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# Privately-owned Toll Roads: How Profit and Welfare Effects Can Have Opposite Signs

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## Abstract

After reviewing the pertinent characteristics of some recent cases of private-company construction and operation of toll roads (mostly with build-operate-transfer arrangements), the paper looks at reasons profit and welfare gains from such projects may diverge, even to the extent of having opposite signs. The discussion covers factors affecting a single road link and also factors arising from financial interdependence between links in a network. Some policy conclusions are drawn.

## 1. Introduction

The case for privatization, in the sense of private provision of new services, depends on the proposition that such provision will be forthcoming if and only if the project is profitable. Furthermore, it is claimed (often tacitly) that if a project is profitable, then it is also in the public interest (which is interpreted here as requiring a positive increment in aggregate welfare). Coupled with this claim is the proposition that all, most, or many projects that are in the public interest will be profitable. These two arguments then lead to the conclusion that privatization offers a socially-desirable approach to project selection.

The principal difficulty with this conclusion is that, in almost any sector, there is a range of interdependencies between the private project and the rest of the economy. In practice, this means it is not always possible to rule out circumstances that defeat the use of profitability as a test for public desirability. For example, there can be many ways in which a government subsidy can accrue, directly or indirectly. And, in that case, profitability includes the subsidy, while the welfare increment does not. This is but one way in which profit and welfare increments *can* have opposite signs.

This difficulty seems to be especially acute in the case of projects for the construction and operation of transport infrastructure, for such projects have especially varied and complex interactions with the rest of the economy. In particular, the users may come from many sectors of the economy; and there can be significant external effects: both negative ones such as pollution, which damages the interests of third parties located nearby, and positive ones such as those arising from changes in the levels of use of *other* transport infrastructure.

This paper studies the causes of divergence between *the signs* of welfare and profit increments in the case of privately-provided toll roads. In recent times, there has been much talk and some action in such provision; pertinent aspects of some of these cases are reviewed in the next section of the paper. Section 3 gives an in-principle examination of the sources of divergence that apply even for a single road considered in isolation. Financial interaction effects, which arise when a private road is part of a network, are studied in section 4. The final section briefly draws some policy conclusions.

## 2. Some Recent Schemes for Privately-owned Toll-roads

While some European countries have relied on private ownership for the construction of high-standard inter-urban toll roads in the period since the second world war, it is only in recent years that the English-

speaking countries have taken up the idea of private toll roads apart, that is, from the extensive 'turnpike' provision of earlier centuries.

Among the recent examples, two initiatives in the U.S. are of interest. In Virginia, the government-owned Dulles Toll Road was built some years ago; it runs from an inner circumferential road in Washington DC to serve Dulles Airport and nearby communities. Recently, the privately-owned Toll Road Corporation of Virginia proposed construction of a 15-mile private toll road going further out from the Airport to Leesburg. Some traffic from the Leesburg area will go no further than the Airport. But much of it will travel in to Washington, thereby paying two toll fees to separate owners; this is an instance of serial interdependence in the road network. (The financial consequences of such a situation will be considered later.) Also of interest is the fact that the Toll Road Corporation is being given some of the right-of-way by landowners, who stand to gain from development stimulated by the presence of the new road. At the same time, it is thought that the Toll Road Corporation might need local government to exercise eminent domain on its behalf to enable it to purchase some parcels of land from unwilling sellers (Gomez-Ibanez, Meyer and Luberoff, 1991, pp. 270 and 271).

Another U.S. example is in California where, in 1990, the Department of Transportation (CALTRANS) called for proposals for private construction and operation of tolled roads (or other transport infrastructure). An interesting feature of this initiative is that would-be developers had the chance to specify schemes anywhere in the state; but "to preclude the possibility of conferring monopolistic powers on any particular project, a project had to have a free (that is, non-tolled) alternative at the point of use" (Cohen, 1991, p. 299). (The presence of alternative roads results in what is here called parallel interdependence; and the financial implications are considered further in section 4.) There is also protection for the private companies: CALTRANS was to give undertakings not to build 'competing' facilities within specified time-periods (Cohen, 1991, p. 301). At the same time, the four proposals that were ultimately selected seem to have major serial interdependence too: "The tentative 'winners' are mostly connectors that fill in fairly obvious gaps in the existing highway system". (Gomez-Ibanez *et al.*, 1991, pp. 261-2). For the four projects selected after a tendering competition, most of the right-of-way is already owned by government (Cohen, 1991, p. 302); it appears that it may be used without payment by the private road developers. Ownership remains with government; and, in each case, the right to receive the toll revenue will be leased to the company for a term of up to 35 years (Cohen, 1991, p. 299).

A further illustration of the potential for significant financial interdependence between links is afforded by the Liefkenshoek tunnel in Antwerp. This was built and is operated by a private company under a concession agreement which did *not* provide government financial assistance. Since the tunnel was opened in July 1991, the financial outcome has been adversely affected by a number of factors including a revised network of roads (approaching the tunnel) that yields less traffic than that anticipated under the original agreement. The company is reported to be in financial distress (de Groof, 1993, p. 894).

In recent years, successive New South Wales governments have embraced the idea of build, operate, and transfer (BOT) arrangements for private-company provision of toll roads, especially in the Sydney metropolitan area. In 1987, the (then) Labour government legislated for the construction of a road tunnel under Sydney Harbour to supplement the capacity of the Sydney Harbour Bridge (which was opened in 1932). Under the contractual arrangement made between the government and a private consortium, (1) the two crossings charge the same toll; (2) the government made a loan to help finance the tunnel construction, and it did so on terms that amount to an outright grant of most of the money; and (3) the government gave the consortium the right to receive a 30-year flow of operating revenues, which in each year is approximate to *the sum of the Bridge and the tunnel toll revenues*. After the 30-year operating period, the tunnel is to be handed over to the government. (A detailed account of the arrangements is given in Mills, 1991.) Although much of the right-of-way is under the harbour, the city-centre space for

both portals is of considerable value; there is no charge to the project for this resource.

The 1988 election of a right-wing government led to the institution of a general policy under which BOT arrangements with private companies have been sought for the construction of major roads in the state. So far, two such urban toll roads, the M4 and M5, have been built; both are radials in the Sydney metropolitan area and were opened to traffic in 1992. While full details of the contracts are not publicly available, some significant public concerns have become apparent.

In the case of the M4, the government had already constructed two sections of high-standard road. At the outer end of the radial, there was a section of some 27 km in length separated by a gap of about 10 km from an inner-end section of 11 km. Vehicles travelled between the two sections by using a lower-standard all-purpose road. The private company built a high-standard road to fill the gap, upgraded the inner section, and became responsible for maintenance of these two parts totalling some 21 km. It also placed its (only) toll plaza at about the mid-point of what had been the inner section, thereby imposing a toll on some journeys that had previously used the inner section without payment and to the chagrin of the drivers involved.

In the case of the M5, the new high-standard road had been planned initially as a government-funded freeway. When built as a privately-owned toll road, the design included fewer entry and exit ramps. One effect of this has been to make it harder to avoid the (only) toll plaza than would have been the case if the initially-planned connectivity had been implemented. This too has provoked complaint.

In May 1993, the NSW government's Minister for Transport announced that another radial road (to be known as the M2) would be built as a toll road over the next four years, "with most of the funding coming from the private sector ... [The Minister] said later that ... the amount of government funding which would be required ... would not be known until after expressions of interest from the private sector had been assessed." (*Sydney Morning Herald*, 31 May 1993, p. 1.)

Finally, the NSW government has also expressed its desire to have private-sector participation in the construction of north and south tolled radials. These would be positioned in such a way that much of their traffic would also pay the toll on the Sydney Harbour Bridge or tunnel, giving another example of serial interdependence between tolled roads.

### **3. Financial Interdependence of an 'Isolated' Road**

As suggested by the case-features described in the last section, even a single road (which is not part of a road network) may have financial interconnections with the rest of the economy, and these connections may be such that the signs of the profit and welfare increments diverge. The present section gives a systematic discussion of possible sources of divergence.

A road that is not worthwhile from a welfare viewpoint may nevertheless be made profitable, and hence be built, if there is some direct subsidy paid to the private company that builds the road. Such subsidy can take several forms. The consortium that built the Sydney Harbour tunnel received major subsidy of construction costs and is receiving extra payments each year besides the revenues from the tunnel tolls. In other cases, it seems private companies sometimes get government payments to defray additional expenses such as the cost of providing works to help mitigate noise pollution. Also, as noted above, for Sydney's M2, the NSW government certainly envisages providing subsidy (in a form not yet specified), presumably because calculations of likely toll revenues suggest that subsidy will be needed to secure one or more private-company bids for the right to construct the road.

Of course, the divergence can run in the opposite direction too, as recognized by earlier authors; see for example the study of the Channel Tunnel by Kay, Manning, and Szymanski (1989). One difficulty in ensuring profitability, even when the road brings a positive welfare increment, arises from problems the road company may face in devising a scheme of tolls to extract a good proportion of the users' gross surpluses. When such surpluses remain in user hands, there can be significant financial benefits accruing elsewhere in the economy; in particular, owners of land that has better transport access as a result of construction of the road may receive windfall gains in the value of their land. This often prompts companies who propose such roads (or other transport infrastructure) to seek government legislation that allows the company to tax these pecuniary benefits. But such betterment levies bring their own difficulties in implementation: estimation of the amount of the financial gain to the landowner can be difficult and arbitrary; and it is difficult to balance conflicting interests when the financial gain is not realized until the land is sold or redeveloped.

For these reasons, it seems better to encourage the road owner to engage in price discrimination; extraction of surpluses in that way does undergo some sort of market test. And to the extent that the road owner enjoys market power, the test may still be socially acceptable when that power can do no more than secure a modest level of profit. In practice, however, companies may employ unambitious toll schedules. In the NSW cases, there is little differentiation by vehicle type and none by time-of-day; the government may have prohibited or at least not encouraged an appropriate degree of price differentiation.

Another factor that reduces profit is the common governmental practice of imposing indirect road-user charges. In particular, these may take the form of a levy on the price of motor fuels. Where this is done, convergence between profit and welfare would be assisted by the government passing on to the road company revenues accruing from fuel that is used on the toll road in question. This has two difficulties in implementation. Estimation of the amounts of fuel thus used may not be altogether straightforward, though these problems should be resolvable to an acceptable degree of accuracy. A more fundamental difficulty arises when part of the revenue from fuel levies is treated as taxation. To draw an operational distinction between taxes and charges, government expenditure on publicly-owned roads may be expressed as a rate per unit of fuel used, and this rate may be used in calculating the payments to be made to the private owner of a toll road.

In schemes where the privately funded road is to be handed over to the government after a lease period of say 25 to 35 years, the absence of a countervailing capital payment by government to the company is a further factor that may lead to negative profit even when the welfare contribution is positive. This point is reinforced by a common contractual arrangement which requires the company to undertake thorough maintenance and to hand over the road in good condition. On the other hand, the present value of such a distant event is fairly modest: at a real discount rate of (say) seven percent over 35 years, the discount factor is 0.094. And the value of the road after 35 years may be reduced by economic obsolescence as well as by *some* physical deterioration.

#### **4. Financial Interdependence between Road Links in a Network**

Besides the direct factors which can separate profit and welfare increments even for a single, isolated road, the circumstances of the cases sketched in section 2 suggest that it is important also to examine the interdependencies that arise between network links. Three types of interdependence have been exemplified in that earlier section serial, parallel, and 'exclusionary'. The last of these refers to the circumstance in which construction of a new road requires, or is accompanied by, exclusion of some previous use. This can occur in either of two ways: an existing road link may be severed physically, or the toll on it may be increased, perhaps from zero. As a result, previous use is terminated or the scale of use is reduced.

Consider first the case of *serial interdependence*. Specifically suppose a simple network in which a proposed toll road extends an existing road, and any toll on that old road is not increased. This case has two key features:

- use of the new road is an extra option
- no-one previously using the old road is excluded from such use.

On the new road, each act of use must have a value in excess of the toll paid, and if toll revenue alone exceeds the cost of provision and operation of the new road (requiring in particular that government pays no subsidy in any form), then the direct welfare increment is positive.

Furthermore, thanks to the absence of exclusion, there is no indirect loss of welfare in relation to the use of the old road. Hence a profitable new road *does* add to welfare. This result is demonstrated explicitly in formal modelling that is reported in a companion paper (Mills, 1993). (That modelling depends on several simplifying assumptions, including supposed absence of congestion.)

For this case, the other question is this: if the road extension brings a welfare increment, will it necessarily be profitable? The new road is used jointly with the old, and the immediate intuition is sound: the profit earned on the new road varies inversely with the level of toll charged on the existing road. Profitability of the new requires that the toll on the old should not exceed an upper bound.

The second case is that of *parallel interdependence*. Again suppose a simple network comprising one existing link, which (it is proposed) will be paralleled by a new toll road. The new road will be of a higher standard, permitting travel at a higher speed and at lower generalized cost (toll apart). Accordingly, the toll will be higher than any toll levied on the existing road. Because there is no exclusion, those who do not switch to the new road can use the old road as before. (This assumes no change in toll there.)

Consider a model in which vehicle operators have different values for time spent on a journey, but pay the same toll (for a given road): suppose that, as a result, the traffic divides between the alternative roads, with the new one being used by those with high time-values for whom the higher toll is outweighed by the value of the time savings. For those who switch, the gross value *to the users* of travelling on the new road (rather than the old) must exceed the difference in tolls. But the social or public value will be less than this private value if the toll on the old road exceeds the marginal cost of use of the old road. In that case, a profitable road can bring a negative welfare increment (as shown in Mills, 1993). As before, a road that brings a positive welfare increment may not be profitable; this time, the chances of profitability are greater the *higher* the toll on the old road, since the roads are now substitutes rather than complements.

The *exclusionary case* may be illustrated by analysis of a small network with both serial and parallel links. Before the new construction, vehicles whose operators put a high value on time saved may opt to use high-grade links where available and ordinary road where there is no alternative; on the other hand, vehicles with low time-values use the ordinary road for the entire journey. After the new construction, it is supposed, the mid-journey link between high-grade and ordinary road is no longer available. (This example captures the essence though not the literal detail of the M4 development in Sydney.)

After the new construction, the choice of route (between all high-grade and all ordinary road) will depend on the toll relativities. It is shown in Mills (1993) that it is possible for the outcome to have these characteristics:

- the existence of the parallel ordinary road limits the toll that may be charged on the new road

- that toll is not limited by the generalized cost of travel on the (mixed-standard) route, because that route is no longer available
- as a result, the toll on the new road may be set high enough to *increase* the generalized cost of travel for high time-value vehicles; and if that happens, the total amount of such travel decreases
- whether or not the generalized cost is increased in that way, the welfare increment from a profitable road may be negative (because the owner of the new road secures profit by extracting more user surplus)
- this adverse welfare result is more likely to occur when the routes previously available were untolled.

## 5. Conclusions

For road investment projects, these many sources of divergence between profit and welfare increments can result even in the two measures having opposite signs. Accordingly, it is not possible to rely on privatization of road construction activity as a device that allows the profitability test to determine which roads should be constructed in the public interest.

The immediate implication is that it is still necessary for government to undertake cost-benefit evaluations. This position does not rule out private participation in the construction of roads, nor does it rule out the tolling of such roads. But the role of such arrangements is then limited to two aspects: provision of funds and productive efficiency. A necessary condition for the latter is that the private company should be given appropriate financial incentives.

This leaves the allocative efficiency aspects in the public sector, where there remain difficulties of securing competent and unbiased cost-benefit evaluations in a context where political pressures may dominate.

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