The Preferences of Voters over Road Tolls and Road Capacity

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Abstract

We consider a congestible road, where the cost of travel increases with the number of users on the road and decreases with capacity. Those persons who do not use the road favor a toll which would maximize revenue, and they oppose spending on road capacity. Users of the road prefer a low toll and a large capacity financed by general revenues. We describe conditions that make majority voting lead to a toll and capacity level that equals the socially optimal toll and capacity, that is smaller, or that is larger. This model can also explain the decrease over time of user fees for road use.

JEL Classification:

D78 - Positive Analysis of Policy-Making and Implementation
H23- Externalities
L98- Government policy on transportation

Introduction

Road charges (including gasoline taxes, tolls, automobile registration fees, and so on) have several attractive features. Road charges can be fair, since users of the road pay for the construction and maintenance of the roads, rather than all citizens. Road charges can reveal taxpayer preferences for the public service (the seminal work is Buchanan (1963)). Road charges may be part of a tax system which redistributes income from the rich (such as car owners) to the poor (such as the unemployed or users of mass transit). The charges can reduce the externalities generated by road use; since road users suffer from some of the externalities (in particular from congestion), road charges may be more politically popular than are other Pigovian taxes. Lastly, when demand is inelastic, road charges can be an important source of government revenues. This paper focuses on the last two aspects. But rather than view charges as redistributive instruments to the poor, we will look at selfish voters, with each preferring a road charge that benefits himself. Although we could consider a wide range of externalities, we will focus on congestion, the externality that empirically appears most important.[1] Since much of our interest lies in examining the road charge preferred by users of the road (who will be the majority of the voters in many rich countries), and since we want to explain why road charges are often small, the focus on congestion poses a greater challenge than an examination of other externalities.

It is well known that road tolls can solve congestion problems (see Walters (1961)), and can increase social welfare. But the toll may nevertheless hurt some people. A policy of imposing a congestion toll without redistributing the revenue to users will make at least some consumers worse off (see Weitzman (1974), Glazer (1981), and Niskanen (1987)). The intuition, as Evans (1992) notes, is that a congestion toll cannot increase the welfare of all consumers. For the welfare of some consumers can increase only if fewer persons use the road. But use will decline only if the costs (toll costs plus time costs) increase for at least some users. These persons are necessarily worse off. This situation effectively holds even if the toll revenue is returned to the population, but the number of people who pay the toll is small compared to the population as a whole, and the toll revenue is distributed among the whole population. And, of course, when people differ, and the toll revenue is distributed among the whole population, both those who pay the toll and those who do not, then consumers who do not pay the toll are necessarily better off.

We see then that, in general, a congestion toll will benefit some people and hurt others. The question naturally arises what toll would be adopted by a government that responds to the preferences of the public. We address that issue. We begin with the standard Downsian model, where policy is set by the median voter. The Downsian model can apply both to elections in which two candidates vie for election, and to referenda. A potential limitation of the Downsian model is that it may apply only to a single issue, with single-peaked preferences. But we shall see that under reasonable assumptions, the Downsian model can apply when voters must decide both on users fees and on investment. And under reasonable assumptions the preferences of voters over fees or over investment will indeed be single peaked.

[1]See Proost et al (2002) for evidence on the European Union; see Small and Verhoef (2007) for evidence on the United States..

Our conclusions would also apply under other views of elections. In particular, under our assumptions the citizen-candidate model (see Besley and Coate (1997) could have the median voter run for office, win election, and determine policy. And rather than let any policy be allowed on the agenda, we could extend the model to consider an agenda setter (as in Romer and Rosenthal (1979)). The toll would then not be the one preferred by the median voter; but the qualitative results, such as that the toll will be higher if the median voter is a driver than if he is not, will continue to hold.

Other work which explicitly models voting on congestion tolls is Marcucci, Marini and Davide (2005). That paper considers three homogeneous groups, and a citizen-candidate model. In contrast we allow for a continuum of voters, where the preferences of the median voter determine policy. We think that such a model is particularly relevant for congestion tolls because it readily applies to referenda, which have indeed been used in Edinburgh and in Stockholm. And whereas they restrict the use of the revenues to subsidize public transport, we allow revenues to be returned to the public. We further extend the analysis by considering the preferences of voters over investment in capacity.

Another paper which discusses the politics of pricing in transportation is Corneo (1997). He shows that if the median income in the populations is the same as the mean income, then voting will result in pricing of the transit authority that is the same as marginal cost pricing, with fixed costs covered by a subsidy: the median voter is also the average voter, which means that maximizing his welfare is the same as maximising society's average welfare. Such a result does not hold in our model---the median voter does not care about the loss in consumer surplus for persons induced not to drive because of a toll, nor does he value the gain to other consumers from the toll he may pay.

The model

Consider an area where road capacity is given at a level K and where congestion is more or less homogeneous in the whole area. Assume further that the location of activities is fixed.

Each of a large number, N, of individuals ($i=1,..,N$) can choose to take a trip or not. The gross benefit of taking the trip is distributed between 0 and Z. Call the gross benefit of a trip to the individual indexed by n as $z(n)$, where $z(1)=Z$ and $z(N)=0$. Denote by n the number of persons who choose to make the trip; the marginal consumer is then the individual indexed by n. The number n will be determined endogenously. Let the capacity (or size) of the road be K, and let the toll be τ. The total cost of a trip, $g(n,K,\tau)$, consists of three terms: (1) the toll τ; (2) a fixed term a (for example, the cost of a car); (3) a time cost that is the value of time multiplied by the time T it takes for a trip. Because of congestion, the time T (and so total trip cost g) increases with n and declines with K. In particular, let the cost be

$$g(n,X,\tau) = \tau + a + bT\left(\frac{n}{k}\right). \tag{1}$$

The toll revenue finances a lump-sum transfer of L to each individual (whether he pays the toll or not), and covers the rental cost of the road capacity (rK). The government's budget constraint is

$$n\tau = NL + rK . \tag{2}$$

Individual i will take the trip only if his total cost is lower or equal to the gross benefit of the trip, that is if $z(i) \geq g(n,\tau,K)$. The utility of individual i is then[2]

$$\begin{aligned} V_i &= y^\circ + L + z(i) - g(n,\tau,X) && \text{if } z(i) - g(n,\tau,X) \geq 0 \\ V_i &= y^\circ + L && \text{if } z(i) - g(n,\tau,X) < 0. \end{aligned} \tag{3}$$

For later use, define the function $\tau(n)$ as the toll paid by the last driver n that still wants to make the trip:

$$\tau(n) = z(n) - a - bT\left(\frac{n}{K}\right). \tag{4}$$

Since $z(n)$ declines with n, and T increases with n, it follows that $\tau(n)$ declines with n.

We first study the choice of the toll, keeping the capacity constant.[3] Next we study the choice of K keeping the toll constant, and finish by studying both options simultaneously.

No congestion

It is instructive to begin with some simple examples. Suppose first that a minority of consumers value a trip at a positive value, a majority value it at zero, and that congestion is non-existent. Then clearly the socially optimal solution is a zero toll. But the majority will favour a toll that maximizes toll revenue, since that maximizes the per capita transfer, L. In short, the toll chosen by a majority will exceed the socially optimal toll.

Identical consumers

As the next simple case, suppose all consumers are identical---each has the same value from a trip, and each bears the same cost of making a trip for any given level of congestion. Suppose, in contrast to the previous case, that congestion, or travel time, increases with the number of trips. The assumptions just made are equivalent to those used in the standard model of the Tragedy of the Commons. One characteristic of such a model is that the revenue-maximizing toll is identical to the toll that maximizes social welfare: because the consumers are identical, a monopolist can extract all consumer surplus, and so internalizes the effects of congestion on the willingness of

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[2]We can extend the model description into a full general equilibrium model by adding a linear production technology. As long as there are no other taxes (or other distortions) in the model this does not generate additional insights. One extension of the model could be congested freight traffic. See Mayeres and Proost (1997) for a simple model with passengers, freight, different types of tax distortions and different income groups.

[3] This capacity could be some minimum level available at very low cost or it could be constrained level that can not be extended because of natural barriers.

consumers to pay for a trip. If he faces zero marginal cost of providing service, then maximizing profits is equivalent to maximizing revenue, which in turn maximizes net benefits from use of the road. Here, then, the toll that would be chosen by a majority of voters would be identical to the toll maximizing social welfare.

Note that this result applies both when a majority uses the road and when a majority does not. If the majority does not use the road, then clearly any person who does not use the road aims to maximize toll revenue, which in turn maximizes the per capita grant, *L*. But the same holds when the majority does use the road. Under any toll, the number of users will be such that each user enjoys zero consumer surplus. So the only consideration to a user is the per capita transfer, *L*. Once again, each voter will favour the revenue-maximizing toll.

We turn next to the more complicated cases where congestion is present, but consumers differ in their valuations of trips.

The socially optimal solution

Before analyzing the solution when the median voter determines the toll, it is instructive to analyze the socially optimal solution. We follow the standard analysis here. Using the definition of the utility function and the budget constraint for the government, we can define the socially optimal solution by looking for the value n^* that maximizes the total consumer surplus minus the total trip costs excluding the toll. The social objective function, in the absence of transaction costs, is to

$$\max \int_0^{n^*} z(n)dn - \left[a + bT(\frac{n^*}{K}) \right] n^*. \tag{5}$$

The optimal number of users, n^*, satisfies

$$z(n^*) - \left[a + bT\left(\frac{n^*}{N}\right) \right] - n^* b \frac{\partial T}{\partial n} = 0. \tag{6}$$

This condition implies that the welfare-maximizing toll equals the marginal external congestion cost:

$$\tau^* = n^* b \frac{\partial T}{\partial n}. \tag{7}$$

Remember that this social optimum is obtained by maximising the sum of all utilities, using an equal weight for a unit of income for all individuals. It pays no attention to the distribution of income.[4]

The median-voter solution

We now suppose that the level of the toll is fixed by a simple majority vote. If single peakedness conditions are satisfied, then the policy adopted by the government will be that preferred by the median voter, which in our model means the voter with the median valuation of a trip, or with valuation $z(N/2)$. Note that under our assumptions,

[4] See Mayeres and Proost (1997) for an approach that integrates income redistribution objectives.

all individuals who do not take the trip have the same objective (maximizing the per capita transfer L). And all individuals who do use the road have the same objective (maximize the difference between the transfer L, and the cost of a trip ($a+bT$)). Whether a person makes the trip or not depends, however, on the toll. Also note that if the individual indexed by $N/2$ makes the trip, than all persons with valuations (z) higher than his will also make the trip, and will therefore favor the toll individual $N/2$ favors. And if individual $N/2$ does not make the trip, then all persons with valuations (z) less than his will prefer not to make the trip, and therefore will favor the toll that individual $N/2$ prefers. That is, a majority will indeed favor the toll preferred by individual $N/2$.[5]

Note that a majority may favor a toll even if a majority of voters are drivers, and the toll revenue is not returned to users. This can be seen with a modified version of the Tragedy of the Commons model. Suppose one homogeneous group of persons, a majority, place a high value on a trip, and also have a high value of time. Another group has a lower value of time. The equilibrium with no tolls can have all the high-valuers use the road, some of the low-valuers use the road, and each low valuer enjoys zero consumer surplus. The extensive use of the road means, however, that the high-valuers suffer greatly from congestion. Now suppose a toll reduces the number of low-valuers using the road. The high-valuers also pay the toll, but the lower congestion can raise their consumer surplus. A majority may therefore favor a congestion toll, though the toll revenue is wasted. This is considered in Marcucci et al.(2005).

Median voter drives

We consider two cases: the median voter drives or does not. Suppose first that the median voter (indexed by $N/2$) takes the trip. His utility-maximizing toll differs from the socially optimal toll because with the uniform lump-sum transfer in place to balance the budget (cf. (2)), he will only receive back a fraction of what he paid as a toll. More specifically, a median voter who finds it optimal to drive will select a number of users n_τ (and a corresponding toll $\tau(n_\tau)$) that minimizes the sum of his trip cost and the net toll payment:

$$\min\left[a+bT\left(\frac{n_\tau}{K}\right)\right]-\left(\frac{n_\tau}{N}-1\right)\tau(n_\tau). \tag{8}$$

As can be seen, the median voter, if he drives, will only receive a share n_τ /N of the toll he paid.

Government adopts the toll satisfying

$$\tau(n_\tau)=Nb\frac{\partial T}{\partial n}+(N-n_\tau)\frac{\partial \tau}{\partial n}. \tag{9}$$

[5]The preferences of the median voter on the toll may not be single peaked. One peak could be a small toll, preferred by him as a user, another peak could be the revenue maximising toll preferred by him as a non user.

The median voter need not favor a positive toll.[6] In (9), the first term is always positive; the second term is always negative. When the congestion function is relatively flat and n_τ is only marginally larger than $N/2$, the second term in (9) may dominate; the median voter may want to subsidize trips rather than to toll them. In this way he can extract tax revenue (L becomes negative) from all the persons who do not make the trip.

Median voter does not drive

As the second case, let the median voter choose not to make the trip. He then wants n_0 to maximize

$$n_0 \tau(n_0). \tag{10}$$

which leads him to choose a toll satisfying

$$n_0 \frac{\partial \tau}{\partial n} + n_0 = 0. \tag{11}$$

This condition means that when the median voter does not drive, he maximizes the toll revenue he can extract from the road users.

The median voter thus will choose the toll given by either (9) or (11). The median voter will prefer the toll which induces him not to drive if

$$n_0 \tau(n_0) > \left(1 - \frac{n_\tau}{N}\right) \tau(n_\tau) + z(N/2) - a - bT\left(\frac{n_\tau}{K}\right). \tag{12}$$

Linear valuation function and linear congestion function

When the congestion function and the $z(n)$ function are linear,[7] we can sign most of the effects. We use the following functions (where all parameters are positive):

$$\begin{aligned} z(n) &= Z - sn \\ T\left(\frac{n}{K}\right) &= \alpha + \beta \frac{n}{K}. \end{aligned} \tag{13}$$

We find the following values for n^* (the socially optimal number of users), n_τ (the number of users when the median voter drives), and n_0 (the number of users when the median voter does not drive):

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[6] For the preference of the median voter (if he remains a car diver) to be single peaked in n^* (and $\tau(n^*)$) in the domain $[N/2, N-1]$, it suffices that the congestion function is convex.

The second derivative of the utility function equals

$-b\frac{\delta^2 T}{\delta n^2} + \frac{1}{N}\frac{\partial^2 \tau}{\partial n^2} + (\frac{n}{N} - 1)\frac{\partial^2 \tau}{\partial n^2} + \frac{1}{N}\frac{\partial \tau}{\partial n}$ and this is negative if the congestion function is convex.

[7] A linear cost function could be justified by the bottleneck model.

$$n^* = \frac{Z - a - b\alpha}{2b\frac{\beta}{K} + s}$$

$$n_\tau = \frac{Z - a - b\alpha}{2b\frac{\beta}{K} + s} + \frac{Ns}{2b\frac{\beta}{K} + s} \tag{14}$$

$$n_0 = \frac{Z - a - b\alpha}{2b\frac{\beta}{K} + 2s}.$$

These equations imply the following ordering of users and tolls:

$$n_0 < n^* < n_\tau \quad \text{and} \quad \tau_0 > \tau^* > \tau_\tau. \tag{15}$$

That is, the toll preferred by the median voter when he does not use the road is greater than the socially optimal toll; in turn, the socially optimal toll is greater than the toll the median voter prefers when he does use the road.

Remember that n_τ can be negative so that, even in the absence of congestion, the majority of car users may favor a subsidy that can take the form of costs (maintenance costs, air pollution costs, etc.) that are paid by the whole population.

The comparison of the revenue-maximizing toll to the socially-optimal toll follows the results of Mills (1981). If users with low reservation prices for facility access are more sensitive to congestion than are users with high reservation prices, then, as Mills (1981) shows, the monopolist will set a toll above the socially optimal one. In our terms, if people differ in their value of time, then the revenue-maximizing toll exceeds the socially-optimal toll.

In our model with differences in the value of trips, the marginal user is indifferent between the revenue-maximizing toll and the toll that maximizes his benefit as a user. And any one with a lower valuation of trips wants a lower toll than the marginal user. So if the median voter is a user, he wants a toll lower than the revenue-maximizing toll.

Choice of capacity in the absence of tolling

We turn next to the choice of capacity. When the toll is zero, the number of users is determined only by the road capacity. The socially-optimal capacity can be derived by maximizing the following expression, where *n* is considered as a function of *K*:

$$\max \int_0^{n(K)} z(n)dn - \left[a + bT\left(\frac{n(K)}{K}\right)\right]n(K) - rK. \tag{16}$$

The number of users as a function of the capacity is given by the user equilibrium equation where for the last user *n(K)*:

$$z(n(K)) - \left[a + bT\left(\frac{n(K)}{K} \right) \right] = 0$$

$$\text{where } \frac{\partial z(n(K))}{\partial K} = -bT'\frac{n}{K^2} > 0 \text{ and } T' = \frac{dT}{d(n/K)}, \qquad (17)$$

$$\text{and so } \frac{dn(K)}{dK} > 0$$

Define the cost of a trip (exclusive of tolls), $a+bT(n/K)$, as average cost or AC. If there is no corner solution (that is, if $K>0$), the first-order condition determines the socially optimal capacity:

$$\frac{\partial n(K)}{\partial K} z(n(K)) - \frac{\partial n(K)}{\partial K} AC(n(K)) - n(K)\left[\frac{dAC}{dK} \right] - r = 0$$

or (18)

$$r = -n(K)\left[\frac{dAC}{dK} \right] = -\frac{\partial AC}{\partial K}\Big|_{n \text{ constant}} n(K) - \left[\frac{bT'}{K} n(K) \right] \frac{\partial n(K)}{\partial K}.$$

We see that capacity should be increased up to the point where the marginal cost of capacity (r) equals the fall in average user costs (AC) for given number of drivers minus the increase in user costs generated by the increased number of drivers. In the absence of user pricing, the induced driving reduces the benefits to the existing drivers.

The choice made by the median voter will again depend on whether he drives or not.

If he chooses not to drive, he gains nothing from road capacity: he must share in the costs, will have no toll revenues, and will gain no benefit from capacity. There would either be no traffic or one could imagine a corner solution where the minimum level of capacity is made available.

If the median voter drives, he will select K (and indirectly n) to minimize his user cost and his share in total capacity costs:

$$\min \left[a + bT\left(\frac{n(K)}{K} \right) \right] + \frac{k}{N} K. \qquad (19)$$

This means a level of K satisfying:

$$\frac{r}{N} = -\left[\frac{dAC}{dK} \right] = -\frac{\partial AC}{\partial K}_{n \text{ constant}} - \left[\frac{bT'}{K} \right] \frac{\partial n(K)}{\partial K}. \qquad (20)$$

Comparing (20) with the condition for the socially-optimal capacity, we see that the median voter, when he drives, exploits the common pool effect. He pays only *1/N* of the cost of extra capacity and he considers as a benefit only his own user cost and the negative effect on his user cost of induced driving.

Figure 1 illustrates why the median voter, when he chooses to drive, will always prefer a capacity larger than the socially optimal capacity. Let $MC = -\frac{dAC}{dK}$ (as in

(18)) represent the marginal social cost of capacity. The socially optimal solution has *MB=r/n(K)*. But the median voter is only one of *n* users, and one of only *N* taxpayers. The median voter therefore wants a capacity at which *MB=r/N.* Since *n(K) < N*, the capacity preferred by the median voter always exceeds the socially-optimal level. This ordering arises from a pure common-pool effect (see Persson (1998)): when the public good is paid by everybody equally, the oversupply of capacity declines with the number of beneficiaries of the public good.

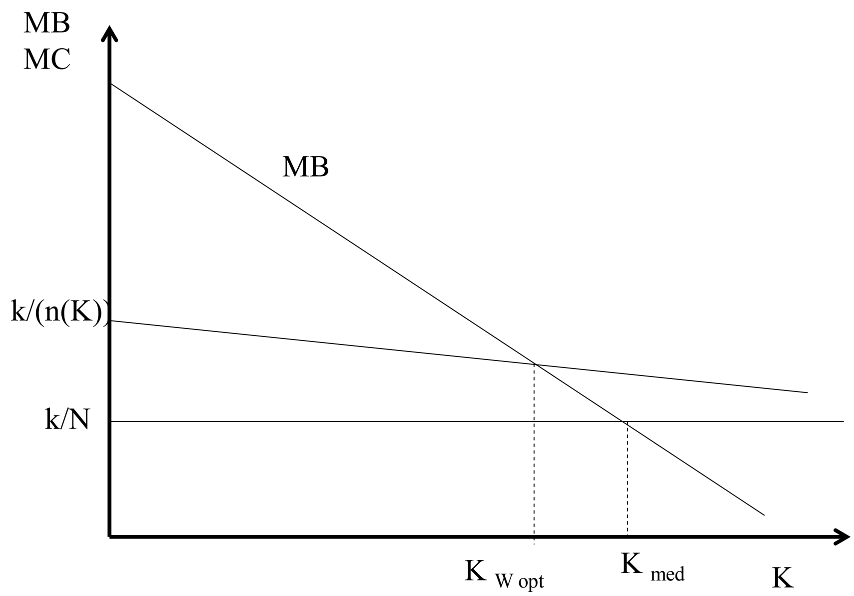

Figure 1 When tolling is absent, the median voter, if he drives, always prefers a road capacity larger than the socially optimal

To see whether the median voter prefers to drive or not, we must analyze his utility at the socially-optimal capacity. Unfortunately, even in the linear case, these conditions are not very tractable.

Choice of capacity with tolling

Consider next the choice of capacity when the road can be tolled. We discuss first the socially-optimal solution. When a planner can control both tolls and capacity, he will select the same toll (equal to the marginal external congestion cost), as in the fixed capacity case, with the toll evaluated at the optimal capacity. Because drivers face a toll equal to marginal cost, increased capacity will no longer induce traffic that reduces the benefits of the investment. We have as pricing and capacity choice:

$$\tau^* = n^* b \frac{\partial T(K^*)}{\partial n}$$

$$\text{and} \qquad (21)$$

$$r = -\frac{\partial AC}{\partial K} n(K^*).$$

This solution can be compared with the choices made by a median voter who decides to drive or not.

If the median voter does not drive, he will benefit from expanded capacity only if drivers pay a toll. The toll will be a net revenue-maximizing toll. We have

$$n_0 \frac{\partial \tau}{\partial n} + n_0 = 0$$
$$\text{and} \tag{22}$$
$$r = -\frac{\partial AC}{\partial K} n^\circ.$$

For a given number of trips, the optimal capacity for the median voter who does not drive minimizes the user costs for all drivers and is therefore the same as the socially optimal capacity for that given number of trips. But as the revenue-maximizing number of users, n°, will be smaller, the revenue-maximizing capacity will be smaller too.

If the median voter does drive, we will have a combination of the tolling rule and the capacity rule that gives

$$\tau^{med} = Nb\frac{\partial T}{\partial n} + (N - n^{med})\frac{\partial \tau}{\partial n}$$
$$\text{and} \tag{23}$$
$$\frac{r}{N} = -\frac{\partial AC}{\partial K}.$$

We can compare the toll and capacity combinations chosen by a welfare optimizer and by a median voter who drives or not by comparing the systems of first-order conditions. These determine the choices if there are no corner solutions. The welfare optimizing choice and the median voter choice each has an equation that determines the optimal toll for a given capacity and an equation that determines the optimal capacity for a given toll. This system of equations can be represented graphically as in Figure 2.[8]

[8] Equations represented in the figures are not necessarily linear.

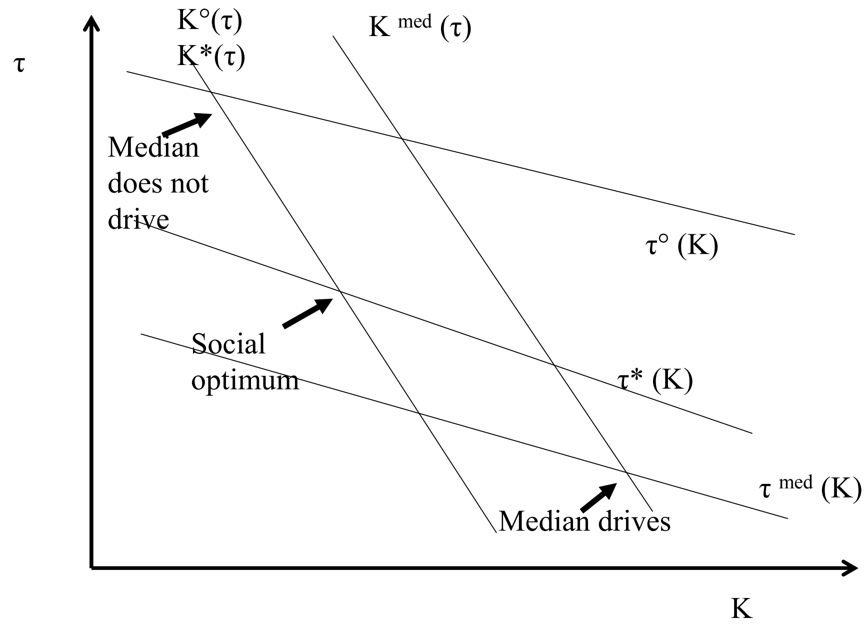

Figure 2 Toll and capacity choices of the median voter compared with the socially-optimal choice

First, we know that for any given K, we have $\tau^{med} < \tau^* < \tau°$. Though $\tau°$ (the toll when the median voter does not drive) does not necessarily decline with K, the values of τ^{med} (the toll when the median voter drives) and τ^* (the socially optimal toll) do decline with K. This gives us the three curves $\tau(K)$ that never intersect. Second, when it comes to investments for a given toll (and given n), we know that the median voter, who does not drive, would apply the same investment rule as under the socially optimal solution. We know that for a given toll and so for a given n, the median voter always prefers a higher capacity than the socially optimal capacity. This gives the two curves $K(\tau)$.

Consequently, the median voter, if he drives, always prefers a capacity higher than the socially optimal capacity, and a toll lower than the socially optimal toll. When the median voter does not drive, he selects a toll higher than the socially optimal one, and a capacity smaller than the socially optimal toll.

Comparative statics and development over time

We are interested in knowing how the toll and capacity evolve over time when income grows and/or the costs or technology of road building change.

For constant costs of road building, we can consider the following comparative static exercise. Assume that increased aggregate income increases the maximum willingness to pay for a trip in a linear way, as illustrated in Figure 3. We assume that an increase in average income from $R1$ to $R2$ rotates upward the willingness to pay curve for a trip from $z(n,R1)$ to $z(n,R2)$. We thus implicitly assume that the distribution of trip values is fixed and that all individuals make the same number of trips

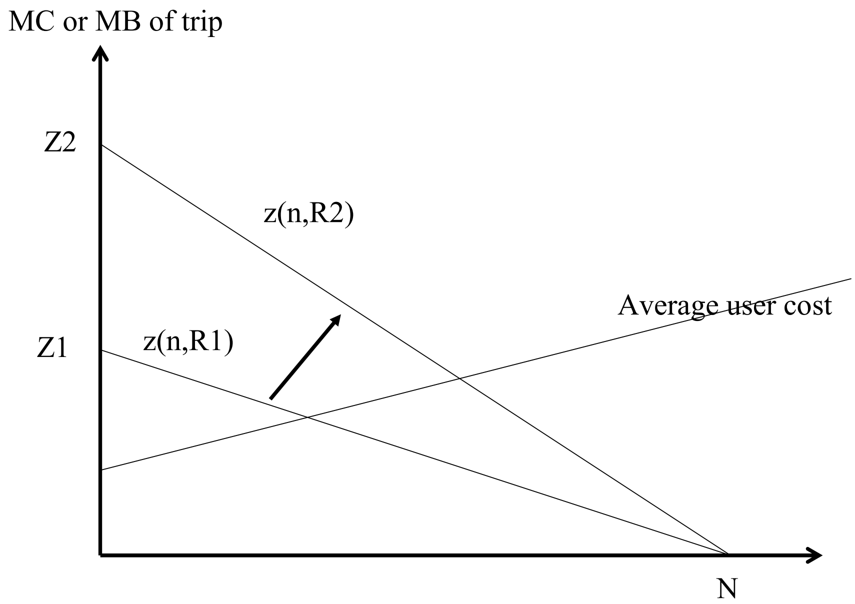

Figure 3 Representing an increase in average income in an economy as an increase in willingness to pay for a trip

We can now study the effect of an increase in aggregate income when capacity is fixed. This could give a profile like in Figure 4. At low aggregate income levels, the median voter is not a driver and favors the revenue-maximizing toll. When aggregate income rises, the number of users will rise and so will the toll. Once a certain level of income is reached, the median voter's valuation for a trip has become so high that he also wants to drive, and this means he favors a lower toll. When income continues to grow, the number of drivers keeps increasing and the median voter favors an increase in the toll.

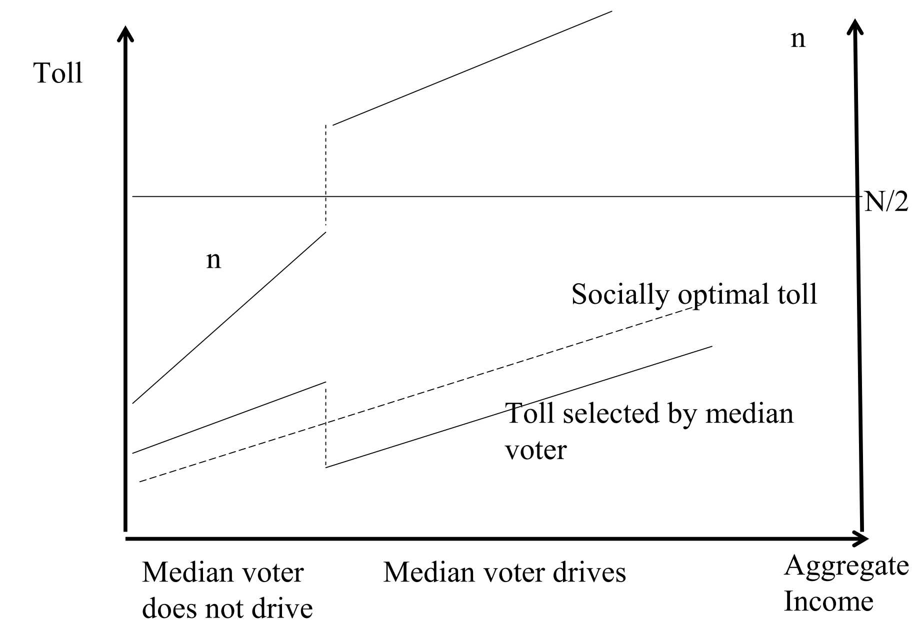

Figure 4 Effect on toll levels of an aggregate increase in aggregate income when capacity is constant

When we take the other extreme, no tolls are possible but capacity can be extended, we could see a pattern like in Figure 5. We see that, as long as the median voter does not drive, he gains nothing from capacity. Once he is a driver, capacity increases, and he wants a capacity higher than the socially-optimal level.

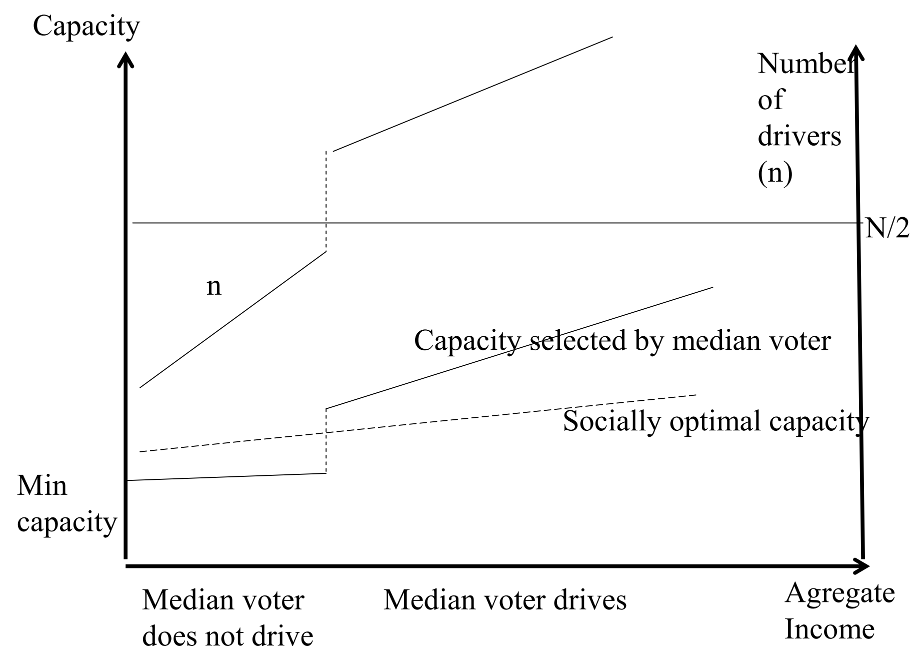

Figure 5: Effect on capacity levels of an aggregate increase in aggregate income when tolling is infeasible

We thus predict that as income increases and the number of drivers increases, the median voter will switch from a person who does not drive to a person who does, and therefore that user fees on roads will decline.

Evidence

Since congestion tolls are so rare, it is difficult to test our models empirically. Other evidence, however, has some bearing on the reasonableness of our assumptions and of our results.

A fair amount of research shows that gasoline taxes (which are related, though of course not identical, to road charges) respond to political pressures. In the United States, gasoline taxes are higher in states with Democratic governors (Besley and Rosen (1998)). In Europe, gasoline taxes are less likely to be increased in election years, and less likely to be increased the greater the number of registered vehicles in the country (Genser and Hannelore Weck-Hannemann (1992)). A comparison of gasoline prices in 86 democratic countries shows that they are lower in countries with presidential government than in countries with parliamentary government (Fredriksson and Millimet (2004).

We predicted that road charges may decline with the number of drivers. Consider the motor fuel tax imposed by states in the United States.[9] Adjusted for inflation, the average gasoline tax declined by 10.7 cents between 1957 and 2002; indeed, in 49 of the 50 states[10] (Missouri is the exception) the inflation-adjusted tax declined. The federal gasoline tax in the United States has also declined over time. For example, the tax was 18.4 cents per gallon in 2006; adjusted for inflation, the tax in 1960 was 27.4 cents, or 49% higher. So this is evidence that the taxes on road use have declined over time because income have made the median voter a driver as shown in the previous section.

Anecdotal evidence shows that citizens can care deeply about road tolls. In 2006, supporters of Mexican presidential candidate Lopez Obrador attempted to gain public support by taking over toll booths and allowing motorists to enter Mexico City without paying tolls. Election results in Sweden are consistent with our model. In 2006, voters in Stockholm supported a congestion toll; this cordon toll reduced congestion in the city, but did not require residents of the city to pay the toll. In contrast, citizens living in the Stockholm area but outside the city enjoyed the lower congestion, but had to pay the toll; these citizens voted against the congestion toll (http://www.thelocal.se/article.php?ID=4941, September 18, 2006).

We have seen that if the median voter is not a driver, then he will favor the revenue-maximizing toll; if he drives but congestion is not too bad, then he will favor a lower toll. That reasoning suggests that, within at least some range, an increase in aggregate driving will reduce the gasoline tax chosen by government; a study of OECD countries by Hammar, Löfgren, and Sterner (2004) finds such an effect.

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9 Data are from www.transact.org/progress/pdfs/February03/table_3.pdf, published by the Surface Transportation Policy Project, 1100 17th St., NW, 10th Floor, Washington, DC 20036

10 Alaska and Hawaii became states after 1957; the data reflect taxes in 1959 for them.

Lastly, recall our analysis of the Tragedy of the Commons, where we expect homogeneous voters to choose the toll that maximizes social welfare. Anderson, Holt, and Reiley (2006) conducted laboratory experiments with congestion generated by the Tragedy of the Commons. The interesting part for our purposes is that the experiments had subjects vote on a congestion toll, with the revenue redistributed to all subjects. The subjects initially set a toll below the socially optimal one (and so below the toll that the median voter would prefer), but in the final rounds of the experiment they settled on the socially optimal fee. So at least for a simple case, experiments verify our predictions.

Conclusions

This paper used a simple model to show that a simple median voter model can explain why the real users' prices for roads tend to decline. The main force driving this result is that the median voter, as long as he is not a driver, benefits from revenue maximizing tolls and from low spending on capacity. When he becomes a driver, he has an interest to oppose high tolls and wants more road capacity paid for by the general public.

The simplicity of the model makes us mention several caveats. First, we used a uniform tax or subsidy as the alternative instrument to raise government revenues. When more complicated tax structures are in place, one can expect that the median voter also manipulates these in his favor. If he is not a driver, he may even be more keen to extract revenues from drivers because he may receive a share in the net revenues larger than $1/N$; the opposite holds if he is a driver.

Second, as the number of voting dimensions exceeds one, an equilibrium may not exist.

Third, we have individuals varying in the valuation of a trip and not in the value of time. Variations in the value of time can be accommodated to some extent by redefining the valuation of a trip as also depending on the value of time.

Fourth, we ignored other transportation modes. If the alternative is priced at marginal cost, our analysis is unaffected. The value of a trip is then redefined as the value of a road trip minus the value of the same trip on a different mode. When the other mode is not priced at marginal cost, our model needs reworking as there is second price and capacity variable to take into account.

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