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PRIVATE SECTOR INVOLVEMENT IN INFRASTRUCTURE PROJECTS

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This paper examines the case for and against private provision of infrastructure with particular emphasis on the allocation of systematic and idiosyncratic risk.

Abstract

There has been little systematic discussion of the issues associated with private involvement in infrastructure. Analysis of the relative performance of the private and public sector in different phases of infrastructure provision suggests that in most cases, the private sector will be most efficient in the construction phase but the public sector will be best equipped to handle the risks associated with ownership. The situation is less clear-cut with respect to operation — a mixture in which core operations are undertaken by the public sector owner with peripheral operations being contracted out may be optimal in many cases.

PRIVATE SECTOR INVOLVEMENT IN INFRASTRUCTURE PROJECTS

1. Introduction

Despite the absence of any coordinated policy, private involvement in the provision of infrastructure has increased rapidly in recent years. However, there has been little systematic discussion of the issues associated with private involvement in infrastructure[1], and little information is available on whether the benefits of private involvement have exceeded the costs or on whether alternative methods of organisation could have yielded greater net benefits.

Economic theory yields guidance on a number of these issues. For example, it can be demonstrated that, in the absence of subsidies, privately financed toll roads are unlikely to generate sufficient revenue to cover the costs of construction. Similarly, principal–agent theory can help to identify areas where private involvement is likely to perform well (or badly).

The paper is organised as follows. In Section 2, the issue of the decline in public infrastructure spending is examined. It is argued that private involvement can do little to reduce the economic costs allegedly associated with high aggregate levels of public borrowing. In Section 3, key issues in the theory of risk management and agency theory are discussed as they relate to the choice between public and private provision. In Section 4, this analysis is applied to determine which phases of infrastructure projects are most, and least, amenable to private sector involvement. In particular, it is argued that so-called BOOT (Build, Own, Operate and Transfer) projects are unlikely to be socially beneficial and that transparency should be favored over the claims of commercial confidentiality. In

[1] The main exception is the report of the working group established by EPAC (1995a,b). The present paper arose out of submissions to this working group.

Section 5, a separate rationale for private involvement, based on the idea that commercial viability is a good test of the social desirability of projects, is discussed. An attempt at synthesis, and a framework for debate on the problem of drawing the boundaries of the public sector, with respect to both provision of infrastructure and the production of goods and services in general, is presented in Section 6. Finally, some concluding comments are offered in Section 7.

2. The decline in public infrastructure spending

Public spending on physical infrastructure has declined as a proportion of GDP over the past twenty-five years. This decline has been a direct consequence of policy decisions to cut public expenditure as a share of GDP and to restrain public sector borrowings. The overall constraint on public spending, combined with pressing needs for current expenditure arising in particular from high levels of unemployment have given governments incentives to cut public capital spending. This has been reinforced by the adoption of aggregate public sector borrowing as a target of policy, imposed through the operations of the Loans Council.

There is no microeconomic rationale for the adoption of a long term target for aggregate public capital expenditure. Rather, the appropriate policy is to undertake infrastructure projects, if and only if, they pass the appropriate benefit–cost test. On macroeconomic grounds, it might be desirable to vary the timing of infrastructure investments but there is no clear case for the adoption of an aggregate target for public capital expenditure.

The most plausible case for a borrowing limit arises from concerns about sovereign risk[2]. It may be argued that governments without borrowing limits will be unable to

[2] Public discussion of debt problems has focused on the current account deficit. However, the debate over the desirability of targeting the current account deficit has shown that the case for targeting is ultimately based on sovereign risk concerns.

convince markets that they will confine themselves to profitable projects and that, when faced with difficulties, they will not repudiate debt or to inflate their way out of difficulty. The high rating of Australian government debt suggests that repudiation is not viewed as a serious possibility[3]. As regards inflation, the critical issue here is not the volume of public debt, but the volume of Australian dollar-denominated debt owed by Australians, whether public or private. On this basis the choice between public and private financing of a given portfolio of infrastructure projects is irrelevant.

In the 1994-95 Budget statement, Treasury argued that the decline in infrastructure spending as a proportion of GDP has been an optimal response to reduced needs for capital expenditure in specific areas of public responsibility. For example, reduced expenditure on school construction is a result of demographic changes that have led to stable or declining student numbers. Similarly, a slowing in demand for transport services justifies a slower rate of expenditure on road construction. This argument may have some merit but it should be examined in more detail. For example, in its discussion of education, Treasury looks only at school education. The number of students in higher education has doubled over the past ten years and the number of students in TAFE has risen by 40 per cent (Maglen et al. 1994), but there has been no corresponding increase in capital expenditure[4].

Moreover, if the Treasury argument were valid, it would imply that aggregate borrowing constraints have not been binding. The very phenomenon of private infrastructure projects and the admission by governments that such projects have been driven by financial

[3] The difference between AA and AAA ratings has been of major concern to Australian State governments recently. It is difficult to explain the extent to which this concern has driven policy on the basis of the differential cost to taxpayers of having slightly lower rated debt. A more plausible explanation is that debt downgrading has more commonly been the result of mismanagement and overspending than of the deliberate acquisition of profitable, but risky, assets. The achievement of an improved rating by disposing of such assets may well be misperceived as a signal of good management and restraint in current expenditure.

[4] As will be argued below, the question of whether further capital investment in higher education is justified is logically separate from the question of whether private or public provision is preferable.

imperatives indicate that the constraints associated with limits on public sector borrowing are binding, and have resulted in the existence of a large stock of unfunded projects capable of generating at least the private sector rate of return to capital.

It has often been suggested (for example, Business Council of Australia 1995, cited in EPAC 1995a p66) that the capacity of the public sector to undertake new investments is limited, and that private involvement is necessary to achieve a socially optimal level of infrastructure investment. However, the limits on public borrowing capacity are self-imposed by government to constrain the supposed adverse macroeconomic effects of excessive diversion of capital to the activities normally undertaken by the public sector, including the provision of infrastructure. The macroeconomic effects of infrastructure investment will be the same whether they are undertaken by the private or the public sector. Hence, if desirable public infrastructure projects are not being undertaken because of limited borrowing capacity, the appropriate policy response is to remove or relax the global borrowing limit, as recommended by EPAC (1995b).

Conversely, if global borrowing limits are believed to be necessary, they should be applied to all infrastructure projects whether private or public. That is, whenever a private firm undertakes an infrastructure project that would otherwise be the responsibility of a given jurisdiction, say, a State government, the borrowing limit for that jurisdiction should be adjusted downward by the amount of the capital employed in the project. The choice between private and public provision of infrastructure should be made on the basis of microeconomic efficiency rather than being driven by aggregate borrowing limits.

Efficiency is not, in general, an adequate guide to policy formulation (Quiggin 1995a). However, private infrastructure projects of the type considered here do not appear to raise important equity issues. Different pricing structures, for example the use of tolls as opposed to petrol taxes to finance road construction, may have equity effects but this question is logically independent from the choice between public and private provision.

For this reason the focus in the present paper will be on efficiency, interpreted to mean the present value of payments by consumers or taxpayers associated with the provision of a given project. The optimal ownership structure will be interpreted to mean that which minimises the present value of costs.

3. Public and private provision of infrastructure — considerations of risk management and agency theory

Economic theory can help to identify areas in which private enterprise is likely to perform relatively well, or relatively badly, compared to public enterprise. The key issues relate to agency problems and differences in the risk premium[5].

3.1 Risk

It is important to distinguish idiosyncratic risk from systematic risk. Idiosyncratic risk is derived from factors specific to a given project, such as the effects of good or bad management or of local weather conditions. Idiosyncratic risk for one project is uncorrelated with the idiosyncratic risks of other projects or with fluctuations in the economy as a whole. Because idiosyncratic risks are uncorrelated, when a large number of projects subject only to idiosyncratic risks are combined the aggregate rate of return will display very little risk. The capacity to pool risk through private mechanisms, such as insurance and portfolio diversification, mean that idiosyncratic risk, *qua* risk, is unimportant in evaluating the market value of a project or enterprise. Similarly, the diversification of public sector risk through the taxation system and the size and diversity of the public

[5] It should be noted here, and throughout the paper, that the risk premium being discussed here is a pure risk premium, applied to the expected value of the stream of returns. The pure risk premium is quite separate from any actuarially fair allowance for the possibility that returns will fall below some anticipated level (for example, in the case of a bond, the possibility that the issuer will default). Such allowances are captured as adjustments to the expected value of flow of returns.

sector means that idiosyncratic risks for public sector projects will cancel out in aggregate. No risk premium should be charged on the basis of idiosyncratic risk. However, the existence of idiosyncratic risk is the major source of the agency problems to be discussed in Section 3.2.

Systematic risk refers to the risk associated with fluctuations in aggregate output. Because systematic risk is correlated across projects, it is not eliminated by risk pooling. Nevertheless, market mechanisms such as portfolio diversification mean that systematic risk can be spread. Much economic analysis has explored the consequences of the assumption of perfect capital markets across individuals in such a way that people with high levels of risk aversion face low levels of systematic risk (see for example, Hirshleifer and Riley 1992).

Fluctuations in the aggregate economy are relatively small compared, for example, with variance in individual wage and salary income. The variance of the annual change in aggregate consumption, expressed as a proportion of total consumption, is around 3 per cent. If the perfect capital market hypothesis were valid, the equity premium, that is, the difference between the rate of return on bonds and the rate required by holders of the market portfolio of equity, should be correspondingly small. Calculations based on standard models of life cycle optimisation (Appendix) suggest that the equilibrium equity premium should be between 0.2 and 0.5 per cent.

In fact, long data series generally show that the rate of return to buying and holding the market portfolio of stocks is considerably greater than the rate of return to bonds. For example, Mehra and Prescott (1985) present data showing that over the period 1889–1978, the average annual yield on the Standard and Poor 500 Index was seven per cent, while the average yield on short-term debt was less than one per cent. The calculations presented by Mehra and Prescott and other writers in the equity premium literature suggest that if capital markets spread risk perfectly, the premium between the expected return on equity

and that on riskless debt should be very small. The The ‘equity premium puzzle’, noted by Mehra and Prescott, is the fact that the premium is so large.

Attempts have been made to explain the equity premium puzzle by invoking alternative preference structures or risk distributions. None, however, has been generally accepted as successful. Mankiw (1986) observes that an equity premium will arise if, *ex post*, systematic risk is concentrated on a relatively small number of individuals; that is, if the cost of recessions is borne disproportionately by those who become unemployed or whose businesses go bankrupt. A perfect capital market would fully diversify the risk associated with recessions, so that, for example, firms could insure themselves against going bankrupt in a recession. In fact, potential insurers find it difficult or impossible to distinguish between the systematic risk of recession, and the idiosyncratic risk associated with business management. Insurance against idiosyncratic risk is generally not feasible because of agency problems (see Section 3.2) and therefore firms cannot obtain insurance agaisnt recession or spread systematic risk. If systematic risk is not spread perfectly by capital markets, an equity premium will arise.

Assuming that at least part of the equity premium reflects imperfect risk-spreading, the public sector mechanism of spreading risk through the tax system may be less costly than the use of private equity. This issue is examined in more detail in Quiggin (1995b, c) where it is concluded that the appropriate risk premium for the public sector is likely to be around one-sixth of that prevailing in the private sector. The superiority of the public sector in handling risk implies that the capital costs of an infrastructure project will, other things equal, be lower under public ownership than under private ownership.The real rate of return required by holders of equity is about double the real government bond rate[6].

[6] Domberger (1995) and Forsyth (1995), criticising Quiggin (1995), focus on the margin between the rate of return on government debt and that on private debt. This margin is very small for highly-rated private borrowers and is irrelevant to the argument presented here, which is concerned with the difference between debt and equity rates of return.

This differential will be reduced to the extent that the private project is financed by debt, and should also be adjusted to take account of the small premium applicable to public sector risk.

Of course, other things are not always equal. There is a large literature on 'government failure', describing situations in which government enterprises will perform worse than private firms. Agency problems, some of which are discussed in the next section, are an important source of government failure. The implication of the discussion of risk presented above is that public ownership will be preferable if the benefits of reduced risk premiums outweigh the costs associated with agency problems and the like.

The public choice literature covering issues such as log-rolling and pork-barrelling may also be considered here. In general, although this literature indicates that political processes may lead to the selection of inappropriate projects, it does not give much guidance on whether private or public provision of projects is to be preferred in cases where political decisions are required. (The argument that private infrastructure projects will be self-funding, and therefore subject to a market test, is discussed in Section 5.) The critical issue is the extent to which political actors can capture the rent associated with decisions about which projects should be undertaken and how they should be financed. The author's view is that the invocation of 'commercial confidentiality' to prevent public scrutiny of private infrastructure projects, even where these involve public outlays or contingent commitments, increases the risk of direct diversion of rent to political actors. However, this issue is beyond the scope of the present paper.

3.2 Agency problems

Agency problems arise when one party (the agent) undertakes a project on behalf of another party (the principal). The theoretical framework used to deal with agency problems is therefore normally referred to as principal–agent theory (Laffont 1989, Chapter 11).

The theoretical framework for principal–agent theory is based on the idea of a productive activity characterised by idiosyncratic risk. It is normally assumed that the agent has private information about the outcomes of idiosyncratic risk. If returns are uncertain and the agent has private information or some other strategic advantage, it will be preferable, other things being equal, for the agent to bear the risk associated with the venture. If the risk is assumed by the principal, the agent will have an incentive to shirk or to divert some of the assets to private uses, then to claim that the bad outcomes of the venture were simply the result of bad luck.

This explains, for example, why government agencies have generally done badly at operating restaurants. The return from restaurants is inherently risky and it is difficult for an outside owner to check on the quality of service. Hence it is hard to stop a hired manager from shirking. The only effective disciplinary device is to make the manager bear the risk associated with the restaurant's operation. Other things being equal, where idiosyncratic risk is important, an owner-operated firm will outperform hierarchical management systems of which public bureaucracies are the archetypal example.

The central implication of the principal–agent literature is that, where possible, the party that has most control over risk should be the owner, that is, the recipient of the residual income. In cases where idiosyncratic risk is associated with response to firm-specific market conditions or with management skill, the implications of principal–agent theory support private ownership. However, in enterprises that are heavily regulated, either because of monopoly power or because they generate significant externalities, the principal–agent analysis implies that public ownership may be preferable.

4. Phases of an infrastructure project

There are three phases of a typical infrastructure project in which there is a choice between public and private sector involvement. These are:

- Construction
- Operation
- Ownership

The relative importance of each of these phases varies from project to project. For example, the 'operation' phase of road infrastructure involves little more than routine maintenance, but for airports, operational issues are central. However the term 'infrastructure' normally implies a large capital expenditure so that the construction phase will be an important aspect of most infrastructure projects.

The most common practice in Australia has been for construction to be undertaken by private sector firms under a system of competitive tendering. The core operations of publicly owned infrastructure have mostly been carried out by the public sector, but peripheral operations such as hospital cleaning have been contracted out. Although there are cases of nominally privately-owned but publicly operated infrastructure projects, including leaseback arrangements on power stations and the recent sale of the Commonwealth car fleet, this choice of ownership structure appears to arise from attempts to evade public secot borrowing limits or to improve the appearance of Budget aggregattes rather than from any efficiency considerations.

4.1 Construction

In the past, it was common for public infrastructure projects to be constructed by government departments using public sector employees. In general, this has proved less satisfactory than the alternative of competitive tendering. In most cases, it is relatively easy to ensure that the private constructor bears most of the risk associated with the infrastructure projects , and therefore has incentives to overcome the agency problem. By contrast, the incentives for individuals within a government department to minimise costs are relatively weak and diffuse.

One difficulty with contracting out to private firms is the possibility that the contractor may go bankrupt. In this event, the public will bear both costs of delay in the project and increased expense in finding a second contractor to complete the work. The risks may be mitigated if the constructor is required to post some form of performance bond, giving the party providing the bond an incentive to monitor the firm's financial status. There should also be a capacity to verify that the project has been completed according to the specified standard. In most infrastructure projects, verification does not appear to be a major difficulty.

4.2 Operation

It is useful, although difficult in practice, to draw a distinction between peripheral and core operations. Core operations are those activities that must be undertaken by the owner of the project either because they are difficult to monitor or because they involve a risk of large losses to the owner. For example, the operation of generating equipment would probably be a core activity for an electricity enterprise, whereas cleaning would be a peripheral activity. Private sector operation of core activities is inappropriate unless the project is privately owned. Until recently, the general practice has been to indentify specific activities as peripheral and then consider options such as competitive tendering and contracting (CTC). More recently, however, the Hilmer process (Hilmer, Rayner, and Taperell, 1993, Industry Commission (1995 a,b) has reversed this presumption; all activities are considered to be potentially subject to CTC unless they can be shown to be core operations.

There is a widespread consensus that CTC for peripheral operations yields significant savings. The figure of 20 per cent, based on the Domberger, Meadowcroft and Thompson (1986) and Cubbin, Domberger and Meadowcroft (1987) studies of the United Kingdom, is commonly quoted. However, two objections may be made to this estimate. First,

Paddon (1991) has argued that savings have declined as the CTC process has proceeded, with recent contracts yielding savings of around 6 per cent. Second, many of the apparent gains may in fact represent transfers arising either from reductions in wages and working conditions (Ganley and Grahl 1988) or from the increased potential for tax evasion associated with many forms of contract employment relative to public sector employment (Quiggin 1994). The Industry Commission (1995b) reduces estimates of the net benefits of CTC, presented previously in Industry Commission (1995a) to take account of the transfer component in measured gains.

4.3 Ownership

The owner of a project is the party bearing the residual risk. There are grounds for public sector ownership of most infrastructure projects. As has already been argued, the superiority of the public sector in bearing systematic risk is illustrated by the existence of the large 'equity premium' between the bond rate and the rate of return demanded by private equity holders.

The principal–agent analysis presented above yields the principle where possible, the party that has most control over risk should be the owner, that is, the recipient of the residual income. For infrastructure projects, particularly those that are components of larger networks, this principle freqently implies that public ownership is preferable.

The risk associated with many infrastructure projects depends far more on public policy decisions than on the management skill of the operator. Consider, for example, the position of a prospective purchaser or lessee of Kingsford–Smith airport or a prospective operator of the proposed Badgery's Creek airport. The profitability of these enterprises is likely to depend far more on government policy decisions with respect to aircraft noise, international aviation agreements, transport links and the like than on the skill with which the airport is managed. Similar risks arise in other cases where governments manage

transport networks. For example, the traffic flow on a toll road will be affected by decisions on housing policy, public transport and other road projects. However, it would be costly and inefficient for governments to give advance guarantees concerning policy on the future management of transport networks. The private operator must either demand a large risk premium in addition to the usual equity premium or must demand guarantees of favorable treatment[7].

As EPAC (1995a) and London Economics (1995) observe, the optimal solution, other things being equal, is for the risk associated with network management to be internalised through public ownership. That is, if the government is the main source of risk, the most efficient contract is one in which the government bears the risk. Similar issues arise in the private sector. The returns to subcontractors and distributors for large corporations are, to some extent, determined by the policy decisions of the corporation concerned. To this extent, subcontractors will demand either precommitment on policy decisions or a higher rate of return. In cases where corporate policy is an important source of risk and there are no offsetting benefits from subcontracting, the optimal solution is vertical integration.

Finally, if the service provided is essential, the government must, in effect guarantee the viability of the firm providing it because the bankruptcy processes are too slow and too likely to interrupt service provision. But the owners and managers of the firm can only be made to forgo the benefits legally available to them under the bankruptcy provisions if the State offers more favorable treatment, such as a buyout at prices above the 'fire-sale' value that would be realised in bankruptcy. Hence the maintenance of essential service implies the provision of some financial guarantees by the government.

In some allegedly private infrastructure projects, the public sector bears all, or a

[7] Precisely such guarantees appear to have been offered in the resolution of the dispute over risk-sharing for the CityLink road project in Melbourne.

large part of, the residual risk. The difficulty of determining where the risk lies has been illustrated by the NSW Auditor-General's attempts to determine the liabilities of the government in respect of the Sydney Harbour Tunnel. In this case, it appears that the government is the effective owner of the Tunnel, that is, the holder of residual risk.

4.4 BOOT projects

A number of recent private sector infrastructure projects have operated on the basis referred to by the acronym BOOT (Build, Own, Operate, Transfer). The idea is that a private firm builds an infrastructure project and collects revenue from the project for an agreed period, after which it is transferred to public ownership. The BOOT approach has a superficial appeal, in that it appears to offer the public something for nothing. On the basis of the analysis set out above, such projects should be treated with the same caution with which economists generally view 'free lunches'. Two main objections may be made to the BOOT approach.

First, in the absence of economies of scope between construction on the one hand and operation and ownership on the other, there is no reason to tie the construction of the project to subsequent ownership and operation. Assuming that private sector control was desirable in all three phases, but that the project was a matter of public concern, it would be preferable for the government to put the construction out to tender, then separately solicit bids for the rights to own and operate the project. In this way, it could be clearly established either that there is no public sector subsidy or contingent guarantee involved in the project or that any such subsidy or guarantee was transparent and available to all firms involved in tendering for the project.

The second objection relates to the transfer phase. If private sector ownership and operation of a given infrastructure project is socially optimal, there is no rationale for eventual transfer to the public after a period determined by the need to negotiation a

politically and commercially acceptable financial package. It would be preferable to leave the project permanently in private ownership.

BOOT projects involve a link between construction and initial ownership and operation of the project, with ownership and operation changing hands after a period of time determined by accounting considerations. Because the allocation of ownership is unrelated to efficiency considerations, it is unlikely to be socially optimal. In cases where public ownership and operation is more efficient than private ownership and operation, BOOT projects will be inferior to a system of competitive tendering for construction. In cases where private ownership is superior, BOOT projects will be inferior to purely private projects.

It might appear that in granting outright private ownership in preference to a BOOT scheme, the government is making a gift to the private operators. This impression is incorrect. Consider the example of an electricity generating station, and suppose that a private firm can operate the station more cheaply than a government authority. Suppose that the government calls for tenders on the project, with firms bidding on the basis of the price that will be charged to consumers[8]. If the tenders are called on the basis of a BOOT scheme, the price a given firm will require will be higher than if the firm is allowed to own and operate the project in perpetuity. Under the assumption that private operation has lower social costs, it may be shown that the present value of total payments by consumers will be greater under the BOOT scheme than under full private ownership.

4.5 Choosing between private and public ownership

To determine the optimal allocation of activities to the private and public sector in specific cases, it is necessary to apply the tools of benefit–cost analysis. The critical test is

[8] Any external effects are assumed to be the same for all public and private firms. Also, by levying taxes on electricity the government can, if it wishes, transfer benefits from consumers to taxpayers in general.

whether the present value of the flow of net social benefits associated with the project will be greater with or without private involvement at a given phase of the project.

Consider for example a road project. Such a project might be undertaken in several different ways:

- Construction by public enterprise, financed by a general petrol tax
- Construction by competitive tender, financed by a general petrol tax
- Construction by competitive tender, financed by a toll[9]
- Construction by a private owner with the right to levy a toll.

Any two of these methods could be compared using the standard tools of benefit–cost analysis. The critical issue is the choice of discount rate. On the basis of the arguments presented above, the appropriate discount rate is the real government bond rate, with a small adjustment, between zero and one per cent, for systematic risk. This issue is addressed in more detail in Quiggin (1995d).

5. The self-financing rationale

A self-financing project is one for which the revenues generated from the sale of services cover the costs of construction and operation and hence one which can be profitably undertaken by a private firm without any subsidy. One important rationale for private infrastructure projects is that such projects will only be undertaken if they are profitable, and therefore *prima facie*, socially beneficial. If this 'self-financing' rationale is correct, private provision represents an important constraint on the tendency for political actors to promote 'pork-barrel' projects for which social benefits are less than social costs. However, the self-financing rationale is applicable only if the project is undertaken without subsidies or other government assistance, and is not characterised by significant

[9] As argued below, such a toll would normally require supplementation from general revenue

externalities[10]. If these conditions are not met, the capacity to generate profits is neither a necessary nor a sufficient condition for a project to be socially desirable. Rather it is necessary to assess social costs and benfefits.

5.1 Toll-financed road projects

Toll roads are commonly seen as a category of self-financing project ideally suited for private provision. However, toll roads fail the condition set out above that the project should not involve externalities. One major class of externalities is network externalities. Roads, railways and harbours are part of a larger transport network, and must be evaluated in that light. The benefits of a new freeway are experienced not only by drivers on the freeway itself but also by those on the alternative routes from which traffic is diverted. These drivers pay nothing, but enjoy less congested and less dangerous roads. Because a toll fails to capture all of the benefits that the road project

On the other hand, there are external costs that are not included in the usual estimates of construction costs for roads. Also, costs such as noise and air pollution and death and injury due to crashes are not taken into account properly. On the whole, increased road construction tends to raise noise and pollution,. However, some road projects, by relieving congestion and diverting traffic away from built-up areas, may reduce pollution and pedestrian deaths. To sum up, because roads are associated with both positive and negative externalities, the ability of a road project to generate sufficient toll revenue to finance its construction is neither necessary nor sufficient to show that the project yields net social benefits.

It is useful to compare toll financing of individual projects with financing through general charges on all road users, such as petrol taxes and registration fees. Users of a toll

[10] In a previous draft of these paper, an additional requirement was suggested, that the services of the project be sold in competitive markets. This suggestion is not correct in general. Although monopoly pricing

road will be subject both to the toll and to the general taxes so that the implicit price for use of the toll road is higher than that for roads in general. Such an outcome will be desirable if, and only if, the negative externalities associated with congestion, pollution, crashes and so on are greater for the roads on which tolls are imposed than for roads in general. This may be the case for bridges, where tolls may be justified as a congestion tax.

In most cases, however, the negative externalities associated with newly constructed roads, those normally considered for toll financing, are likely to be less than the negative externalities associated with roads in general. Newly constructed roads are likely to be less congested, and further away from built up areas, and, therefore, to generate smaller negative externalities than old roads. In this case, the pricing mechanism itself may reduce the benefits of the project. Tolls on new roads divert traffic onto old, toll-free rods, leading to worse congestion and more accidents. From an efficiency viewpoint, if tolls must be imposed, it would be better to impose them on congested roads regardless of their date of construction or their nominal ownership. In the absence of a general system of road pricing, isolated tolls on new roads will, in general, be inferior to a general system of user charging through fuel taxes and registration fees.

The traffic diverting effects of toll-financing will reduce the net benefits of road projects, and the toll will fail to capture all of the benefits to road users. Because of these two effects, toll finance will provide sufficient revenue to finance construction only in cases where the benefits of new toll roads greatly exceed the costs. In all other cases, some form of subsidy will be required. This may be either a direct public subsidy, a guarantee of debt, or a provision by which the private contractor is allowed to levy tolls on existing roads previously constructed with public funds as with the Sydney Harbour Tunnel the M4 Motorway in Western Sydney, and the proposed expansion of Tullamarine

freeway[11]. In addition, private promoters have not, in general, been required to pay the acquisition costs of land.

In summary, toll financing is unlikely to provide sufficient revenue to fund road projects. Because some form of subsidy is usually reuqired, and because road projects involve negative as well as positive externalities, the profitability of a project to its promoters bears little relationship to the question of whether its social benefits exceed its costs. The self-financing rationale is, therefore, not applicable to road projects in most cases[12].

6. Drawing the boundaries of the public sector

The discussion presented above suggests that complete withdrawal of the public sector from the production of goods and services, including infrastructure services, is unlikely to prove economically efficient. How, then should the boundary of the private and public sectors be defined? In many cases, there is not enough reliable data to to provide reliable estimates of the relative benefits of private and public ownership. It may therefore be useful to view the problem as one of multicriterion decision making and to set out a number of dimensions on which projects may be classified as more or less suitable for private involvement.

The main dimensions are

(i) Labour-intensity v Capital-intensity

[11] One or other of these features appears to be common to all private road projects in Australia. A more extensive of search of projects mentioned in the fortnightly *Privatisation Review* (Institute for Privatisation Research , 1994, 1995 various issues) and an examination of the projects discussed in EPAC (1995a) failed to disclose any road projects that were clearly self-funding on a stand-alone basis.

[12] Thus, there is no reason to suppose that increased private funding of road projects will lead to a reduction in political pork-barrelling. In fact, the use of claims of 'commercial confidentiality' to prevent public scrutiny creates new dangers. The reduced transparency of the process increases the potential for rent-seeking activities, such as the award of contracts to politically favoured groups.

(ii) Internal v External risk

(iii) Competitive market vs monopoly

(iv) Externalities/market failures and need for regulation or tax/subsidy arrangements

These dimensions will be discussed briefy in turn. First, it is generally agreed that the cost advantages of the private sector arise primarily in relation to labour. Conversely, the analysis of the equity premium presented above suggests that the public sector has cost advantages in undertaking capital-intensive projects. Second, the greater the extent to which the risk associated with the returns to the project are subject to internal control, the greater the benefits of private ownership and a residual claimant. Third, there is general agreement that monopolies are more suitable for public ownership than firms producing goods for slae in competitive markets. Finally, the greater the importance of externalities and related market failures, the less useful is the market test of profitability. In addition, the greater the need for government intervention to respond to externalities, the greater the benefits of public ownership in internalising the resulting regulatory risks.

The dimensions outlined above provide a basis, though not necessarily a conclusive one, for ranking projects according to their suitability for private or public provision. If one project is closer than another to the private end of the spectrum on all dimensions, the first project is more suitable for private provision. For example, butcher shops are near the private end of the spectrum on all of the dimensions listed above. Conversely, roads are near the public end of the spectrum on almost all dimensions. The negative view of private toll road projects taken by EPAC (1995a, 1995b) is fully justified.

Writers on the topic differ considerably in the weight placed on the different dimensions. The treatment in traditional public economics texts focuses almost exclusively on (iii) and (iv). By contrast, Quiggin (1995d) focuses mainly on (i) and EPAC (1995a, b) on (ii). There is also disagreement on the point at which the boundary should be drawn. This may be illustrated by Figure 1. Here only two dimensions, labour intensity – capital

intensity and internal risk – external risk, are included. The relative intensity of labour and capital is represented by the labour share of total cost, ranging from zero to one. The risk allocation variable is given by the proportion of the total variance of returns attributable to internal risk, also ranging from zero to one. The space of possible project characteristics is represented by the unit square.

A number of examples of possible firms or projects are located in Figure 1. Those in the bottom left hand corner are highly capital intensive projects where risk is predominantly external to the project, such as roads. Those in the upper right hand corner are labour-intensive and involve mostly internal risk, such as butcher shops. Projects near the lower horizontal axis are those where risk is predominantly external. For example, the returns to a specialist supplier of defence equipment are primarily dependent on government policy decisions. Projects near the left vertical axis are capital intensive and those near the right vertical axis are labour intensive.

The curves drawn on the map represent alternative possible judgements as to the appropriate location of the public–private boundary. Curves AA, CC and DD represent different judgements about the relative performance of the private and public sectors, but they give the same weight to the factors under consideration. The difference between curves BB and CC is one of relative weight. Curve BB represents a judgement which places more weight on the capital–labour ratio and less on the allocation of risk than does curve CC.

A more complete analysis, involving the inclusion of other dimensions not drawn here, may lead to different results. For example, it seems unlikely that considerations of capital intensity or risk allocation would yield support for public ownership of postal services. However, public ownership may be supported on the basis of concerns of types (iii) and (iv), particularly if the existence of a basic letter service with a uniform price is regarded as a public good.

Thus, a wide range of different judgements may be accommodated within the framework set out here. This does not mean, however, that a multi-criterion approach of this kind has no policy implications. Consider the examples of butcher shops and roads. These are located at opposite extremes on all dimensions, including those not drawn in Figure 1. This suggests that butcher shops should be among the last enterprises considered for public ownership and roads among the last considered for privatisation. In fact, publicly owned butcher shops in Queensland were among the first fruits of the rush of enthusiasm for public ownership following the Labor party's adoption of the socialisation objective in 1921. Conversely, private toll road projects have been popular in the current period of enthusiasm for privatisation. In both cases, the fact that the projects were relatively easy to implement appears to have outweighed economic considerations.

7. Concluding Comments

The current enthusiasm for private infrastructure, like the enthusiasm for public ownership which it replaced, has been based more on ideological beliefs in the virtues of one sector and the vices of the other than on any systematic economic analysis. Many current proposals for private sector involvement in infrastructure provision appear to be generated by the inappropriate incentives associated with global borrowing limits. Although the analysis presented in this paper and in other studies (EPAC 1995a, London Economics 1995) shows that road projects are among the least promising candidates for private ownership , they have been among the most popular choices for governments seeking to reduce measured debt. In most cases, it would have been preferable to pursue the traditional approach of bond-financed competitive tendering, with revenue to service the debt being generated by general road user charges rather than by specific tolls.

Analysis of the relative performance of the private and public sector in different phases of infrastructure provision suggests that in most cases, the private sector will be

most efficient in the construction phase but the public sector will be best equipped to handle the risks associated with ownership. The situation is less clear-cut with respect to operation — a mixture in which core operations are undertaken by the public sector owner with peripheral operations being contracted out may be optimal in many cases.

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Appendix - The equilibrium rate of return on assets with systematic risk

Suppose that a riskless asset yields a rate of return r. Then, following Grossman and Shiller (1982, see also Grossman, Melino and Shiller 1987), it may be shown that in an efficient capital market any other asset will yield the rate of return $r + \rho$, where the risk premium ρ is given by

$$E[\rho] = \sigma \, \text{cov} \, (\rho, \Delta \log C) \tag{1}$$

where $\Delta \log C$ is the rate of growth of aggregate consumption. The term cov $(\rho, \Delta \log C)$ plays essentially the same as the beta coefficient in the Capital Asset Pricing Model, measuring the systematic risk associated with the asset in question, while σ may be interpreted as the coefficient of relative risk aversion. Observe that no premium is associated with idiosyncratic risk, that is with risk that is uncorrelated with aggregate consumption.

The coefficient of variation of $\Delta \log C$ is around 0.03 in most OECD countries, including Australia and the United States. Estimates of σ based on direct elicitation of risk preferences are typically around 1. Estimates based on observations of labour supply tend to be smaller. Some larger estimates have been derived from financial market data, but these are derived from solving for σ on the assumption that a relation like (1) holds. They cannot be used to test whether (1) does in fact hold.

To solve for the expected rate of return to any given asset, it is now sufficient to know the standard deviation of the rate of return for that asset and the correlation between returns and aggregate consumption. For example, the standard deviation of the rate of return to the market portfolio of equities in the United States is about 20 per cent, and the correlation with aggregate consumption is about 0.33. This implies that

$$\text{cov}\,(\rho, \Delta \log C) = 0.33 * 0.20 * 0.03 = 0.002$$

so that for $\sigma = 1$, the implied premium over a riskless asset is about 0.2 per cent. Using the model of intertemporal optimization of consumption derived above, and evidence on the growth and variability of aggregate consumption, Mehra and Prescott (1985) compute equilibrium asset prices for debt and equity under a wide range of parameter values. They show that the equity premium should be no more than 0.5 per cent.