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Road Pricing and Public Transit: Unnoticed Lessons from London

Kenneth A. Small

University of California at Irvine

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Observers of city life have long looked to mass transit to create urban vitality. Transit is supposed to make possible a healthy high-density street life, promote economically vital business and retail agglomerations, and concentrate development into interesting and attractive patterns. Above all it is supposed to limit road congestion without resorting to a ubiquitous system of ugly and environmentally damaging high-volume roads.

These longings have been frustrated by the limited ability of mass transit to attract travelers out of automobiles and by the enormous expense of building and operating mass transit. While many recently built transit systems have had desirable effects, none have seriously impacted traffic congestion. Furthermore, few cities have been able to afford a system extensive enough to make more than a small dent in the urban fabric. The share of trips by mass transit continues to fall virtually everywhere.

Meanwhile, other policies to control congestion have been disappointing. The only one that seems able to create a dramatic improvement — road pricing — is highly unpopular. Even so, congestion has proven so intractable that pricing has begun to gain a foothold — in Singapore since 1975, in three Norwegian cities since the 1980s, on selected express lanes and bridges in California, Texas, and Florida, and on a new east-west expressway in suburban Toronto. Most dramatically, in 2003 London's Mayor Ken

Livingstone introduced road pricing on the streets of Central London, in the form of a daily charge of £5 (about US$8) during business hours on weekdays.

Why has transit failed as a means to alleviate congestion, while road pricing, despite severe political liabilities, is experiencing an upswing? Ironically enough, we may have been looking at the problem backwards. Rather than mass transit being the solution to congestion, perhaps congestion pricing — a measure often viewed as an alternative to transit —could in fact be its savior.

By clearing cars off the most congested streets, pricing sets off a "virtuous circle" for mass transit, especially bus transit. Here's how it works:

- More expensive rush-hour road travel encourages use of alternatives including mass transit. This builds the transit patronage needed for financial viability.
- Reduced automobile congestion speeds up those transit vehicles that share the streets with cars. This in turn creates two further favorable effects:
- Patronage is further encouraged because rides on public transit are now faster.
- The financial state of the transit provider is further strengthened because higher speeds reduce driver and equipment costs for serving a given route.
- Higher patronage and lower costs encourage the agency to add service in the form of new routes, greater frequency, or both. Lower costs also encourage the agency to reduce fares.
- Better and cheaper transit service further encourages patronage. Some of it is diverted from automobiles, thereby further reducing congestion.
- This new patronage reinforces agency finances and service offerings; and so the circle goes on….

These effects can all take place quickly. Over a longer time, there may be other effects as well. By reducing demand for parking, new downtown land becomes available for development, thereby increasing the economic efficiency and vitality of downtown. By making travel from a distance more expensive, nearby residential land is increased in value (depending on the rules for who pays the congestion charge); this encourages higher density there, making it easier to serve with high-quality transit and retail centers within walking distance. If the road-pricing revenues are used to enhance public goods provided downtown — arguably part of political feasibility anyhow — then even land used for downtown businesses may rise in value, especially if the "virtuous circle" significantly enhances its accessibility through better transit service. This rise in land prices creates some of the hoped-for positive effects on downtown development density.

Each of the elements in this favorable chain of events has been known in the research literature, but no one seems to have pulled them together to remark on the prospect that road pricing could give a significant shot in the arm to transit. To keep it simple, let's look at just the short-run effects — those described in the bulleted list above. Any long-run benefits are then icing on the cake.

Quantifying the Impacts

Livingstone's audacious policy innovation surprised everyone with its smooth implementation and quick success, cutting entering car traffic by 33 percent and increasing car speeds within and to the central area by 14-20 percent. Less well know is that Livingstone gave high priority to simultaneous improvements to public transit, especially bus transit. Clearly, it was politically savvy to connect road pricing and public transit. But the analysis here suggests that more and better service was made possible, and desirable, by congestion pricing itself. Can we quantify this connection?

The "virtuous circle" involves a lot of interacting effects, so one might think it impossible to account for them all simultaneously. But we can determine the net outcome by making some simplifying assumptions, applying well-known empirical values, and looking to local data for a few additional needed parameters.

First, let's assume that transit users incur time costs consisting of time spent on the vehicle (valued at half their wage rate) and time spent walking to and waiting at a bus stop (valued at the full wage rate).

Second, the bus operating agency can react to increased patronage by getting larger vehicles or running more of them, or both; it tries to balance these so as to minimize the sum of its own and its users' costs. The result is economies of scale (a decline in average cost as patronage increases) when looking at these combined costs.

Third, the bus agency reacts to changes in its costs or revenues by changing its fares, so as to keep its total operating deficit the same. Thus fares are *increased* to cover any new service (presuming the new service loses money), but *decreased* to pass on any savings in average cost. If, in addition, congestion pricing is accompanied by an explicit increase in the total operating subsidy, as it was in London, we can assume this subsidy is also passed through in lower fares, once we have accounted for the cost of serving the additional patronage that such lower fares attract.

Fourth, travelers increase their use of transit by 0.25 percent for every one percent fare decrease, and by 0.30 percent for every one percent increase in number of bus-miles operated.

These assumptions permit us to calculate the impact of congestion pricing on transit with a surprisingly small number of parameters specific to the city in question. I now turn to the results of such calculations for two cases: one based on London's experience in 2003, and the other using parameters more typical of US cities.

Central London is unusual in several respects. First, public transit carries a very high share of weekday trips — over 85 percent even before congestion pricing. As a result, even a big reduction in automobile traffic has only a modest direct impact on bus ridership, estimated here at just 6 percent for the system put in place in 2003. Second, the fraction of bus costs recovered through fares is high, about 80 percent, which means that service expansion can be carried out with minimal damage to the budget. Third, a large hunk of pricing revenue from the London pricing scheme was allocated to the bus operating agency, increasing its subsidy by an amount equal to some 7 percent of the baseline cost of providing all bus transit in Central London.

To depict a city more typical of the U.S., I calculate also a second scenario where these three features are altered: modal diversion from pricing is larger (30 percent of initial ridership), initial cost-recovery ratio is smaller (40 percent), and there are no additional subsidies to the agency. These two scenarios are described in the top panel of the accompanying table. In both scenarios, bus speeds are assumed to rise by 9 percent as a result of reduced congestion.

Results of Numerical Calculations

Quantity	London	Typical US City
Assumptions:		
Direct modal shift to bus (% of initial bus ridership)	6	30
Speed increase (%)	9	9
Bus agency initial cost-recovery ratio (%)	80	40
New subsidies (% of original total agency cost)	7	0
Results:		
Service (% change in bus-miles)	23	21
Fare (% change)	-11	-26
Ridership (% change)	16	31
Average user cost (change as % of fare)	-48	-117
Average agency cost (% change)	-5	-15
Benefits to mass transit agency & users:		
From speed increase (% of total agency cost)	35	35
From direct patronage increase (% of total agency cost)	4	-4

Results, shown in the middle panel, are dramatic. For London, they show bus service being increased by nearly a quarter and fares reduced by 16 percent. As a result, the initial 6 percent increase in transit use, arising directly from the incentive of high prices for driving in Central London, has become magnified to a 16 percent increase. Average user cost for a bus trip is drastically reduced, due mainly to faster travel but also to more frequent service and increased route coverage. Average agency cost per passenger declines modestly, not enough to overcome the effect of ridership increases on total operations expenses but still enough to allow fares to decline, thanks to more passengers and new subsidies.

In a case more typical of a US city, the results are even larger. Ridership is up 31 percent and average user cost down by more than 100 percent of the initial fare. Fares can be reduced 26 percent, despite a 21 percent increase in (money-losing) service, thanks to higher bus occupancy (due to patronage rising faster than vehicle-miles) and lower driver costs (due to faster trip speeds).

What are the benefits of these changes? Adding the cost savings to the agency and its users, we see in the bottom part of the table that total net benefits, expressed here as percent of initial agency cost, are quite high. This does not include any benefits of the pricing scheme itself to automobile users, nor does it include revenues from road pricing. The bulk of these benefits arise from the speed increase, suggesting they would be much smaller for a rapid rail system not subject to street congestion. The benefits from the patronage increase alone, arising from the scale economies mentioned earlier, are positive but small for London. They are slightly negative for the typical US case because initial subsidies are so high that these trips are not paying their social cost even accounting for scale economies — an indication that expansion of patronage is not a desirable goal within the objectives quantified by the model. Of course, if public transit provides some of the additional benefits mentioned earlier, but not counted here, this patronage increase may still be desirable.

Conclusions

The “virtuous circle” of cost savings and ridership increases, triggered by policies aimed at discouraging automobile travel on congested city streets, can give a real boost to public transit, especially bus transit. In London, the evidence suggests this is a reality: new service has been added and ridership has gone up notably. London’s mayor may have viewed transit improvements as part of the necessary politics, or as just good management; but we can view them as logically following from the favorable conditions created by congestion pricing.

The benefits to transit users and providers are direct and quantifiable. I don't need to take a position on the marvelous side benefits often attributed to public transit. But the irony is, to the extent those side benefits are real, they add weight to the arguments not for transit policies *per se* but for good management of street resources through pricing. Transit advocates have every reason to be among the greatest boosters of road pricing.

Further Reading

Herbert Mohring. "Optimization and Scale Economies in Urban Bus Transportation," *American Economic Review*, 62, 1972, pp. 591-604.

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