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Congestion pricing and the future of transit

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Congestion pricing provides opportunities for transit to become more self-reliant. Both the theory of congestion pricing and its use in congested US corridors are examined. A 5% increase in commuter demand for transit is estimated in suburban corridors. New opportunities for transit are required if transit is to remain competitive in the USA. Automobile commuting is faster and more convenient as well as generously cross-subsidized for most US urban commuters.

Keywords: congestion pricing, transit, future, USA

Public transit in American cities is in trouble. Despite three decades of generous federal, state and local assistance, transit is chosen for a decreasing proportion of trips. Although the downturn in ridership has been reversed, and peak-period commuter travel in the largest cities retained, the share of all trips has decreased. Since 1970, employment has almost trebled, but commuting by transit is virtually unchanged. The automobile provides a faster, more convenient and comfortable alternative for most travelers. There are, however, market niches where transit continues to be successful. One of these – the suburban to central-city commuter market – is examined here in reference to congestion pricing: the policy of charging travelers the full price of using congested highways.

In return for governmental assistance, transit has been obligated to maintain transit employment, provide mobility for the poor and elderly, help revitalize central cities, and to reduce pollution, energy consumption and road congestion. These goals have become a burden, and transit officials should reconsider their support for them. Moreover, transit no longer can rely on increasing governmental assistance, because support for social programs is dwindling. Many more Americans, especially those who vote, now prefer self-reliant (libertarian) policies that might help them achieve the 'affluent lifestyle' rather than policies that relate to fairness, equality and values emphasizing caring beyond oneself (Yankelovich, 1994). Transit agencies also must change by challenging the automobile for a share of travelers in those markets where transit is competitive.

Transit can become more self-reliant by improving service to regular customers. In the central city, frequent and reliable service is required. Competition between modes such as bus and rail can be an advantage, because redundancy increases both the level of service and consumer choice. Rationalization of service to satisfy social objectives frequently resulted in the spreading out of service to the detriment of customers in central cities. In the suburbs, a more flexible, demand-responsive service is required by those too young or otherwise unable to drive. Because few regional transit agencies can provide flexible and economical suburban services, private providers, operating under contract, should be utilized. Competition on the margin from private providers can help transit throughout the entire metropolitan area, because it limits wage expectations by public employees and motivates them to provide superior service. It introduces competition into what is frequently viewed as a monopoly.

Along congested corridors between the suburbs and the central city is where transit has its best prospects. Although this is considerably smaller than the central city market for transit, it is a market where some transit modes can be competitive with autos. This opportunity was explained by Meyer *et al* (1966), but few were ready to accept their advice when generous assistance was becoming available for transit as a social program. Where separate right of ways exist, commuter rail and bus services already compete successfully with autos. And if road users were asked to pay the full cost for using these congested highways – if there were a 'level playing field' – both bus and rail ridership would increase.

Congestion would decrease and commuter buses and vanpools would be able to use existing lanes without the need for exclusive facilities. A whole new range of transit options, both public and private, might appear to fulfill the needs of an expanding commuter market.

These opportunities are mentioned in 'Transit in American cities' (Fielding, 1996). There is little discussion, however, of the suburban to central city market or of how congestion pricing might affect transit if political opposition can be surmounted. These omissions provide the focus for this article.

Commuter rail's success is described first to highlight the expanding market for suburban to central city commuting. A discussion of the seriousness of road congestion in metropolitan areas follows to justify the need for congestion pricing. Then, the principles of congestion pricing are described in detail, because it is a concept that deserves to be included in urban and transportation geography courses. And the article concludes by examining the implication for transit.

Commuter rail

Commuter rail[1] services are blossoming in US metropolitan areas. Success illustrates the potential demand for public transit along corridors where commuters are trying to avoid the delays caused by highway congestion. In 1980, commuter rail existed in only five urbanized areas: New York–New Jersey, Boston, Philadelphia, Chicago and San Francisco. By 1994, new commuter rail systems were operating in Los Angeles, Fort Lauderdale–Miami, Northern Virginia and Connecticut. Each system is registering substantial growth: Northern Virginia's Railway Express, for example, increased average daily boardings from 3700 (June 1992) to 800 000 in 1994. Success has encouraged other cities, and Atlanta, San Diego and Seattle are reviving service.

All of these systems require subsidies. Fares cover approximately one-half of the cost of operations and track maintenance nationally, with subsidies for individual agencies varying between US$0.12 and $0.30 a passenger mile depending on utilization and the expense of track maintenance. The subsidy per passenger is highest for new systems, but these systems will become more efficient as increasing demand allows them to spread costs over more passengers. Of course, fares could be raised to cover variable costs if auto commuters were required to pay their fair share of highway cost. But they are not. Commuters using congested facilities are cross-subsidized by other users and general taxpayers.

Expansion onto parallel rights of way allows commuter rail to expand capacity. The capacity of single-line track is 6200 seated passengers per hour – almost treble the usual capacity of a single freeway lane. Competition with freight movement limits passenger capacity, but operating agencies can use two strategies: they can either persuade the railroad to move freight during off-peak periods, or purchase the track. Metrolink has exercised the latter option in Southern California by purchasing duplicate or under-used railroad facilities. As demand increases, they intend to double-track lines in the most congested corridors. With modern signaling equipment, this will more than treble capacity so that rail corridors will have approximately the same peak capacity as urban freeways. Similar expansion in other metropolitan areas offers an alternative mode for severely congested corridors where expansion of highways is either too expensive or opposed by residents.

Highway congestion

Delays caused by congestion afflict most urbanized areas. Hanks and Lomax (1991) analyzed traffic in 39 urbanized areas and demonstrated that congestion was widespread and has serious economic consequences. They also estimated the costs of delay caused by congestion for 1989 in the 20 most congested areas. Costs ranged from $5240 million in Los Angeles to $290 million in Minneapolis–St Paul. The highest cost per registered vehicle was in Washington, DC, at $920 per vehicle. If allocated exclusively to work trips in personal vehicles, delay would cost $1.92 per trip or approximately $0.16 per vehicle mile in the nation's capital region. Time wasted stuck in traffic is annoying for commuters, but the loss to businesses relying on truck freight is more serious because it impairs productivity.

The most serious losses are highly localized. First, the most severely afflicted are those urbanized areas with more than a million inhabitants. And second, even within these areas, congestion is generally limited to radial corridors during peak periods. Increasing user fees on all travelers to construct more highways will not solve the problem. Charges must be targeted at the congested corridors to persuade some travelers either to change their departure time or change to a more effective mode.

California illustrates the problem faced in the most severely impacted states. High rates of household income growth have enabled individuals to purchase additional automobiles, and they are using them for commuting more frequently and driving further. Road capacity has not increased proportionately. Vehicle miles of travel doubled in California between 1973 and 1990 while lane-miles of state highways increased from 45 600 to 48 700 – a mere 6.8%.

Various traffic management strategies have been tried without much success. Transit expansion has been generously assisted by state and local funds,

[1] Suburban Rail services as opposed to Metro (Underground), Light Rail or Streetcar services (see Knowles and Fairweather, 1991)

but only 9.1% of commuters in the San Francisco and 4.5% in the Los Angeles urbanized area are regular users. Even the aggressive expansion of high occupancy (HOV) lanes has had little effect. They were intended to increase vehicle occupancy through ridesharing, but vehicle occupancy for urban commuters, statewide, declined slightly between 1980 and 1990. Despite the widespread availability of HOV lanes in many congested corridors, the potential reduction in solo driving has not occurred. Even the mean travel-time savings of 14 minutes, for users of HOV lanes in Southern California, has not been sufficient to persuade a higher proportion of drivers to forego the convenience, flexibility and comfort of driving alone (Collier and Christiansen, 1993). Of the respondents to this survey who have access to HOV lanes, only 28% use them occasionally. Ridesharing has increased absolutely, but not sufficiently to offset the increase in driving alone.

As Morrill (1991) has observed, the automobile has 'proven to be an incredibly liberating technology', and under current policies, transit is a poor competitor as buses and vanpools become stuck in the same traffic, and even rail and express buses using exclusive right of ways only save time for those commuting over very long distances. All of these difficulties for transit are aggravated by pricing policies that favor the auto commuter.

Only when commuters are required to pay the full cost for driving on congested highways – their variable costs plus the cost of delay they cause to others – will some commuters be prepared to alter their travel behavior. Because highway agencies do not charge this congestion price, highways are overused and transit neglected.

Congestion pricing

Congestion pricing is based on the concept of charging user fees based on the cost of constructing and maintaining facilities plus the cost of the delays caused for other travelers (National Research Council, 1994, Ch. 2). It is like utility pricing where additional charges are levied during peak period to discourage use; to reduce demand so that the utility company may avoid the high cost of constructing additional facilities required for only a few hours each day. When highways are uncongested, in off-peak periods, user charges need cover only the cost for amortizing construction and maintaining the highway plus a small social cost (*Figure 1*, D–E). However, when highways are congested, in peak periods, every additional user creates a demand for additional space. As lanes cannot be added in the short run, congestion occurs causing delays (increasing social costs) for all users. Congestion would be reduced if users were required to pay a toll representing the difference between the private and social cost (*Figure 1*, C–F). These tolls could make all users better off; some travelers might delay their trip until

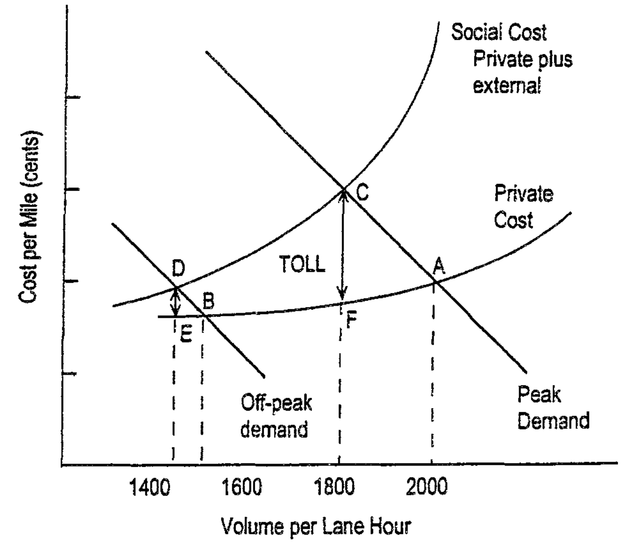

Figure 1 Congestion pricing for highways

Note: When the variable cost of automobile operation is increased by adding a toll equivalent to the social cost, demand is reduced. A smaller toll is appropriate during off-peak periods because the addition of vehicles does not delay other travelers. Remaining social costs include noise, air pollution and accident-related costs.

the price was lowered, others would shift to transit alternatives, and others would pay the higher toll to enjoy a faster trip. And this latter group, which is prepared to pay a premium to save time, would supply the revenue required to construct additional facilities. Under this scenario, transit would be more price competitive; those sharing a ride economize on tolls, while those paying fares to use separate rights of way would be paying prices equivalent to tolls.

Tollways are a solution for congested corridors in urban areas where travel alternatives are limited. They depend for their success, however, on the ability to vary tolls with the level of congestion. Posdena (1990) provides examples of appropriate congestion tolls for the San Francisco Bay area. He estimated that, during the peak, the toll per mile should be $0.65 on central area highways and $0.21 in the suburbs. During the off-peak period, a toll of between three and five cents would be appropriate in all locations. These tolls include both the cost for amortizing construction and maintenance, as well as cost of delay caused by each additional vehicle. Similar congestion tolls appear to be appropriate for New York. A recent study of the corridor between Queens and Manhattan in New York indicates that the toll of $3.00, or $0.56 per minute of time saved, for using the Midtown Tunnel is sufficient to divert travelers to other rail and road alternatives (Hickling Corporation, 1994).

Hefty, peak-period charges are required to eliminate congestion on central city highways. Some users will pay because the tolls are more than offset by the value of time saved. Some will join carpools to share the higher cost, but others will choose transit.

Highway tolls are unpopular. One of the principal reasons for this is that there is only a very generalized notion of the true costs required to build and maintain urban highways. Most Americans believe they have already paid for their highways, but they have not. The cost per mile of constructing and maintaining an additional lane of the freeway varies between $0.10 in the suburbs to $0.20 in the central city, and motorists pay a user fee averaging only $0.018 per mile! Peak-period commuters, who pay the same average fee (A in *Figure 1*), but create the need for additional lanes, are cross-subsidized by other users. And highway users as a group are not paying a sufficient amount to maintain and replace their roads; they require subsidies from general-purpose taxes (US Department of Transportation, 1994).

Estimates for the value of time lost through road congestion are based upon wage rates, because it is assumed that those adversely affected are commuting to work. The most widely accepted value is 50% of the average hourly wage, but there is no uniformity (Small, 1992). There is even less agreement about the effect upon commuters of charging this price in order to allow them to avoid delays. As there have been few instances where motorists have been given the opportunity to pay for time saved, appropriate market prices have not been revealed. Most of the evidence comes from either policy or simulation studies. The National Research Council's (1994) conference proceedings, *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion*, and Jones (1992) provide comprehensive surveys. Both caution that the effects of tolls are site and travel-purpose specific and eschew any attempt to define universal values.

Economists refer to the sensitivity of demand, for a good like transportation, to changes in price as the 'elasticity' of response. Elasticities are presented as percentages; a price elasticity of demand of −0.20 indicates that when price increases by 10%, demand will decline by 2%. *Table 1* summarizes the results from studies that have estimated the price elasticity of demand for highway and transit travel. There are variations in effects, and these would have been even larger had evidence from other countries been included. The studies indicate, however, the magnitude of the charge, in addition to the $0.093 per mile, average, variable cost of automobile operation, required to change commuting behavior. The effect on transit of congestion tolls is generally positive and will have its largest effect on the behavior of long-distance commuters traveling from the suburbs to central cities.

Analyses of travel behavior in response to congestion charges suggest an elasticity ranging 'From −0.1 or −0.2 at the low end to −0.3 or −0.4 at the high end, depending on the level of charge, the current costs of travel, and the capacity of alternative roads and transit systems' (Bhatt, 1994, p 78). On a regionwide basis, additional charges between $0.10 and $0.15 per mile are forecasted to be adequate to reduce congestion in the Washington, DC region. As stated in the previous section, the estimated cost of delay was $0.16 per mile in 1989. Tolls at this level are consistent with the $0.12 per mile charged to users of the Dulles Toll Road, but are lower than the per mile fees of $0.20 to $0.25 suggested for toll roads in Southern California. Much higher tolls are required to change behavior when travelers have become accustomed to commuting by automobile.

Automatic toll collection

Annoying delays at toll plazas are another reason why toll roads are unpopular. But these delays are

Table 1 Percentage change in vehicle miles of travel (VMT), and trips by mode resulting from an increase in peak-period charges on single occupant auto users

Type of study	VMT	Auto	Transit
Policy studies:			
Levinson (1980) New York: increased bridge tolls by $1.00		−10	+4
Bhatt (1994) Washington, DC: regionwide peak toll averaging $0.15/mile	−2.7 : −8.1		
Gillen (1994) review of studies: 10% increase in auto toll			+3.2 : 4.1
Goodwin (1992) review: 10% increase in gasoline price; changes in traffic levels (long run elasticities)		−3 : −5	3.4
Simulation studies:			
Harvey (1994) San Francisco Bay: average areawide increase $0.10/mile	−1.8	−2.2	+
Harvey (1994) Los Angeles: average areawide increase $0.15/mile	−5	−3.8	+
WSA (1993) Orange Co., Ca: Toll Roads: increasing toll from $0.10/mile to $0.13/mile	−3.4		
WSA (1992) Orange Co., Ca: SR 91, increase toll from $0.10/mile to $0.20/mile	−12.9		
Case studies:			
Golden Gate Bridge: 1990 increase in bridge tolls from $2.00 to $3.00		−7.5	+

Note: WSA = Wilbur Smith Associates.

no longer necessary. Electronic toll collection equipment allows collection of tolls without stopping. Instruments positioned over the road detect signals from the vehicle and charge the appropriate user fee. Regular users are required to establish an account, register their vehicle/s, and purchase a dashboard transponder that emits an identification code. Several toll roads have installed equipment for collection of flat tolls so as to reduce congestion at the toll booth (Pietrzyk and Mierzejewski, 1994). Equipment is reliable and available from competing suppliers. The prospects for congestion pricing are much improved with electronic toll collection; all that is needed is a demonstration.

State Route 91 (SR 91) between Riverside and Orange counties in Southern California will be the first test of congestion pricing in the USA when it opens in late 1995. A private company has been granted a franchise to construct four lanes in the median of the existing, six-lane freeway (Fielding, 1994). Tolls will vary with congestion so as to eliminate the delays experienced by users of the adjoining 'free' lanes. It is estimated that tollway users will save between 10 and 12 minutes traveling the initial 10-mile segment.

A peak period toll of $2.50 ($0.25 per mile) has been suggested as sufficient to prevent overcrowding. In addition, buses, vanpools and carpools with three or more occupants will initially have free access to the toll lanes. The private company projects that this toll is sufficient to amortize their investment, yield a satisfactory profit and ration access. But if their projections are incorrect, and too many drivers choose the toll lanes, they can increase the price.

Fortune Magazine, April 5, 1993, summarizes the proposed operation as follows:

> The new road's most appealing feature is its ability to operate without toll plazas, which often cause backups. To enter the fast lane, a car must have an automatic vehicle identification (AVI) tag clipped to its rearview mirror. The tag, which is being developed by MFS (Omaha, Nebraska) and Texas Instruments, could cost drivers around $30. About the size of a credit card but twice as thick, it incorporates a microchip, an antenna, and a lithium battery. As a car approaches the toll road, the card exchanges radio signals with the highway's computers, which charge the toll against the driver's prepaid account, typically $80 a month. If a car has no AVI tag, the system will alert a waiting highway patrolman to nab the interloper or will videotape the car's license plate for ticketing by mail.

Electronic notice boards will give travelers advance warning about the changing price for access. Tolls will vary in response to demand. Prices will be increased during peak periods to avoid congesting the restricted lanes, with roadway signs designed to flash numbers as high as $9.99. The aim is to maintain speed so that patrons save time compared with users of the unrestricted lanes. Tolls will be based on a value of time saved – estimated at $0.22 per minute, for peak-period commuters in single-occupant vehicles. During the shoulder of the peak and the off-peak periods, tolls will be lowered to encourage use. Travelers can then decide whether to merge into the central toll lanes or remain in the free lanes.

Public transit users benefit from the time saved by accessing the toll lanes without paying the toll. In a simulation of the effect of congestion pricing on travel behavior in the SR 91 corridor, compared with a situation where only free, HOV lanes were constructed, Chu and Fielding (1994) demonstrated that average vehicle occupancy will increase by between 5% and 6% under congestion pricing options. The number of persons likely to use buses and vanpools and car pools with three or more occupants increases as the toll is raised. A parallel railroad track is available and plans exist to introduce commuter rail service. This was not included in the simulation study but, when available, it will provide additional options for travelers in this congested corridor.

If successful on SR 91, congestion pricing could easily be expanded. Several metropolitan areas have networks of high-occupancy vehicle (HOV) lanes which are underutilized. If all highway users had the option of paying to use these lanes, utilization would improve, highway revenues would increase, and congestion pricing would gain a constituency of support. Fielding and Klein (1993) have labeled this conversion of HOV lanes to pay-for access as high-occupancy toll (HOT) lanes. Availability of electronic toll collection and increasing highway congestion make these changes appealing. Both Phoenix and Seattle have programs under review that are modeled after SR 91.

Benefits for public transit

Availability of electronic toll collection will reduce opposition to congestion pricing, and public transit will benefit from changes that require peak-period auto commuters to pay the full cost of travel. As costs increase, some commuters in SOV will shift to ridesharing or to express bus and commuter rail where these options are available. And those who shift will decrease congestion and travel time for those who choose to pay the toll. Even travelers who choose to neither pay the toll nor shift to transit will benefit, because toll revenue can be used to reduce user fees or improve transportation facilities, including new transit options.

We are uncertain about how many travelers will choose transit. The elasticity ratios reported in *Table 1* are primarily 'own elasticities': changes that are expected in one mode resulting from increased operating cost. The reported 'cross elasticities' – the change that occurs in other modes – are less reliable.

The elasticities reported by Levinson (1980) and Gillen (1994) are accompanied by cautions about the need to consider trip purpose and the competitiveness of transit. Goodwin (1992) reports similar increases for transit, but his survey estimates change in response to increases in gasoline prices. Most of the studies forecast that transit ridership will increase, but refrain from reporting magnitudes. An increase in transit ridership of between 1% and 2%, in response to a 10% increase in congestion charges, would be a conservative estimate.

Congestion pricing will increase transit ridership where transit substitutes are available. The principal beneficiaries will be travelers commuting along congested corridors where vanpools, express bus and rapid rail options are present. Commuter trips from the suburbs to central cities represent 16.4% of all work trips. And if just 1% of these trips in major metropolitan areas switched to transit, this would increase peak-period transit demand by 422 000 daily work trips – more than 5%.

Assuming additional capacity was made available, the influx of new riders could result in the following transit improvements.

- Transit service would be more effective. Increased demand would allow more frequent rail service, and a more intense, suburban network for commuter buses. Vanpool users would be more likely to find neighbors willing to share a ride, and this would reduce the time required to gather participants.
- Increased ridership should improve transit revenues if fares reflect the advantages gained through ridesharing. Additional revenue could be used to increase service frequency and coverage.
- Commuter buses and vanpools already using freeways would travel at increased speed and be more time competitive with autos.
- New transit options would appear. Unsubsidized and privately operated commuter buses have all but disappeared from metropolitan areas with the exception of New York–New Jersey. If charges, varying between $0.15 and $0.65 per mile along a congested corridor, were added to the average, variable cost of $0.093 to operate an automobile, then private bus service becomes competitive. Airport commuter vans, for example, cost between $1.40 and $1.50 per mile to operate. Under congestion pricing, they could be commercially viable with four or five passengers. Therefore, it is reasonable to anticipate that entrepreneurial commuters will lease vans and offer to sell rides to other long-distance commuters.

A 5% increase in commuter demand for transit along congested corridors is possible. This assumes that car pooling will remain more attractive than transit, and neglects the attractiveness of more frequent service to commuters, other than those suburban-to-central-city corridors. For example, using more suburb-to-suburb commuters will board and alight at intermediate stops, and some central city residents will choose transit more regularly when service frequency is increased. Kain (1994) emphasizes the benefits of congestion pricing for central city residents. He sees the addition of more frequent, express services as especially attractive to those living and working in the central city where the costs of car ownership and parking are much higher than in the suburbs. Kain hypothesizes that transit ridership could double in areas such as Los Angeles if congestion pricing is implemented.

Increased ridership assumes widespread adoption of congestion pricing, but it is a controversial program that most policy makers have been unwilling to adopt. After describing the advantages of congestion pricing, Borins (1988) labels it as a policy whose 'time may never come'. A more positive view has been adopted here encouraged by recent progress in Southern California. However, Giuliano (1994) is far less optimistic than I have been over the willingness of commuters to change their travel mode. But until we have the results from SR 91, neither of us has empirical data to substantiate our hypotheses. Black (1995) when discussing this paper at the Annual Meeting of the Association of American Geographers, commented that highway congestion is localized in a few cities and will lessen in intensity as the number of autos ceases to increase, because this market is almost saturated – with autos almost equaling eligible drivers. This argument, however, overlooks the increasing trend to use autos for commuting and the inability for the most congested regions to 'build their way out of congestion'. If congestion pricing does not spread from California, traffic congestion will increase delays in major metropolitan areas. And this will increase the attractiveness of transit using grade-separated rights of way.

Conclusion

Charging for road use provides the only efficient solution to highway congestion. And, if adopted, public transit would be faster and more competitive with automobile travel. During the 1980s, transit agencies focused on improving management and controlling costs. Meanwhile, ridership remained flat, and the proportion of all trips taken on transit has declined, as the auto has become increasingly available, more convenient and relatively inexpensive to operate. Governmental assistance has helped transit renew antiquated equipment and expand both rail and bus services, but transit remains competitive in very few locations. Elsewhere, transit service is either too slow or too infrequent and often both. Only when and if auto users are required to pay the full cost of traveling along congested highways will transit become more competitive.

Congestion pricing is based on the concept of charging user fees that include both the cost of constructing and maintaining additional facilities, and the cost of delays caused when an additional motorist enters a congested facility. Motorists, especially peak-hour commuters, do not pay these fees; they are subsidized by other users and general tax revenues.

Requiring motorists to pay the full cost of peak-period road use assists transit in several ways: it signals that express bus and commuter rail are cost-effective alternatives to the auto for long-distance commuting; it allows transit agencies to offer more frequent services and raise fares; and it encourages the reservation of HOT lanes on existing freeways for auto users willing to pay tolls and for vans and buspools.

My colleagues and I have argued elsewhere that the easiest way to implement this change is to implement congestion pricing, one lane at a time, when freeways are expanded (Fielding and Klein, 1993). The toll lanes on SR 91, in Orange County, California will give us an opportunity to observe how commuters respond to this policy.

Commuter rail service will also benefit. If roads are priced appropriately, rail becomes more competitive with autos and affords relaxing travel for some commuters. Increasing highway congestion has already spawned the revival of commuter rail in several metropolitan areas. Expansion will continue, even without congestion pricing, because rail service is viewed as contributing to the secure, suburban lifestyle that many families aspire to achieve – especially those who vote. Rail transit will expand, because it appeals to an influential constituency, and it will help maintain governmental assistance for public transit.

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References

Bhatt, K (1994) 'Potential of congestion pricing in the Metropolitan Washington Region' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242, 2 62–88

Black, WR (1995) Discussant's comments on Gordon J Fielding's 'Congestion pricing and the future of transit' presented at the Annual Meeting, Association of American Geographers, Chicago, 17 March 1995

Borins, SF (1988) 'Electronic road pricing: an idea whose time may never come' *Transportation Research* **22A** 37–44

Chu, X and Fielding, GJ (1994) 'Electronic road pricing in Southern California: policy obstacles to congestion pricing' in *Proceedings of the International Conference on Advanced Technologies in Transportation and Traffic Management* Singapore

Collier, C and Christiansen, T (1993) '1992 State of the commute in Southern California' Paper presented at Transportation Research Board 72nd Annual Meeting, Washington, DC

Fielding, GJ (1994) 'Private toll roads: acceptability of congestion pricing in Southern California' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242

Fielding, GJ and Klein DB (1993) 'High occupancy/toll lanes: phasing in congestion pricing a lane at a time' *Research Foundation Policy Study* 170

Fielding, GJ (forthcoming, 1996) 'Transit in American cities' in Hanson, S (ed) *The Geography of Urban Transportation* 2nd edn, Guilford Press, New York

Gillen, D (1994) 'Peak pricing strategies in transportation, utilities, and telecommunications: lessons for road pricing' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242

Giuliano, G (1994) 'Equity and fairness considerations of congestion pricing' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242

Goodwin, PB (1992) 'A review of demand elasticities with special reference to short and long run effects of price changes' *Transport Economics and Policy* **26** 155–169

Hanks, JW and Lomax, TJ (1991) *Estimates of Urban Roadway Congestion – 1990* Texas Transportation Institute, College Station, TX

Harvey, GW (1994) 'Transportation pricing and travel behavior' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242, 2, 89–114

Hickling Corporation (1994) *Unsticking Traffic: When Transit Works, and Why* US Department of Transportation, Federal Transit Administration, Washington, DC

Jones, P (1992) *Review of Available Evidence on Public Reactions to Road Pricing* University of Westminster, Transport Studies Group, London

Kain, J (1994) 'Impacts of congestion pricing on transit and carpool demand and supply' in National Research Council *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242

Knowles, RD and Fairweather, EA (1991) *The Impact of Rapid Transit* Metrolink Impact Study Working Paper 2, Department of Geography, University of Salford, UK; also in Hoyle BS and Knowles RD (eds) (1992) *Modern Transport Geography* Belhaven Press, London, 90

Levinson, HS (1980) *Estimating Behavioral Response to Peak-Period Pricing* WSA, New Haven, CT

Meyer, JR, Kain, JF and Wohl, M (1966) *The Urban Transportation Problem* Harvard University Press, Cambridge, MA

Morrill, RL (1991) 'Myths about metropolis' in Hart, JF (ed) *Our Changing Cities* Johns Hopkins University Press, Baltimore, MD 1–11

National Research Council (1994) *Curbing Gridlock: Peak-Period Fees to Relieve Traffic Congestion* Transportation Research Board, Washington, DC, Special Report 242

Pietrzyk, MC and Mierzejewski, EA (1994) 'Electronic toll collection systems: the future is now' *Transportation Research News* **175** 14–19

Posdena RJ (1990) *Market-Based Solutions to the Transportation Crisis: The Concept* The Bay Area Economic Forum, San Francisco, CA

Small, KA (1992) *Urban Transportation Economics* Harwood, Chur, Switzerland

US Department of Transportation (1994) *Transportation Statistics: Annual Report 1994* Bureau of Transportation Statistics, Washington, DC

Wilbur Smith Associates (1992) *Traffic and Revenue Study: SR 91 - Median Improvements* WSA, New Haven, CT

Wilbur Smith Associates (1993) *Traffic and Revenue Study: Proposed San Joaquin Corridor, Orange County, California* WSA, New Haven, CT

Yankelovich, D (1994) 'How changes in the economy are reshaping American values' in Aaron, HJ, Mann, TE and Taylor, T (eds) *Values and Public Policy* Brookings Institution, Washington, DC, 16–53