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Economic Arguments on Toll Roads

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From the economic point of view, tolling is an instrument that can be uniquely suited to the collection of efficient road use prices. Because they affect resource allocation, toll rate levels need to be considered when decisions are made about the appropriateness of a toll scheme. It is argued that tolling (at rates above marginal costs) is equitable—those who benefit should pay—but beneficiaries may not pay in full or at all if they are not users of the toll road. Nevertheless, tolls are generally imposed for the purpose of raising additional net revenue, and they appear to be a suitable instrument if the object is revenue earmarking or private financing and management of roads. However, investment lumpiness and increasing returns make roads a commercially viable enterprise only occasionally. Means other than explicit tolls may be better for attracting private intervention. High associated costs are a disadvantage of tolling; in some cases the cost of distortions

introduced by tolling may make incompatible the objectives of revenue generation and efficient resource allocation. It is important to ensure that effects on the economy at large, not only on the toll agency, are included in toll road analysis. This is not generally done and is the reason for this paper. There are, however, a number of conditions under which tolling may be appropriate (i.e., not worsen resource allocation or even improve it over untolled roads despite higher costs inevitably entailed in tolling with current technologies). Examples of results from tolling in two developing countries are provided. In this paper only tolling of interurban roads is discussed.

Toll roads are generally equated with high-standard roads, and nontoll roads with low-standard roads. Most analyses are limited to cash-flow considerations of the agency in charge. Such analyses, which may be appropriate for the toll agency, leave out economic costs to society at large. Such costs may be important enough to change the outcome of the analysis and the

resultant recommendations. Thus toll roads may not be the best option for increased funding of the road sector.

In this paper are reviewed the objective and major issues of tolling: road use pricing, additional revenue, high collection costs, earmarking and decentralization, and equity. The quite different effects of tolling in two developing countries are also reviewed.

ECONOMIC ARGUMENTS

Objects of Tolling

Tolls are generally imposed for the purpose of raising additional net revenue. As a revenue-raising device, they appear to have equity in their favor: the user pays. In addition, tolling allows the revenue streams from roads or from particular roads to be segregated. Tolls therefore appear to be suitable instruments if the object is revenue earmarking or private financing and management of roads. It is, however, as an instrument of efficient pricing of road use that tolls appear to possess unique advantages that are of importance in relation to rational resource allocation. Any particular tolling scheme may have a variety of objectives, and when a proposal to toll is examined, two questions need to be answered: First, to what extent will tolls achieve a given objective, ignoring all others? Second, are the different objectives mutually compatible and, if not, what is the cost of pursuing one in terms of the others?

Major Issues

Road Use Pricing

A main argument for tolls is that they could allocate road users between tolled and untolled roads so as to ration available road space to users for whom it has the highest value. Toll rates may be varied flexibly (even discontinued) according to hour and day of the week to reflect varying cost conditions, such as congestion, as accurately as they can be evaluated so that road use cost is recovered without cross subsidizations. Where there are alternative roads, tolling of one may achieve service level differentiation on both; differentiation is the more desirable the more heterogeneous the traffic mix (i.e., relegate congesting, slow, or nonmotorized traffic to one road and allow motorized traffic to circulate at higher, free-flow speeds on the other; or separate local and long-distance traffic). Tolling also enhances users' awareness of costs and provides a direct link between the cost and the benefit of the trip. If tolling raises efficiency or improves resource allocation, the extra cost of collecting tolls may be fully justified.

These advantages operate within limits. Practical considerations reduce the potential flexibility of toll rates. Tolling hitherto untolled roads may be politically unacceptable, and toll evasion reduces the potential pricing effect. Service level differentiation could also be achieved without tolling. In some instances, the provision of additional road capacity may be a better way of reducing congestion than is reduction of demand; this depends on the costs of expansion and the benefits from additional trips or trips that tolls would discourage.

Another major limitation is that there is no economic justifi-

cation for tolling uncongested roads to capture marginal user costs. General road user charges can be made to do that at a lower cost. If there is a fiscal justification for charging users of uncongested roads more than marginal costs, this can be achieved as well, if not better, by general road user charges.

Additional Revenue

The primary fiscal objective of tolling schemes is to raise revenue over and above the yield of general road user charges (e.g., fuel taxes). Rates set to cover social marginal cost when there are externalities will have a yield greater than current expenditure on the tolled road. If tolling causes traffic diversion to untolled roads, the cost of maintaining those will rise so that the final outcome is uncertain. The situation changes when traffic volumes are such as to lead to some congestion on all substitute roads because congestion on the untolled alternative roads sets a limit to traffic diversion from the tolled roads. It is then possible to raise additional net revenue through toll rates equal to social marginal cost. Tolls may be raised even higher but with the consequence of a distortion—some desirable traffic is suppressed. The question is then whether tolls are a lower-cost means of raising general revenue than are other taxes. It is known that raising public revenue has a high cost. The stage may have been reached at which public investments with potential returns higher than overall opportunity costs cannot materialize because raising the rate of a tax would no longer increase its yield or because a ceiling on the public debt constrains borrowing. Income taxes may be administratively too costly, or evaded, in developing countries. In such cases, tolling above marginal costs may improve the efficiency of overall resource allocation despite its costs.

The target revenue from tolls is frequently taken as the full cost of the roads including construction and financing. In few cases have toll revenues reached that level, in spite of high traffic levels. Negative cash flows for (sometimes long) initial periods entail refinancing costs, and some toll operations could not break even even if repayment periods were extended. Tolls do add to revenues from road users at large, but only marginally. In developing countries generally, lower traffic levels may not pay enough to cover the fixed, minimum cost of even simple toll collection systems. Some 5,000 vehicles per day would appear to be the minimum required to yield a net revenue from tolling.

High Collection Cost

A major argument against tolls is that other road user charges can raise the same revenue with lower collection costs: raising the rate of an existing tax entails no extra collection cost. There already exist electronic technologies that can reduce collection costs on high traffic roads and thus do away with a main drawback of tolling. Traffic levels, however, are normally not high in developing countries, and it will take a long time before such technologies can be widely applied in those countries. In the meantime, manual methods would have to be used; manual methods have relatively low direct costs but also potentially high indirect costs on account of revenue diversion. Collection also imposes on users the cost of delays and vehicle operation in the stop-go cycles at barriers.

Experience with high-traffic-volume toll roads (expressways with controlled access) in member nations of the Organization for Economic Cooperation and Development indicates that, on average, road construction costs increase from 10 to 15 percent on account of toll-related facilities; collection and other ad hoc toll road operation costs are about equal to road maintenance costs, and collection costs absorb some 10 to 15 percent of toll revenues. This can be compared with collection costs of some 14 percent of general tax revenues in the United States. In developing countries with lower traffic volumes, experience with two-lane toll roads is more varied. Additional costs are relatively low, but revenue diversion can be extensive. Collection cum revenue diversion costs have been observed to vary between 7 and more than 50 percent. On the other hand, it is not clear whether the overall economic distortion from tolling is costlier than that arising from general taxation; an additional U.S. \$1 revenue from taxes has been estimated to result in a welfare loss of up to U.S. \$0.33 in the United States.

Earmarking and Decentralization

Toll revenues can be fully or partly earmarked; this may permit private management and financing of roads (construction, maintenance). Such revenues may alternatively accrue to the general treasury. In practice, toll revenues in most developed countries have been insufficient to fully recover road costs because of investment lumpiness and long initial periods of negative cash flows and consequent refinancing charges. For private interest in a concession to materialize, a sizable government equity contribution is needed as well as guarantees against revenue falling short of projections. Even so, private financing costs more than general government borrowing or bonds because of the higher risks involved. Public-private joint ventures could reduce the need for public funds. Developing countries should expect difficulties in attracting private risk capital for road construction against toll revenue promises, given the generally low traffic levels that do not justify tolling and more general questions of creditworthiness.

Toll revenues can be earmarked for the agency in charge of the road network. This still allows private intervention under contract, not by way of toll concessions, and may lead to improved maintenance of tolled roads. However, it may also lead to less maintenance on untolled roads and, more generally, to a misallocation of resources if revenues exceed justified road maintenance budget levels. This pitfall can be avoided if revenues above a certain level accrue to state or general treasuries and are not earmarked for road activities, as is done in Mexico.

Equity

Tolling appears to be equitable inasmuch as "the user pays." However, it may be inequitable when only some roads are tolled (especially if substitute roads are not tolled) and even when all roads are tolled, if rates exceed marginal costs. The toll collection system itself and the location of toll collection booths have an effect on equity (e.g., the rate can be a fixed amount or reflect distance traveled, can equal marginal cost or exceed it, can represent discriminatory pricing, or can be col-

lected from all or only some users). In developing countries slow-moving vehicles such as bicycles and animal-pulled carts that circulate on untolled roads cause a higher than average road use cost by creating congestion but may not pay even the average road use cost.

Whether tolling can achieve equity in the sense of income redistribution is debatable and has not been proven. The lowest income road users may suppress trips if cost increases on both the tolled and the untolled roads; high-income users may have a net benefit even when paying the toll if this saves them time. The distributional effect of what revenues are spent on may be more important than the incidence of the toll: more roads that will also require contributions from general revenues but mainly benefit the rich or social schemes.

Balance of Considerations

Tolling is neither good nor bad per se: Its desirability depends on how prices (toll rates) are set and on what allocation objectives are accepted. Its desirability also depends on how the cost of raising revenue through tolls compares with the cost of raising revenue by other means and with the loss of benefits attributable to not having additional revenue. The cost of raising revenue through tolls, in turn, depends on the network configuration and traffic levels (are there substitute roads? are other roads tolled? is it desirable to provide service level differentiation?), which determine costs or benefits of traffic diversion; on collection costs; on the cost of initial investment and operation and whether provision is made for alternate roads for local traffic when access to the tolled road is restricted; and on the cost of potential toll revenue diversion.

The various objects of tolling would not conflict, and tolling may therefore be appropriate, when

- Toll rates are equal to social marginal cost (marginal use cost plus cost of externalities) or when they are "what the traffic will bear" short of diverting;
- Tolls are levied on (a) facilities with less than free-flow conditions and reduction, redistribution, or reallocation of traffic to another mode is sought (i.e., where road supply is not fully elastic) or (b) facilities with captive traffic and traffic levels high enough to justify collection costs (i.e., where demand is relatively inelastic because of absence of substitute roads); and
- Toll revenue surpluses, if any, after road operation costs and load amortization are covered, accrue to the general treasury (i.e., revenues are not, or only partly, earmarked).

However, equity is not preserved.

In other situations the main objectives of tolling may conflict. If there is a net revenue objective, the least-cost toll system that can achieve the revenue objective should be ascertained. This system may be adopted if it improves resource allocation [i.e., if its costs are lower than (a) costs of alternative means to raise the same revenue and (b) the cost of benefits that would not materialize in the absence of the revenue]. Equity considerations may affect the decision. It is also possible that no toll system can meet the objective, either because traffic

levels are too low or because raising toll rates may not increase revenues.

New roads should be constructed to common design standards according to their priority in the overall public program. Priority should be determined on the basis of economic cost-benefit and least-cost analyses and intermodal, safety, and regional objectives. Whether or not to toll the road may be analyzed thereafter; the expectation of toll revenues may advance construction of a lower priority road and, if this is so, it is particularly important that prospective costs and revenue estimates be realistic because other, higher priority roads may be deferred.

Government road agencies can operate toll roads directly or through contractors. If concessions including construction and financing of a new road are to be established, governments should take responsibility for their development and operation to ensure a cost-effective, integrated system of highways. The terms and conditions must be set out and controlled by the state according to the general design, minimum maintenance standards, and other rules applicable to all roads. Concessions should only be awarded if they are viable without government guarantees that eliminate all risks to concessionaires; government equity will probably be needed.

Against this background, tolling should be viewed as a limited means of raising net revenues. Where traffic levels are low in general, general road user charges can better capture average road use costs from all users. Only roads with some degree of congestion may be worthwhile analyzing to ascertain whether tolling may be a preferred option. The possibilities for economically "successfully" tolling interurban roads will be relatively few.

EXAMPLES FROM DEVELOPING COUNTRIES

In one developing country, toll collection is probably as efficient as it can be: charged in one direction only, collection costs are reported to average about 7 percent of revenues, although there are wide variations among road sections because of variations in traffic levels. The open toll system adopted results in higher charges for those traveling shorter distances, but it implies few other economic costs or distortions given the lack of alternative routes and thus little traffic diversion because of tolling. The same government agency responsible for roads at large is in charge of toll operations. Tolls are not related to road construction but are seen as a user charge; however, fuel charges and licence fees would be better means for recovering average costs from all users.

In another country, with many alternative routes, tolling of one of them is not efficient. The country has a well-developed system of free federal and state roads. There has been a fast growth of traffic generally and on the Federal Route 1, where an additional 782 km of new expressway was to be provided. The cost would have been high and it was decided to operate the expressway as a toll road in the hope that this would bring in additional resources, permit a faster pace of construction, raise public awareness of the cost of infrastructure, and assure equity by making the beneficiaries of this new high-quality road pay for the privilege.

The highway authority was created in 1980 as the toll

authority. Although this was an autonomous agency under the ministry of works, it could not set toll rates or invest without ministerial approval. The income from grants, toll revenues, and other earnings and borrowing was expected to pay for operating expenses and loan service. The government was neither to guarantee repayment of borrowings by the authority nor to fund its operations. The government transferred to the authority an expressway section, ongoing works on a number of other sections, and related commercial loans; but it did not endow it with other capital funds. The authority was staffed with personnel seconded from other government agencies and relied heavily on private consultants and contractors.

Until 1985 only two sections were operated as open toll roads. These sections, 84 km long, were ready and in use before tolls were imposed. Some 36 km of the length to be built had been completed, 234 km were in various stages of construction, and studies on the remainder were ready or under way. Loans of some \$2 billion were obtained, mainly from foreign banks. The authority as a whole had a negative cash flow, which should worsen when loan repayments start. Toll levels with the existing volume of traffic would have to be quadrupled to meet the financial obligations. Any increase of that order, however, would divert most traffic and be politically unacceptable. The financial autonomy of the authority appears to be no greater than that of the ministry of works. Its creation had no visible effect on the rate of construction, and it is not obvious what advantage was gained by creating it rather than leaving the ministry of works in full charge of the federal road network.

The prospect of toll revenues did not mobilize additional resources for road construction. No private company was found to accept the risk of recovering an investment through tolls. Government guarantees were necessary to borrow for road construction. The cost of borrowing was not affected by the prospect of toll revenues; the amount of borrowing for a particular road program was not affected either; tolls only accrue after construction is paid for, and accumulated revenues from existing toll roads are relatively insignificant and would be no different from general revenues. Expected toll revenues from a new road would not cover the interest on the capital (let alone amortize it); yet the capital cost increases by at least 10 percent on account of tolling installations, and this diverts resources from other potential projects. The pace of road construction was not affected; overall budgetary constraints prevailed, as they do in any other public investment program.

The effects of tolling the expressway section have been analyzed. This section is part of a corridor that is also served by Federal Route 1, state roads, and the railway. Omitting the latter, total traffic in the corridor in 1983 was 67,000 vehicles per day (vpd) near the northern end (24,000 on the expressway) and 29,000 vpd near the southern end (15,000 on the expressway). This traffic consisted mainly of commuters and, on weekends, beach-related traffic. Before the 63 km of expressway were opened to traffic in 1977, the only direct link between the two centers was Federal Route 1, which was approximately the same length as the expressway but was built to a lower standard. Access to the expressway is limited and, since June 1982, it has been operated as an open toll facility with two toll plazas. Nearby state roads running almost parallel to the expressway permit vehicles to bypass the toll plazas but still

use the rest of the expressway, at the cost of travel over a longer distance and on roads of lower standard.

Motorcycles pay no toll; commercial vehicles up to medium size pay twice the passenger car rate; and heavy trucks pay three times that rate. The northern plaza charges one-half the rates charged at the southern plaza. If the full length of the expressway is used, the average toll per car-kilometer is less than 10 percent of related vehicle-operating expenses including other road user taxes but excluding the value of time. Even such low rates appear to have had a considerable impact on route choice. Before tolling, the expressway had consistently higher traffic growth than the alternate federal route; after tolling, the proportion of traffic that used the expressway declined. On the basis of conservative assumptions, it is estimated that 14 percent of the expressway traffic deviated at the northern plaza and some 12 percent at the southern. This diverted traffic consisted of only some 5 percent of long-distance traffic but a higher proportion of local traffic. It may be concluded that road users are sensitive to price variations and that car users are particularly sensitive to time savings.

Conservative estimates of the effects of tolls on road users, the government, and the economy at large can be summarized as follows:

- Government increased its net revenues from road users by \$10 million (only 0.5 percent) at a cost to the economy of \$5 million in real resources. Collection costs amounted to some \$2.6 million, 20 percent of gross revenues from tolls.
- The administrative cost in the form of collection costs added between 33 and 100 percent to road use cost, depending on vehicle type. Also considered should be the cost of the separate public administration that was set up to carry out functions that could have been carried out by the existing ministry of works.
- Toll revenues are earmarked, but with the current low toll revenues earmarking makes little difference. This will become more important as more road sections are tolled and if overall budgetary constraints prevail.

The "equity" argument—those who benefit should pay—is not supported by the effects of tolling. Taxes on road users are high and cover both maintenance and construction costs of roads, and tolls represent a further taxation. The toll structure that was adopted lessens income tax progressivity; the structure becomes more "equitable," in the sense that the tax incidence on different vehicle types is more similar, but the level becomes more "inequitable." Tolls add between 33 and 100 percent to existing taxes on road users, depending on vehicle type. The same tax revenue could have been obtained by increasing existing taxes on all road users by 0.5 percent (i.e.,

the share current toll revenues are of total revenues). Such a measure would also imply a larger payment by those vehicles that pay no toll but benefit indirectly from a good expressway that lowers congestion on alternate roads. However, it would also make vehicles elsewhere pay more, for no benefit. An increase, if any is needed, would be more equitable if raised by local taxes. Only when electronic tolling becomes available at low costs can tolling become the best possible means to recover from each road user the "exact" cost of the roads and externalities corresponding to the form and time of use.

Public awareness of the cost of public infrastructure increased as intended, but public willingness to pay did not. Most people recognized that it was "fair" for those who use a faster road to pay a premium. Nevertheless, traffic diversion indicates resistance to paying. Only those who perceive that paying the toll is cheaper than deviating stay on the tolled facility.

In this experience, tolling has a high economic cost. Half of every dollar of net revenue from tolling is conservatively estimated to be lost in uneconomic uses. One-half of this cost is the cost of toll collection. The remainder is the higher transport cost incurred by people who deviate from the expressway when a toll is levied because the toll exceeds the perceived value of the extra operating cost and the extra time associated with traveling on alternative roads. Road users are sensitive to price increases but indifferent to whether the increase is due to a pure financial transfer (toll) or to a higher use of resources (vehicle-operating costs on poorer alternate roads and time). They will try to minimize the perceived cost increase. The perception of cost may not be accurate and may lead to choosing a more costly alternative. Current toll levels are low, but it is not certain that an increase in toll rates would improve the revenue-to-economic cost ratio. Traffic diversion would also increase, as would total uneconomic costs. Tolling (of uncongested roads) generates least economic costs where alternative roads are not available or are also tolled.

When general resources were used for toll facilities, the end result may have been to curtail, rather than increase, economic investments. The standards adopted for the expressway, particularly in providing limited access and grade intersections, would probably have been lower on a "free" road. The needed pavement rehabilitation of the section, on the other hand, might have been deferred had it not been for the tolling argument.

More data and analyses are needed for a full assessment of the economic impact of tolling, but, even in the absence of fuller information, the chief results of tolling in this case are clear. By and large, the tolling policy did not achieve its objectives: the premium for attaining these objectives is nevertheless being paid in high economic and administrative costs. The government is currently reviewing the organization of the highway authority.