

¿Es posible reducir la congestión?

Juan de Dios Ortúzar

Para atacar el problema de congestión vehicular en ciudades se deben conocer sus causas, importancia y entender por qué el fenómeno tiende a empeorar en el tiempo. En esta contribución, además de lo anterior se estigmatiza la solución tradicional (de sentido común), consistente en construir infraestructura, y se mencionan paradojas que ayudan a entender por qué esta propuesta ha fallado de forma tan espectacular en todo el mundo. Se concluye con una somera explicación de las componentes esenciales de una estrategia eficaz de solución al problema.

¿Qué es y cuánto cuesta la congestión?

Si le preguntaran a un automovilista de Atlanta o Los Angeles si existe congestión en Santiago, probablemente creería que es una broma; en estas ciudades los conductores gastan aproximadamente 55 horas al año en “tacos”, el doble que hace sólo siete años. Un informe reciente basado en la situación de 68 áreas urbanas de EE.UU., destaca

que en los últimos 20 años el tiempo perdido sentado en un taco ha aumentado tres veces, a un costo de 78 billones de dólares al año. Esto ha traído aparejados otros efectos nocivos, e incluso dio origen a una nueva expresión: *road rage*. Ejemplo de ello es el caso de una mujer condenada a 13 años de cárcel en diciembre de 2000, por haber matado a balazos a otro conductor en la salida de una autopista en Alabama (Salant, 2001). Es importante destacar que estamos hablando del país (y las ciudades) con mayor inversión en autopistas urbanas en el mundo ... claramente por ahí no parece estar la solución.

En Santiago consideramos que hay alta congestión si no podemos circular a la velocidad deseada, pero nunca hemos experimentado los niveles de congestión existentes en las grandes urbes de países desarrollados. En Ingeniería de Tránsito se calcula el grado de saturación (x) de las calles como la razón entre el flujo de vehículos (q) que circula por ellas y su capacidad (s). Existe congestión evidente cuando x es superior a 0,7 y ésta se puede calificar de caótica (como en algunas ciudades de EE.UU.) a partir de 0,9.

El costo más visible de la congestión (aunque ciertamente no el único) y básicamente lo que más

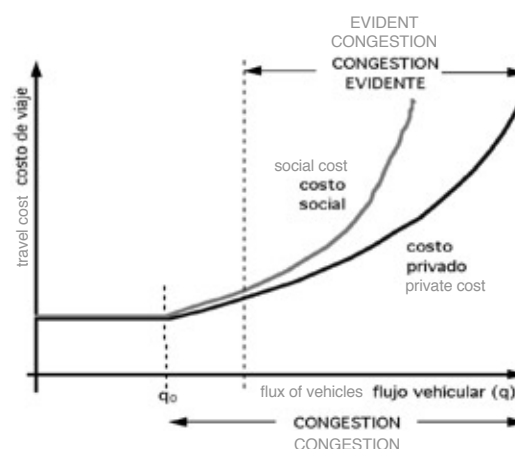
of 68 urban areas in the USA mentions that over the last 20 years the amount of time wasted in traffic jams has increased thrice, causing expenses of 78 billion dollars a year. This has brought along other side effects, such as the one known under the name “road rage”. An example of this is the case of a woman who was recently condemned to 13 years of jail in December 2000 for the murder with a gun of another driver, near the exit of an Alabama highway (Salant, 2001). It is important to point out that we are talking about the country (and the cities) with the highest budget for urban highways in the world. The solution clearly does not seem to lie that way.

In Santiago, we consider we are caught in a traffic jam if we cannot travel at the desired speed, but we have never experienced the level of road congestion that exists in the larger cities of developed countries. In Traffic Engineering, the level of congestion (x) on the streets is calculated dividing the flux of vehicles (q) circulating by them and their capacity (s). One can speak of an obvious congestion when x is higher than 0.7 and congestion can be called extreme when (as in some American cities) it reaches 0.9.

The most visible cost of congestion (though

Figura 1: Costos privados y sociales con y sin congestión

Figure 1: Private and social costs with and without road congestion



Is it possible to reduce vehicular congestion?

Juan de Dios Ortúzar

In order to tackle the problem of vehicular congestion in cities, first we need to find out its causes, understand its importance and the reasons why this problem tends to get worse over time. This paper, apart from approaching those goals, criticizes the traditional solution to this problem, based in “common sense”, and which consists in building infrastructure. Some of the paradoxes that have contributed to the dramatic failure of this approach all over the world are brought up. Finally, I will outline some of the elements that might be part of a more effective solution strategy.

What is road congestion and how much does it cost?

If somebody told a driver in Atlanta or Los Angeles that there is a big road congestion problem in Santiago de Chile, they would probably think it's a joke: in those cities, drivers spend about 55 hours a year in traffic jams, twice as much as they did two years ago. A recent report based in the situation

certainly not the only one), and the one that worries users the most is the increase in travel time. However, each of the drivers involved perceives only a part of the phenomenon: the effect of congestion on their trip, but not the effect of their trip on congestion. Figure 1 shows how, when congestion starts (q flux), the average travel time (private cost perceived by road users) starts to grow, since the presence of additional vehicles makes the flux impossible, therefore reducing average speed. More importantly, however, the amount of extra time added by each new vehicle that begins to use the roads also goes up. Unfortunately, users do not perceive this marginal, social cost. (Figure 1)

On the other hand, since vehicle flux involves cars, buses and trucks, Traffic Engineers use the concept of vehicle equivalence (v.eq.). In terms of the space it uses, for instance, a car equals 1.0 v.eq. and an urban bus amounts to 2.5 v.eq. This allows a very interesting deduction; in Santiago, for instance, cars transport an average of 1.5 passengers per trip, and a bus usually contains about 40 passengers. In other words, the average occupation rate of a bus is 12 times more efficient than that of a car for congestion purposes (in

1970) que permiten ilustrar por qué esta opción ha demostrado ser no sólo prohibitivamente cara, sino que totalmente ineficaz en la práctica, tal como ilustraba el ejemplo al principio de este trabajo. Es importante también señalar que esto fue demostrado teóricamente hace casi 40 años (Buchanan, 1964), pero cuesta convencer a quienes toman decisiones.

Por lo tanto, la única forma remanente de atacar el problema de congestión es lograr convencer a los usuarios de auto que no utilicen este medio en forma indiscriminada; para esto, lamentablemente, se necesita una política de “garrote y zanahoria”.

La propuesta de los especialistas

A diferencia de los bienes privados, los servicios tales como agua, electricidad, teléfonos y, por supuesto, las vías urbanas, son bienes públicos. Lo interesante es que se puede demostrar que si un bien público está congestionado, debe ser tarifado a costo marginal para conseguir una asignación óptima de recursos. Es curioso constatar que esto ocurre con todos los anteriores, excepto con las vías urbanas.

La tarificación vial, o tarificación por congestión (el garrote), consiste precisamente en cobrar por el uso de vías congestionadas a fin de que

sus usuarios perciban el costo social (marginal) de viajar por ellas, y tomen sus decisiones de elección de ruta, modo de transporte, etc., en forma eficiente. La cantidad a cobrar, dado un flujo determinado, es igual a la diferencia entre el costo social y el costo privado de viaje (ver Figura 1). Esto, desgraciadamente, no es fácil de implementar en la práctica; por esto se han diseñado aproximaciones, algunas de gran complejidad técnica, que ya se están aplicando en varias ciudades del mundo (Singapur, Oslo, Teherán y, a partir del próximo año, Londres).

La opinión prácticamente unánime de los especialistas es que la única forma de atacar en forma seria el problema de congestión vehicular en ciudades, consiste en proveer un buen sistema de transporte público (digno, eficiente y seguro), la zanahoria, unido a un sistema de tarificación vial en las rutas o áreas congestionadas de la ciudad. Si estos dos elementos no forman parte de la estrategia para atacar la congestión, se puede garantizar que ésta no tendrá resultado.

En particular, intentar resolver la congestión merced a construir nueva infraestructura (como la muy cuestionada autopista Costanera Norte en Santiago, o la lamentable política de reducir áreas verdes para ensanchar calles existentes), no

sólo es excesivamente caro sino que posiblemente tienda a exacerbar el problema ya que constituye una señal a favor del uso del auto y un agravante del círculo vicioso del transporte público. ARQ

Bibliografía: Buchanan, C., *Traffic in Towns*, Penguin Books, Middlesex, 1964. / Downs, A., *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion*, The Brookings Institution, Washington, D.C., 1992. / Murchland, J.D., “Braess’s paradox of traffic flow”, *Transportation Research* 4, 1970, pp. 391-394. / Ortúzar, J. de D. y Willumsen, L.G., *Modelling Transport*, 3ª Edición, John Wiley & Sons, Chichester, 2001. / Salant, J.D., “Motorists spend an average of 36 hours a year sitting in traffic: congestion is worst in L.A., how does your city rank?”, *Associated Press*, Nueva York, 5 de Julio de 2001.

Nota: Agradezco a Margarita Green por su colaboración en el texto.

two choices only. (Figure 2)

The previous equation shows that the apparently commonsensical solution (reducing congestion by building more infrastructure) does have some rational ground. There are, however, several paradoxes (see for example Downs 1962 and Murchland 1970) that illustrate why this option is not only very costly, but totally inefficient in practice, as the example given earlier illustrates. It is also important to point out that this was demonstrated theoretically 40 years ago (Buchanan 1964), but those who make the decisions are hard to convince.

Therefore, the only way to solve the vehicular congestion problem is managing to convince car users not to use that transportation means indiscriminately; in order to get to that point, unfortunately, one needs a “carrot and stick” policy, where those who follow recommendations get an incentive and those who do not follow them are discouraged through some kind of punishment.

The experts’ proposal

Unlike private goods, services such as water, electricity, phones and, of course, urban routes, are public goods. The interesting thing is that one can demonstrate that, if a public good suffers

congestion, marginal costs must be reflected in charges to users so that an optimal distribution of resources is attained. It is curious to notice that this happens with all the formerly listed public services, except urban routes.

Road tolls consist in charging for the use of congested routes, so that the users perceive the social (marginal) cost of traveling through them and make a decision concerning their travel route, transport means, etc., efficiently. The amount that should be charged for a given flux equals the difference between the social cost and the private travel expense (see figure 1). This is unfortunately not an easy rate to implement. That is why approximations, some of them of high technical complexity, have been developed, and are already being applied in several cities throughout the world (Singapore, Oslo, Teheran, and, starting next year, London).

Specialists agree unanimously that the only way to solve this problem seriously is to provide a good public transportation system (comfortable, efficient, and safe), the carrot, together with a system of road use tolls in the congested areas or routes. If these two elements are not part of the strategy to fight congestion, it can be warranted

that the fight will be lost.

In particular, trying to solve congestion through the construction of a new infrastructure (such as the frequently criticized Costanera Norte Highway in Santiago, or the absurd policy of reducing green areas in order to widen already existing streets), is not only excessively expensive, but will possibly exacerbate the problem, since it encourages the use of cars and it worsens the vicious circle of public transportation. ARQ

Bibliography: Buchanan, C., *Traffic in Towns*, Penguin Books, Middlesex, 1964. / Downs, A., *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion*, The Brookings Institution, Washington, D.C., 1992. / Murchland, J.D., “Braess’s paradox of traffic flow”, *Transportation Research* 4, 1970; pp. 391-394. / Ortúzar, J. de D. y Willumsen, L.G., *Modelling Transport*, 3ª Edición, John Wiley & Sons, Chichester, 2001. / Salant, J.D., “Motorists spend an average of 36 hours a year sitting in traffic: congestion is worst in L.A., how does your city rank?”, *Associated Press*, Nueva York, 5th of July of 2001.

Note: Thanks to Margarita Greene for her collaboration in this article.