Getting Downtown

Relief of Highway Congestion through Pricing

Stephen F. Williams

EACH MORNING a Chicago radio station presents a bulletin of traffic conditions on the major expressways in the area. On bad days, the network announces running times, such as "It's 90 minutes on the Kennedy from Mannheim to Ohio," a distance of only fourteen miles. The waste of time is staggering. Surely, one thinks, there must be ways of getting better value out of Chicago's imposing expressway system.

Two approaches are especially congenial to politicians and administrators—building more highways and managing traffic more effectively. But there is a third—making drivers pay for using the highways at peak hours of congestion. This approach is a stepsister, languishing in learned journals where equations outnumber sentences. Yet here and there it is attracting glimmers of interest. Singapore has actually put peak-hour pricing into practice, and the Urban Mass Transportation Administration is scheduled to subsidize some small experiments this summer. It is time the idea enjoyed the whirl of public discussion.

The Singapore Experience

Singapore instituted its present pricing system in June 1975. Officials designated a downtown zone of about twenty-five square miles, with twenty-two entry points. During the morning rush hour from 7:30 to 10:15 A.M., passenger cars and vans could enter the zone only if they displayed special licenses. These sold for $33 a month or $1.67 a day.* Car pools of four people or more were exempt. The government's purpose was to bring about a 25–30 percent reduction in peak-hour traffic. What happened was a good deal more dramatic. According to a before-and-after study by the World Bank ("Relieving Traffic Congestion: The Singapore Area License Scheme," June 1978), overall traffic in the priced period fell about 40 percent, car traffic 65 percent.

What happened to all the people? Car pooling increased sharply. The number of vehicles qualifying for the car pool exemption doubled, while smaller car pools also rose in number as people sought to cut the burden of the license fee by splitting it with others. Bus ridership increased too, and buses were able to move a bit faster through the less congested streets.

As the World Bank study showed, however, not all the peak-hour reduction took such a welcome form. Far too many travelers simply changed the time of their trips to just before or just after the priced period. A bit of this would have been all to the good—spreading the peak travel across a longer period and reducing the valuable time consumed by congestion. But so

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*The charges were set slightly lower initially, but raised to these levels in December 1975.

much of it occurred that traffic bulges appeared on either side of the former rush hour. Thus, traffic in the worst half-hour (10:15 to 10:45 A.M.) was only 7 percent less than it had been in what was formerly the worst half-hour (8 to 8:30 A.M.), and the old rush hour became relatively deserted. Similarly, far too many travelers simply changed their routes. Indeed, enough people whose destinations were on the far sides of the priced zone shifted to "free" roads around it to produce considerable congestion on those roads.

These not altogether expected responses provide a dramatic demonstration of what economists call "edge effects": distortions that occur when people flee a priced zone and pile up its unpriced borders. The edge can be one of time or geography. The Singapore system obviously has both—leading to the traffic bulges around the restricted morning period and around the restricted area. The system also has a combined time-and-geographic edge. To simplify monitoring, the designers did not place a charge on exit from the core, expecting the evening traffic to mirror the morning's. This did not happen. Evening traffic fell only trivially. Evidently many travelers who were headed for places across the restricted zone would skirt it in the morning but cut through it when returning in the evening.

The flaws in Singapore's scheme demonstrate the major difficulty facing the designer of a congestion pricing system: how to make it simple enough to be workable without creating too many harmful side effects.

The Basic Concept

The Singapore system, warts and all, works well enough to have lasted. But a pricing scheme, some might argue, could do little to solve U.S. traffic problems because American drivers are hopelessly addicted to their cars. There is growing evidence, however, that price matters, even here. For example, as U.S. gasoline prices increased in the 1970s, gasoline demand responded, first rising more slowly than before and then in the last two years actually falling. For another example, the initiation last year of monthly parking fees of $10 to $30 for federal employees in Washington, D.C., has caused, according to preliminary reports, a 3 to 10 percent drop in employee car use. This drop is especially impressive, given that agencies had already induced a good deal of car pooling by regulatory measures.

The simple idea underlying a congestion charge is that, because price does matter, people will tend to overuse a resource when they do not have to pay the full cost of each use. Peak-hour travelers impose delay costs on one another. Of course each traveler takes his own time into account. But on an urban expressway a driver often inflicts costs on other drivers that are several times greater than those he suffers himself. Just as the failure of society to price air and water causes these resources to be overused (polluted) and imposes costs on others, so the lack of congestion pricing leads to overuse of highways at rush hours. By making travelers bear these costs, congestion pricing persuades some of them to switch to car pooling, public transportation, and travel at less congested hours. Without prices, many a traveler is now making solo journeys whose value is not worth the total costs imposed—that is, the "private" costs of his time and vehicle operating expenses, plus the "social" costs of others' time.

In an ideal congestion pricing system every vehicle would be charged exactly the costs that it imposed on others at any particular time and place. Thus for each morning and evening period there would be matching prices, at every stage, with the most popular times having the highest prices and the surrounding times having prices that were gradually lower, but still high enough to prevent bulges. Geographically, too, prices would shade off smoothly from the routes of the highest traffic density.

Oddly enough, the technology for such an ideal system may be available at reasonable cost. Two schemes stand out. The first is an in-car meter that would run up charges based on electric impulses from control points in the streets. The other is an in-car identification device that would trigger a mechanism in the street, which would register the information necessary to charge each owner on, say, a monthly basis.

At present, however, these schemes appear unnecessarily radical. For one thing, people are not at all used to being charged for something historically provided "free," especially when it cannot be explained that the revenue is needed to pay for construction costs. With all that con-

ceptual novelty, congestion pricing probably cannot afford to be saddled with a Buck Rogers technology. In any event, more conventional devices can probably come close enough to curing the edge problems. But first let us look at the main alternatives to congestion pricing.

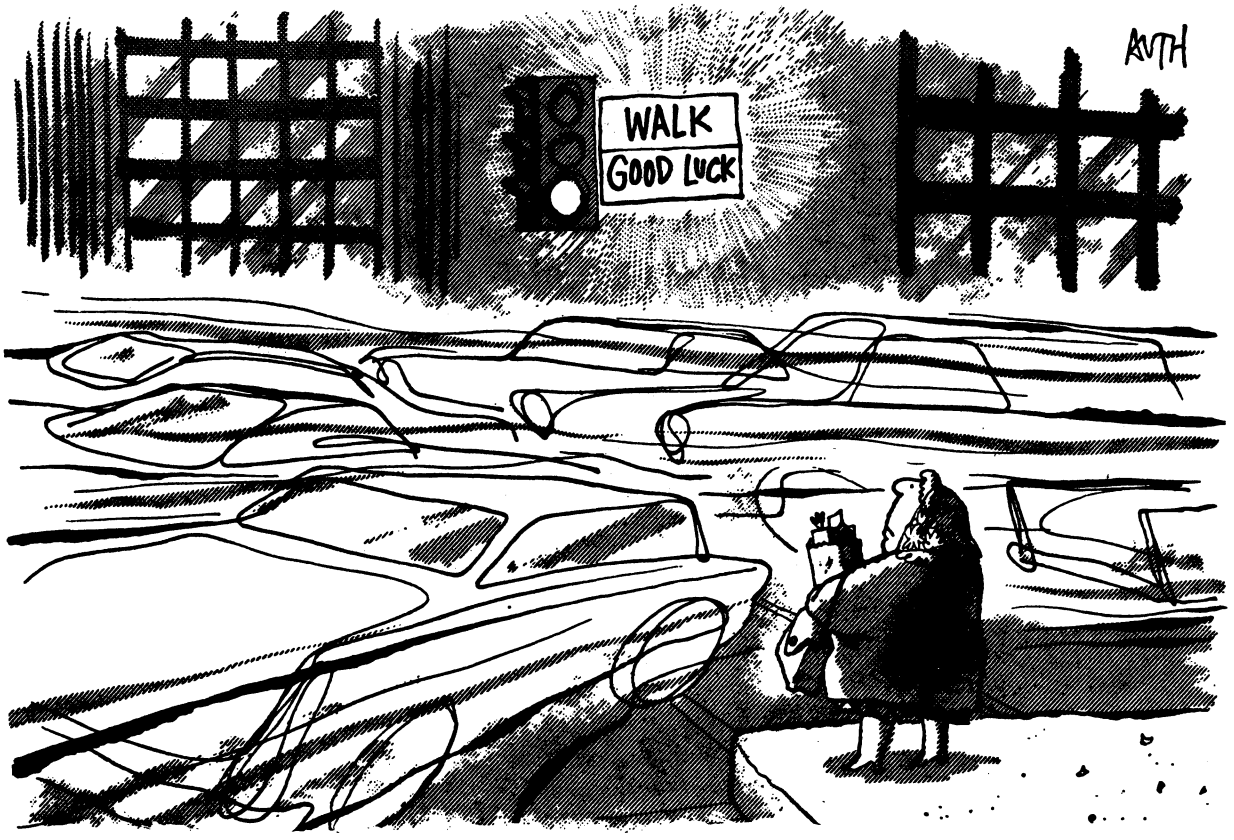
More Highways and Better Traffic Management

Highway building and traffic management may well have some place in a program for curing urban highway congestion. But neither is a substitute for pricing.

To try to solve the congestion problem exclusively by building more highways is like trying to solve water pollution exclusively by increasing stream flows. It increases the supply of the resource but does nothing to ensure that the amount supplied is used intelligently. The result is enormous waste. As early as 1963 the estimated cost of building enough extra lanes to meet rush-hour traffic loads had risen, for some urban expressways, to $23,000 per regular commuter. It is no wonder that urban highway construction has dwindled (by 37 percent in the 1970–75 period, to take one figure).

In the face of such enormous construction costs, highway engineers have accepted the idea of managing *demand* more effectively. But to date, they have gone no further than to give "high occupancy vehicles" (HOVs) a preferred status in the queue. For example, where entry ramps are metered to improve expressway flow, highway engineers are willing to accept ramp designs that enable HOVs to bypass the main access lanes. Where there are tolls, they may allow HOVs less congested access to the tolled facility or even exempt them from the toll (as on the San Francisco–Oakland Bay Bridge). And occasionally they will go so far as to assign an entire lane to HOVs (or even two lanes, as on the Shirley Highway into Washington, D.C.).

All of these devices retain queuing as the basic method for allocating highway use. And there is a crucial difference between queuing and a price system: Queuing rations access to users who are most willing to *throw away* a valuable resource (time). A price system, on the other hand, requires users only to *transfer* a claim on resources (money); and the resources need not be wasted because the recipient of the claims, here the government, can use them to reduce taxes or improve services.



Within the framework of queuing, one can reduce the waste of time only by increasing some other real loss. To illustrate the point with a rather extreme example, queuing time on entry ramps could be reduced by directing noise at the unfortunate waiters and increasing it gradually to the ear-splitting point where enough people are driven out of the queue (to HOVs or other times of travel) that congestion falls to the economically ideal level. But the social cost, which would then take the form of discomfort and hearing loss as well as waiting time, would have to equal the value of the loss that formerly consisted exclusively of wasted time. By contrast, prices can bring demand into line with supply without inflicting a loss on society as a whole.

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The demand management devices now used by highway engineers, like command-and-control regulatory systems in general, sort out high-value and low-value uses crudely and at unnecessary social costs. They make some choices conditional on the chooser's accepting burdens that are intrinsically unrelated to his choice. The people for whom car pooling is relatively costly (because of their location, their tastes, or the value of their time) can persist in travel as single occupants only by continuing to throw away their time and that of others in delay on the ramp, on the highway, or in the toll lane. Under a pricing system, people pay for their choice, but since they pay in cash, society can use the payments for worthy purposes.

Winners and Losers

Thus peak-hour pricing, well conceived and well executed, should increase the size of the social "pie" in the city adopting it. Although fewer vehicles would be traveling on urban highways, the net value that the highway contributed to society would be greater. Just as pollution charges can lead to more highly valued uses of air and water by eliminating the emissions whose value to the emitter is less than the damage they cause to others, so highway charges would make the highway network more valuable by eliminating auto use with a value less than the delay costs it inflicts.

But a change that increases total wealth may also redistribute wealth among individuals. Who would win and who would lose under congestion pricing?

Winners. Urban taxpayers would win because the introduction of a pricing scheme shifts de facto ownership of the highway from users to the entity that receives the revenues—the city. Again the analogy to air pollution is instructive. Without charges, the air is in effect owned collectively by users—polluters and breathers—and, being owned collectively, it is abused and its value reduced. Pollution fees transfer the polluters' ownership to whatever unit of government collects the fees. Congestion pricing has the same effect.

Car poolers and bus riders would also win because they would enjoy the benefits of less congestion at relatively little extra charge—or none if car pools and buses were exempt. Finally, some people, perhaps a surprisingly large number, would find the time they saved more valuable to them than the charges. Estimates of the ideal charge for an urban expressway tend to run about $.30 a mile. If a $4.50 charge on a fifteen-mile commute saves fifteen minutes, a commuter can be a winner without placing a desperately high value on his time.

Losers. At first glance, the most obvious candidates for grand losers would seem to be the poor. The reason for this is that congestion pricing shifts the basis for allocating the highway from readiness to spend time to readiness to spend money, and the poor typically assign a lower dollar value to their time than the rich.

In fact, however, many of the poor would unequivocally gain. Because traffic would move more quickly, current car poolers and current bus users, who include disproportionate numbers of the poor, would enjoy a pure gain in saved time. Beyond that, if buses became more crowded (in Singapore the reverse actually happened), the city could readily correct this loss of amenity—either by taking advantage of the lighter traffic to coax more trips out of the same number of buses and driver-hours, or by using the pricing proceeds to improve service.

But what of the poor person who lives in an area with little public transportation, or

none, and who works in the priced zone? Happily, congestion pricing has a peculiarly mild impact even on this apparent victim. The very fact that stirs our concern for him—the low dollar value he sets on his time—suggests a way for him to mitigate the burden of the price. Time, after all, is the major cost of the several alternatives to a solo peak-hour trip. Merely by taking the time to recruit *one* fellow car pooler, a commuter can cut the money price in half; and if larger car pools are exempt (as in Singapore), the commuter can eliminate the money price altogether merely by finding three kindred spirits. Finally, anyone can cut the price by incurring the inconvenience costs (mainly time) of traveling at off-peak hours.

Thus, the poor as a group would not necessarily do badly under peak-hour pricing, even when we view them only as travelers. But the poor are also urban taxpayers and recipients of urban services. As such they would stand to gain from tax reductions or service increases made possible by the pricing revenues. And the poor would probably also gain as consumers. If freight shipments were exempt (as in Singapore), shipping costs would fall, producing a decline in commodity prices. Even if freight were not exempt, the savings in wage and vehicle expenses resulting from speedier deliveries might more than offset the cost of the congestion charge, and, again, commodity prices would fall.

The other principal candidates for losers would seem, again at first glance, to be central-city firms and landowners. Some point out, for example, that any program that increases the out-of-pocket costs of access to the central city, *without changing anything else*, makes it more difficult for central-city firms to attract employees, clients, and customers. Thus, under congestion pricing, firms desiring to hold employee compensation constant would have to offset the congestion price with a pay increase, and firms desiring to remain competitive would have to reduce prices on their products and services.

But all that overlooks the gains from pricing. For peak-hour travelers who save more in time than they pay in charges (whether driving alone, car pooling, or using buses), the central city becomes more attractive. And for those going downtown in off-peak hours—probably the bulk of shoppers—the charge does not apply. In general, the central city benefits by becoming more efficient as a commercial and shopping center and more aesthetically appealing. Air pollution levels should fall and pedestrian amenities should rise, as they have in Singapore. Finally, there is the added municipal revenue. Real estate or sales tax reductions financed out of the pricing revenues could considerably sweeten the deal.

Possible Forms of Congestion Pricing

If we put aside the high-technology metering systems, the leading techniques for implementing congestion pricing are toll systems, area charges, and parking charges.

Toll systems have two advantages. First, they use a small number of entry points—those where the expressway disgorges its burden into the city. Second, they provide an easy solution to the time edge effect because they can accommodate a variable charge—a high rate for the peak and lower rates for the one or two time zones on either side.

But the ease with which tolls can cure the time edge effect is likely to be offset, in many cities, by unfortunate geographic edge effects. Motorists could duck off the expressway just before the toll, with the result that congestion is preserved on all but the last segment of the expressway and increased on the nonexpressway streets in the core. Further, the toll collection process would itself consume some of the time that pricing is intended to save. Finally, toll systems would entail a large capital investment in the collection areas, an investment politically difficult to justify for a system launched as an experiment.

Area charges—which price access to an area by the sale of permits, as in Singapore—avoid many of the inconveniences of toll collection. Persons entering the priced zone would have to display the correct sticker, presumably sold by mail or in stores or vending machines. The last-minute escape to arterials would become irrelevant, and the scheme's flexibility would be plain for all to see.

Besides, area pricing has the advantage of being able to handle both time and geographic edge effects, by having more than one concentric geographic zone and several time zones. But the system mounts to unrealistic complex-

ity fairly quickly. For instance, a plan with daily and monthly stickers, three geographic zones, and two time zones would require twelve different stickers. If the system is to rely on visual monitoring as cars flow along, it must not overstrain the human capacity to distinguish symbols quickly.

Singapore's experience with monitoring is encouraging, in that only one or two extra policemen have been needed to monitor each of twenty-two entry points. But this ease of enforcement was obtained at the cost of having only two sticker types (daily and monthly), with severe edge effects as a consequence. In other words, the smaller the edge effects, the higher the monitoring costs.

Parking surcharges possess the important advantage of piggybacking on an existing transaction, the driver's payment at the parking lot. And because the transaction is a more or less sedentary one, it can easily handle enough pricing variety to deal well with edge effects. Commuters can be charged differential rates, with the highest rates applied to peak-hour arrivals and to parking in the downtown center. The main flaw of a surcharge system is that it cannot catch vehicles moving through the center city to destinations on the other side. If there is heavy through traffic, or if heavy through traffic develops once the surcharges have cut back traffic headed into the core, commuters will suffer a cash burden without enjoying faster traveling time.

The parking surcharge's greatest appeal over other pricing systems is, perhaps, that it seems to involve the least assault on established institutions. Thus it is not surprising that the Urban Mass Transportation Administration (UMTA) is using this approach in the experimental pricing programs it plans to start this year. The sites of the experiments—beach areas in Hermosa Beach and Santa Cruz, California—enjoy the key preconditions for the success of parking charges: there is little or no through traffic, and little or no chance that lessened congestion will attract any new through traffic.

Political Hazards

Like many policy innovations, congestion pricing is not perfect. Its practical problems—edge effects, de facto shifts in property rights, and possible impact on the poor and the central city—are real. Nevertheless, they are probably manageable, at least if the pricing scheme is carefully tailored to the particular area.

But when citizens are asked about congestion pricing they often reply that they have already paid once for the highway—through taxes—and that once is enough. To the travelers who fear they would lose from the program (because, for them, the time gains would be worth less than the charges paid), the argument may seem powerful. The answer, of course, is that peak-hour travelers have not paid for one of the inputs to their trips: the time of other travelers. Apart from that answer, the only way to secure their political support is by a shrewd program for distributing the revenue (possibly even a simple per capita rebate).

[Congestion occurs because] peak-hour travelers have not paid for one of the inputs to their trips: the time of other travelers.

The real problem is a political one, of the sort that inheres in so many market solutions. Indirect payment through such forms as queuing is typically much more palatable than direct payment. Our very language illustrates the depth of the problem. Throughout this article I have used the term "expressway" for something that people normally call a "freeway." On a moment's reflection the ordinary "freeway" user will acknowledge that the road is not free, that it is financed by taxpayers. Still, the difference between direct and indirect payment seems to be enough for the indirect method to have captured the semantic advantage of the word "free."

Yet there are grounds for hope. An ancillary benefit from congestion pricing is reduced air pollution. As the high costs of present pollution control strategies become more obvious, congestion pricing may win friends as a thrifty weapon in that battle. Another appealing side effect is reduced energy consumption. Finally, history offers some encouragement. Radical ideas that have merit do eventually become settled policy. With luck, Singapore and UMTA's forthcoming experiments may speed the process. ■