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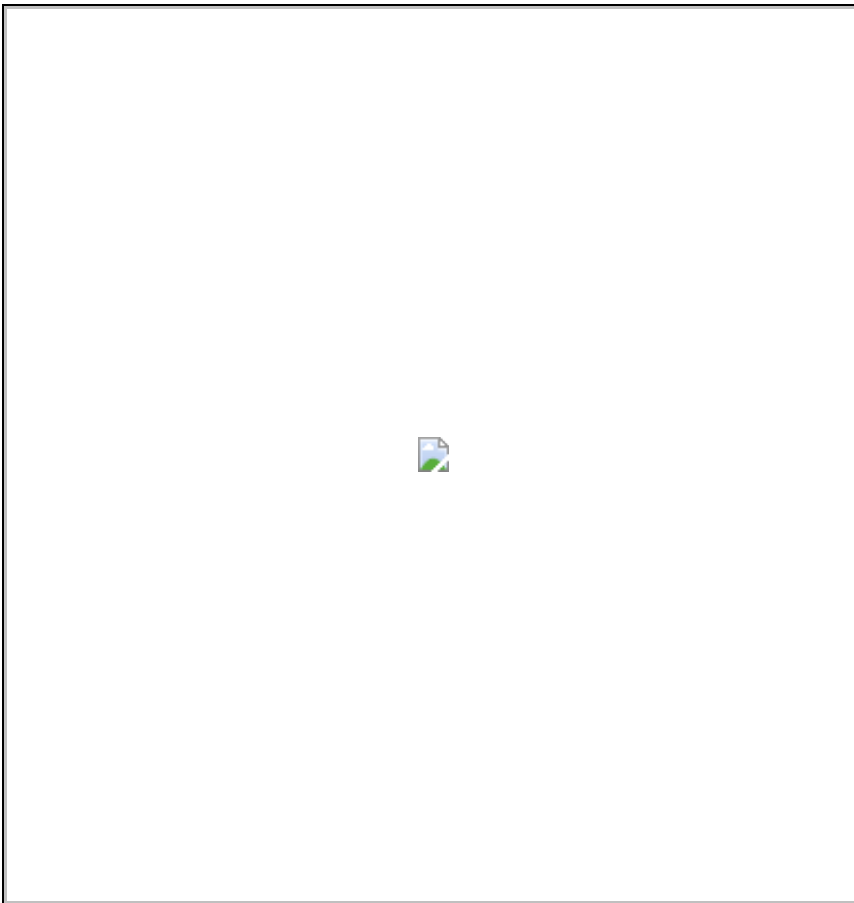
TRAFFIC CONGESTION: ITS ECONOMIC AND SOCIAL CONSEQUENCES

Urban transport in the largest Latin American and Caribbean cities consumes about 3.5% of regional GDP — a percentage that is inflated by the effects of traffic congestion. In addition to the costs of congestion in terms of lost economic efficiency, there are also negative consequences in terms of social cohesion. The phenomenon of traffic congestion, which is caused mainly by relatively wealthy car drivers, lengthens journey times and, more importantly, forces up public transport fares. Owning a car is one of the fruits of human progress; using it in conditions of acute congestion or contamination is a social ill. For further information, please contact Ian Thomson ithomson@eclac.cl.

WHAT IS CONGESTION?

Popular use and dictionary definition. "congestion" is a word that is commonly used both by technical people and by the general public, but its precise meaning is not very easy to pin down. Dictionary definitions tend to define it as the action and effect of congesting or being congested; but that does not tell us much unless we know what "congesting" means. Some dictionaries go on to explain that, figuratively, "congesting" means blocking the way, or obstructing the circulation or movement of something. In our case this "something" would be vehicle traffic.

Towards a practical definition of traffic congestion. Even specialized texts sometimes fail to offer very rigorous definitions. One possible objective definition would be "the condition that prevails when the entry of an additional vehicle into a traffic flow increases journey time for other vehicles." See figure 1, which plots, as the function $f(q)$, the time (t) needed to travel along a street, for different traffic volumes (q).



In this figure, according to our definition, congestion would begin at traffic volume $0q_0$. This means that congestion generally starts at quite low traffic volumes. To adjust the definition to popular understanding of the concept of congestion, while retaining the principle of objectivity, the term could be defined as "the condition that prevails if the entry of an additional vehicle in a traffic flow increases journey times for other vehicles by more than $x\%$ ". In the figure, the function $\delta(qt)$ $\delta q = t + qf'(q)$ shows the change in total journey time of vehicle in a traffic flow, when this flow is increased by one unit. Up to the point where congestion, as defined above, begins (i.e. provided the volume is no greater than $0q_0$), the two functions

coincide, and the change in total vehicle journey time is simply the journey time corresponding to the vehicle entering the flow. From $0q_0$ onwards, however, every extra vehicle entering the traffic flow increases journey times for the rest, and the two functions diverge. One objective, though still arbitrary, definition of congestion would be the volume of traffic at which $\delta(qt)$ $\delta q = at_0$, where, for example, $a = 1.50$.

THE CAUSES OF CONGESTION

A little congestion is healthy. In the previous section we referred implicitly to the basic cause of congestion, namely the friction between vehicles in a traffic flow, such that the entry of an additional vehicle impedes the circulation of the others. In an urban area, especially at times of high demand, congestion is inevitable; in fact, up to a point, it is even desirable since the cost it imposes may be less than the cost of eliminating it.

The problem is mainly caused by cars. Some vehicles generate more congestion than others. In traffic engineering, each vehicle type is defined in terms of equivalent passenger car units, or pcu. A private car has a pcu factor of 1.00; the pcu equivalence of other vehicle types depends on how much they disrupt the traffic flow, or the highway space they actually occupy compared to a car. Usually a bus is considered to have a pcu of about 3.00, and a truck 2.00. Strictly speaking, the pcu factor varies depending, for example, on whether one is considering the approach to a highway intersection or a stretch of road between intersections.

Although a bus causes more congestion than a car, typically more people travel in a bus than

in a car. If a bus carries 50 passengers, and a car 1.5 people on average, then every car occupant produces 11 times the congestion attributable to each bus passenger. Thus, *ceteris paribus*, congestion decreases if the share of buses in the journey modal split increases. On the other hand, in situations where a bus carries fewer than 4½ passengers, these would cause less congestion if they were to travel in cars. Although buses do not normally transport fewer than 4½ passengers, it does sometimes happen — for example, the off-peak hours in Santiago, Chile, in the latter part of the 1980s, or in Lima ten years later.

Latin American habits also contribute to congestion. Apart from this, certain ways of behaving are more likely to cause congestion than others. In some cities (Lima, for example) car drivers, in an attempt to gain themselves a few extra seconds of journey time, have the habit of advancing as far as they can at intersections; this blocks the traffic flow and ends up generating extra delays for others that are much greater than savings they obtain for themselves. In other cities, such as Santiago, the tradition of buses stopping just before intersections is also a cause of congestion (and accidents). In cities with an abundant supply of taxis, such as Lima or Santiago, the phenomenon of taxis being driven around at a swan's pace looking for passengers is another source of congestion. In many Latin American cities the presence in traffic flows of old or badly maintained vehicles is a further aggravating factor.

A badly designed or poorly maintained street system also causes unnecessary congestion. An example of this are bus stops located just where the road narrows — a frequent occurrence in a number of cities. In many Latin American cities, such as Caracas, rainfall accumulated on the road surface reduces the road's capacity and thus increases congestion; sometimes the pavement also gets damaged, so the capacity constraint persists long after the rain has ceased.

Another factor aggravating congestion is lack of knowledge about traffic conditions. Given two alternative routes available to reach a destination, if a motorist knew traffic conditions were worse on road A, s/he could take road B where her/his own contribution to congestion would be less. Simple lack of geographic knowledge can also increase the average distance travelled on each journey and contribute to congestion. A hypothetical study carried out at the University of Texas, in the USA, suggests that keeping drivers informed about traffic conditions on different parts of the highway network could reduce congestion far more than imposing road user charges.

Generally speaking in Latin America, motorists' behaviour compounded by the condition of the highway network and vehicle maintenance, reduce the effective capacity of a street, or network of streets, compared to those of equal geometric dimensions in Europe or North America. Measurements made in the early 1970s showed that an expressway in Caracas had a capacity of just 67% of its similar-sized North American counterpart.

THE COSTS OF CONGESTION AND WHO PAYS THEM

Congestion raises bus fares and delays their passengers. As mentioned above, congestion is generated mainly by motorists, who not only suffer the consequences of their own actions, but also have public transport users pick up a major part of the bill. In Caracas in 1971 (at 2000

prices) every occupant of a motor car was responsible for a congestion cost of USD 0.18 per km, while each bus passenger generated just USD 0.02.

In Latin America particularly, the incomes of urban bus users are far below those of urban motorists. In Santiago, an analysis of data generated by the 1991 origin-destination study indicated that the family income of bus passengers was some CLP 99,321 per month, while that of motorists was about CLP 308,078. In other words, the incomes of car occupants were more than three times those of bus passengers. Data for São Paulo show that in principle the situation there is no different from that in Santiago. Moreover, if there were figures for other cities in the region, the conclusion would probably be the same.

Congestion not only delays bus passengers, but also, obviously, the buses themselves. This generates a need for additional vehicles, plus drivers to operate them. Fares go up as a consequence.

Table 1: Increases in public transport operating costs caused by vehicle congestion in Brazilian cities	
City	Increase in bus operating costs attributable to congestion
Belo Horizonte	6.2%
Brasília	0.9%
Campinas	6.4%
Curitiba	1.6%
João Pessoa	3.7%
Juiz da Fora	2.1%
Porto Alegre	2.6%
Recife	3.5%
Rio de Janeiro	9.6%
São Paulo	15.8%

This phenomenon was analysed by ECLAC in 1982, and more recently for the largest Brazilian cities, where bus transport operating costs are estimated to be up to 16% higher than they used to be, as a result of traffic congestion. See table 1. Note that the percentage values are very low in Brasília, where highway space is exceptionally abundant, and Curitiba, where buses operating radial routes travel along exclusive lanes.

How serious is the problem? The operating costs of vehicles used in cities of over 100,000 inhabitants consumes about 3.5% of gross domestic product (GDP) in Latin America and the Caribbean, excluding optional journeys such as those undertaken at weekends. The social value of journey times is equivalent to roughly another 3% of GDP, so clearly very significant amounts of resources are used in urban transport. It would therefore seem reasonable to expect that moderate-cost measures to reduce congestion would yield significant benefits through shorter journey times.

Source: *Estudio de diseconomías del transporte urbano en Brasil: los impactos de la congestión*, Boletín de los Transportes Públicos de la América Latina, ANTP, Year V, No. 30, São Paulo.

Even though it implies longer journey times, Latin Americans generally continue to show a strong preference for travelling by car. There are a variety of explanations for this, some

stemming from social structure and cultural characteristics; People also worry, with or without reason, about the risk of theft on board public transport vehicles, especially crowded buses at peak hours, etc. Faced with the choice of reaching the destination slowly by car travelling on congested roads, or a little more quickly via public transport, it is by no means certain that all Latin America motorists would always choose the second, quicker, alternative. This attitude is likely to change in the future. In fact in certain cities of higher cultural level, such as Buenos Aires (where the quality of public transport is also above the average for Latin American cities), one can already discern a relatively greater willingness on the part of the travelling public to use public transport.

This preference for travelling by car has a number of consequences, some of which transcend the bounds of the transport sector as such and have negative macroeconomic implications. Consider the fuel price hikes that have occurred in 1999 and 2000, stemming from increases in international crude oil prices. The typical Latin America motorist is probably not using his car much less than before; instead, s/he makes sacrifices by cutting consumption of other goods and services. In the short run at least, this reduces demand for such products, many of which are likely to be produced by the domestic economy, while at the same time making it likely that instead of reducing the quantity of foreign currency the country spends on imports, it spends more as a result of higher oil costs.

The more sectoral-based impacts caused by traffic congestion include the following:

- Demand among motorists for new public transport systems could be quite small, given that the vast majority of users of a new metro line, for example, would probably take passengers from buses rather than private transport;
- To attract motorists to public transport, they need to be offered better alternatives, not

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