Indirect taxes and the numeraire

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Since the emergence of Cost Benefit Analysis (CBA) in a development context in the 1960's (Little Mirrlees, 1969, 1974, UNDO 1972) the role of the numeraire or unit in which project effects are measured has been seen as crucial. Apparent differences between the alternative approaches were put down to this basic choice - government income measured at world prices in one and domestic at domestic prices in the other. Subsequent work showed how the alternatives could be reconciled relatively easily (Curry and Weiss 1990, 2000, Potts 2002). However independently of this strand of the literature work on CBA in the UK has added a new dimension regarding the type of prices at which project effects are valued – with the alternatives either factor cost (producer prices) or market prices (consumer prices) with the difference between these determined by the inclusion or exclusion of indirect taxes with an economy –wide 'indirect tax correction factor' required to move between them (Sugden 1999).

The indirect tax correction factor is the average rate of indirect taxation in an economy and is the adjustment used to move between the two price units. The logic is that if 't' is this average rate of tax then goods valued at 1 net of tax are valued at 1 +t inclusive of tax.[1] Hence for a project that costs $1 million at factor cost benefits to consumers (valued through a willingness to pay survey, for example) must be at least $1+ t million since surveys are at market prices and to move to comparable factor cost units requires division by 1 +t. Another way to express this is if the project is funded by an increase in direct taxation. To fund the $1 million expenditure taxes must rise by more than $1 million, since as the proportion t/1 +t of all consumer spending goes to the government there will be a loss of indirect tax revenue from the increase in income tax as spending falls. To raise an extra $1 million from income tax requires a rise in tax of $1 + t, as the loss from the fall in indirect tax receipts will be t, as t = (1 + t)*(t/ 1 +t). Hence for consumers to benefit from the project, their willingness to pay must be at least $1 + t, which is their loss of disposable income.[2]

This adjustment for different price units has implications for the conduct of CBA. In the traditional development approach there is little discussion of the treatment of indirect taxation. The main focus is whether indirect taxes reflect a charge for a development 'bad', covering a negative externality, in which case it is suggested they should be included in costs.[3] The standard approach for nontraded goods is that indirect taxes are included in an estimate of benefits that reflects willingness to pay of consumers and in the valuation of non-incremental inputs taken from other users by a project, as their tax-inclusive price is

[1] To simplify the discussion here does not distinguish between indirect taxes on consumption and production.
[2] These examples come from Sugden (1999).
[3] See for example the section 12.5 in Little and Mirrlees (1974).

taken to reflect the willingness to pay of the other users. This approach is fully consistent with use of a market price unit. On the other hand, where project inputs are incremental, as their supply is expanded to meet project demand, valuation is on the basis of the resource costs involved in their production and the standard procedure is to omit indirect taxes on the grounds that these are transfer payments. Hence there is the potential for the mixing of valuation at factor cost and market prices.

Where traded outputs and inputs are involved world prices will be converted to national currency at an exchange rate, a notional shadow exchange rate (SER). The most commonly applied formula for the SER adjusts the market rate for the average rate of taxes and subsidies on trade (Curry and Weiss 2000). This is roughly equivalent to an analysis at market prices, although net average tax on trade can be at a different rate to the average rate of indirect taxation as applied to domestically produced goods.

Some examples

To illustrate a potential difference between the standard development approach and the factor cost/market price distinction we turn to some simple examples with numerical values given in table 1. First we take a simple case of a project with a non-traded output as a benefit that uses two non-traded inputs one incremental and the other non-incremental and labour. In the second and third examples we introduce a traded outputs and inputs as well. We first illustrate the factor price and market price approaches.

In example 1, algebraically for output j the willingness to pay price inclusive of indirect tax is Pj. The willingness to pay price for non-incremental input n is Pn which is inclusive of indirect tax whilst the cost of production at factor cost (exclusive of any indirect tax) for incremental input y is Cy. Labour cost L is labour's opportunity cost at factor cost prices. The average indirect tax correction factor is 1 + t where t is the average rate of indirect taxation. Hence in the two price alternatives net benefits (NB) are given as follows

Factor Cost $NB1 = Pj/(1 + t) - Pn/(1 + t) – Cy - L$

Market Prices $NB2 = Pj - Pn - Cy*(1 + t) - L*(1 + t)$

In this adjustment in a factor price analysis all values initially at a willingness to pay price are divided by 1 + t and correspondingly in a market price analysis all values at factor cost are multiplied by the economy-wide average rate of indirect taxation. The results will be equivalent but in different numeraire so that NB2 = NB1*(1 + t). Where item-specific tax rates are applied the equivalence will not hold as there will be different values for t for each item.

The standard development approach values output j at Pj as a willingness to pay price and input n at Pn, as a measure of the willingness to pay for the input. However it values y at Cy as economic supply cost and labour at L, as output foregone, both at factor cost prices. Hence net benefits are

NB3 = Pj - Pn - Cy - L

which is a mixture of market price and factor cost values. In factor price terms relative to NB1 this implies benefits are overstated by Pj*(1 – 1/1 +t) and costs are overstated by Pn*(1- 1/1+t).

This inconsistency can only be resolved by arguing that with total expenditure in an economy unaffected by an individual project incremental expenditure on a non-traded output reduces expenditure on other goods by an equal amount, in this case by Pj. This reduction in expenditure elsewhere means a reduction in government indirect tax revenue to partially or wholly offset the taxes paid on j (Jenkins et al 2011). The fall in government revenue is treated as a cost which reduces the benefit from the production of j.

This treatment of changes in taxes as an additional benefit or cost may seem inconsistent with the canonical principle of CBA that taxes are transfers that merely redistribute income. Its rationalization appears to be that in a competitive market a tax (treating a subsidy as a negative tax) is the only difference between a demand price (reflecting willingness to pay) and a supply price (representing unit resource costs). Hence a tax measures net economic benefit and this will accrue as income to the government. Therefore when demand shifts away from a substitute good as a result of the production of incremental output and shifts towards a substitute as a result of the use of a non-incremental input the resulting change in tax revenue represents not a transfer but a change in economic benefits.

In calculating the indirect loss in tax revenue as demand for j diverts expenditure away from substitutes the average indirect tax rate t is used on the assumption that the diverted expenditure could go on any domestically produced good. The reduction in expenditure Pj triggers a loss in government tax revenue of Pj*(1– (1/1+t)). [4] Using this assumption where j is also taxed at the average rate there will be no net change in the government's tax position.

Similarly for non-traded input n which is diverted away from other users by a project, other users will have funds equal to Pn to spend on other goods. Pn includes the tax component and if it is assumed again that this available expenditure could be spent on any good there will be an additional tax take of Pn*(1 – (1/1+t)), which reduces the cost of using n.

By incorporating the loss in government tax revenue due to production of j and the gain of tax revenue by the use of n, NB3 can be rewritten as

NB3 = Pj – Pj*(1 -1/1+t) - (Pn –Pn*(1 -1/1+t)) – Cy - L

[4] As Pj and Pn are inclusive of tax at rate t the non-tax component is (1/1+t) in percent.

or NB3 = Pj *(1/1 +t) – Pn (1/1+ t) – Cy – L

so that NB3 equals NB1.

Compatibility with a factor cost analysis thus requires allowing for the indirect tax impact of the use of non-traded goods on government income. The adjustment through the use of an economy-wide indirect tax rate was not incorporated in the original development texts and is only an approximation since we cannot know the actual distribution of marginal expenditure diverted away by a project. Where the exact composition of diverted expenditure is known the economy-wide rate of tax should be replaced by a product-specific rate.

Traded goods

Introducing traded goods raises a further level of complication. In the second example we assume output j is traded as an export. The standard development approach values traded goods at world prices (in this case fob) before any trade tax but then converts at an exchange rate the SER that incorporates the effect of net taxes on foreign trade. Keeping inputs and labour as before net benefits will be

NB4 = Pj*(OER*(1 +t_f)) - Pn/1/(1 + t) – Cy – L

where Pj is the fob price, OER is the market exchange rate, t_f is net tax on foreign trade and SER = OER(1 +t_f).

Here it appears that indirect trade taxes are part of benefits (Pj*SER) reflecting willingness to pay for foreign exchange and hence benefits are at market prices while all costs are at factor costs. This is the standard 'partial equilibrium' approach for traded goods and it appears to make the analysis incompatible with the factor cost/market price adjustment.[5] The analysis becomes compatible by treating the benefits of the project as Pj*OER which is a factor cost value plus the tariff revenue raised for the government through the generation of foreign exchange by the project exports which are then spent generating a revenue for government of Pj*OER*t_f. Here it is the tax rate for traded goods t_f that is relevant not t.

Where a project uses imported inputs a similar argument holds but in reverse. In the third example we assume that whilst output j is an export good, input n is now imported or importable, so Pn is a cif import price. The net benefit can now be rewritten as

NB 5 = Pj*OER(1 + t_f) – Pn* OER(1 + t_f) – Cy – L

[5] More complex versions of the SER formula depending upon what is assumed about the uses or sources of funds for the foreign exchange generated or used by a project (Jenkins et al 2011a).

As before Pj and Pn as world prices net of tax can be interpreted as factor cost prices, whilst the change in the net revenue position of the government is (Pj*OER* t_f)– (Pn* OER*t_f). Export j creates tariff revenue as expenditure on traded goods is increased, whilst import n reduces it as it lowers expenditure on other goods. The project-specific import tariff on n, which is omitted from the calculation, is a transfer between the importer and the government. However as in the case of non-traded goods the difference between world prices with and without the tax t_f is treated as a net economic benefit arising from the difference between a demand price, reflecting willingness to pay and a supply price, reflecting economic cost. It is a net benefit that accrues to the government.

Conclusions

The indirect tax correction factor has been used in appraisals in the UK for a number of years, yet it has rarely figured in discussion on CBA in a development context. This note aims to clarify the adjustments needed to make the standard development approach and the factor cost/market price equivalence approaches compatible. The key point is that for non-traded goods willingness to pay benefits and costs need to be adjusted by this correction factor otherwise there is inconsistency. This is based on the assumption that total expenditure in an economy is given and that the allocation of diverted expenditure can be approximated by an economy-wide average. Whilst the adjustment is approximate if applied it will have the effect of lowering benefits from projects in non-traded sectors producing incremental output, although there is a partial offset in reducing the cost of using non-traded non-incremental inputs. However if average indirect tax rates are low at an economy-wide level, due to the existence of many untaxed sectors, the practical implications will be small.[6]

Table 1 Case 1

t = 0.10	Factor cost	Market prices	Adjusted CBA
Pj = 100	Pj = 100/1.1 = 90.9	Pj = 100	Pj = 100 – 100*(1 – 1/1.1) = 90.9
Pn = 50	Pn = 50/1/1.1 = 45	Pn = 50	Pn = 50 – 50*(1 – 1/1.1) = 45
Cy = 30	Cy =30	Cy = 30*1.1= 33	Cy = 30
L = 10	L = 10	L = 10*1.1 = 11	L = 10
	NB1 = 5.45	NB2 = 6.0	NB3 = 5.45

[6] For example ADB (2017) ignores this adjustment.

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