APPENDIX J: CONVERTING TRAFFIC CONGESTION INTO CASH

The information needed to understand a problem depends upon one's idea for solving it. MELVIN WEBBER

Chapter 19 argued that tolls on freeways will convert traffic congestion into cash, and a simple model can illustrate the process. The model is roughly based on the traffic flows observed on the I-405 freeway in Los Angeles (see Table J-1). Column 1 shows the number of cars per mile in a lane (counted as if seen in a snapshot from the air). As more cars enter the freeway and density increases, the average speed (in column 2) declines because drivers become more cautious when they must follow closer together. The traffic flow in the lane (the number of cars counted passing a point on the freeway during an hour, in column 3) increases until it reaches a maximum of just over 1,900 cars an hour, which occurs at a density of about 60 cars per mile and a speed of 32 miles an hour. If more cars enter the freeway and density increases further, the increasing congestion begins to reduce flow (in the "backward-bending" part of the speed-flow relationship termed "hypercongestion," as shown in the upper part of the figure beneath the table). For example, the flow can be 1,790 cars an hour with a density of 40 cars per mile and a speed of 45 miles an hour (at point C in the figure), but if more cars crowd onto the road and density increases to, say, 100 cars per mile, the speed falls to 17 miles an hour and the flow declines to 1,670 cars an hour (at point B). Hypercongestion thus reduces both speed *and* flow. The benefits of tolls are easiest to see when traffic would be hypercongested without tolls.

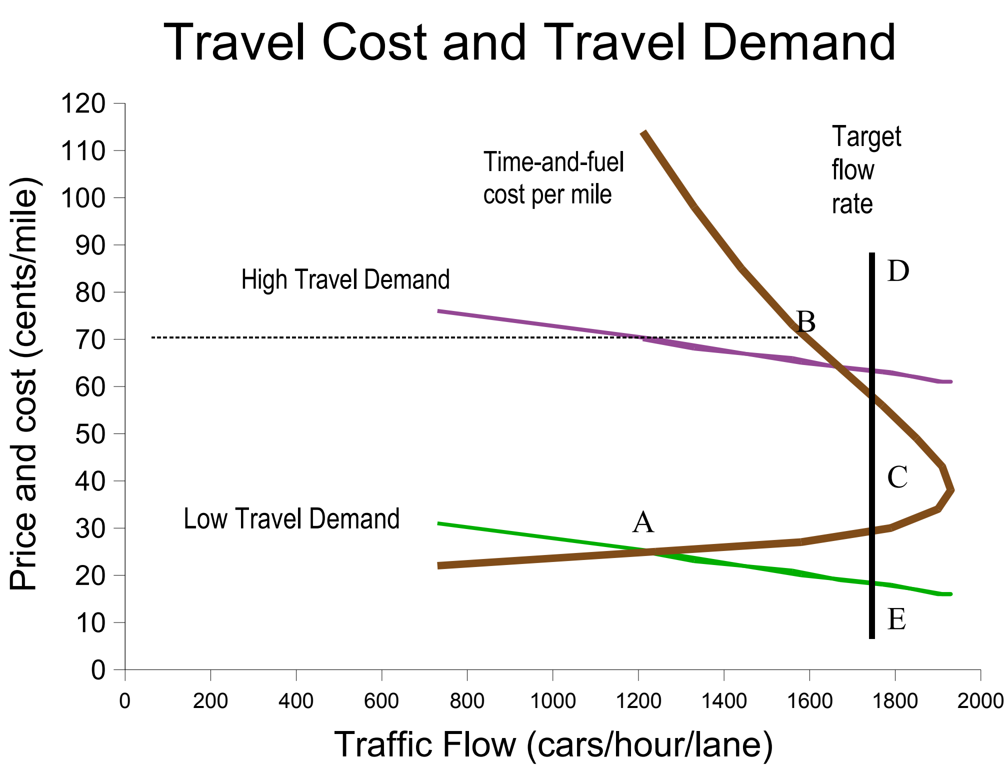
In our example, the uncongested flow of 1,790 cars an hour traveling at 45 miles an hour (point C) is better than the hypercongested flow of 1,670 cars an hour traveling at 17 miles an hour (point B) because more people get where they want to go, and they travel faster. With hypercongestion, more people are on the freeway (more cars per mile), but fewer people get where they want to go (fewer cars per hour past a point), and they travel slower. Alas, hypercongestion with high density and low flow at low speed are common on Los Angeles freeways, which have large sections with average speeds ranging from 15 to 24 miles per hour during the PM peak (3 p.m. to 7 p.m.).[1]

TABLE J-1

DENSITY, SPEED, FLOW, TIME, COST, AND THE DEMAND FOR FREEWAY TRAVEL

Density (cars/mile)	Speed (miles/hour)		Flow (cars/hour)	Travel time (minutes/mile)	Travel cost (cents/mile)	Travel demand (cents/mile)	
						Low	High
(1)	(2)		(3)=(1)x(2)	(4)=60/(2)	(5)=10+15x(4)	(6)	(7)
10	73		730	0.8	22	31	76
20	62	A	1240	1	25	25	70
30	53		1580	1.1	27	20	65
40	45	C	1790	1.3	30	18	63
50	38		1900	1.6	34	16	61
60	32		1930	1.9	38	16	61
70	27		1910	2.2	43	16	61
80	23		1850	2.6	49	17	62
90	20		1770	3	56	18	63
100	17	B	1670	3.6	64	19	64
110	14		1560	4.2	73	21	66
120	12		1440	5	85	22	67
130	10		1330	5.9	98	23	68
140	9		1210	6.9	114	25	70

Columns 6 and 7 show the prices that lead to the demand for the travel flow in Column 3.



The dysfunctional nature of hypercongestion can be seen by looking at the time (in column 4) it takes a car in the traffic flow to go one mile at different flow rates. In our example, with a flow of 1,790 cars an hour traveling at 45 miles an hour it takes 1.3 minutes for each car to go one mile, while in the hypercongested flow of 1,670 cars an hour traveling at 17 miles an hour it takes 3.6 minutes per mile. Hypercongestion slows everybody down and reduces total travel.

We can calculate a solo driver's cost of traveling a mile by assuming the vehicle's fuel cost per mile and the driver's value of time spent in travel. Column 5 shows the cost per mile of travel if we assume the vehicle's fuel cost is 10¢ a mile and the driver's value of time is 15¢ a minute ($9 an hour). At 62 miles an hour a driver's cost of travel is 25¢ a mile (10¢ + 1.0 x 15¢), but if speed declines to 17 miles an hour the cost of travel increases to 64¢ a mile (10¢ + 3.6 x 15¢).[2]

If only a few drivers want to travel on the freeway even when speeds are high, congestion is not a problem, or not much of one. We can illustrate the effect of travel demand on speed and flow by assuming a demand curve for travel. Column 6 shows the prices that lead to the demand for the travel flow in Column 3 during the off-peak hours, and this price-quantity relationship is plotted as the lower demand curve in the figure.[3] The low demand curve intersects the cost curve at point A in the figure where the flow is 1,240 cars an hour, speed is 62 miles an hour, and the cost of travel is 25¢ a mile. No need for tolls here.

Problems arise, however, if travel demand is high and the flow becomes hypercongested. Column 7 shows the prices that lead to the demand for the travel flow in Column 3 during peak hours, and this relationship is plotted as the upper demand curve.[4] The high demand curve intersects the cost curve at point B where the flow is 1,670 cars an hour, speed is 17 miles an hour, and travel cost is 64¢ a mile. Compare hypercongested point B with the alternative of point C where the flow is 1,790 cars an hour, speed is 45 miles an hour, and the time-and-fuel cost of travel is only 30¢ an hour. Point C is far better than point B, but if we are at point C and the demand increases, more drivers will crowd onto the road and depress the speed until the flow is hypercongested. Point B can be a stable equilibrium if 1,670 drivers are willing to travel on the road at the low speed of 17 miles an hour. Hypercongestion creates a serious problem because we could have both a higher flow *and* a lower time-and-fuel cost of travel.

How can we avoid hypercongestion at the time of peak travel demand? By charging a toll to prevent overcrowding. Suppose we aim to achieve a stable flow of about 1,800 cars an hour at about 45 miles an hour. Whenever flow nears 1,800 cars an hour anywhere on the freeway and the speed declines toward 45 miles an hour, introducing a toll at that location can keep the traffic at the target flow rate without any further decline in speed. (This policy is similar to the pricing strategy on the I-15 Express Lanes in San Diego, as explained in Chapter 12.) In the figure, the vertical line ECD shows the target flow rate of 1,800 cars an hour; whenever the demand curve crosses the average cost curve to the left of point C, the toll is zero. But when demand rises and the flow approaches the target rate at point C, the toll kicks in and varies to keep the flow at a steady 1,800 cars an hour at a speed of 45 miles an hour.[5] When demand rises to the high level shown in the figure, the toll rises to 33¢ a mile (the price indicated by the line CD), the cost of fuel and time would be 30¢ a mile (line CE), and the total cost to the traveler is 63¢ a mile (line DE).

A toll of 33¢ per mile may seem high, but the tolls on existing congestion-priced roads in California are even higher at the peak hours. On the I-15 Express Lanes in San Diego, for example, the peak-hour charge for an 8-mile trip on a weekday is $4, or 50¢ a mile. On the Route 91 Express Lanes in Orange County, the peak-hour charge for a 10-mile trip on Friday afternoon is $6.25, or 62.5¢ a mile. Many people are willing to pay the price for a quick trip, and keeping congestion in check makes the freeway system much more productive—more people can get where they are going in a shorter time.

In the high-demand case, we can choose between two traffic situations—without or with tolls. Table J-2 shows how the tolls affect solo drivers. *Without* the toll, a solo driver's total cost of time and fuel is 64¢ a mile. *With* the toll, the driver's total cost of time, fuel, and the toll is 63¢ a mile, so the driver saves a net of 1¢ a mile after paying the toll but saving time; the flow is also 8 percent higher. The toll thus slightly reduces the driver's cost of travel and slightly increases the flow. But there is another important benefit: the toll revenue. The toll is 33¢ a mile, so the public revenue is 33 times the drivers' saving of 1¢ a mile. Instead of spending time stuck in traffic, drivers spend money for a faster trip, and the revenue is available to pay for public services. With a toll of 33¢ a mile and a flow of 1,800 cars an hour, one lane-mile of the freeway will generate $594 an hour in toll revenue (1,800 cars x 33¢ per mile). With a density of 40 cars per lane-mile, the toll is about $15 an hour per car ($594 ÷ 40). A 45-mile trip at the peak hour would take one hour at 45 miles an hour, and the toll would be $15 for the trip (45 miles x 33¢ per mile). In comparison, without the toll, the trip would take 2 hours 40 minutes at

17 miles an hour in hypercongested traffic (45 miles ÷ 17 miles an hour). A solo driver would thus pay $15 to reduce travel time by 100 minutes, or 15¢ per minute saved ($9 an hour), which is the assumed value of time savings for a solo driver.

TABLE J-2
FREEWAY TRAVEL WITH AND WITHOUT CONGESTION TOLLS:
SOLO DRIVER

	Speed (miles/hour)	Flow (cars/hour)	Fuel cost ($/mile)	Time cost ($/mile)	Toll ($/mile)	Total cost ($/mile)
	(1)	(2)	(3)	(4)	(5)	(6)=(3)+(4)+(5)
Without tolls	17	1670	0.1	0.54	0	0.64
With tolls	45	1787	0.1	0.2	0.33	0.63
Change	18	117	0	-0.34	0.33	-0.01

We can also examine how the tolls affect carpoolers. Table J-3 shows the travel cost per person in a three-person carpool. Note how little carpooling saves *without* tolls. In hypercongested traffic with a speed of 17 miles an hour, each person in a three-person carpool suffers a time cost of 54¢ a mile, and the fuel cost of 10¢ a mile is split three ways, so each person's individual cost of time and fuel is 57¢ a mile, compared with the solo driver's cost of 64¢ a mile (in Table J-2). Carpooling thus reduces the cost of automobile travel on the untolled road by only 7¢ a mile, or 11 percent. Now look at the case *with* tolls. At 45 miles an hour, each person in a three-person carpool incurs a time cost of 20¢ a mile, while the money costs of 43¢ a mile for fuel and tolls are split three ways, so each person's total cost of travel is only 34¢ a mile. When compared with the carpooler's cost of 57¢ per mile on the untolled road, carpooling on the tolled road thus reduces the cost of automobile travel by 23¢ a mile, or 46 percent. The tolls thus strongly encourage travelers to carpool and ride public transit, so the flow of *people* along the freeway will increase even more than the flow of *cars*.

TABLE J-3

FREEWAY TRAVEL *WITH* AND *WITHOUT* CONGESTION TOLLS:

PER PERSON IN A THREE-PERSON CARPOOL

	Speed (miles/hour)	Flow (cars/hour)	Fuel cost ($/mile)	Time cost ($/mile)	Toll ($/mile)	Total cost ($/mile)
	(1)	(2)	(3)	(4)	(5)	(6)=(3)+(4)+(5)
Without tolls	17	1670	0.03	0.54	0	0.57
With tolls	45	1787	0.03	0.2	0.11	0.34
Change	18	117	0	-0.34	0.11	-0.23

Consider how the tolls would reduce the cost of an average 30-mile round-trip commute to work in Southern California.[6] If the tolls reduce the time-and-money cost of travel in a three-person carpool by 23¢ a mile, each person in the carpool saves $6.90 a day (23¢ x 30 miles) or $138 a month after the tolls are introduced. Because each person in the carpool saves 34¢ a mile in time cost and pays only 11¢ a mile for the 33¢-a-mile toll split three ways, congestion tolls are a great bargain for carpoolers.

Traffic congestion is far more complicated than this simple model can show, but the principles of congestion pricing don't depend on the specifics of each case. The target flow rate during peak hours will depend on the circumstances, but it should always be less than the rate at which hypercongestion sets in. Congestion tolls literally convert wasted time into real money.

Despite their obvious theoretical advantages, congestions tolls have been hard to sell to voters and therefore to politicians, because drivers oppose paying for roads that are now free. As a way to generate political support for tolls on congested freeways, Chapter 19 proposed returning the toll revenues to the cities thorough which the freeways pass. Consider how this idea might work in Southern California, which has the worst traffic congestion in the U.S.[7] Los Angeles County's 882-mile freeway system passes through 66 of the county's 88 cities.[8] Suppose California charges congestion tolls on these freeways and distributes the resulting revenue to these 65 cities on a per-capita basis to compensate them for the freeways' harmful effects. In political reality, the toll-revenue distribution formula would be much more complicated than this simple proposal, but the important point is to create a formula that will energize elected officials to demand the use of tolls to reduce traffic congestion and generate municipal income. Distributing the toll revenues to cities with freeways can illustrate the proposal to create politically effective claimants for the toll revenue.

Sharing the toll revenue among cities with freeways can be justified on two grounds. First, freeways remove large swaths of land from cities' property tax rolls, and motorists pay no sales taxes as they drive through the city. The toll revenue can therefore be considered payments in lieu of the property and sales taxes the cities would otherwise receive. Second, drivers pollute the air as they pass through cities, the roar of traffic violates the surrounding neighborhoods, and the freeways themselves are often ugly. The toll revenue can therefore be justified as compensation to those who must live with this air, noise, and visual pollution. One obvious use of the revenue is to build soundwalls to protect the residents of the cities penetrated by the intrusive freeways. In thinking about congestion tolls, every mayor, councilmember, and interest group will know the toll revenue from the freeways within their borders will remain in their city, while most of the drivers who pay the tolls will only be passing through. By reducing traffic congestion, the tolls will also improve air quality in these cities. Residents will therefore benefit from the tolls because their environment will improve and they will get better public services. This toll-sharing policy can thus remove a political obstacle to congestion pricing: the beneficiaries will be easier to organize.

The average per capita income is only $20,100 a year in the 66 cities *with* freeways, but is $35,100 a year in the 22 cities *without* freeways, so congestion tolls will transfer money to poorer cities from richer ones (see Table J-4). A city doesn't need to have a freeway running through it to suffer from external costs, however. The four poorest cities without freeways (Cudahy, Huntington Park, La Puente, and Temple City) could be included among the recipient cities because freeways pass close by all four, and their per-capita incomes are below the average of other recipient cities. If so, the per capita would be $20,000 a year in the 70 "recipient" cities, and $47,000 a year in the remaining 18 "donor" cities.[9] High-income cities without freeways won't receive any toll revenue, but think of it this way: would they prefer to have freeways so they could

TABLE J-4

PER CAPITA INCOMES OF CITIES IN LOS ANGELES COUNTY

($ per person per year)

66 Cities *with* Freeways						22 Cities *without* Freeways	
City	Income/ Capita	City	Income/ Capita	City	Income/ Capita	City	Income/ Capita
Agoura Hills	$39,700	El Segundo	$34,000	Norwalk	$14,000	Avalon	$21,000
Alhambra	$17,500	Gardena	$17,300	Palmdale	$16,400	Beverly Hills	$65,500
Arcadia	$28,400	Glendale	$22,200	Paramount	$11,500	Bradbury	$57,700
Artesia	$15,800	Glendora	$26,000	Pasadena	$28,200	Cudahy	$8,700
Azusa	$13,400	Hawaiian Gardens	$10,700	Pico Rivera	$13,000	Hermosa Beach	$54,200
Baldwin Park	$11,600	Hawthorne	$15,000	Pomona	$13,300	Hidden Hills	$94,100
Bell	$9,900	Industry	$9,900	Redondo Beach	$38,300	Huntington Park	$9,300
Bell Gardens	$8,400	Inglewood	$14,800	Rosemead	$12,100	La Habra Heights	$47,300
Bellflower	$16,000	Irwindale	$13,100	San Dimas	$28,300	La Puente	$11,300
Burbank	$25,700	La Canada Flintridge	$52,800	San Fernando	$11,500	Lomita	$22,100
Calabasas	$48,200	La Mirada	$22,400	San Gabriel	$16,800	Malibu	$74,300
Carson	$17,100	La Verne	$26,700	Santa Clarita	$26,800	Manhattan Beach	$61,100
Cerritos	$25,200	Lakewood	$22,100	Santa Fe Springs	$14,500	Palos Verde Estates	$69,000
Claremont	$28,800	Lancaster	$16,900	Santa Monica	$42,900	Rancho Palos Verdes	$46,300
Commerce	$11,100	Lawndale	$13,700	Signal Hill	$24,400	Rolling Hills	$111,000
Compton	$10,400	Long Beach	$19,100	South El Monte	$10,100	Rolling Hills Estates	$51,800
Covina	$20,200	Los Angeles	$20,700	South Gate	$10,600	San Marino	$59,200
Culver City	$29,000	Lynwood	$9,500	South Pasadena	$32,600	Sierra Madre	$41,100
Diamond Bar	$25,500	Maywood	$8,900	Torrance	$28,100	Temple City	$20,300
Downey	$18,200	Monrovia	$21,700	Vernon	$17,800	Walnut	$25,200
Duarte	$19,600	Montebello	$15,100	West Covina	$19,300	West Hollywood	$38,300
El Monte	$10,300	Monterey Park	$17,700	Westlake Village	$49,600	Whittier	$21,400
				Average	**$20,100**	**Average**	**$35,100**

Source: U.S. Census 2000

The two groups' average incomes are weighted by the cities' populations.

share the revenue? Probably not. The tolls can make a big contribution to public finance in low-income cities that suffer an unfair share of the freeways' costs.

Both federal and state laws will have to be changed to permit congestion tolls, and distribution of the revenue will be more complicated than simply giving it to cities with freeways.[10] Motorists will pay the tolls, after all, and using some of the revenue to improve the freeways may reduce their opposition to the tolls without significantly reducing the cities' support. The tolls may have to be high to clear congestion at specific bottlenecks, for example, and some of the revenue can also be used to increase capacity at these locations.[11] But because the tolls will reduce traffic congestion, they can substitute for other transportation investments that make sense only if the roads remain free. For example, between 2005 and 2030 the Southern

California Association of Governments (SCAG) proposes spending $47 billion for transportation improvements (including $13 billion for road improvements and $29 billion for a high-speed rail system). In its bottom-line summary of the results, SCAG estimates that in 2030 the region's average vehicle occupancy rate will fall from 1.4374 persons per car without the investments to 1.4364 persons per car with them.[12] (The predicted 0.01-persons-per-car change in the vehicle occupancy rate is statistically and practically insignificant, but one would hope to see vehicle occupancy *increase*, not fall.) In comparison, congestion tolls can yield billion of dollars a year in revenue, and immediately increase both travel speeds the vehicle occupancy rate.

Because congestion tolls can eliminate the need for some astronomically expensive rail and highway projects, they can free up gasoline taxes to maintain the existing transportation system. All things considered, congestion tolls can greatly improve transportation finance even if most of the revenue is distributed to cities. The right use of the revenue is a *sine qua non* for congestion tolls, and it is more a matter of politics than economics.

Using a transportation model calibrated for Southern California, Elizabeth Deakin and Greig Harvey estimated the annual revenue that would result from congestion tolls in the Los Angeles region: $3.2 billion in 1991, rising to $7.3 billion in 2010.[13] Kenneth Small estimated that congestion tolls in Los Angeles would have produced $3 billion, net of collection costs, in 1991.[14] These estimates are conservative compared to the Texas Transportation Institute's estimate that the total costs of traffic congestion in Los Angeles were $8.4 billion in 1991, and $12.8 billion in 2001.[15]

Congestion tolls in Los Angeles County can generate several billion dollars a year and substantially improve local public finances. Because 9.2 million people live in the 70 toll-recipient cities and the unincorporated area, each $1 billion will produce about $110 per capita in municipal revenue. If the congestion tolls yield $5 billion a year net of collection costs, for example, they will generate about $550 per capita for the recipient cities. Because the 70 toll-recipient cities' general revenues averaged $577 per capita in 2001, the tolls will almost double these cities' general revenues, and the poorest cities will gain the most in proportion to their income.[16] Toll revenue of $550 per capita for Maywood, for example, would amount to 6 percent of the city's per-capita income ($550 ÷ $8,926), while cities with per-capita income greater than $53,000 a year would receive nothing because they have no freeways. This pattern of revenue distribution can help redress the wide disparities among rich and poor cities in parks, police protection, and other public services.

Nonresidents, such as tourists and trucks driving through the region, will also pay tolls, so the total revenues will exceed the residents' payments.[17] And because these nonresidents will save valuable time, even they will be better off if their time savings are worth more than their toll payments. The time saved will be especially valuable for goods movement on trucks to the ports of Los Angeles and Long Beach, which together handle 43 percent of the nation's seaborne cargo, with about 15 percent of it being transported by truck on the Long Beach Freeway. Trucks from throughout the country converge on the overburdened freeways leading to the two ports, making Southern California the nation's colon for foreign trade. In response to congestion tolls, port-bound trucks will either pay for peak-hour driving or shift to off-peak hours, and the region's residents will benefit in either case.

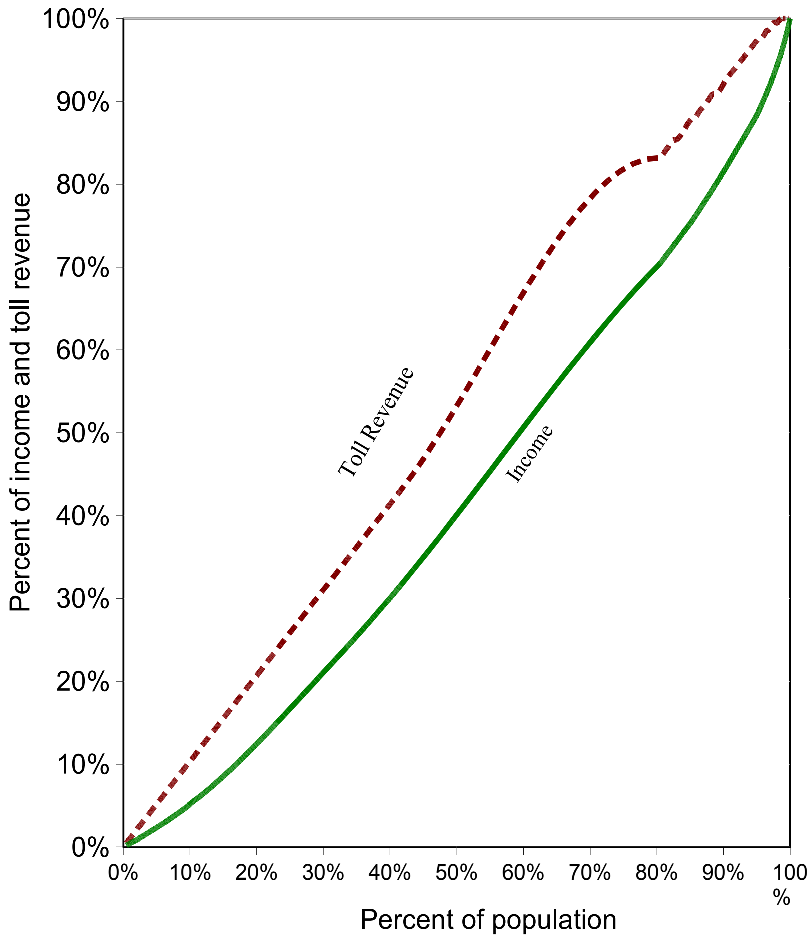
Will tolls on the freeways divert some drivers onto the parallel surface streets? Speed on the freeways will increase in response to the congestion tolls—that is the reason for the tolls—and the traffic flow will increase rather than decrease. If congestion tolls increase the speed and flow of traffic on the freeways, how can they also increase traffic on the parallel surface streets? Instead, shorter travel times on the faster freeways may draw traffic *off* the surface streets. But if traffic tolled off the freeways does crowd the parallel surface streets, congestion tolls will also be appropriate on these streets to keep them flowing freely. Residents can be exempt from paying tolls on surface streets in their own city but would pay for driving on congested streets in other cities. Just as parking spaces can provide public revenue for neighborhoods, congested surface streets can create public revenue for cities, and in both cases the revenue will be paid by nonresidents. Any spillover traffic from the tolled freeways can thus provide even more revenue for low-income cities.

Deakin and Harvey estimated that higher-income motorists will pay most of the tolls because the highest-income quintile (the top 20 percent of the income distribution) own 3.1 times more cars than the lowest-income quintile and drive 3.6 times more vehicle miles per day.[18] Because higher-income motorists also drive more during the peak hours, the highest-income quintile will pay five times more in tolls than the lowest-income quintile.[19] Thus the tolls will in the main transfer money from high-income motorists to low-income cities. But high-income motorists will also benefit. Travel speeds will increase after tolling begins, and drivers who place a high value on saving time are better off as a result of the tolls and the time savings taken together. After all, when we are driving to work, hurrying to catch a plane, or rushing to the hospital for an emergency, do we want the freeways congested by low-value, discretionary trips that could easily be made at off-peak hours? Most people would surely be willing to forego a few of their least essential peak-hour, single-occupant vehicle trips if they could, in exchange, drive much faster for all their other peak-hour trips, and congestion tolls offer exactly that bargain. In addition, the tolls will convert congested traffic into cash for low-income cities and turn wasted time into public services.

Distributing the toll revenue on a per-capita basis will moderate the region's income inequality. Figure J-1 shows the distribution of personal income and toll revenue in Los Angeles County. The horizontal axis measures the cities' cumulated share of the county's population, arrayed according to increasing per-capita incomes. The vertical axis measures the cities' cumulated share of the county's total income and toll revenues. The upper and lower curves show toll revenue and income as a function of population.[20] The 20 percent of the population who live in the 33 poorest cities receive 12 percent of the county's income but 21 percent of the toll revenue. In contrast, the 20 percent of the population who live in the 43 richest cities receive 30 percent of the county's income but only 17 percent of the toll revenue. The 1 percent of the population who live in the eight richest cities receive 4 percent of the county's income and no toll revenue.

These distributional results refute any objections to congestion tolls on the grounds they will harm the poor. A few poor people who live in the richest cities and drive during congested hours may lose a little, but the great majority will save time, breath cleaner air, and gain better public services at low cost. When we consider the whole population, the congestions tolls will clearly be progressive, not regressive, because the lowest-income people don't own cars and won't pay tolls but will receive better public services. Even when we consider only drivers and ignore the better public services in low-income cities, the results can still be progressive because peak-hour driving is lowest among the poorest drivers. Almost everyone can win from the congestion tolls.

Figure J-1
Cities' Shares of Population, Income, and Toll Revenue



University of Southern California transportation economist Genevieve Giuliano says the conventional complaint about congestion tolls—that they are regressive and will harm the poor—may actually be motivated by a baser and more short-sighted reason: drivers simply oppose paying to use roads they believe should be free.[21] Returning the toll revenue to cities with freeways can turn this typical debating ploy around. Politicians can support congestion tolling on the high-minded ground that it will help the poor, even if another reason is more important—their cities need the money, and they deserve it!

Returning the revenue to cities with freeways will create far greater political support than would using it to reduce general taxes because any tax cut would be small and hard to perceive. Many people would also doubt that taxes will be reduced at all. And if taxes are not reduced, any increase in general public spending—regardless of its worth—would also be hard to perceive, while drivers will pay the tolls every day. In either case, the benefits of reduced taxes or increased general spending would be so indirect, distant, delayed, and diffuse that most people may disregard them entirely. In contrast, returning the toll revenue to cities with freeways will produce direct, proximate, immediate, and concentrated benefits that can embolden politicians from cities with freeways to insist on congestion charges. No one will have to organize the beneficiaries—cities—because they are already organized.

Using some of the revenue to finance transportation, if done in the right way, might further increase the political appeal of congestion tolls. For example, the Los Angeles Metropolitan Transportation Authority (MTA) funds public transportation and a wide array of transportation projects including bikeways, pedestrian facilities, and local road and highway improvements throughout the county. Most of its tax support comes from an added 1¢ sales tax rate throughout the county, which generated $1.1 billion in 2003.[22] Thus, if $1.1 billion of congestion toll revenue were allocated to the MTA, the sales tax rate in the county could be reduced by 1¢, from the current 8.25 percent to 7.25 percent.[23] The congestion tolls, by themselves, can greatly improve transportation, and if the toll revenue were $5 billion a year, $3.9 billion a year would still be available to cities.

The 70 cities with freeways plus the county (representing the unincorporated territory) could become a lobby for the congestion tolls, and they already have a strong influence in the legislative process. To show the importance of this potential coalition, consider an alternative use of the toll revenue—a revenue-neutral reduction in the gasoline tax. Reducing the gasoline tax may seem reasonable because it would compensate motorists who are paying the tolls and would not take more money for the government. But those who would receive the toll revenue—motorists—are not organized as a political entity. Millions of motorists would benefit from the lower gas tax but not by enough to make a strong political demand for the congestion tolls. At best, the reduction in gasoline taxes would mollify motorists but would not create a coalition to support the tolls.[24] If the revenue is distributed to cities with freeways, however, many elected officials may decide to buy into the congestion tolls because they have been bought off by the resulting revenue.

A purely economic analysis of congestion tolls misses the key political point. Unless the revenue provides benefits to interest groups who will support road pricing, congestion tolls will remain difficult in practice no matter how efficient and fair in theory. If the revenue goes to cities with freeways, politicians will not have to say they are going to charge everyone for driving in congested traffic and then figure out a fair way to spend the money. Instead, they can propose a fair way to deal with three problems at once—traffic congestion, the environmental costs of freeways, and the fiscal distress of low-income cities. Drivers will pay the tolls only when they get a direct individual benefit—faster travel—and cities with freeways will get better public services—such as parks, police protection, sidewalk repairs, and soundwalls. Many people will have good reason to champion road pricing.

1. Southern California Association of Governments (2004, Appendix C, Exhibit C.5). Hypercongestion is a complex phenomenon that is difficult to model, but many people are familiar with travel on freeways at low speed in closely spaced traffic. Small and Chu (2003) and Verhoef (2003) explore the complex nature of hypercongestion.

2. This calculation understates the cost of hypercongested flow because the fuel cost per mile increases when cars travel in slow stop-and-go traffic.

3. The equation for the off-peak demand curve is Q = 3,200 – 80P, or P = 40 – Q/80.
4. The equation for the peak-hour demand curve is Q = 6,800 – 80P, or P = 85 – Q/80.

5. Small and Chu (2003, 329) say the speed-flow relationship is often quite flat until capacity is reached. The optimal flow is thus frequently near to capacity, suggesting that the marginal cost curve becomes almost vertical near capacity. If so, the line CDE can be considered the marginal cost curve after point D is reached. Lindsey and Verhoef (2000) explain that the maximum feasible flow on any road segment depends on factors such as the number and width of traffic lanes, grade, road curvature, speed limit, weather, vehicle types, and the behavior of individual drivers.

6. A 1991 origin-destination travel survey of commuters in Southern California found that the average one-way vehicle commute distance was 15 miles (Southern California Association of Governments 1991). Other commuter surveys conducted between 1989 and 1996 found that average one-way vehicle commute distances ranged from 14.8 to 16.9 miles (Southern California Association of Governments (1996).

7. According to the Texas Transportation Institute's *2003 Urban Mobility Study*, Los Angeles has the worst traffic congestion in the United States. In 2001, 88 percent of peak-hour VMT was in congested traffic. The TTI estimated 667 million person-hours and 1 billion gallons of gasoline were wasted in congested traffic, and these figures more than tripled since the first estimates in 1982. The estimated cost of congestion was $1,005 per person in 2001.

8. Like a city, Los Angeles County would receive toll revenue in proportion to the length of freeways in the unincorporated area.

9. Removing the four poorest cities from the "without freeways" group sharply increases the weighted-average income per capita of the 18 remaining cities because the four poorest cities have large populations while most of the richer cities have small populations. Avalon, which would be the poorest remaining city without a freeway, is on Catalina Island 26 miles off the coast, and it would be unaffected by the congestion tolls.

10. In practice, the formula for distributing the toll revenue might resemble the federal formulas for distributing gasoline tax revenues to states.

11. Just as high prices for curb parking will reveal where investment in off-street parking is justified, high congestion tolls will reveal where investments in additional road capacity are and are not justified. The tolls thus have another benefit: they will provide an excellent guide for investment decisions. If tolls reveal where investment is most productive, the existing gasoline tax revenue may be more than enough to finance it. In this case, all the congestion toll revenue can be distributed to cities.

12. Southern California Association of Governments (2004, Appendix C, p. C-29).

13. Deakin and Harvey (1996, Tables 7-14 and 7-18).

14. Small (1992, 371).

15. See the Texas Transportation Institute's *2003 Urban Mobility Study,* which is available online at http://mobility.tamu.edu/ums/mobility_data/tables/los_angeles.pdf.

16. The cities' general revenues are taken from the California State Controller's Office, *Cities Annual Report, Fiscal Year 2000-2001.* General revenues are defined as revenues that cannot be associated with any particular expenditure; examples include property taxes, sales taxes, and business license fees. General revenues do not include fees and charges for direct services, such as the revenue from municipally owned electric utilities. The population of Los Angeles County is 9.5 million, of whom 990,000 live in unincorporated areas.

17. In calculating the net revenue distributed to cities, however, the toll collection costs must also be considered. If these collection costs are less than the tolls paid by nonresidents, the cities will earn more revenue than the regions' residents pay.

18. Deakin and Harvey (1996, Tables 8-1 and 8-3). At the national level, in 2002 the highest-income quintile of households owned 2.9 times more cars than the lowest-income quintile (U. S. Bureau of Labor Statistics, 2004, Table 1).

19. Deakin and Harvey (1996, 8-6). And because men are more likely then women to drive in congested conditions, men will also pay more in tolls (Deakin and Harvey 1996, 8-7).

20. The Lorenz curve for distribution of income among individuals would lie below the curve for the distribution of income among cities because the average income in 88 cities mask the inequality of individual incomes within each city. A curve showing the distribution of toll payments among individuals would also lie below the curve for the distribution of the revenue because both VMT and the propensity to drive in congested traffic increase with income.

21. Giuliano (1992).

22. See the Los Angeles County Metropolitan Authority's financial statements on their website at www.metro.net/about_us/finance/propositions.htm.

23. Although the congestion tolls would provide $1.1 billion a year to the MTA, note that using the toll revenue to replace the sales tax would provide a benefit to everyone in the County, not just to motorists. What might look like throwing a bone to motorists would, in reality, be a tax cut for everyone, most of whom happen to be motorists.

24. In their study of the gasoline tax in Britain and the United States, Ian Parry and Kenneth Small (2002) estimated the optimal tax rate is about $1 per gallon, or 2.5 times the current U.S. tax rate. Using the congestion toll revenue to reduce the gasoline tax would thus do nothing to remedy the undertaxation of gasoline. Because collection costs will undoubtedly be higher for congestion tolls than for gasoline taxes, the reduction in gasoline taxes would be less than the toll payments.