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ABSTRACT

This paper examines the social opportunity cost of a hypothetical public project in Australia and compares these values with the cost of the project as measured by factor prices. Since 2001, the Australian taxation system has included an *ad valorem* tax, the Goods and Services Tax, however relatively little analysis of the impact of this tax on public project evaluation methods has been undertaken. This tax creates divergences between social opportunity cost and conventional cost measures. Therefore it is recommended that shadow prices be applied to pubic projects. Following Campbell (1975), a shadow price can be introduced into Australian project evaluation in the form of a cut-off benefit cost ratio. The calculations reported on in the paper indicate that this ratio lies between 1 and 1.3 for public projects in Australia.

Key words: allocative efficiency, cost benefit analysis, efficiency, optimal taxation, project evaluation, social discount rate

JEL Classification: D61, H21, H43

I. INTRODUCTION

Researchers and practitioners have long considered the problem of what discount rate to use when evaluating public sector projects. Naïve application of a discount rate can lead to a serious misallocation of resources within an economy, making public sector projects look more (or less) attractive than they should be in economic terms. Often the use of discounted cash flow techniques overlooks a key economic issue – the benefit/cost study should take into account both the trade-off between current and future consumption (social time preference or STP), and the social benefits that could be obtained from alternative uses of resources involved (social opportunity cost or SOC) (Campbell (1975), pp.171-2).

As Creedy (2007) has noted, the STP rate is sometimes called the 'consumption discount rate' as it is applied to money values of consumption in each period. However, the pure time preference rate is sometimes called the 'utility discount rate' because it is applied to weighted consumption values, with the weighting function described as a 'utility function'.

In most applied cost benefit analysis literature, it is simply taken for granted that discounting money values is appropriate, rather than starting from the more fundamental social welfare function. This is because, from the perspective of many practitioners, it is often more difficult and time consuming to estimate the social welfare function. Often the additional analytical return is meager for the extra effort involved.

HM Treasury (2003) recommends that STP be used as the standard real discount rate for future benefits and costs. It comprises two components: (1) the rate at which individuals discount future consumption over present consumption, assuming no change in expected per capita consumption; and (2) an additional element, if per capita consumption is expected to grow over time. In the UK context this was estimated to be 3.5%, which takes into account diminishing marginal utility from consumption over time when there is expected to be additional per capita consumption.

In a study of STP rates across 167 countries and across time from 2005-2050, Joice and Prado (2006) estimated that the STP for Australia was 3.3% within a range 2.8% to 3.8%.

However, the gaps in shadow pricing for taxes on individual inputs can represent omitted costs as well as benefits, where the tax treatment of the input varies according to use (Bureau of Transport Economics (1999), p.86). Diesel fuel taxes in Australia are one example of this. This paper extends an analysis developed for the Canadian context in Campbell (1975) to an appropriate benefit/cost rule for evaluating Australian public projects in light of a national *ad valorem* tax.

II. PUBLIC INVESTMENT

Typically, economic practitioners assume that undertaking an additional public project diverts resources from private to public use. In this case we consider that factors of production such as labour and capital are in fixed supply between the public and private sectors. As Campbell (1975, p.172) has noted, use of other sources of factors of production (unemployed resources, other areas of the public sector or the foreign sector) could readily be incorporated into an extension of this analysis.

This raises a critical question. To what extent does the use of resources in a public sector project, which may produce a stream of benefits, curtail private activity but still lead to an increase in social welfare? It can be argued that social welfare is improved when social benefits (SB) from the project exceed the social benefits the factors or production would have otherwise produced from private use. This latter foregone benefit can be termed the social opportunity cost (SOC) of the project.

The standard Benefit Cost Rule that most practitioners apply is:

$$SB / SOC > 1.$$

For the purpose of this analysis we assume that there is no risk or uncertainty attached to the benefit. This allows us to focus on the SOC associated with drawing factors of production from the private sector. It is possible to make an approximate estimate of SOC using market prices and interest rates for the consumption goods that the resources used in the public project would have otherwise produced in private use.

We assume that this estimate of SOC exceeds the private market valuation of the resources (or 'Cost') by an amount equivalent to the present value of tax payments that would have been generated by their use in the private sector. The introduction of a tax 'wedge' in the analysis drives us to introduce a revised benefit/cost rule based on a more easily obtained measure of cost:

$$SB/\ \text{'Cost'} > SOC\ /\ \text{'Cost'}$$

In this instance SOC exceeds 'Cost' by the present value of foregone tax payments, so the cut-off benefit/cost ratio (SOC/'Cost'), exceeds unity. This enables us to simplify the calculation of a shadow benefit/cost ratio for evaluating projects in the Australian public sector, along the lines of Campbell (1975).

III. MEASURING SOCIAL OPPORTUNITY COST

Suppose that a proposed public project employs labour and capital services with a private market value of $10 in the current year. While the timeframe is a limiting assumption, introduction of additional years of construction does not add anything in particular to this analysis.

Setting aside circumstance relating to market distortions (i.e. monopolistic or monopsonistic behaviour), it is possible to conceive two causes of a divergence between SOC and 'cost': an indirect tax on consumption goods, and a tax on profits (Campbell (1975), pp.173).

We can assume that a fixed proportion, (*b*), of labour and capital services is diverted from the production of capital goods and (1 - b) is diverted from the production of private consumption goods.

Therefore, \$10(1 - b) worth of labour and capital services is diverted from production of consumption goods, with a producer's value of \$10(1 - b). Under a Goods and Services tax regime, an *ad valorem* tax is applied at rate (t). Consumers would value these services at the producer's price *plus* the GST, or \$10(1 - b)(1 + t).

The diversion of \$10(b) of labour and capital services from the production of capital goods would have resulted in private investment of \$10(b). Following Campbell (1975, p.173), the consumer's valuation of this private investment is the stream of consumption goods in present value terms that could be attributed to that investment. If this was the only output from that investment, there are four components into which it can be decomposed.

First, indirect tax collections $\{t / (1 + t)\}Cy$, where Cy is the value at consumer prices of foregone consumption in year y.

Second, where there are tax collections on profits, these can be estimated by $\{1 / (1 + t)Cy - Xy\}x$, where Xy represents the cost of the variable factors of production, and x is a flat rate profit tax.

Third, private sector profits net of tax are $\{1 / (1 + t)Cy - Xy\}(1 - x)$.

Fourth, there is value added attributable to the use of variable factors, Xy.

We make the assumption that in the absence of the private investment project, these variable factors would be employed in an alternative activity, so they would have yielded Xy. Therefore, the fourth component of the consumer value of consumption goods forgone is offset by a corresponding benefit elsewhere in the economy.

The annual net social benefit forgone as a result of displacing the private investment is (Cy

– Xy). If we assume that investment of \$10(b) would have resulted in a flow of consumption goods in perpetuity, the annual social return forgone as a result of the displacement of the private project can be expressed as \$10(b)r^*, where r^* is a real rate of return in perpetuity that incorporates the three components of value of forgone consumption goods, and represents a net social loss.

The present value of the annual net social loss is \$10(b)(r^* / r), where r is the real market rate of interest.

Recognising that the displaced investment's profits, net of tax, would have represented a return of r%, which is the opportunity cost rate of return, r^*% will exceed the market rate by an amount corresponding to the foregone indirect and profits tax collections.

The SOC of the proposed public project is the present value of the privately produced consumption goods forgone as a result of diverting \$10 (1 - b) from the production of those goods, and \$10(b) from the production of investment goods. The SOC can be calculated to be: $\$10\{ (1 - b)(1 + t) + b(r^* / r) \}$.

IV. A 'SHADOW' BENEFIT/COST RATIO

Suppose an analyst adopts the \$10 estimate as the 'cost' of the public project discussed in this paper. In many cases it may appear to be reasonable to use market prices to estimate the value of the labour and capital services employed in the project. However, this may lead to an incorrect project evaluation because of a tax-induced wedge between 'Cost' and SOC.

Since the standard benefit/cost rule is SB / SOC > 1, where SOC exceeds 'Cost' because indirect and business profit taxes are positive, the use of a 'Cost' concept in CBAs will tend to make public projects appear more favourable in their impact on social welfare than they actually are.

The annualised yield on 10-year Commonwealth Government Bonds over ten years to

October 2008 was 5.8%. Over that same period the consumer price index increased by 3.2% per annum. This gives a real market rate of interest (r) of 2.5%. Real interest rates have been higher in earlier periods.

The following table shows the range of k values, $k = (1 - b)(1 + t) + b(r^* / r)$, where t is 10% and r^* is 2.8%.

B	R	0.01	0.02	0.03	0.04	0.05	0.06
0.00		1.10	1.10	1.10	1.10	1.10	1.10
0.25		1.53	1.18	1.06	1.00	0.97	0.94
0.50		1.95	1.25	1.02	0.90	0.83	0.78
0.75		2.38	1.33	0.98	0.80	0.70	0.63
1.00		2.80	1.40	0.93	0.70	0.56	0.47

The following table shows the range of k values, $k = (1 - b)(1 + t) + b(r^* / r)$, where t is 10% and r^* is 3.8%.

B	R	0.01	0.02	0.03	0.04	0.05	0.06
0.00		1.10	1.10	1.10	1.10	1.10	1.10
0.25		1.78	1.30	1.14	1.06	1.02	0.98
0.50		2.45	1.50	1.18	1.03	0.93	0.87
0.75		3.13	1.70	1.23	0.99	0.85	0.75
1.00		3.80	1.90	1.27	0.95	0.76	0.63

V. POLICY CONCLUSIONS

We have developed a Benefit / Cost Rule for evaluating public projects in Australia. Following Campbell (1975), the rule has two parameters: a real market rate of interest (reflecting the social time preference), and the shadow benefit / cost ratio (reflecting the social opportunity cost). Use of the rule requires the following approach:

1. compute a set of estimates of the time-stream of values, at current prices, of Social Benefits;
2. compute a set of estimates, at current prices, of the time stream of ‘Costs’;
3. compute the real market rate of interest and use it to form the ratio of present value of Social Benefits to the present value of ‘Costs’;
4. select an appropriate value for b on the basis of the nature of the proposed project and the proposed arrangements for financing it; and
5. accept or reject the proposal according to whether the ratio of Social Benefit / ‘Cost’ is greater or less than the k value implied by r and b.

We might reasonably expect r to be between 2 and 4 per cent, while b values might typically be expected in the range 0.25 to 0.50. With r^* in the range 2.8 to 3.8 per cent, this means the value of k will normally be in the range 1 to 1.3, implying benefits may need to be up to 30% more in present value terms than costs before such a proposal could be accepted.

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