Reason Foundation

NOVEMBER 1993 POLICY STUDY NO. 170

HIGH OCCUPANCY/ TOLL LANES: PHASING IN CONGESTION PRICING A LANE AT A TIME

by Gordon J. Fielding & Daniel B. Klein

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EXECUTIVE SUMMARY

A consensus is emerging among transportation economists that the best way to deal with freeway congestion is to charge for driving during peak hours. The main barrier to implementation is political: drastic change is politically unpopular. This paper proposes a way of overcoming the political obstacles by phasing in congestion pricing over a period of many years.

The proposal involves modifying the current concept of High Occupancy Vehicle (HOV) lanes. Current HOV lanes are not very effective at reducing traffic; 43 percent of car-poolers are members of the same household. They cost everyone but serve few drivers. We propose replacing HOV lanes with HOT lanes: High Occupancy/Toll lanes. A HOT lane would give free passage to three-occupant vehicles (HOV3s) but permit all others to pay a peak-hour toll for access. This would utilize more of the lane's capacity, demonstrate congestion pricing on a wide scale, and generate revenues to pay for HOT lane construction. In cases where the choice is between a HOT lane or no additional lane, the HOT-lane option also promotes ridesharing.

Existing HOV lanes would be converted to HOT lanes, and planned HOV lanes built as HOT lanes instead. Once a HOT lane reached capacity and there was demand for more of its services, the adjacent lane would be converted to a second HOT lane. Over time this process could be repeated.

Two Southern California projects will soon offer drivers the opportunity to experience HOT lanes. One is the private toll lanes project under construction on the Riverside Freeway (SR 91) in Orange County. The other is a planned HOT lane conversion on I-15 in San Diego County.

HOT lanes at surface levels can often be financially self-supporting from toll revenues, thereby permitting the expansion of the planned Southern California HOV network with private capital, rather than limited public funds. Elevated HOT lanes, which are much more costly, could be developed as public-private partnerships with mixed funding. Provisions for private construction and operation of toll lanes on existing freeways already exist in the law of both California and the federal government.

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Habit is habit, and not to be flung out the window by any man, but coaxed downstairs a step at a time.

—Mark Twain

I. INTRODUCTION

Advanced technologies have made it as easy to price highways as it is to price telephone service, miniature golf, or entrance to a movie theater. The transaction costs of manual toll collection have been eliminated by Automated Vehicle Identification (AVI) and Electronic Toll Collection (ETC). These developments allow congested highways to be priced like any other scarce commodity so as to manage demand and provide an inducement to investment in transportation services.

A consensus has emerged among economists and policy analysts that charging for roads provides the only efficient solution to highway congestion in urban areas. But this view is not widely shared by the public. Some transportation officials, elected officials, and involved citizens prefer solutions that mandate ridesharing, expand transit services, or attempt to build a way out of the problem. Yet, tax revenues continue to fall short of projected improvements. Previous studies from the Reason Foundation have outlined the thesis that as road space is a scarce resource, and transportation developments strain public finances, the most efficient way to allocate use and finance construction is via congestion pricing.

We seek to extend this idea by showing how High Occupancy Vehicle (HOV) lanes can be *gradually* converted to High Occupancy/Toll (HOT) lanes.[1] Our thesis is that opinions towards pricing will change only once officials and involved members of the public have become acquainted with pricing on highways. Only then will they realize the potential to: 1) reduce the cost of moving people and goods; and 2) generate money for highway improvements. Their aversion to the loss of benefits enjoyed from a "free" road obscures the benefits to be achieved by pricing.

When developing *new* highways, engineers and the public are more open to the idea of tolling, because toll financing is seen as a way to pay for construction of the facility. But when it comes to existing freeways, they are often opposed to retrofitting with a pricing mechanism. Drivers believe they have the right to travel when and where they desire regardless of the congestion they create. This is the main reason why roads are congested at peak hours. If commuters were charged the social cost for using roads, then ridesharing, trip rescheduling and transit use would increase. But we have all become accustomed to a socialized road system.

The result, as for example in agricultural policy, is perpetuation of the bad policy—namely, providing highways as "free"-ways. Increasing congestion and the enormous cost of constructing new facilities call for a different approach, but the public mind exhibits a strong status quo bias. The art of political reform becomes finding ways of working around the limitations of the public mind. A strategy of gradual reform is required.

The availability of HOV lanes on urban freeways provides an opportunity to introduce pricing. When capacity is underutilized, HOV lanes could be converted to HOT lanes to demonstrate the ability of congestion pricing to improve mobility. The HOT lanes concept would introduce tolling gently, one lane at a time over the span of decades. It would be an incremental strategy that could be expanded as the merit of the policy was realized.

The best program of pricing allows charges to vary with congestion conditions. Economists use the term *congestion pricing* to distinguish variable tolls from the fixed tolls we're accustomed to on bridges. Telephone companies and many other enterprises have employed demand-variable price techniques for years to improve the match between user needs and capacity.

II. STATUS QUO BIAS

Although we fancy ourselves consistent and fully rational beings, a more ironic self-image suits us better. Economists and social psychologists have discovered numerous anomalies to the simple picture of consistency and rationality. People do not have unbounded powers to assimilate information and work out optimal strategies. They rely on hunches and rules of thumb. Furthermore, how they assess a situation sometimes depends on where they are standing. The anomaly that concerns us here is one that researchers have called the "status quo bias."[2]

Suppose you win a pair of tickets to the World Series. Your neighbor says, "Wow!," and offers you $60 for the tickets. You say "No way." However, had you not won the tickets, you would *not* have been willing to buy a pair for $60. You are not willing to sell at $60, but also you would not have been willing to buy at $60.

Consider another example. In a classroom of college students, researchers gave a Cornell coffee mug to every other student. All students were asked to examine a mug, either their own or their neighbor's. The researchers then asked mug-owners to write down the minimum price that they would take for their mug, and those without mugs to write down the maximum price they would pay for a mug. These bid-ask exchanges were carried out at random, and there was no incentive for students to misrepresent their preferences.

Now, since the mugs were distributed at random, we might expect that the mug-owners would value a mug no more than the others. The prices written down would, in that case, be similar across the two groups. But that's not the way it really works. Once you give something to someone and tell her it's hers, she immediately develops an attachment to the object or amenity, an attachment that an onlooker does not develop. The median mug-owner asked $5.25 for his mug, while the median mug buyer offered only $2.50.[3] After just a few minutes of establishing a status quo of mug ownership, those with mugs came to value them *twice* as much as those without mugs!

The coffee mug example is just one of many experiments that researchers have conducted to demonstrate the status quo bias. After controlling for all imaginable alternative explanations, researchers continue to find that people have a substantial impulse to hold on to what they have. When people have the opportunity to change their status quo, the *loss* aspects of the change consistently *loom larger* than the gain aspects. Researchers demonstrate this simply by endowing individuals differently and then offering the change. Consider the example of the World Series tickets: in the status quo of ticket-ownership, losing the tickets looms larger than gaining $60. But in the status quo of no-tickets, losing $60 looms larger than gaining the tickets.

Besides the personal attachment to the familiar versus the visible but unfamiliar, we must further recognize that in practice the gains of change are not visible. Losses are the removal of visible, *existing* benefits. Gains, by contrast, are only prospective. They often are hard to imagine and hard to describe, and the public has no incentive to make the effort. The public recognizes losses much more readily than gains, which often come to be denigrated as "vague" or "merely speculative." Whenever someone proposes cuts in government services, the status quo bias operates because losing the existing benefits of the services is tangible, whereas the prospective gains associated with fiscal conservation are impossible to know and impossible to describe.

The implications of the status quo bias and the invisibility of prospective gains are important. Existing policy arrangements might be favored by the public, not because they are inherently better or more efficient, but simply because they exist! When someone proposes privatizing the U.S. Postal Service, the public feels a threat to the services it has grown accustomed to, and might sympathize with the employees who would lose their jobs.[4] When someone proposes retrofitting tolling on a freeway, the public feels a threat to the familiar way of travel, naturally sympathizing with the regular users who would suddenly have to pay for something they used to get for free. The biases suggest that a change foisted upon the public, a change that the public would resist if it could, would eventually become the new status quo, and the public would grow similarly attached to it.

Although it has been only recently that researchers have accumulated experimental evidence of status quo bias, writers have long been aware of the phenomenon. Consider the following quotations:

> Supreme Court Justice Oliver Wendell Holmes (1897)[5]: *It is in the nature of a man's mind. A thing which you enjoyed and used as your own for a long time, whether property or opinion, takes root in your being and cannot be torn away without your resenting the act and trying to defend yourself, however you came by it.*
>
> Friedrich A. Hayek (1960)[6]: *There are ... groups that have reached a more or less stationary position, in which habits and ways of life have been settled ... These ways of life may suddenly be threatened, ... and not only the members of such groups but often outsiders also will wish them to be preserved.*

> Aaron Wildavsky (1987)[7]: *To wipe out tangible benefits people already enjoy—familiar products, traditional jobs, with their 'identifiable and self-aware constituencies'—is politically more difficult to do than to stop something new that is not yet surrounded with a self-protective belt of interest.*

The status quo bias tells reformers that they need to be especially sensitive to the losing groups. One helpful strategy is to compensate losers for their losses. Another is to tiptoe around the status quo, to distribute losses over the population and over time, so no self-aware and visible objector group develops. A gradual approach might succeed where an all-at-once approach would fail.

III. TRAFFIC CONGESTION AND EXPANSION OF HOV FACILITIES

The astonishing increase in automobiles and their use for commuting has caused traffic jams in metropolitan areas. The number of cars and light trucks increased almost 50 percent nationwide between 1975 and 1990, a period when it has become difficult to expand highway capacity. In metropolitan areas, where employment has expanded and women are most likely to participate in the labor force, traffic congestion has increased and is likely to continue increasing to some degree.

Increasing ridesharing is one way to reduce traffic congestion. The time and bother of coordinating shared travel, however, tends to outweigh the personal savings from ridesharing as people become more affluent. Between 1977 and 1990, ridesharing nationwide declined, and will continue to do so unless policies that promote ridesharing are implemented.

HOV lanes in California, for example, have successfully increased ridesharing in some locations. After two HOV lanes were added to State Route 55 in 1985, average vehicle occupancy on all lanes increased from 1.17 to 1.26 during the first year. This means that 7.2 percent fewer vehicles were required to transport the same number of travelers. The addition of HOV lanes has occurred throughout the nation, and major additions are planned for metropolitan areas in the South and West (see Table 1).

Table 1

SUMMARY OF HOV PROJECT MILES BY METROPOLITAN AREA

Metropolitan Area	HOV Project Miles	
	Operating	Proposed
Boston, Massachusetts	--	3.0
Charlotte, North Carolina	--	3.0
Dallas, Texas	5.2	58.0
Denver, Colorado	4.1	12.0
Fort Lauderdale, Florida	--	27.0
Hartford, Connecticut	10.0	9.0
Honolulu, Hawaii	10.5	--
Houston, Texas	60.3	37.2
Los Angeles/Orange County, California	173.0	279.0
Miami, Florida	12.6	1.8
Minneapolis-St. Paul, Minnesota	12.8	1.2
Montreal, Quebec, Canada	4.3	--
Nashville, Tennessee	--	8.0
New York City, New York/New Jersey	9.8	34.0
Norfolk, Virginia	13.3	12.0
Orlando, Florida	30.0	--
Ottawa, Ontario, Canada	15.4	5.0
Phoenix, Arizona	17.0	17.0
Pittsburgh, Pennsylvania	14.4	8.1
Sacramento, California	8.0	3.0
San Diego, California	20.0	5.0
San Francisco Bay Area, California	38.4	137.1
Seattle, Washington	31.8	97.0
Vancouver, British Columbia, Canada	4.0	6.0
Washington, D.C./Northern Virginia	27.4	26.7

Note: California totals have been updated to reflect more recent data provided by Caltran's "HOV Lane Fact Sheet," 1993.

Source: K.F. Turnbull. *An Assessment of High-Occupancy Vehicle Facilities in North America: Executive Report (DRAFT).* Report FTA/TX-89/1-925-5F, Texas Transportation Institute, College Station, Texas, August 1992.

Three deficiencies are apparent in the current HOV lane policies. First, during the shoulders of the peak periods, when other lanes are congested, many HOV facilities are underutilized. Drivers of single occupant vehicles (SOVs) resent being deprived access to facilities paid for by "their fuel taxes." Second, since access is permitted to vehicles with as little as two occupants (HOV2), 43 percent of carpoolers are members of the same household.[8] Many of them and other carpoolers would probably travel together even without a HOV lane. Vehicle occupancy could be increased if access were restricted to vehicles with three or more travelers (HOV3) as is required in the San Francisco Bay region, although this would further reduce utilization of HOV lanes. Third, HOV lanes are expensive to construct. Adding HOV lanes to the Santa Ana Freeway is estimated to have cost $5 million per lane mile south of Santa Ana, and is expected to cost more than twice that much north of Santa Ana. Currently, HOV lane expansion is paid by fuel taxes and sales taxes that come from everyone, many of whom do not participate in the benefits. These taxes are regressive. Upping the HOV requirement and permitting SOV buy-ins into the HOV lanes—converting them into HOT lanes—would counter these deficiencies.

IV. A STRATEGY FOR ACHIEVING CONGESTION PRICING: HOT LANES

Permitting single-occupant vehicles (SOVs) to buy into the HOV lanes would produce many benefits with only small losses. In the case of an existing HOV lane, HOV2 travelers would suffer because they would have to purchase access. But a regular HOV traveler might also have to travel on occasion as an SOV traveler who would opt to buy-in. In practice, the set of losers is not easy to identify.

Charges would be varied to encourage efficient use while permitting HOV3s to pass free. Travelers would still have some added incentive to form HOV2s, since the travelers could split the cost of the charge and enjoy speedier travel. And HOT lanes could potentially pay for themselves in congested corridors and attract private investment into highways.

In terms of shifting the status quo, many motorists would invest in ETC equipment to make use of the HOT lane and other toll facilities in the region. The population of SOVs would not be divided into those who always use HOT lanes and those who never do. Rather, SOVs will opt for the HOT lane depending on their time constraints and the prevailing charge at that time of day. In consequence, a large fraction of the population might be occasional HOT-lane users. Being able to obtain superior service when pressed for time will lead people to support having differential services on the highways. And people will gradually become accustomed to paying for highway travel.

Another way that HOT lanes help to "shoehorn" pricing into public practice is that HOT lanes generate revenues for highway improvements. Revenues from the SOV buy-ins can be used to upgrade the highway, or to finance the HOT lane itself in the case of a newly constructed lane.

Once a HOT lane is operating at capacity, expansion of pricing into a conventional lane would have a constituency of user support. Motorists will have come to appreciate the benefits of differential services, many people will have already equipped their car with ETC, and the freeway ethic will have been undermined. As the public gradually comes to understand that charging users is superior to general taxation for road financing, perhaps complete retrofitting will be feasible. Figure 1 shows the phases of the evolution of a freeway into a tollway, beginning with the *conversion* of a conventional lane into a HOV lane. Figure 2 shows the evolution, beginning with the *construction* of a HOT lane.

Figure 1

Gradual HOT-Lane Conversion Process

Status Quo:	C	C	C	C	4 Conventional Freeway Lanes
Phase 1:	HOV	C	C	C	
Phase 2:	HOT	C	C	C	
Phase 3:	HOT	HOT	C	C	
Phase 4:	HOT	HOT	HOT	C	
Final Phase:	HOT	HOT	HOT	HOT	Complete Retrofitting

The figure shows one direction of an existing four-lane freeway.

Figure 2

HOT-Lane Construction leading to HOT Lane Conversion

Status Quo:		C	C	C	C	4 Conventional Freeway Lanes
Phase 1:	HOT	C	C	C	C	
Phase 2:	HOT	HOT	C	C	C	
Phase 3:	HOT	HOT	HOT	C	C	
Phase 4:	HOT	HOT	HOT	HOT	C	
Final Phase:	HOT	HOT	HOT	HOT	HOT	5-lane Tollway

The figure shows one direction of an initially four-lane freeway.

The ambitious plan to add HOV lanes on every freeway in Los Angeles County provides an opportunity to use the HOT-lanes approach. Although Los Angeles and Orange counties already have more HOV lanes than any other metropolitan area, the $6.2 billion expansion plan for the next 30 years must compete with rail programs that enjoy broad public support.[9] Furthermore, major revenue shortfalls are expected over the next ten years. Self-financing achieved by pricing could improve the likelihood of actually achieving the new capacity called for by the HOV plans.

V. RECENT DEVELOPMENTS OF HOT LANES

Some existing facilities, such as the San Francisco bridges, combine free HOV3 passage with tolling for lower occupancy vehicles. More significant examples of HOT lane projects are now under way.

A. The Intermodal Surface Transportation Efficiency Act (1991)

The idea of HOT lanes is part of a broader movement toward the tolling and privatization of highways, bridges, and tunnels. Often privatization arrangements take the form of build-operate-transfer projects (BOT). The movement is especially strong in Asia and Europe,[10] but the United States has also taken definite steps in the same direction. In 1991 Congress passed the Intermodal Surface Transportation Efficiency Act (ISTEA), which reversed the longstanding federal policies against toll facilities. ISTEA permits federal funds to be used on tolled facilities—up to 50 percent for highways and 80 percent for tunnels and bridges. ISTEA sheds the old requirement that federal funds be repaid if the highway is privatized; it permits tolling to be retained after the debt is retired; and, most pertinent for HOT lanes, it allows federal rights of way to be used for tolled expansion of existing highways. Seven states and Puerto Rico have enacted private-tollway legislation, and others are in the process of doing so.[11]

Section 1012(b) of ISTEA authorizes the Federal Highway Administration (FHWA) to commission five demonstration projects using congestion pricing. Some 16 projects were submitted in January 1993, from which one, congestion pricing on the San Francisco Bay Bridge, was selected. Several projects proposed variations of HOT lanes but these were not selected. The FHWA announced in the *Federal Register* that all types of HOV buy-in proposals will be excluded from congestion pricing pilot projects under ISTEA, asserting that "HOV buy-in projects would not promote the congestion relief and related air quality and energy conservation objectives of the ISTEA."[12] This exclusion of HOT lane projects pertains only to the current solicitation period (through November 1993), but might be an indication of attitudes that will continue to prevail. Although ISTEA money will not be assisting HOT-lane projects in the near term, HOT-lane projects of each type—construction and conversion—are already under way.

B. HOT-Lane Construction: The SR 91 Project in California

In the median of State Route 91, the primary link between Orange and Riverside Counties, the California Private Transportation Corporation (CPTC) has been granted the right to plan, construct, and operate four tolled lanes for 35 years. These lanes will operate like a HOV facility, permitting vehicles with three or more (HOV3) to travel free at first, and at a discount later, should their use hamper profitability. Vehicles with one or two occupants will be permitted to buy-in.

Congestion on State Route 91 is already severe for five hours each day. Caltrans had planned one HOV lane each direction in the median, and had cleared the project environmentally, but had insufficient money for construction. By making excess HOV lane capacity available to toll-paying vehicles, CPTC estimates that the charges will be sufficient to cover operating costs as well as provide a 17-percent return on investment (which is capped under the franchise). An additional 6 percent can be earned by increasing vehicle occupancy levels; any such excess income must be shared with the state.

Preliminary estimates indicate that travelers would be willing to pay a charge of $2.50 per trip during peak hours for the time saved to travel the 10 miles. Charges will vary in response to demand; rates will be increased during peak periods to avoid congestion in the reserved lanes, with roadway signs designed to flash amounts as high as $9.99. Although this project is one of the four major projects launched by California's law AB 680 in 1989, it is a HOT lane construction project since it is tolled expansion of an existing freeway, and it exempts HOV3 vehicles from the charge.

Gordon J. Fielding (1993)[13] conducted traffic simulations for the variations of the SR 91 facility. Compared to a scenario where one HOV3 lane is added, the results for the scenario where two HOT3 lanes are added are as follows: congestion on the conventional lanes is reduced, the HOT lanes are uncongested at peak periods, and *the number of travelers participating in ridesharing is increased.*

These preliminary results go against the policy views adopted by the FHWA. The construction of new HOT lanes can not only reduce congestion but also improve ridesharing. The ridesharing concern expressed by FHWA only makes sense for HOT lane *conversion*, but their policy excludes HOT-lane *construction* projects as well. We feel that the federal policy toward HOT-lane construction projects should be changed. And even in the case of lane conversion projects, FHWA should reconsider the policy. Innovative demonstration like the following example from San Diego should not have been excluded by FHWA.

C. HOT-Lane Conversion: SANDAG's I-15 Project

While a private company begins HOT lane construction in Orange County, the San Diego Association of Governments (SANDAG) plans a HOT lane conversion on Interstate 15. In 1988, Caltrans opened an eight-mile, two-lane, reversible HOV Expressway in the median of I-15 to buses, vanpools, and HOV2s. Currently, only 50 percent of the capacity of the reversible segment is utilized during the morning peak.

In 1991, SANDAG developed the I-15 Transit Development and Congestion Pricing Demonstration Project, which would permit SOV buy-ins to the two reversible HOV lanes. The first phase would implement a low technology approach by offering a "subscription-decal," allowing SOVs to enter the HOV lane without stopping to pay a cash toll. The second phase would implement an AVI system. Although SANDAG has been denied funding under ISTEA, the Federal Transit Administration has awarded SANDAG a grant for transit development and the HOT lanes project in the eight-mile segment of I-15. Assemblyman Jan Goldsmith, former mayor of Poway, was instrumental in passing California enabling legislation for the project (AB 713). This measure was enacted in September 1993, permitting the project to go forward.

San Diegans seem to be eager to buy into the under-utilized HOV lanes. Project director John Duve reports that "The proposed Demonstration has received substantial and continuous coverage by the media. Each article or commentary has been supportive of the proposed Demonstration project."[14] The public seems willing to undergo HOT lane conversion, whereas it would probably resist stoutly an attempt at retrofitting pricing all at once.

VI. FINANCIAL FEASIBILITY

Can HOT lanes actually be financially self-sufficient and therefore attractive to the private sector? This section develops order-of-magnitude estimates of the financial feasibility of HOT lanes. Table 2 presents cost data on existing and planned HOV facilities in Los Angeles County. As can be seen, surface-level HOV lane additions (which generally involve some new paving plus new signage and lane restriping) cost in the vicinity of $2–5 million per lane-mile. Elevated HOV facilities, built above existing freeways, cost in the range of $19–23 million per lane-mile.

To estimate possible revenues, we develop two alternative cases. In the pessimistic case, assume congestion lasts six hours per day, five days per week, 52 weeks per year. During these priced hours, lower-occupancy vehicles pay 20 cents per mile to use the HOT3 lane. The lane is assumed to carry 1,750 vehicles per hour per mile, and 70 percent are lower-occupancy vehicles subject to the charge.[15] Annual revenue per lane mile in this case is $382,200.

The optimistic scenario (from a financial standpoint!) is that congestion lasts seven hours a day, six days per week, 52 weeks a year. During these priced hours, the charge for lower-occupancy vehicles is 25 cents per mile to use the HOT3 lane. The lane carries 2,000 vehicles per hour per mile, 70 percent of which are lower-occupancy and pay the charge. Annual revenue per lane mile in this case is $764,400.

How do these revenues compare with costs? To obtain a range of financial returns, we will again produce pessimistic and optimistic estimates. Assume that the surface-level HOT lane costs $5 million per lane-mile and that revenues equal the lower of our two estimates. In this case, gross revenues would return only 7.6 percent of the construction costs per year to investors. This is not a sufficient return to attract debt or equity investment, nor does it account for operating (e.g., electronic toll-collection) and maintenance expenses. If we substitute the high-revenue scenario, the gross return is 15.3 percent of construction costs per year, a figure which begins to approach a plausible market return (again, neglecting operating costs).

If we construct the most optimistic case, using the low end of the construction cost range ($2.14 per lane-mile) and the high end of the revenue range ($764,400 per lane-mile), the gross return on investment is 35.7 percent. If annual operating and maintenance expenses equal 10 percent

Table 2

PLANNED HOV-LANE SYSTEM: LOS ANGELES COUNTY

	Freeway Miles	Lane-Miles	Cost ($M)	$M/Lane-miles
Surface				
Existing	29	58	$68	$1.17*
Under Construction	46.8	93.6	$494	$5.27
Planned	227	454	$974	$2.14
Elevated				
Under Construction	2.6	5.2	$100	$19.20
Planned	99.4	198.8	$4,512	$22.70
Totals	404.8	809.6	$6,148	$7.59

* For projects completed from 1973 through 1993.

Source: *The Urban Transportation Monitor*, October 1993.

of construction costs (i.e., $214,000 per lane-mile per year), then the net return on investment is 25.7 percent. This would be more than adequate to attract taxable debt and equity investment; for comparison, the ceilings on rate of return in the four existing Caltrans franchises for private toll roads range from 17 to 21.25 percent.

For the elevated HOT lanes, the extremely high construction costs would require unreasonably high toll levels in order to achieve a commercial rate of return. To obtain a 15 percent annual return on an investment of $20 million per mile would require a rush-hour toll in the vicinity of $1 per mile.

The conclusion from this brief exercise is that some surface-level HOT lanes could be financially feasible as private-sector projects of the kind already embodied in California's existing AB 680 program. On the other hand, where revenues would not be sufficient to achieve the required commercial rates of return (as in the case of elevated HOT lanes), a public-private partnership of the kind authorized under ISTEA would permit private capital to cover a large fraction of the cost. Thus, California could achieve additional highway capacity in the form of HOT lanes with a relatively small outlay of public funds.

VII. HOW TO FRANCHISE HOT LANES: MARGINAL-RETURN BIDDING

The message that we seek to convey is that HOT lanes can popularize congestion pricing. But this approach can also generate private investment in public improvements. These two themes are interrelated, because without the added revenue generated by pricing, private construction and operation of highways is not financially attractive.

Since HOT lanes in congested corridors can be self-financing, we suggest that HOT lane projects be carried out and operated by private enterprise. How is the contract for a HOT lane project to be awarded?

In a paper titled "How to Franchise Highways," we proposed a scheme for the government to conduct a head-to-head competition for the franchise contract to construct and operate a new highway facility.[16] The scheme, called marginal-return bidding, is designed to select the most cost-effective contestant, to encourage cost minimization during construction, to limit profit rates, and to minimize post-contractual administering of the contract. The method is well-suited to any franchise project that has the following features: a large up-front investment; the approximate cost of the investment can be reliably estimated; the operating costs are small compared to the costs of initial construction; the project generates a continuing stream of income; and the approximate income can be reliably estimated. HOT lane projects, either of the construction or conversion variety, satisfy these conditions. Here we briefly explain our scheme.

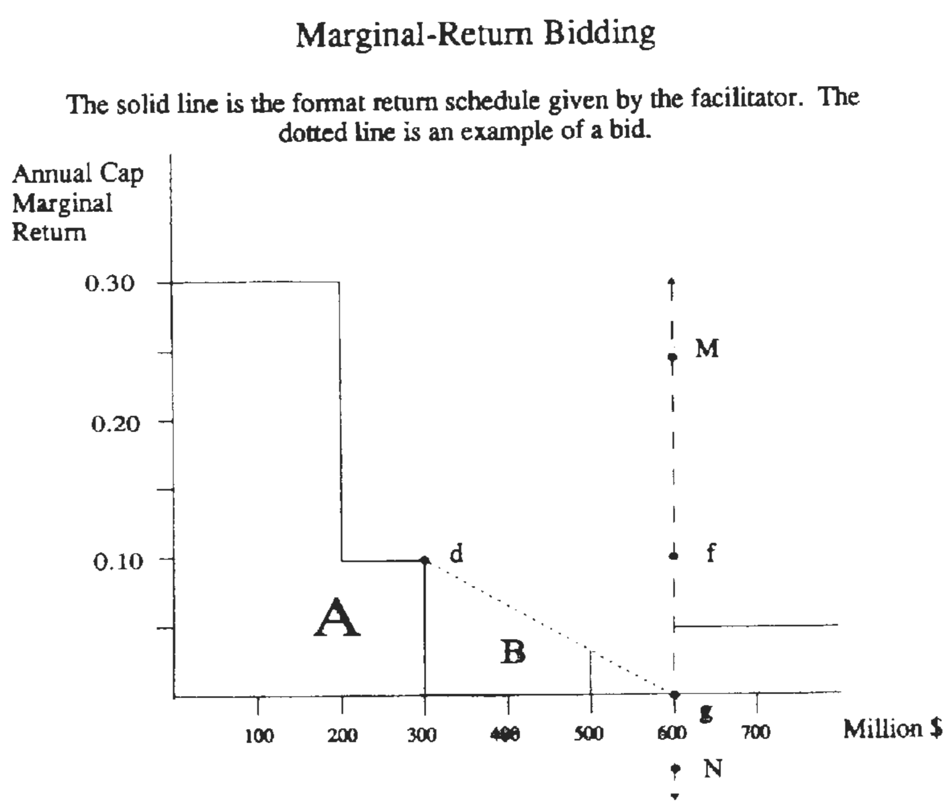
We propose that franchise bidding take the form of marginal-return cap schedules. The idea is best explained by an example.

Suppose that the state has accomplished the design and environmental approval of a HOT lane project. The state estimates the cost of completing the project to be $500 million. The state has written the contract and only needs to determine its holder. The state presents the solid lines shown in Figure 3, which we call the *format* portion of the rate-of-return cap schedule. The format schedule permits 30 percent earnings on the first $200 million, 10 percent on the next $100 million, *is undefined* on the next $300 million, and 5 percent on anything more than $600 million. The unidentified portion—from $300 million to $600 million—is filled in by the winning bid. A contestant's bid takes the form of a straight line segment connecting point d to the vertical line at $600 million (line MN). Let z be the signed vertical distance on MN from point g. Therefore, for example, at point f the z value is 0.10; at point g it is zero. Bids are essentially z's, and may go below zero. The lowest z wins the franchise.

Suppose a contestant wins the franchise with a bid of z equal to zero. Its return schedule would be the format schedule plus the dotted line. If costs turned out to be $500 million, its annual cap return would be area A plus trapezoid B (which sum to $83.3 million, or a 16.7 percent return). The return cap on the marginal dollar (the 500 millionth) would be 3.3 percent, a rate significantly below what that dollar could earn in an alternative investment. On the margin the operator is discouraged from inflating costs. And as costs increase, this discouragement becomes more severe. For example, if costs were $550 million, the average return would drop to 15.4 percent and the marginal return to 1.7 percent.

The format return schedule shown in Figure 3 is only an example. In any actual case, the facilitator would draw the format schedule based on the conditions of the project in question. The beauty of the bid component is that the competitive framework will utilize knowledge that is dispersed among the contestants, and will adjust the *total* return cap appropriately.

Figure 3



For HOT lane projects that will not be self-financing, the state can still use marginal-return bidding to franchise the project, but it would have to add a fixed subsidy to the package. Such a fixed subsidy would not affect the operation of the franchise competition, nor the incentives of the franchise winner.

Marginal-return bidding combines the virtues of competitive franchise bidding with the virtues of traditional rate-of-return regulation, while avoiding their worst vices. Like competitive bidding, it preserves head-to-head competition for the field and tends to select the most efficient contestant. Also, it discourages gold plating and internal inefficiency—serious problems with traditional rate of return regulation. The operator has the incentive to achieve performance specifications at the lowest possible cost. Unlike some forms of competitive bidding, it leaves pricing flexible, so appropriate toll practices can be developed in response to demand.[17] Furthermore, it requires little post-contractual administering of the contract. Whereas traditional rate-of-return regulation requires careful monitoring to guard against gold plating, marginal-return bidding only needs to document costs. The state could simply audit the operator's books. Determining whether certain expenditures were in fact made is a much simpler task that determining whether they were *good ones* to make.

This presentation of marginal-return bidding has ignored several important factors: 1) arrangements for operating costs; 2) excess earnings and bonus incentives; 3) monopoly power and the marginal user; and 4) collusion in bidding. The reader is referred to our paper "How to Franchise Highways" for a discussion of these points.

VIII. CONCLUSION

When it comes to changes in public policy, the public exhibits a tenacious will to maintain the status quo. Partly this is due to personal psychology: people become attached to whatever they are accustomed to, and the losses of any proposed reform loom larger than the prospective gains. And partly it is due to invisibility of prospective benefits. The benefits do not have a support constituency and remain poorly understood.

Although researchers have supported the idea of highway pricing for decades, and now with advanced technology the case is stronger than ever, the public remains reluctant to retrofit highways with pricing. We propose to overcome the status quo bias by introducing pricing gradually in the form of HOT lanes.

The chief reservation about HOT lanes is that HOT lanes will injure the progress of ridesharing. The validity of this point depends significantly on the type of HOT lane project. When a HOT lane is converted from a pre-existing HOV lane, there is a possible detrimental effect on ridesharing, as some ridesharers will opt to take the fast lane as a SOV buy-in. Also, the SOV buy-ins will reduce the time saving in the HOT lane, leading some would-be ridesharers to travel solo in the conventional lanes. However, increasing the ridesharing requirement to HOT3 would give an incentive to travelers to form three-person carpools.

Converting a HOV lane into a HOT lane will introduce a more efficient method of financing highways, and the funds can be used for upgrading and maintaining the highway. Nearly all motorists will find a benefit in being able to take the speedier lane when time is precious. Finally, improved utilization of the reserved lane will relieve slightly, congestion in the conventional lanes. Reports from the SANDAG I-15 project suggest that, in the public mind, these prospective benefits outweigh the damage done to ridesharing.

In the case of HOT lanes being newly constructed and expansion being impossible without the toll revenue base, there are only benefits. Thanks to the revenue from SOV buy-ins, the public receives a highway expansion that offers differential service. Differential service is valuable to everyone because it permits each to avoid costly delays when time is especially precious. As for ridesharing, the new HOT lanes would be an inducement.

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Fielding and Klein have jointly authored papers on modern toll roads for *Transportation Quarterly* and *The Journal of Transport Economics and Policy.*

ENDNOTES

1. The term "HOT Lanes" was first suggested by Fred L. Williams, Ph.D., a program analyst at the Federal Transit Administration, during a June 1992 FTA/Federal Highway Administration conference on congestion pricing.

2. Daniel Kahneman, Jack L. Knetsch, and Richard H. Thaler, "Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias," *Journal of Economic Perspectives*, Winter 1991, vol. 5, pp. 193–206.

3. Daniel Kahneman, Jack L. Knetsch, and Richard Thaler, "Experimental Tests of the Endowment Effect and the Coase Theorem," *Journal of Political Economy*, December 1990, vol. 98, pp. 1325–1348.

4. Researchers have shown not only that Ms. A is more sensitive to her own losses than her own gains, but also that she tends to have more sympathy for Mr. X for his losses than she has for his or someone else's gain. See Daniel Kahneman, Jack L. Knetsch, and Richard Thaler, "Fairness as a Constraint on Profit Seeking: Entitlements in the Market," *American Economic Review*, vol. 76, pp. 728–741 (1986).

5. Oliver Wendell Holmes, "The Path of the Law," *Harvard Law Review*, vol. 10, pp. 457–478 (1897).

6. Friedrich A. Hayek, *The Constitution of Liberty* (Chicago: University of Chicago Press, 1960), p. 50.

7. Aaron Wildavsky, *Searching for Safety* (New Brunswick: Transaction Publishers, 1987), p. 35.

8. C. Collier and T. Christiansen, "1992 State of the Commute in Southern California," paper presented at the Transportation Research Board 72nd Annual Meeting (Washington, D.C., January 1993).

9. Nora Zamichow, "Caltrans Unveils Big Plans for Car-Pool Lanes," *Los Angeles Times*, June 30, 1993, p. B1.

10. William D. Eggers (ed.), *Privatization 1993* (Los Angeles: Reason Foundation, 1993), pp. 19–36.

11. Robert W. Poole, Jr., "Private Tollways: How States Can Leverage Federal Highway Funds," *Policy Study*, no. 136, (Los Angeles: Reason Foundation), February 1992.

12. *Federal Register*, June 16, 1993, vol. 58, pp. 33–93.

13. Gordon J. Fielding, "Private Toll Roads: Acceptability of Congestion Pricing in Southern California," paper presented at the Congestion Pricing Symposium, sponsored by Transportation Research Board (Washington, D.C., June, 1993).

14. John L. Duve, "Implementing Congestion Pricing: How Congestion Pricing Came to Be Proposed in the San Diego Region," presented at the Urban Transportation Congestion Pricing Symposium, sponsored by the Transportation Research Board (Washington, D.C., June 1993), p. 17.

15. Gordon J. Fielding, "Private Toll Roads."

16. Gordon J. Fielding and Daniel B. Klein, "How To Franchise Highways," *Journal of Transport Economics and Policy*, May 1993, vol. 27, pp. 113–130.

17. For the classic presentation of the idea of user-price competitive bidding for a franchise contract, see Harold Demsetz, "Why Regulate Utilities?," *Journal of Law and Economics*, vol. 11, 1968, pp. 55–65. For discussions of the shortcomings of Demsetz's idea, see Victor P. Goldberg, "Regulation and Administered Contracts," *Bell Journal of Economics*, vol. 7, 1976, pp. 426–48; and Oliver E. Williamson, "Franchise Bidding for Natural Monopolies—In General and With Respect to CATV," *Bell Journal of Economics*, vol. 7, 1976, pp. 73–104.

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