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## Alternative Strategies for Coping with Traffic Congestion

Genevieve Giuliano and Kenneth A. Small

Traffic congestion is a disruptive fact of urban life. It inflicts delays and frustrations in virtually all major cities in the world, new or old, rich or poor. Although many countermeasures have been tried, it is hard to name a city in which there is much satisfaction with the existing state of affairs. About the only positive aspect of congestion is that it reflects the pulse of life, a demand for travel and trade that typically accompanies economic activity.

In this paper, we review a wide variety of policies aimed at reducing traffic congestion. In so doing, we gain insights as to why the problem is so intractable. Put simply, the most politically appealing measures are undermined by the strength of the demand for flexible and individualized peak-period travel. This demand renders some measures impotent from the start, and undoes others by producing complex behavioral changes. Those few measures that would work involve either major institutional changes or strong financial incentives; these characteristics arouse distrust and threaten to create significant wealth transfers, making such measures exceedingly difficult to enact in a democracy.

Before analyzing policies toward congestion, we briefly survey several trends in travel behavior that help define the problem. We then provide an illuminating case study of the unfortunate experience with congestion policies in the Los Angeles area, followed by a review of several alternative policies, including inaction, land-

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use intervention, highway capacity expansion, low-technology mass transit, and pricing.

We caution that this paper is not about air pollution or other environmental problems. As it happens, the policies we believe are most effective against congestion are also likely to help clean the air. But that is not their main purpose, and there is no reason to expect them to substitute satisfactorily for sound environmental policies

## I Travel Trends

The twentieth century has been marked by a sustained and very widespread rise in ownership and use of automobiles and trucks. Between 1970 and 1987, the per capita stock of motor vehicles rose by 39 percent in the U.S., 88 percent in twelve nations of Western Europe, and 141 percent in Japan. Per capita vehicular travel (vehicle-kilometers per person) grew as well: 41 percent in the U.S., 69 percent in Europe, and 84 percent in Japan.[1] These increases have taken place despite strong attempts to curtail automobiles, especially through financial support of public transit and, in Europe, through high use and ownership taxes (Pucher, 1988). Thus, it appears that even when transit service is convenient and inexpensive, people increasingly prefer the greater flexibility of traveling in their own vehicles.

Highway capacity has not kept pace with the resulting growth in traffic, and congestion has naturally resulted. Although data are spotty, it appears that the level of road congestion in most large urban areas has risen substantially in recent years. For example, an index of daily travel volumes relative to road capacities shows increases in 47 of 50 such areas in the U.S., with the average index value rising by 16 percent (Meyer, 1993). More detailed data from the few individual areas where it is available suggest that this imbalance has taken its toll on highway speeds. For example, in Washington, D.C., average speed declined on sixteen out of

[1] These data are from "Motor Vehicle Use Statistics, Selected OECD Countries, 1970 1987," compiled by the staff of the Royal Commission on National Passenger Transportation (Canada), Ottawa



twenty arterial highways, with an average change on all twenty of – 13 percent (Meyer, 1993). On the San Francisco-Oakland Bay Bridge, aggregate time spent in congestion delay each weekday was estimated to have grown from 4,730 vehicle-hours in 1984 to 10,080 vehicle-hours in 1991 (Dittmar, 1993, p. 6).

Such trends are not without limit. In both Europe and the United States, vehicle ownership as a proportion of population has grown more slowly since 1975 than previously (Lave, 1992b, p. 9); in fact, in much of the U.S. it appears to be approaching a saturation level of one car per adult of driving age. For example, Lave (1992a) examines the U.S. ratio of passenger vehicles to population between ages 15 and 74; this ratio rose steadily from a value of 0.30 in 1940 to 0.95 in 1989 (pp. 5–6). Whether or not this translates into a leveling off of vehicle usage trends remains to be seen; but in places where most trips use single-occupant vehicles already, there is only limited room for further growth unless speeds rise or people show a historically unlikely willingness to spend more of their day in travel.

In any case, congestion is already at levels that hamper the economic functioning of our large urban agglomerations; and it continues to worsen in many, especially in areas of rapid growth. This state of affairs has spawned major efforts to implement policies to reduce congestion, to which we now turn.

## II The Los Angeles Experience: Rail Transit and Travel Demand Management

Los Angeles is known throughout the world as the prototype of the late twentieth-century city. Its extensive mix of low- and medium-density communities is distributed over more than 3,500 square miles and is connected by hundreds of miles of high-capacity expressway. Rapid growth was accommodated by enormous highway investment, especially in the 1920s and again in the postwar economic boom of the 1950s and 1960s. New highways complemented the trends in automobile usage occurring throughout the nation, and Los Angeles has thus been at the leading edge of these trends.

Changes in metropolitan form have proceeded in concert with

**Table 1.** Population Shares by County, 1960–1990 Los Angeles Region (in percent)

| County | 1960 | 1970 | 1980 | 1990 |
|---|---|---|---|---|
| Los Angeles | 77.91 | 70.53 | 65.03 | 60.99 |
| Orange | 9.08 | 14.24 | 16.81 | 16.59 |
| Riverside | 3.95 | 4.60 | 5.77 | 8.05 |
| San Bernardino | 6.49 | 6.83 | 7.78 | 9.76 |
| Ventura | 2.57 | 3.79 | 4.60 | 4.60 |
| Total Region | 7,753,670 | 9,978,000 | 11,497,827 | 14,531,533 |

Source: Compiled from U.S. Census of Population and Housing, 1960, 1970, 1980, and 1990, issued by U.S. Bureau of Labor Statistics, U.S. Department of Commerce.

**Table 2.** Employment Shares by County, 1970–1990 Los Angeles Region (in percent)

| County | 1970 | 1980 | 1990 |
|---|---|---|---|
| Los Angeles | 75.63 | 69.79 | 64.65 |
| Orange | 12.08 | 16.97 | 19.30 |
| Riverside | 3.79 | 4.20 | 6.63 |
| San Bernardino | 5.50 | 5.52 | 5.42 |
| Ventura | 3.00 | 3.53 | 3.99 |
| Total Region | 4,397,793 | 6,122,296 | 8,042,274 |

Source: Compiled from Regional Employment and Industry Statistics, 1970, 1980, and 1990, issued by the U.S. Bureau of Labor Statistics, U.S. Department of Commerce.

an auto-oriented transport system. Both population and employment have decentralized, as documented in Tables 1 and 2. Of the five counties that make up the Los Angeles Consolidated Metropolitan Statistical Area, Los Angeles County is the largest and contains the City of Los Angeles, whose downtown is the region's historic center. The tables show that both population and employment growth have been most rapid in the suburban counties, first in Orange County and later in the more remote Riverside and San Bernardino Counties.

Decentralization has been accompanied by dispersion. In 1980, just one-third of all jobs were located within 32 large employment centers; the other two-thirds were dispersed throughout the metropolitan area (Giuliano and Small, 1991). Travel is consequently dispersed as well, leading to complex patterns of flows by direction and location. Interestingly, these population and employment shifts have not resulted in longer trips; people are able to work or to engage in other activities relatively close to home because of this intermixed land-use pattern (Gordon, Richardson, and Jun, 1991).

During the 1980s, rapid population and employment growth generated a new transportation crisis in Los Angeles, and the traditional policy of adding more highway capacity lost public support. Concerns about air quality, energy, and the quality of life, as well as the perception that additional investment in highways would be self-defeating, have caused policymakers to adopt a new strategy of providing and encouraging alternatives to the automobile. This strategy includes two important elements: massive investment in rail transit, and a comprehensive program of transportation demand management (Wachs, 1993).

## A Rail Transit

The regional transportation plan for Los Angeles now includes extensive investment in a completely new rail network providing for both light and heavy rail transit service. Most of the investment is focused in Los Angeles County, where $78.3 billion is earmarked for rail transit projects over a thirty-year period (LACTC, 1992). The purpose is to increase the modal share of transit and, in the long run, to redirect land-use patterns to a more compact, higher density urban form.

There is little evidence to suggest that these goals can be achieved. Elsewhere in the U.S., investment in rail transit has proven to be a terribly inefficient way to divert trips from automobiles. This conclusion is documented by Pickrell (1989) for ten U.S. cities, and is further illustrated by the experience with the Los Angeles Blue Line, the first small piece of the ambitious rail program to begin operation. The Blue Line is a single light-rail line extending 23 miles from downtown Los Angeles to the city of Long Beach. Completed in 1991 at a capital cost of $877 million, its 1992 annual operating cost was $42 million, of which just 11 percent was covered by fares. Surveys show that only about 30 percent of its passengers are former automobile users (drivers or passengers); the remainder are former bus patrons or new travelers. The public subsidy for each regular Blue Line passenger attracted from automobile comes to between $20,000 and $36,000 per year (Moore, 1993), or approximately $40 to $72 per one-way trip.

This poor experience is easily explained. First, rail transit is far more costly to build and operate than bus transit, which in Los Angeles covers nearly 40 percent of operating cost from fares (90 percent for some heavily used inner city routes). Numerous studies have shown that the cost of providing bus service is lower than rail except in corridors with passenger volumes much higher than those experienced in any North American metropolitan area not already served by rail transit (Small, 1992a, pp. 104–106). Second, the dispersed travel patterns of Los Angeles make it impossible to take advantage of rail transit's high capacity. Even hundreds of miles of rail lines can only marginally increase transit access within the region.

There is also reason to doubt that the hoped for land-use changes will take place as a result of investment in rail transit investment. High-density compact cities developed before the automobile. In North America, they were the result of industrialization and the earlier state of transportation technology. The technology of production required agglomeration. Access to the intercity rail network was critical, and streetcar systems shaped residential patterns for workers. None of these conditions exist today, and the continued shift to service- and information-based industry suggests that economic activity will be even less "place dependent" in the future.

## B Transportation Demand Management

The second major policy thrust in Los Angeles is transportation demand management (TDM). This approach encompasses a variety of strategies that seek to encourage ridesharing and transit use; examples include carpool matching, transit and ridesharing sub-



sidies, and telecommuting programs. Voluntary TDM programs have been provided by many large employers since the 1970s. Most recently, employer-based TDM programs have been mandated by state and local laws.

The most extensive TDM program in Los Angeles is Regulation XV, established in 1988 by the South Coast Air Quality Management District as part of its air quality compliance plan. It requires both public and private employers having 100 or more workers at any given site to implement a plan to increase ridesharing to a specified level, which typically represents an increase in average vehicle occupancy of 25 percent from the 1988 level. Similar regulations will soon apply to many U.S. urban areas as a result of the federal Clean Air Act amendments of 1991.

Regulation XV has resulted in small though significant increases in vehicle occupancy: 3.4 percent after one year and 6.5 percent after two years (Giuliano and Wachs, 1992b). These changes have resulted from the provision of mild positive incentives such as preferential parking for carpools, emergency ride home for ridesharers, and individualized trip planning.

The increase in ridesharing after the first year was estimated to reduce total vehicle-distance traveled in the region by just 0.4 percent (Giuliano and Wachs, 1992a, p. 11). This does not account for new trips generated from latent demand, that is, from people who originally were deterred by the congestion from making solo trips. These figures reflect the fact that the regulation applies only to a small portion of all travel. Work trips account for about 20 percent of all trips within the region, and no more than half of all workers are covered by the regulation (Southern California Association of Governments, 1993; Giuliano, Hwang, and Wachs, 1993).

Costs of the regulation are borne by employers in the form of ridesharing incentives offered to employees and expenditures undertaken to meet the procedural requirements of the regulation. Estimates of these costs vary from $12 to $263 per year for every employee commuting during the peak period, or about $3,000 per annual peak-period auto trip reduced – far less than the Blue Line, but nevertheless a very high cost to employers (Earnst and Young, 1992).

This disappointingly small effect in the first two years of Regulation XV is not likely to get much larger. The program relies heavily on marketing efforts and visible but small enticements to encourage ridesharing, while doing little to counter the powerful forces favoring the drive-alone automobile. Serious financial incentives, such as large carpool subsidies or charging for parking, have been strongly resisted by employers. Furthermore, the regulation's ridesharing goal is not enforced: compliance is measured by the filing of plans, not by their results. It is therefore doubtful that any significant fraction of peak-period traffic can be removed from the roads by Regulation XV; and whatever is will most likely be quickly offset by shifts from people who now avoid the peak due to the severity of its congestion.

### C Lessons from Los Angeles

Policies that aim to contain the onslaught of traffic congestion by offering inducements to rail transit or ridesharing are easily overwhelmed by the forces of dispersion, income expansion, and desire for flexibility, all of which favor travel in individually controlled vehicles. There are certainly some older, compact cities whose urban forms facilitate such policies better than in Los Angeles, but even there land-use trends run strongly in the opposite direction. Especially in newer cities and in the rapidly growing peripheries of older cities, attempts to apply these policies are likely to be expensive and disappointing. We turn now to some other possibilities.

## III Other Policies

### A Doing Nothing

One policy worth serious consideration is to do nothing. Congestion can be looked upon simply as an accompaniment to the benefits of urbanization. One may take hope from the apparent leveling in automobile ownership in those nations where it is approaching one vehicle for every adult. There is perhaps further hope from new technology that makes life in slow-moving cars more bearable and productive: mobile telephones, fax machines,



high-fidelity music, talking books, and even microwave ovens have all made their automotive debut.

Furthermore, one may argue that congestion is self-limiting. People have only so many hours in the day, and they will not spend all of them on the road. So as congestion gets worse, they alter their behavior. If they do so by driving less – as opposed, say, to driving larger and more comfortable vehicles – congestion will respond favorably until some equilibrium level of bearable pain is reached.

Unfortunately, one of the major ways people respond to congestion is to further decentralize their jobs and residences. This results in the paradoxical finding that even while congestion on specific facilities has gotten worse, the average speeds encountered by commuters have not (Gordon, Richardson, and Jun, 1991; Pisarski, 1992). Decentralization offers many benefits, including shorter commutes, lower land costs, less crowding, and easier access to open space. Nevertheless, to the extent that land-use patterns are being altered by the existence of traffic congestion, which is an unpriced externality, our theoretical expectation is that those patterns are inefficient.

This is all the more troubling because dispersion is precisely the wrong response to another unpriced externality, urban agglomeration economies. The major reason for urban concentration to occur is that it enhances the productivity of certain activities. But these productivity benefits cannot be fully achieved if congestion is causing people to desert densely developed areas. Dispersal of urban development also aggravates a variety of environmental problems such as the loss of wetlands, damage to wilderness and wildlife, and pollution of runoff water from developed land.

No matter what adaptations are made, the problem remains that people spend an inefficient amount of time in traffic. This time is a deadweight loss that reduces the urban economy's overall ability to generate high living standards. Any urban area that is able to overcome this inefficiency will thereby achieve a competitive advantage.

## B Expansion of Highway Capacity

The traditional engineering solution to traffic congestion is simply to build more road capacity. This solution suffers from the fact that in highly congested urban areas, a great deal of potential peak-period traffic is deterred only by the existence of congestion itself. This potential traffic, or latent demand, has been called by one of us a "reserve army of the unfulfilled" an enormous reservoir of people who would like to make peak-period trips by private passenger vehicle but for whom it is not quite worth subjecting themselves to the current level of congestion (Small, 1993). This latent demand will tend to fill any new capacity during peak periods, just as it tends to fill any peak-period capacity released by policies, such as those tried in Los Angeles, that focus only on a limited class of trips.

Taken to its extreme, sufficient latent demand implies Downs's Law (Downs, 1962), also known to engineers as the "fundamental law of traffic congestion." It states that capacity expansion makes no difference to peak-period travel speeds. This is true only within limits, of course; there is some amount of capacity that would accommodate both current and latent demand without congestion. In most highly congested and growing urban areas, however, that amount is well beyond what is financially feasible. This is what is meant by the increasingly accepted observation that "we cannot build our way out" of present urban congestion.

In the future, it may be possible to expand capacity through technology that controls the spacing between vehicles, thus allowing existing roadways to carry higher volumes of traffic. Such technology is part of research into and development of Intelligent Vehicle-Highway Systems (IVHS), or "smart cars" and "smart roads." The ultimate capabilities of electronic guidance as a means of expanding capacity are unknown, but this much is already clear: the research and development process will be very expensive. Therefore, we do not regard IVHS as a feasible congestion-relief strategy in the medium term.

Our inability to build our way out of congestion does not mean that further highway building is of no value, nor that it should be excluded in an integrated policy toward congestion. Even if there were no reduction in congestion, fulfilling the desires



of the reserve army is an important benefit. And capacity expansion can in fact reduce congestion at the edge of the peak period because a substantial portion of latent demand represents peak shifting: trips that have been rescheduled earlier or later than is convenient in order to avoid the worst congestion (Small, 1992a, pp. 112 116). Allowing these people to enjoy the benefits of more preferred travel schedules is an important benefit, and also causes the peak to narrow, creating additional benefits to those traveling at its edges.

Looking more broadly, effective transportation is what allows a city to operate as an integrated whole. Many of the agglomeration economies that power a large urban area involve precisely those activities for which speed and flexibility are crucial: acquisition of information, coordination, flexible decision making, adaptation to rapid change (Chinitz, 1961). The decentralized but highly interdependent modes of production characterizing modern metropolitan areas are exemplified by the increasingly vertically disintegrated patterns, with their specialized and flexible labor markets, documented for the Los Angeles region by Scott (1988).

It is crucial, therefore, that transportation policy facilitate the flexible travel patterns needed for metropolitan areas to work efficiently. Where the road system is severely congested, its ability to provide this function is badly compromised. Although highway expansion can help, it cannot solve the problem because it cannot sufficiently reduce peak congestion. We must look at other policies.

## C Land-Use Intervention

Many urbanists and environmentalists believe that existing patterns of land use are the root cause of today's urban problems. They argue that dispersion fosters further dependence on the automobile, leading to congestion, environmental degradation, and a deteriorating quality of urban life (Newman and Kenworthy, 1988, 1992; Gordon, 1991). They conclude that a coordinated policy promoting high-density development supported by mass transit could ultimately reshape cities and reduce congestion and automobile use.

Such policies, whatever their potential benefits, would encounter opposing trends that are solidly entrenched. Decentralization has been part of the urban development process since at least early in this century, and has accelerated in the post-World War II era (Muller, 1981; Lowry, 1988; Linneman and Summers, 1991). The trends we have described for Los Angeles apply to a lesser degree to nearly all urban areas throughout the world (Bourne, 1989; Brotchie, Anderson, and McNamara, 1993).

Although the highway system is one explanatory factor, many other decentralizing forces are also at work. These include the growing demand for single-family housing associated with rising household incomes, the changing structure of economic activity, the increasing scale of residential and employment development, and, in the U.S. at least, historical preference for low-density living (Giuliano, 1989; Downs, 1992). Nor is there any indication that the forces of decentralization are abating. Rising incomes, information-based production, more flexible work arrangements, and increasing weight on environmental quality in individual location choices all foster continued decentralization and reliance on the automobile (Chinitz, 1991; Shortreed, May, and Dust, 1985; Webster and Bly, 1987).

Absent market forces, extensive regulation would be necessary to promote compact city development. In the United States, a coordinated land-use program would require the preemption of regulatory authority from local governments and a historically unprecedented level of control over private property decisions. Moreover, it is unlikely that the desired reduction in congestion would occur even if such a policy were implemented, because transit would not attract sufficient numbers of trips and because auto trips would not be significantly shortened. Several recent simulation studies provide supporting evidence. For example, researchers simulated the effects of assigning 65 percent of forecast population growth and 75 percent of forecast employment growth in the Los Angeles region to large activity centers and to areas with rail stations. Doing so would require very powerful land-use controls; yet the simulations show only 10–15 percent of work



trips going by transit.[2] This would be a sizable increase from the present 4.5 percent, but would have only a small impact on automobile travel and is well below the 19 percent target for transit share contained in the current regional transportation plan (Southern California Association of Governments, 1993). In Portland, Oregon, a proposal to replace a planned suburban freeway with a combination of transit improvements, transit-oriented mixed-use development, and transportation demand management is estimated to increase the transit work-trip mode share from 9 percent (with the freeway plan) to 13 percent (with the transit and TDM package); daily vehicle trips per household would decrease from 7.7 to 7.1 (1000 Friends of Oregon, 1992, Tables 16 and 17). As to trip length, Downs (1992) finds that only unimaginably drastic increases in densities of new development could significantly reduce the average commuting distance in a typical U.S. metropolitan area.

We conclude that land-use strategies are not effective because even very dramatic controls on new development can have only incremental effects on overall land-use patterns, and consequently on travel flow patterns, within a metropolitan area. Although one may argue that higher densities and pedestrian-friendly cities are justified on the basis of aesthetic or environmental considerations, they cannot, by themselves, significantly reduce congestion.

## D Improved Bus Transit and Paratransit

We have argued that rail mass transit is not an effective tool for restructuring land use, and we have shown that attempts to divert auto trips to rail transit have had only limited success. Is there a role for other forms of public transit in addressing urban congestion problems?

Transit use is concentrated in the largest metropolitan areas. Fully 85 percent of all U.S. transit service is provided in the twenty largest urban areas; the New York area alone accounts for 41 percent of all U.S. transit ridership (Fielding, 1987, p. 42). Within

[2] These estimates are based on preliminary results provided to the authors by the Southern California Association of Governments.

these large metropolitan areas, the downtown commute remains the single largest transit market. Even in Los Angeles, the public transit share for commuters to the downtown area is 10 percent, compared to only 3 percent for the entire metropolitan area.[3] Transit has remained somewhat competitive for downtown commute trips because of the cost and/or limited supply of downtown parking and the superior line-haul speed of rail-transit in congested corridors. However, work-related travel constitutes a declining portion of all travel, and downtown work trips constitute a declining portion of all work trips. If transit is to solve urban congestion problems, then, it must compete in other markets.

Research shows that demand for transit is generally more elastic with respect to service quality than to price (Small, 1992a, p. 11). The same is true for the cross-elasticities between auto demand and transit characteristics. This suggests that the best strategy for increasing the market share of transit may be through improvements in service quality, which includes travel time, comfort, reliability, ease of access, and convenience of transfers.

One possible strategy is to permit buses, vans, and in some cases carpools to bypass congestion by means of exclusive rights of way, known as High Occupancy Vehicle (HOV) facilities. Their design can range from completely separate roadways or even networks of roadways, perhaps integrated with park & ride lots, to the marking of one travel lane as HOV only. HOV facilities are operating in at least seventeen U.S. metropolitan areas, and the concept has been adopted as the core of transportation plans in several of them, for example Houston and Seattle. Data from several HOV facilities document increases in peak-hour vehicle occupancies of up to 13 percent (Southworth and Westbrook, 1985). In Los Angeles, the San Bernardino Busway, which serves a major downtown commuting corridor, carries an average of 7,000 inbound passengers during the peak hour, or about the same number of people as the four adjacent general purpose lanes combined.[4]

[3] Computed from records of employment sites with 100 or more workers maintained by the South Coast Air Quality Management District.

[4] 1993 vehicle occupancy data provided to the authors by the High Occupancy Vehicle Branch, California Department of Transportation, District 7



There is some evidence that HOV lanes on freeways or urban arterials can provide large benefits to commuters. In addition to reducing congestion by inducing modal shifts, HOV lanes reduce the number of person-hours spent in congestion by allowing those vehicles with the greatest numbers of passengers top priority in getting past traffic queues. Furthermore, bus service is substantially improved threefold: travel times for passengers are reduced, driver costs are reduced due to the higher speeds, and frequency of service is improved due to higher ridership density. Simulations by Mohring (1979) for urban arterials and Small (1983) for expressways indicate that these factors can combine to create a substantial reduction in time spent in congestion and a significant increase in patronage for bus transit.

A second strategy that has achieved considerable success is that of tailoring commuting services to very specific markets, typically long-distance commuting to one or a few major employment sites. Examples include subscription bus service, other express busses, buspools, and vanpools.

Subscription bus services serve a specific work location. Seats are reserved, and fares are paid on a weekly or monthly basis. These services are usually operated with intercity tour buses, complete with personal reading lights and reclining seats. An example is the service operated by the Golden Gate Bridge, Highway, and Transit District, which serves downtown San Francisco from several small suburban cities to the north. Its passengers are mainly affluent downtown workers attracted by the comfort and convenience of the service. Annual ridership is approximately 5 million.[5]

Other express bus services are aimed at long-distance commuters to sites located throughout a large employment center. Such services exist in several major U.S. cities (Giuliano and Teal, 1985). For example, the City of Los Angeles provides downtown express service consisting of nine routes, each serving a specific suburban community. No stops are made on the line-haul portion of the trip, and a shuttle is available for taking passengers to other

[5] 1992 annual ridership data provided to the authors by the Golden Gate Bridge, Highway and Transit District, San Francisco.

destinations within the downtown area. Annual ridership is approximately 1.8 million.[6]

Buspools and vanpools offer another low-cost option for long-distance commuting to a specific employment site. The driver, who works at the employment site, may own the vehicle or may drive an employer-owned vehicle for a small wage. Significant numbers of buspools and vanpools exist in Hartford, Norfolk, Boston, and Los Angeles, among other places (Giuliano and Teal, 1985, p. 154).

A third strategy is the use of shuttle van or jitney services. In Southern California, private shuttle services have become the dominant airport access mode other than the private car. In this type of service, well suited to the dispersed travel patterns of Los Angeles, individuals from several nearby points are collected and transported to the major destination. The potential for other useful and profitable operations is demonstrated by the existence of thriving illegal jitney services in New York and Miami. A recent study estimates that illegal jitneys in Miami carry between 43,000 and 49,000 daily passengers, or about 25 percent of the weekday public transit ridership; most riders are low-income workers (Urban Mobility Corporation, 1992).

Higher quality, more flexible forms of public transit such as these could potentially divert some commuters from auto to transit. But expansion of such service is made difficult by two major barriers. First, conventional public transit services are already so costly that the subsidy requirements for even higher quality service appear too high to local governments. This problem is exacerbated by the tendency of public transit authorities to let inefficiencies and wage increases absorb a large portion of any state or federal subsidy they receive (Pickrell, 1985; Lave, 1991). This barrier may sometimes be overcome by contracting with private bus operators, which typically have lower labor costs and less administrative overhead (Giuliano and Teal, 1987).

The second barrier is legal. Private transit operators are heavily regulated and must apply for operating authority for each proposed service. In an effort to protect their own markets, both

[6] 1993 annual ridership data provided to the authors by the City of Los Angeles Department of Transportation



public transit agencies and taxi operators strongly oppose jitney operations, and usually succeed in defeating the operating license request.

We conclude that a variety of innovations could potentially offer significant improvements to transit service in selected markets. Vigorous efforts to overcome institutional and legal barriers could have a significant payoff. Although the market for these services is too small to reverse the overall dominance of automobiles, it is large enough to offer some limited relief to growing traffic congestion.

## E Pricing Policies

The fundamental problem with the policies described above is that they do not significantly alter the relative advantage of automobiles for most trips, even during rush hours, when accommodating those trips is most problematic. In the United States, transportation policy has historically favored motor-vehicle transportation. Developing an extensive highway system, making driver's licenses widely accessible, keeping motor-vehicle taxes low, subsidizing indirect costs, and not charging for the social costs of the automobile are all part of this policy. Under these circumstances, efforts to lure drivers to other modes are bound to fail, because the advantage of solo driving in terms of cost and convenience is overwhelming. Thus any effective policy for addressing urban congestion must be based on some form of price adjustment. Mass transit has more promise in some other nations, but even there it is pitted against powerful forces encouraging individualized vehicles; hence, its success is very much in doubt unless complemented by pricing policies. In this section we discuss two possibilities, parking pricing and congestion pricing.

### 1 *Parking Pricing*

More than 95 percent of U.S. workers were offered free parking at their place of work in 1990 (Shoup, 1993). One important reason is federal tax policy, which treats employer-paid parking as a tax-exempt fringe benefit, but does not allow a similar exemption for employee-paid parking or (until recently) for any other employer-paid commuting subsidies (Shoup, 1982).

Free parking at work strongly distorts the cost of commuting in favor of driving alone. For example, Willson (1992) estimates the average employee's parking subsidy in downtown Los Angeles to be $3.87 per day, an amount far greater than the gasoline cost of the average daily commute. Shoup (1993) argues that employer-paid parking is an important explanatory factor for the observed decrease in journey-to-work vehicle occupancy from 1.3 in 1983 to 1.1 in 1990, and that elimination of these subsidies could reverse this trend. Several case studies conducted by Shoup and his colleagues provide supporting evidence. They estimate that the availability of free parking, on average, increases the share of commuters who drive alone by 25 percent (Shoup, 1993).

Because of the political difficulties associated with eliminating a widely used tax break, and in view of the strong opposition any proposal to charge workers for parking would encounter, Shoup proposes an alternative strategy, the "parking cash out": require employers who provide parking subsidies to offer that subsidy in cash as well. For example, if a downtown employer is now leasing spaces at $150 per month and offering them free to employees, the employer would instead offer each employee the option of a free parking space or $150 per month in cash. Employees would be better off because they would be offered a new option without any existing option being taken away; those who value the parking space at less than $150 (less income tax) would take the cash, resulting in reduced demand for parking spaces and fewer auto commute trips. The only extra cost for employers would be giving cash subsidies to employees who previously did not use the free parking spaces, but Shoup argues that there are in fact very few such employees. A limited version of the parking cash out, applying only to employers who lease their parking spaces, became law in California in 1993.

Parking pricing would indirectly affect urban congestion by reducing the number of peak-period vehicle trips. All else equal, it would have greater impact in areas where parking costs are high; these are typically also the areas where congestion is most prevalent. Shoup identifies several additional benefits as well. The reduction in demand for parking spaces on the part of commuters



would result in reduced parking prices, which in turn might attract more off-peak travelers such as shoppers and tourists. The increase in demand for ridesharing would generate economies of scale by making it easier to locate suitable carpool partners. Finally, in the long run, reduced demand for parking spaces would free up land for development and promote more intensive (and efficient) land use.

An offsetting drawback is that parking could be diverted to nearby unpriced residential streets. It is therefore important to coordinate the introduction of any such policy with a review of parking conditions in adjacent areas and, if necessary, the introduction of measures to minimize such adverse spillovers.

Parking pricing has a strong rationale even in the absence of congestion, as a means of improving resource allocation between land used for parking and land used for other urban activities. Its effect on congestion is only incidental, because parking is only crudely correlated with activities that cause congestion. The commuter who parks free at work may or may not be adding to peak-hour flows on a substantial length of congestion roads. Furthermore, parking policies have no effect on through trips. For this reason, attention has also been directed to pricing policies aimed more directly at congestion itself.

## 2 *Congestion Pricing*

For many years economists have advocated directly charging road users for traveling at the most congested places and times. Such a policy, called congestion pricing, can be viewed as a variant of conventional toll roads in which charges vary by time of day, just as they do for long-distance telephone service. It is an example of a broader array of policies, known as road pricing, which use fees to influence travel behavior. Road pricing also includes higher fuel taxes, taxes on total motor-vehicle travel, and some newer innovations such as the toll rings surrounding Norway's three largest cities. Most such policies have only limited effects on congestion, and are usually motivated by the goals of infrastructure finance or environmental protection.

Congestion pricing, in contrast, is very specifically targeted toward reducing congestion. It is a demand-side policy, but differs from most by applying its incentives to all highway users rather than only to a selected subset such as commuters or potential transit riders. To be effective, the peak price must be high enough to make serious inroads into peak demand. This is not as hard as it might seem, as there are numerous possible alternatives to peak-hour driving: transit, carpooling, other destinations or routes, rescheduling of trips away from peak periods, combining of trips into multipurpose tours, or elimination of some trips altogether.

It is this very richness of alternatives that causes several policies we have reviewed to be undermined by latent demand. Congestion pricing does not suffer from this drawback because it uses money, instead of congestion delay, to ration scarce highway capacity. The price applying to peak times creates an incentive not to overuse that capacity, and the incentive remains even when congestion itself is drastically reduced. Rationing by money instead of time is also more efficient because time spent in congestion delay is simply wasted, whereas the tolls paid by travelers are revenue to some public or private organization: revenue that can be spent on something useful, or substituted for some other revenue source.

The existence of congestion pricing would also make other policies aimed at reducing road traffic more effective. In particular, public transit could better compete with the auto. Increased transit demand would improve transit productivity, making it possible to provide more and better transit service for a given level of subsidy. Selective additional transit subsidies would be made possible by the very large revenues that would be raised by a comprehensive system of congestion pricing. In some markets, such as major commuting corridors, pricing autos would make it possible to provide profitable paratransit services such as flexible vanpools or commuter bus services.

Congestion pricing suffers from great political liabilities, however. It charges for something now free, and its immediate distributional consequences appear to be regressive (Giuliano, 1992, 1993). Although studied extensively in London and field-tested in Hong Kong, no city has adopted congestion pricing except Singapore, where since 1975 cars have been required to show a daily pass in order to cross into the central city during peak hours (Hau, 1992).



Recently, however, congestion pricing has attracted a great deal of interest. It has been adopted in two limited experiments, on the A1 motorway north of Paris and on a private four-lane expressway under construction within the median strip of the existing Riverside Freeway in Orange County, California. Recent U.S. highway legislation funds up to five demonstration projects of congestion pricing, to be determined through competitive proposals. A number of road-pricing schemes that may be precursors to congestion pricing are in place in Norway and close to implementation in Sweden and The Netherlands. Proposals for Hong Kong, London, and Cambridge, England, are under active discussion (Hau, 1992; Gomez-Ibanez and Small, forthcoming).

Several factors are responsible for this surge of interest. Technology now enables toll collection to be nonintrusive and easy for the traveler. As conventional toll roads become more common for financial reasons, the additional step of fine-tuning the toll structure for demand management seems less drastic. Furthermore, congestion pricing could be a source of much-needed new revenue, or a replacement for revenue sources that impose undesirable distortions on the economy. There is evidence that the political unpopularity of road pricing is greatly reduced by incorporating it and its revenue uses into an integrated package (Jones, 1991; Tretvik, 1992). Strategies for accomplishing this are suggested by Goodwin (1990) and Small (1992b).

Like any price change, congestion pricing would have significant effects on the distribution of real incomes. The complexity of the shifts in labor, housing, and land markets makes the ultimate distributional impacts far more difficult to predict than the direct impacts, which have been the focus of most analyses (Giuliano, 1993). Even the true direct impacts cannot be judged without looking at how the revenues are spent.

Any successful strategy for enacting congestion pricing will probably include using some of the revenue to expand or otherwise improve highways. Most of the recent road-pricing innovations adopted or considered in Europe and the United States contain this feature. Furthermore, as we suggested earlier, some increase in highway capacity is likely to be needed to meet the transportation requirements of a large modern urban economy.

Another element of a successful strategy will probably be reliance upon an incremental approach toward comprehensive policies. Experience in England, Sweden, Hong Kong, and the Netherlands suggests that sweeping proposals, no matter how well studied and how logically presented, are politically unviable (Gomez-Ibanez and Small, forthcoming). But experience also shows that simple, limited experiments are possible, and favorable experience with these may lead to more sophisticated trials. In this respect the many road-pricing projects that have been im-plemented or are under discussion in Europe and Asia are en-couraging, as is the demonstration program now getting under-way in the United States.

## IV Conclusions

In order for an urban area to realize the agglomeration economies that make it productive, its transportation system must provide for the kinds of movements that integrate activities across space. Increasingly, rapid change and the importance of information in modern urban production requires movements that are flexible and varied. These are precisely the kinds of forces that combine with personal convenience to support a widespread demand for travel in individualized vehicles.

The severity of today's urban traffic congestion interferes with this role of the transportation system. Productivity is diminished from what it could be. Coping mechanisms such as trip reschedul-ing and greater decentralization are to some degree inefficient, in part because they reduce the close interconnectedness of activities that fuel the agglomeration economies of a healthy urban area.

Current policies are unable to cope with the magnitude of the problem. Attempts to lure people into other modes, even with grandly expensive rail transit systems, are impotent against the convenience of individualized motor vehicles. The incentives are insufficient to draw many people out of cars, and they are over-whelmed by latent demand on the part of people immune to the particular incentive being offered. Capacity expansion creates sig-nificant benefits, but is often too expensive and too damaging to the environment.

The policies that would be most effective are those that apply



negative incentives to a large portion of peak-hour highway users. Parking pricing and congestion pricing can both rely on a large research base for confirmation of their likely effectiveness. Both encounter strong political resistance, although parking pricing seems somewhat more amenable to designing a scheme, such as Shoup's cash out, that has few losers. Congestion pricing has many losers, making it more difficult, though perhaps not impos-sible, to design a package of revenue uses that is understandable, credible, and capable of offsetting the losses for most groups of citizens.

The politics of pricing policies have recently been more en-couraging, but it is still unlikely that they will be adopted soon in anything like a full-scale application. So what is there in the meantime?

There are some modest policies that can make a modest differ-ence. Specialized transit and paratransit services have shown some promise for attracting riders with little or no subsidy. High-occu-pancy vehicle lanes can offer carpools and busses a premium ser-vice, saving them time and money and improving the patronage and financial viability of bus transit. Such lanes may also provide a limited niche for introducing congestion pricing, by offering solo drivers the option of using these faster lanes for a fee, as is being planned for two freeways in southern California (Fielding and Klein, 1993). Privatization of some transit services, and elimina-tion of regulatory barriers to organized ridesharing services such as shuttle vans, can increase the range of options offered for flexi-ble travel within existing subsidy requirements.

Policies such as these, approached with realistic goals and with an eye on keeping costs and regulatory burdens reasonable, may in combination offer substantial relief until better solutions become possible.

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