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Using the Revenues from Congestion Pricing

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Executive Summary

Congestion pricing has many goals and benefits, but one thing is clear: its success depends on wise use of the revenues. The economic theory behind the concept relies on these revenues to help compensate for the payments required of highway users. Practical and ethical considerations similarly dictate that those who would otherwise be harmed by the fees receive tangible benefits from the revenues.

This paper investigates the possibilities for designing a package of congestion prices and revenue uses that can attract wide support. The suggested approach returns two-thirds of the revenues to travelers through travel allowances and tax reductions, and uses the rest to improve transportation throughout the area and provide targeted services to affected business centers. By replacing regressive sales and fuel taxes, this approach offsets the tendency of the prices alone to have a regressive distributional impact. By lowering taxes, funding new highways, improving transit, and providing business services, the package provides inducements for support from several key interest groups.

The potential amounts of money involved are discussed using nationwide data, and in more detail using a case study of ubiquitous facility pricing throughout the Los Angeles region. With peak-period prices averaging 15 cents per vehicle-mile in congested regions, revenues in the Los Angeles scenario would be about $3 billion annually after collection costs. The suggested allocation includes $700 million, funneled through employers, to provide a travel allowance of $10 per month for every employee in the region, regardless of mode of travel to work. It also funds a reduction of 5 cents per gallon in the fuel tax, replaces half the dedicated sales-tax surcharge now in place in four counties in the region, and rebates $460 million in local property-tax revenues now going to subsidize highways. About $1 billion annually is left over to fund new highways, transit improvements, and services to employment centers.

Illustrative calculations of the effects on various individuals suggest that the combination of travel-time savings, travel allowance, and tax reductions alone nearly compensate low and average-income auto commuters, and more than compensate high-income auto commuters, many carpoolers, and transit users. Therefore, the entire package can be viewed as a very low-cost way of providing $1 billion annually in new highway, transit, and business services.

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I. Introduction

Congestion pricing is widely recognized to be politically difficult because it adds a price to something previously free. Theory suggests, however, that enough revenue can be generated to more than offset the losses to individual travelers. If this theory applies, it ought to be possible to design a package of congestion charges and revenue uses that looks attractive to most people. Surveys confirm that support for the concept is much higher when it is presented as a complete financial package with explicit proposals for using revenues.[1]

The ability to design such a package, then, is both a test of the applicability of the economic theory and a challenge to those who wish to implement the concept. The details of the design will largely determine the policy's political feasibility, its fairness, and even the nature of the resulting transportation system.

This paper considers some principles that could guide a revenue-allocation scheme for a comprehensive program of congestion pricing, one that covers an entire urban region using area pricing or facility pricing or both. In particular, the paper investigates the possibilities for making the entire package appeal to the narrow self-interest of most residents. It accomplishes this by considering how various categories of people and institutions are affected by congestion pricing, and suggesting measures that would tend to offset those effects that are negative. It also considers measures that would appeal to influential interest groups in order to attract their political support. It then attempts to estimate roughly the magnitudes of revenues and expenditures that might typically be involved, to see what a feasible package could look like.

The exercise appears to show that there is room within a realistic scenario to spread benefits widely, so as to more than fully offset the costs to a majority of residents. Furthermore,

these benefits can be made visible and understandable to ordinary citizens and leaders of major interest groups. The key to these results is the large magnitude of the congestion fees collected.

Demonstrating that such a package is feasible does not necessarily mean it is the one most likely to achieve political acceptability. To make that deduction would require accepting a theory of politics based entirely on self-interest. While I do not endorse such a theory, I believe it is a useful benchmark. If there is an institutionally feasible package of revenue uses that makes congestion pricing look attractive to individuals' self-interest, then there is a greater likelihood of finding a package that can attract support in a real political environment.

The analysis of this paper is for the case of publicly owned highways that have already been paid for or whose financing is being undertaken through normal channels. An alternative scenario, not considered here, would be a new road financed through dedicated tolls levied on users. Differentiating the toll by place and time of day is an effective way to increase revenue, especially if the highway competes with a parallel free route subject to peak-period congestion.[2] This potential of congestion pricing has been recognized in planning for at least three privately proposed highways in the United States,[3] but is seldom recognized for roads in the public sector.

Another scenario not considered here would be to commercialize a major portion of the road system: that is, to turn it over to a public or private authority that is required to be largely self-financing. There is reason to believe that in the long run efficient user charges, including congestion pricing, would enable such an authority to break even on the urban portion of its network.[4] Moving to such a system would require major changes in taxation and cost accounting, as well as a procedure to account for the value of roads already built, so cannot easily be addressed in the context of this paper.

II. Direct Impacts of Congestion Pricing

We now turn to the distributional impacts of congestion pricing. We can distinguish three categories of people who are most directly affected.[5]

(1) Existing Solo Drivers on Highways To Be Priced. People driving alone on congested highways during peak hours will face much higher user fees, coupled with a dramatic improvement in service level. Because it takes only a modest reduction in use to greatly improve travel times, the efficient level of fees will accomplish that reduction and no more. Therefore, the majority of such users will pay the fee and continue to drive. Others will switch to alternative modes, times, routes, or destinations, or will forego the trips altogether.

Users with very high values of time will find that the service improvements more than offset the fees, so they will benefit. The rest, especially those for whom the alternatives to driving during peak hours are particularly unattractive, will experience losses. An exception might be some who find that alternative modes such as carpool or bus become so much faster, due to less congestion, that they are happier using those modes after the policy change than they are driving alone now. (This can happen whether or not carpools are exempted from the fee, since carpooling allows the fee to be divided among two or more people.)

(2) Existing Carpool or Bus Users on Highways To Be Priced. People now using high-occupancy modes subjected to highway congestion will mostly benefit. They receive the full benefit of improved travel time, but with a more modest cost increase per passenger. An exception might be two people with low values of time sharing a carpool, if carpools are charged at the same rate as other vehicles.

(3) Existing Users of Highways Not To Be Priced. Highways outside the scope of the pricing policy, but close enough to be alternative routes, will experience some increase in traffic. This traffic will adversely affect their present users. The effect should small, because any highway which would suffer major congestion due to diverted traffic should instead be included in the pricing plan.

III. Interest Groups

To realistically assess political feasibility, we need to consider not only individuals, but groups likely to be identified in any public debate over congestion pricing.

Traveling Public. People who use the transportation system extensively, especially automobile drivers, can be expected to express some common interests that will shape any political debate over congestion pricing. If galvanized on a transportation issue, these people can be a very large voting block, as exemplified by the large membership of the American Automobile Association. Their interests include reducing congestion, improving service on mass transit, and keeping taxes and user charges low.

State and Local Officials. Political, administrative, and technical officials must reconcile the public's demand for services, including transportation, with strong resistance to taxes. Many of these officials have career interests in constructing public works, whether or not efficient. State and local officials have a strong interest in finding ways to finance transportation projects and other services.

Public Transit and Taxicab Industries. State and local officials in agencies supplying mass transit services are joined by transit unions in seeking increased levels of transit funding.

Taxicab operators want to ensure a stable operating environment, continued demand for their services, and regulatory authority to pass on any increases in their costs.

Business Sector. Local businesses share an interest in good public services, including both freight and passenger transportation, to support their activities. Some depend crucially on reliabe timing of deliveries, and hence care a great deal about the inefficiencies of congestion; but they seek solutions to it that maintain their flexibility. They also share an interest in low business taxes. Beyond that, their interests can be quite divergent, ranging from a desire to increase downtown property values to a desire to promote new outlying development. Developers are especially active in transportation issues, and often play an important role in lobbying officials and shaping public opinion on transportation proposals.

Environmentalists and Slow-Growth Advocates. Successful lobbying groups have formed around issues of environmental degradation due to highways and their associated development. Concerns include scenic values, air pollution, noise, water runoff, and loss of wildlife. Typically these groups oppose most proposals to expand the highway system, although they are often willing to compromise on highways that are smaller and less environmentally damaging.

Trucking Organizations. While more active at state and national than local levels, these organizations are dedicated to better highways, full access to trucks, and financing mechanisms that do not target heavy vehicles. They are vehement in opposition to restrictions on truck movements, for which congestion pricing can substitute.

Low-Tax Advocates. A number of disparate organizations have successfully united to oppose tax increases, including past versions of the dedicated sales-tax surcharges now in place in many metropolitan areas. Some of these groups are amenable to higher user fees, while others

oppose all government charges. Some are interested in privatizing highways. All favor reducing taxes.

IV. Some Guiding Principles for Using Revenues

Because congestion pricing is designed to reduce congestion, the higher user charges faced by peak-period highway travelers are accompanied by reduced travel times. This means that only a portion of the revenues need be used to offset the higher charges in order to fully compensate travelers in the aggregate. Because it is impossible to precisely target those who are most adversely affected, it is desirable to more than fully compensate the majority. Even so, the revenues are so large that there should be some money left over to promote general social goals and to garner political support.

In this section, I outline some measures designed to achieve the objectives of offsetting negative impacts, promoting social goals, and garnering political support from interest groups. The strategy is to fund enough programs with different distributions of impacts so that nearly everyone affected will find at least some offsetting benefits, and a majority will perceive the entire package as an improvement.

A. A Simple Tripartite Division of Revenues

Any revenue-allocation scheme is more understandable to the public if part of a simple overarching strategy that appeals to common sense. I propose one that keeps nearly all the money in the transportation sector, yet through several quite different mechanisms. The proposal is to allocate one-third of the revenues to each of the following categories:

(i) monetary reimbursement to travelers as a group;

(ii) substitution for general taxes now used to pay for transportation services; and

(iii) new services including transportation services.

This is a rather conservative strategy compared to some that have been suggested. Phil Goodwin proposes a revenue allocation of one-third to highway improvements, one-third to transit, and one-third to either general tax relief or increased general expenditures.[6] This has an appealing focus on transportation improvements. However, spending two-thirds of the money on new projects would significantly expand the scope of government and thereby unnecessarily identify congestion pricing with one side of a divisive ideological debate. Furthermore, that such a large increase in transportation funding might not be justified, especially since congestion pricing, as a demand-management tool, can substitute for some otherwise needed expansions of highway capacity.

It is argued by some that the only politically salient case for congestion pricing is to fund new highways.[7] Category (iii) can include some explicitly designated and well publicized highway improvements to help meet desires for such expenditures. Nevertheless, I have not incorporated this motivation as a dominant part of the proposed scheme because once again, there is no guarantee that sound investment policy would involve that much new money. (This argument applies even more strongly to the suggestion made by the Bay Area Economic Forum that revenues from each corridor be targeted to highway improvements in that corridor.[8]) It may make more sense to tie congestion pricing to the financing of a particular highway as part of a small-scale demonstration project, such as suggested by Robert Poole for a corridor in California,[9] than in the areawide implementation envisioned here.

The scheme proposed here follows a principle advocated by Dallas Burtraw for compensating losers from decisions in environmental policy.[10] Burtraw suggests that "linked compensation," in which losses are offset by measures that directly alleviate the harm done, is viewed by most people as fairer and more understandable than monetary transfers. In our case, the biggest loss <u>is</u> a monetary transfer, so the offsetting transfers in categories (i) and (ii) can be understood as linked compensation. For those who avoid the fee by switching to less convenient

alternatives, some of the new services in category (iii) offer the possibility to directly redress their losses by improving their trip through better transit service or better pedestrian and cycling facilities.

Burtraw's argument, and indeed the whole rationale for category (iii), presumes that the new services will actually be used by people whose travel is affected by the plan. This highlights an important proviso in any compensation scheme: providing gold-plated services that appeal to planners rather than users will not make the package palatable.

B. Specific Measures

I list below seven specific measures that seem to meet the goals outlined here. They are categorized according to the tripartate scheme just suggested. They are chosen to ensure that benefits are widespread, can be made visible through credible publicity, and reach the major categories of people who bear the burdens of the congestion charges.

(i) Reimbursements to Travelers:

(1) Fund a program of employee commuting allowances. This measure would encourage employers to establish a general commuting allowance to offset some of the extra commuting expense incurred by their workers. The allowance would be a fixed amount per month for each employee, regardless of mode or time of travel; this way it will not undermine the incentives that are the main purpose of the congestion charges.

Travel allowances have also been advocated as substitutes for the common practice of providing free employee parking. If desired, the two goals could be coupled in a single program. As has been noted in the literature on parking, one impediment to travel allowances is their taxability under present U.S. tax law.

The great advantage of using congestion-pricing revenues to fund travel allowances is that it puts money directly back in the hands of commuters, while giving them the flexibility to avoid some or all of the higher fees by shifting modes, routes, or times of day if they can do so conveniently. Furthermore, employers are given a public-relations tool that can help them avoid employee dissatisfaction arising from higher commuting costs. Because the allowance is a fixed amount per employee, it benefits all working people equally and thereby offsets the regressive tendencies in the congestion charges themselves.

(2) Reduce road user taxes. Another direct way to offset the new user charges is to reduce taxes assessed on highway users. The primary candidates are motor-vehicle license fees and fuel taxes. This measure offsets the impact on those people who actually pay the congestion fees, and more generally benefits highway users.

One way to do this would be to rebate a portion of motor-vehicle license fees. However, license fees in some states are based upon the value of the vehicle and are thereby deductible from federal income tax; thus if they were rebated or reduced, federal tax liabilities would rise accordingly, so some of the benefit would not accrue to local residents and businesses. An alternative for such states is to lower the fuel tax in the region covered by congestion pricing. Although this might seem at odds with the goal of reducing automobile use, the fuel tax is actually a poor surrogate for road use, and is increasingly becoming undermined by improvements to fuel efficiency and introduction of alternative fuels. To the extent that these changes are considered desirable components of environmental or energy policy, there are better tax instruments available in the form of emission charges,[11] taxes on crude petroleum, and taxes on the carbon content of fuels.[12]

(ii) Reduced general taxes:

(3) Replace all or part of any dedicated sales-tax surcharge that applies in the region. Since congestion fees adversely affect many users of the transportation system, it is logical that they be applied to transportation programs broadly. One way to do so is to substitute them for the portion of the sales tax that in many metropolitan areas had been added as a surcharge, dedicated to transportation financing.

While the logic of this measure is in support of transportation, its benefits accrue in proportion to taxable sales. It is therefore progressive because it substitutes for a regressive tax. It also addresses a primary goal of low-tax advocates.

(4) Rebate a portion of property taxes. Even aside from the dedicated sales tax, a substantial portion of funding for highway construction and maintenance is derived from local general revenues. In 1989, $12.8 billion of the $28.0 billion spent by local governments for highways was derived from property-tax and other general revenues of local governments.[13] About one-third of this was explicitly from property-tax revenues, but all of it can be regarded as absorbing local-government tax revenues for which property taxes are the primary source.

A property tax rebate therefore would serve to reduce the hidden subsidy to automobile use, while reducing yet another tax. It would also offset losses in property value that would otherwise occur to some landowners as some of the burdens of the peak-period charges are shifted.

The property tax has the practical advantage that it is easy to identify the people who pay it. A rebate rather than a reduction would make the connection between the congestion fees and this offsetting benefit more salient.

This measure would be valued by homeowners, other land owners including businesses, and low-tax advocates.

(iii) New services including transportation services:

(5) Fund new highway capacity. As noted earlier, this is arguably the single most persuasive policy to the public at large, since it meets a widespread desire and has an easily perceived link to highway fees.

This measure would please the traveling public, the highway industry, and developers and landowners served by the new capacity. It would probably not be viewed favorably by environmentalists, but there is a redeeming feature for them also: by applying congestion pricing to any new facility, its capacity can be less than it otherwise would be while still providing a better level of service. Hence where highway proposals already have strong support, congestion pricing provides a demand-management tool that permits a smaller and less intrusive facility.

(6) Fund improvements to public transit. This can be viewed both as "linked compensation" to people who switch to public transit because of the fees, and a provision to meet a general social goal. To some extent it is also a practical necessity, because the increased transit patronage will require increased service. The measure should appeal to environmentalists, public officials, transit unions, and those concerned with the poor.

Congestion fees provide incentives to use any alternative to solo driving, including carpool, public transit, walking, and bicycling. There are legitimate uses of funds to facilitate all these modes of travel. Examples include carpool matching services, increased transit frequency, more pleasant pedestrian walkways, and safer bicycle paths. However, it is important that the expenditures be tied to some reasonable prospect of actual use. The value of the whole program would be undermined if substantial revenues were diverted to projects that are very costly relative to their value to users. In particular, congestion pricing will be doomed if it is viewed simply as a "cash cow" for projects that would otherwise be rejected as cost-ineffective.

Normally, high-occupancy-vehicle (HOV) lanes should not be included among such improvements. A successful congestion-pricing program would reduce congestion to levels for which the advantage of special lanes would be minimal. In fact, one of the side benefits of congestion pricing is that existing HOV lanes could be converted to general use, thereby increasing the overall carrying capacity of the highways and simplifying law enforcement.

(7) Improve public services to business. Businesses in areas served by congested highways, especially downtown areas subject to areawide pricing, rightly fear that some customers and suppliers will shun them if access is made more expensive. One way to prevent this outcome is to provide other services which are valuable to those businesses. Examples include street repair and cleaning, lighting, pedestrian amenities, landscaping, trash removal, and snow removal. Some low-cost transportation improvements in the targeted area, such as pedestrian walkways and bus-stop shelters, could also be included. In downtown areas especially, such services are sometimes in drastic undersupply due to cities' fiscal conditions. The measure would work most effectively if business groups in each locality chose the projects to be funded.

It should be noted that fears of lost business due to parking and traffic restrictions have often proved to be unfounded; the improved traffic flow and pedestrian amenities can make the area more rather than less attractive.

This measure should appeal to businesses and to public officials who are hard pressed to provide needed services.

V. Some Financial Magnitudes for a Workable Package

Several studies have estimated the magnitude of peak-period prices that would reduce congestion to efficient or at least tolerable levels. A study based on the San Francisco Bay Area suggested that if both prices and investment in highway capacity were optimized, the peak-period

congestion charges would range between 5.4 and 36.2 cents per mile in 1990 prices, depending on assumptions and location.[14] The Federal Highway Cost Allocation included an analysis supporting congestion fees on the order of 15 cents per mile (1989 prices) for an urban auto, and raising some $50 billion in revenue if applied nationwide.[15] A well-publicized proposal by the Bay Area Economic Forum includes a congestion price of 5 cents per mile on the region's most congested 100 miles of highway as a "sample market-based package."[16] A recent study cosponsored by the Environmental Defense Fund (EDF) and the Regional Institute of Southern California suggests peak-period congestion fees for the Los Angeles region's expressway system averaging 15 cents per mile, based on an extensive modeling effort that estimated the level of fee needed to raise expressway speeds to 35-40 miles per hour.[17]

It is difficult to draw general conclusions from such figures, but it may be useful to consider the extent of congestion costs recently estimated for 39 urban areas in a study by the Texas Transportation Institute.[18] For the 20 urban areas with the largest such costs in 1988, estimated total congestion costs (time delay and excess fuel consumption) range from $5,240 million in Los Angeles to $290 million in Minneapolis-St. Paul.[19] The area with the highest congestion cost per registered vehicle is Washington, D.C., with $920 per vehicle; the tenth highest is $420 per vehicle in Atlanta. Making the very crude approximation that the appropriate charge per vehicle-mile would equal the present average congestion cost,[20] the charge for Atlanta in 1989 would be approximately 18.2 cents per vehicle-mile for congested travel on expressways and principle arterial streets, bringing in annual revenues of $760 million.[21] By way of comparison, the subsidy from property-tax and general revenues to highways from local governments throughout the entire state of Georgia was $358 million in 1989.[22] Therefore, the revenues from congestion pricing in a typical large city appear far more than ample to eliminate the subsidy from local governments.

VI. Case Study: Southern California

I now examine in more detail whether the money raised by congestion pricing would be sufficient to fund a variety of programs at significant levels. To do so, I outline a specific package for using the revenues that might be generated from a comprehensive system of congestion fees on all congested freeways and arterials in the five-county Los Angeles region. All figures refer to 1990 conditions.

The starting point is the scenario carefully constructed and analyzed in the EDF study mentioned earlier, in which peak-period charges averaging 15 cents per vehicle-mile are applied to those highways now subject to heavy congestion. EDF estimates that in fiscal year 1990-91, about 97 billion vehicle-miles traveled (VMT) took place on the region's highways, of which 28 billion were under seriously congested conditions.[23] I will refer to travel at those times and places as "peak VMT."

The charges are estimated to reduce total VMT by 5 percent, or 4.8 billion per year.[24] They would shift some additional VMT, which I assume to be half the above amount or 2.4 billion, from congested to uncongested times and places. This implies a 26% reduction in peak VMT, from 28 billion to 20.8 billion. Annual revenues would therefore be 20.8 billion times 15 cents, or **$3,120 million**.

From these, we must subtract collection costs. Estimates for the electronic pricing system tested in Hong Kong indicate a cost of 6.6 cents per trip (in 1990 U.S. prices),[25] which is far lower than manual collection costs for conventional toll booths. The smart-card system studied for Holland was projected to cost about twice as much per transaction,[26] but the much higher volume of travel in the Los Angeles region should lower the cost per transaction for either system. The existing automatic toll collection system in New Orleans costs about $.04 per trip.[27] With these precedents in mind, I assume the collection cost per 10-mile trip would be 6.6 cents. This implies an aggregate collection cost of **$137 million**, or 4.4 percent of revenues.

Our estimate of available net revenue is therefore **$2,983 million.** I now describe a package of uses for this revenue that follows approximately the three-way division mentioned above. It is summarized in Table 1.

(1) Fund a program of $10/month employee commuting allowances. Data from the California Economic Development Department suggest a total of 5.8 million employees in the five-county area. Annual cost: **$696 million.**

(2) Reduce fuel taxes by 5 cents per gallon. In 1990, Californians consumed 15,126 million gallons of taxable fuel.[28] I assume that 62 percent of this derives from the Los Angeles region, that being the region's fraction of VMT in 1991.[29] Annual cost: **$349 million.**

(3) Replace half of the dedicated sales-tax surcharge. Four of the five counties in the Los Angeles region have a dedicated sales tax for transportation purposes. The rate is 0.5 percent in Orange, Riverside, and San Bernardino Counties, and 1.0 percent in Los Angeles County. From data provided by the California State Board of Equalization, it appears that annual revenues at these rates amount to approximately $1,050 million.[30] Reducing these rates by half would thereby require **$525 million.**

(4) Rebate property taxes in an amount equal to all property-tax and general-fund revenues presently used by local governments for highways. In 1989, local governments in California allocated $127 million of property-tax revenues and $883 million of general-fund revenues to highways.[31] Assuming that the Los Angeles region accounts for 46 percent of this, in proportion to its VMT, total elimination of this subsidy would cost **$464 million.**

(5) Fund new highway projects by adding 20 percent to funds raised by the present dedicated sales tax. Since not all the sales-tax proceeds are used for highways, this amounts to more than a 20 percent increase in highway spending from this source. This would provide a significant boost to the region's ability to tackle the extensive backlog of highway projects considered essential by the county transportation commissions. Funding required is 20 percent of $1,051 million, or **$210 million.**

(6) Fund increased transit services at 150 percent of the amount needed to absorb the expected diversion from peak highways. Suppose half the 4.8 billion VMT reduction is diverted to transit, average trip length is 10 miles, and new transit service to accomodate the diversion requires a subsidy of $1.00 per trip. The cost to serve diverted passengers is then $240 million. This increased service, besides accommodating the additional passengers, improves the convenience of the mass transit system to everyone by increasing frequency and/or route coverage. An additional 50 percent would provide considerable scope for still further improvement. Total funding: **$360 million.**

(7) Improve public services to businesses in impacted business centers. This would be a discretionary program, possibly with a formula distribution among employment centers, designed to alleviate adverse effects on businesses. Specific items should be determined by affected businesses, although the rules could require that a fixed portion be devoted to transportation-related improvements. One possible allocation would be: carpool matching services, $25 million; walking and bicycling facilities, $100 million; transit shelters and information, $75 million; other, $179 million. These amounts are chosen to exhaust the remainder of the revenues. Total: **$379 million.**

VII. Effects on Some Protypical Residents

In order to gain understanding of how residents in various circumstances might be affected by the proposed package of congestion pricing and revenue uses, I compute in Table 2 the implications for selected people of the package just outlined for the Los Angeles region. These calculations adopt very simple assumptions and consider only the direct impacts, ignoring any shifting of fee payments, tax burdens, or time benefits. Such shifting would surely occur since ease of travel interacts with many markets including those for labor, land, and retail goods. Hence the calculations to be described should be viewed not as measures of the true changes in people's economic situations, but rather as an indication of the extent to which the direct, immediate impacts of the various provisions would tend to cancel each other. The situations chosen are illustrations, not necessarily averages of classes of people.

The first three columns of the table show people who "stay and pay," i.e., solo drivers who continue to drive alone after the pricing is in place. The first has a roughly average value of time of $5.00 per hour;[32] whereas the second and third ("rich" and "poor") have twice and one-half this value, respectively. Column (4) is a poor person who finds it worthwhile to switch to carpool in order to cut the road price in half, incurring thereby the equivalent of a 15-minute penalty in travel time. Columns (5) and (6) represent a carpooler and a transit user, respectively, who do not change mode as a result of the scheme.

A. Assumptions

Key assumptions for each case are given in the first panel of the table. The low-income commuter has a one-way trip including 5 miles on congested roads; the others have 10 miles, except the person who initially carpools, who (in keeping with the tendency of carpooling to occur among people with longer trips) is assumed to encounter 20 miles of congested roads. The

congestion fee of $0.15 per mile applies to carpools also, but for them it is assumed to be shared equally by two travelers. Average speed on congested roads is assumed to rise from 20 to 30 miles per hour due to the introduction of pricing, while the transit user's one-way trip falls from 30 to 25 minutes.

Each commuter, except the transit user, is assumed to own an automobile. The average-income solo commuter (column 1) drives 10,000 miles per year including nonwork trips, for an annual fuel consumption (at 25 miles per gallon) of 400 gallons. Savings in fuel consumption due to less congestion are not considered. The rich consumer travels 20 percent more than this, the poor person 20 percent less; in addition, being a carpooler reduces annual fuel consumption by 20 percent.

The average sales-tax liability per household for the present surcharge is computed as 80 percent of total surcharge revenues divided by the 4.9 million households in the region in 1990, on the assumption that 20 percent of sales-tax revenues are derived from business rather than household purchases. The high-income commuter is assumed to spend 20 percent more than this average, and the low-income commuter 20 percent less. Similarly, property-tax revenues rebated to the "average" household are computed as the aggregate rebate ($464 million) times 60 percent, divided by 4.9 million households; this is on the assumption that 40 percent of property taxes are paid on business rather than residential property. Rich people are assumed to receive twice as much rebate, and poor people only one-half, due to their different property assessments. The transit user is assumed to be a renter, receiving no rebate. The calculations exclude any indirect benefits arising from reduced taxes on businesses and landlords, even though these may be passed through to consumers and renters.

B. Results

The results shown in the table include the fee payments, the value of time savings, and the monetary benefits arising from the first four of the revenue uses outlined earlier. Hence they take into account the immediate impact of the travel allowance and tax reductions, but not the value of expenditures on highways, transit service, and business services.

The results show that for the average and low-income continuing driver and for the person who switches to carpool, the time and monetary benefits alone are enough to offset most but not quite all the fee payments. For the rich commuter, the continuing carpooler, and the transit user (who has no fee payments), time and monetary benefits far exceed the fee payments. Qualitatively, these results are as expected. The rich benefit a good deal, not because they pay less or receive substantially more rebated taxes, but because they value their time savings more. The average-income driver who faces a reasonably long commute on priced roads is hurt the most, but still the package of revenue uses offsets most of the difference between her payments ($750 per year) and her valuation of the time savings ($417 per year). The poor auto driver, whether continuing to drive alone or switching to carpool, is also almost fully compensated; this is because his trip is assumed to be relatively short, while the package of travel allowance and tax rebates varies only slightly with income. The long-distance carpooler receives a large time savings and divides the fee among two commuters, so comes out a clear winner; so does the transit user, who pays no fee but receives some time savings and substantial allowance and tax rebates.

It is worth stressing that the greater benefits accruing to rich than to poor auto users is almost entirely due to their higher valuation of the same time savings. Both pay approximately the same amount and receive approximately the same allowances and tax reductions. Both also receive the same benefits in time savings. The difference is that that time savings is more highly valued by the richer commuter.

Obviously, cases could be constructed with greater losses. A poor or average-income person with a longer one-way commute on congested highways and no feasible alternative would suffer. In the longer run, the congestion fee gives such people a very powerful incentive to alter their situations to avoid such heavy charges. For example, they might change residences, change jobs, or negotiate new work hours that permit offpeak travel.

These calculations suggest that most of the adverse effects of congestion pricing can be offset, for most commuters, using about two-thirds of the revenues for direct tax abatements and monetary transfers to travelers (categories i and ii). To complete the picture, we must consider how these people would evaluate the services provided with the other third of the money (category iii). Those services are being funded at $1.034 billion, or $211 for every household in the region. Hence it seems plausible that they can be made sufficiently worthwhile to most people as to be worth losses such as those illustrated in columns (1), (3), and (4). Focusing on services especially valued by low and middle-income commuters would provide the best chance to gain such people's support.

VIII. Conclusion

The scheme proposed here is, of course, one of an infinite variety that are possible. My goal has been to combine a theoretical insight — that there is more than enough revenue to fully compensate all losses — with some practical considerations of institutions, politics, and perceptions. The proposal weighs heavily on the side of viewing the revenues from congestion pricing as a substitute for other revenue sources rather than a gigantic windfall for expanded government programs; yet it still provides for substantial new services, which can help attract support from a wide spectrum provided they are chosen to serve real needs. Needless to say, the balance among various programs can and should be adjusted to fit the desires of the people whose lives will be affected.

Table 1
A Package of Revenue Uses for the Los Angeles Region

Program		Annual Amount ($millions)
(i) Reimbursements to Travelers:		
(1)	Employee commuting allowance ($10/mo.)	696
(2)	Fuel tax reduction (5 cents/gal.)	349
(ii) General Tax Reductions:		
(3)	Sales tax reduction (1/2 of transportation surcharge)	525
(4)	Property tax rebate (eliminate local highway subsidy)	464
(iii) New Services Including Transportation		
(5)	Highway improvements	210
(6)	Transit improvements	360
(7)	Business services in impacted centers	379
TOTAL (Net revenue)		2,983
Collection costs		137
TOTAL (Gross revenue)		3,120

ENDNOTES

1. Peter Jones, "Gaining Public Support for Road Pricing Through a Package Approach," Traffic Engineering and Control, vol. 32, no. 4 (April 1991), pp. 194-196.

2. For a demonstration, see Kenneth A. Small, Urban Transportation Economics, Chur, Switzerland and Philadelphia, Pa.: Harwood Academic Publishers, 1992, pp. 140-143.

3. Time-varying prices are being planned for proposed privately built additions to State Routes 91 and 57 in southern California, and is under consideration for the midstate toll road proposed for northern California. These are three of the four projects undertaken under California Assembly Bill 680, passed in 1989. For a full description, see Jose A. Gomez-Ibanez and John R. Meyer, "Private Toll Roads in the United States: The Early Experience of Virginia and California," Final Report to the U.S. Department of Transportation, issued by the Taubman Center for State and Local Government, Harvard University, December 1991, ch. 4-5. For a general analysis of the feasibility of private toll roads using tolls that vary by time of day, see Philip A. Viton, "Private Roads," working paper, Department of City and Regional Planning, The Ohio State University, August 1991.

4. Kenneth A. Small, Cliford Winston, and Carol A. Evans, Road Work: A New Highway Pricing and Investment Policy, Washington, D.C.: Brookings Instutition, 1989, ch. 6.

5. These categories are adapted from a more complete taxonomy outlined by Jose A. Gomez-Ibanez, "The Political Economy of Highway Tolls and Congestion Pricing," presentation at the Seminar on Congestion Pricing, Federal Highway Administration, Washington, July 1991.

6. The idea of a three-part division of revenues appears also in a quite different proposal by P. B. Goodwin, "How to Make Road Pricing Popular," Economic Affairs, vol. 10, June/July 1990, pp. 6-7.

7. Gomez-Ibanez, "The Political Economy of Highway Tolls and Congestion Pricing," op. cit.

8. Bay Area Economic Forum, Market Based Solutions to the Transportation Crisis, San Francisco: Bay Area Economic Forum (May 1990).

9. Robert W. Poole, Jr., "Introducing Congestion Pricing on a New Toll Road," Transportation, forthcoming.

10. Dallas Burtraw, "Compensating Losers When Cost-Effective Environmental Policies Are Adopted," Resources, (Washington: Resources for the Future), No. 104, Summer 1991, pp. 1-5.

11. See, for example, the proposals in Bay Area Economic Forum, Market Based Solutions to the Transportation Crisis, op. cit., and Michael Cameron, Transportation Efficiency: Tackling Southern California's Air Pollution and Congestion, Environmental Defense Fund and Regional institute of Southern California, March 1991.

12. See, for example, William D. Nordhaus, "To Slow or Not To Slow: The Economics of the Greenhouse Effect," The Economic Journal, vol. 101 (July 1991), pp. 920-937; or Dale W. Jorgenson, Daniel T. Slesnick, and Peter J. Wilcoxen, "Carbon Taxes and Economic Welfare," in Brookings Papers on Economic Activity: Macroeconomics, edited by Martin Neil Bailey and Clifford Winston, Washington, D.C.: Brookings Institution, 1992, pp. 393-454.

13. U.S. Federal Highway Administration, Highway Statistics 1990, Table LGF-21, p. 106.

14. Theodore E. Keeler and Kenneth A. Small, "Optimal Peak-Load Pricing, Investment, and Service Levels on Urban Expressways," Journal of Political Economy, vol. 85, no. 1 (Feb. 1977), pp. 1-25. The range given is based on that for "urban-suburban" and "central city" areas in their table 6, p. 20. The figures are updated from 1972 to 1990 prices using inflation factor 2.826, based on the composite price trend for federal-aid highway construction, from Federal Highway Statistics 1990, table PT-1, p. 69; this factor is used because highway construction cost is the primary determinant of the congestion charges in the Keeler-Small analysis.

15. U.S. Federal Highway Administration, Final Report on the Federal Highway Cost Allocation Study, Washington, D.C.: U.S. Government Printing Office (1982), Appendix E, table 12, p. E-53. The figure in the report is 11.2 cents/mile (1981 prices), representing "excess delay" caused by an urban auto at volume-capacity ratio 0.85. I have updated to 1989 prices using average hourly earnings of employees in nonagricultural establishments, which is related to value of time and appropriate to the analysis used in the cost allocation study. For total revenue, see table 14, p. E-59; the $48 billion noted there for urban roads (in 1981 prices) includes charges for air pollution and noise as well as congestion.

16. Bay Area Economic Forum, Market-Based Solutions to the Transportation Crisis: Incentives to Clear the Air and Ease Congestion," San Francisco: Bay Area Economic Forum (May 1990), p. 6.

17. Michael Cameron, Transportation Efficiency: Tackling Southern California's Air Pollution and Congestion, op. cit., p. 40.

18. James W. Hanks, Jr., and Timothy J. Lomax, Roadway Congestion in Major Urbanized Areas 1982 to 1988, College Station, Texas: Texas Transportation Institute (July 1990). The 1989 data quoted are from updated tables provided by the authors and computed as part of an ongoing study.

19. Hanks and Lomax, op. cit., table 17, p. 49.

20. This assumption would be appropriate if travel time were a linear function of travel volume on a given facility, except that it does not account for the lowering of congestion that would occur. Most analyses find travel time to rise faster than linearly with volume, which implies higher charges.

21. This calculation is based on aggregate congestion costs of $760 million per year, from Hanks and Lomax, op. cit., table 17, p. 49, updated to 1989; and 4,175 million congested VMT per year, based on daily expressway and arterial VMT from table 16, p. 45 (updated to 1989) and percent of those VMT that are congested from table B-7, p. B-7 (updated to 1989).

22. Highway Statistics 1990, op. cit., table LGF-21, p. 106.

23. Calculated from Cameron 1991, op. cit., pp. 9, 19.

24. Cameron 1991, op. cit., Table 3, p. 37.

25.Timothy D. Hau, "Congestion Charging Mechanisms: An Evaluation of Current Practice," preliminary draft, March 23, 1992, p. 32.

26. Ibid., p. 37.

27. Ibid., p. 23.

28. U.S. Federal Highway Administration, Highway Statistics 1990, Table MF-2 (p. 4).

29. Data from the California Department of Transportation.

30. "Revenues Distributed to Special Districts from Transactions and Use Tax, 1990-91." The Orange County tax and half of the Los Angeles County tax went into effect on the same date, near the end of fiscal year 1990-91. Because revenues distributions of the two halves of the Los Angeles County tax are reported separately, the fraction of a full year's revenues for the newly enacted taxes that were distributed during 1990-91 could be measured at .071; the same ratio is assumed to apply to Orange County.

31. U.S. Federal Highway Administration, Highway Statistics 1990, Table LGF-21 (p. 106).

32. Small 1992, op. cit., pp. 43-45, summarizes information measuring the value commuters place on their travel time. He concludes that the best supported value is 50 percent of the wage rate, or $4.80 per hour for the average nonagricultural employee in the U.S. in 1989 (p. 77).