lights time, and time spent at stops are not affected by exclusive bus lanes. In addition, buses slow down each other in exclusive bus lanes (a form of congestion). The potential gains of eliminating "ordinary" road congestion for buses are probably small, more symbolic than real. As a matter of fact, they have been estimated in the much quoted IPEA-ANTP study, as shown in Table 17. That study defines "ideal" transport times for buses, on the most congested links, and compares it with "actual" transport times. The difference, called delays, is allocated between delays due to traffic lights, delays due to stops, and delays due to congestion.

[1] That it be done in the name of fighting congestion is somewhat ironic.

Table 17 - Delays Incurred by Buses, by Cause of Delays, Most Congested Links, Evening Peak Time[a], Ten Cities, 1998

	(Delays, in % of ideal transport time)			
	Traffic lights	Congestion	Stops	Total[b]
Sao Paulo	8	16	12	36
Belo Horizonte	19	4	c	34
Recife	9	3	12	25
Porto Alegre	9	3	15	29
Curitiba	19	2	14	35
Brasilia	3	2	c	15
Campinas	7	1	5	16
Joao Pessoa	9	1	19	29
Juiz de Fora	10	0	17	29

Source: IPEA-ANTP 1998p. 37
Notes: [a]Data is also available for the morning peak time; delays are smaller at the morning peak; [b]Total is not equal to the sum, because "other" causes of delays are not indicated; [c]Classified under other.

Table 15 suggests that, with the exception of Sao Paulo (and perhaps of Rio, for which no data is available), delays caused to buses by congestion represent only 1-4% of the ideal transport time. They are 4 or 5 times less important than delays caused by the inevitable stops or traffic lights. Exclusive bus lanes would eliminate these delays —assuming no bus congestion, an optimistic assumption. We have seen that bus trips last on average 55 minutes (in Rio and Sao Paulo). The time saved would amount to 1.5-6 minutes per trip. This is not negligible, but not massive either, particularly when one considers that it relates to the most congested links in the cities selected, and at the most congested time period. On most links and off-peak periods, the gain would be even more modest. In Sao Paulo, the delays caused by congestion are more important and their elimination would produce larger savings of about 6 minutes per trip (on the most congested links and times). But Sao Paulo is also the place where car trips are much more numerous than bus trips, and the time saved on bus trips would be more than compensated by the time lost on car trips.

This is not to deny the fact that, on certain streets and roads, exclusive bus lanes are socially desirable. But this is to question the widely accepted view that exclusive bus lanes are systematically desirable. The creation of an exclusive bus lane produces benefits (for bus users) and costs (for car users). Benefits are not as important as is generally assumed. Costs cannot be ignored. Both must be assessed, on a case by case basis, and decisions taken accordingly.

The best instrument to deal with congestion where and when it is a serious problem is the introduction of congestion pricing. Congestion pricing, the introduction of a charge equal to the marginal cost of congestion, will not "eliminate" congestion —an uneconomic goal— but reduce it to the optimal level. It should be seriously considered and investigated, for certain areas or routes. Whether the economic costs of assessing and collecting the tax are worth the economic gains it will produce is an empirical matter.

Exclusive bus lanes and congestion taxes should therefore be utilized when and where appropriate, but only when and where appropriate. In many cases, however, building new roads or improving existing roads will be the best solution. Present urban transport policies ignore roads; they should not.

VI - Conclusion

This note has attempted to discuss some of the dimensions of urban transport in Brazil. It emphasizes the great economic, and consequently social, importance of an efficient transport system —efficient in the sense of transporting as rapidly as possible people, particularly for work, in urban areas. It examined the public policy interventions in favor of urban transport that have taken, or are taking, place. The two most significant are (i) massive programs of investments in rail transport (for a yearly equivalent of about half a billion US dollars), and (ii) the Vale Transport system, a tax paid by enterprises and earmarked to sustain the demand for public transport (far an amount of about a billion US dollars per year). In spite of many weaknesses, the VT is found to be a good system, because of its broadly (although imperfect) progressive nature.

One other finding of this paper relates to the relative importance that is given and should be given to rail versus road, and to private transportation versus public transportation. The dominant, and even hegemonic, view is that rail transportation should get attention and resources, and that roads should be primarily reserved for buses. In general, both ideas are mistaken, and dangerous. Urban transport policies must plan for road construction and improvement. And urban transport connot be reduced to public transport. Consideration of the trends in spatial development reinforces this view. Urban trips will more and more be trips in relatively low density areas, and in medium sized cities —trips that often cannot easily be satisfied by public transport in general and even less so by rail transport.

The author of this paper was also surprised by the relatively low level of information and analysis of urban transport issues in Brazil. The same few and questionable numbers are repeated and quoted. A disproportionate share of data and analysis comes from one single lobby. There is nothing wrong in having a lobby producing analysis and studies, often of a reasonably good quality. What is wrong is that it be the major, nearly monopolistic, source of information.

This paper has not touched upon what is probably now the most important issue in urban transport in Brazil, namely the organization of bus transportation. Bus transportation remains, and will remain in the coming decades, the major mode of urban transportation, particularly for the poor. It does not function well, and it is in deep crisis. Significant changes will have to be introduced.

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