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# How to do (or not to do)...

## Cost valuation in resource-poor settings

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Methods of cost-effectiveness analysis (CEA) have largely been developed for application in Western country settings. Little attention has been paid to the methodological issues in cost valuation in resource-poor settings, where failing exchange rates and severe market distortions require further clarifications of appropriate valuation methods. This paper links insights from social cost-benefit analysis with the current CEA guidelines to develop a more apt approach to cost valuation in resource-poor settings.

**Key words:** cost valuation, transferability, economic evaluation, cost-effectiveness analysis, developing countries

### Introduction

Guidelines for cost-effectiveness analysis (CEA) in resource-poor settings generally have a clear disease focus, covering diarrhoeal diseases (World Health Organization 1988), immunization (World Health Organization 1979), HIV/AIDS (Pepperall et al. 1994; Kumaranayake et al. 2000), tuberculosis (Sawert 1996), or safe blood services (World Health Organization 1998). One common feature of all these guidelines is that they draw on costing methods that have largely been developed for application in Western countries, in which markets function relatively well, and observed prices of goods often reflect economic value (Sugden and Williams 1978; Gittinger 1984; Gold et al. 1996; Drummond et al. 1997; Walker 2001).

However, these methods may not be readily applicable to resource-poor settings in the presence of failing exchange rates, trade restrictions and market distortions. In those instances, observed prices or charges do not necessarily reflect the economic value and need to be particularly accounted for in cost analysis. For example, an emerging question is the valuation of drug costs in the presence of patents. This is especially relevant in HIV/AIDS control now that off-patent antiretroviral drugs are becoming available. Which drug price should be included in CEA? Also, in the presence of import tariffs, a relevant question is whether international or (higher) domestic prices should be included in CEA? Furthermore, in many developing countries, the Ministry of Health receives many inputs free of charge or at reduced price, such as donated drugs, radio or television time for health education and communication, or volunteer labour. What value needs to be established for these items, considering that they could have alternative uses?

In addition, there is little methodological guidance to the question of how to transfer intervention cost estimates from one country to another. This is especially relevant for many developing countries which do not have the resources available to carry out CEA for many interventions.

This paper provides a practical approach to deal with the above issues and draws thereby on guidelines for social cost-benefit analysis (SCBA) (Little and Mirrlees 1969; United Nations Industrial Development Organization 1972), as developed in the late 1960s for the evaluation of development projects in resource-poor settings. SCBA guidelines are grounded in the economic concepts of 'opportunity cost', here defined as the value foregone by not using the same resource in the best alternative activity, and the term 'shadow price' is used to reflect the opportunity cost, or the true cost (or value) to society (Little and Mirrlees 1969; United Nations Industrial Development Organization 1972; Sugden and Williams 1978; MacArthur 1997). The paper also draws on the World Health Organization manual for cost analysis in primary care (Creese and Parker 1994). The World Health Organization guidelines on cost-effectiveness analysis are partly based on the findings of this present paper (Tan-Torres Edejer et al. 2003).

A methodological framework to the valuation of costs in a resource-poor setting is proposed in the following section. This includes the choice of price level and

a distinction between traded and non-traded goods. The subsequent section discusses the extrapolation of intervention costs to other settings. Costs may vary because of differences in resource prices and/or resource quantities, but the focus of this paper is on the former only.

## Cost valuation

### Choosing the price level

In nearly all economies, domestic market price levels are higher than world (or international) market price levels, which may be caused by exchange controls, import quotas and other trade restrictions. Since interventions consume a mixture of domestically and internationally produced goods, it is important for purposes of consistency to define the price level (also called *numeraire*) against which costs are valued. Consider, for example, a cost analysis of a tuberculosis outreach programme, which uses a vehicle and drugs, both imported against a tariff of, respectively, 25% and 20% (Table 1). If drug costs are valued against international price levels, also vehicles should be valued similarly, and any import tariff should be excluded. Or, if both goods are valued against domestic price levels, import tariffs should be included.

In principal, the rank ordering of projects is not affected by the choice of international or domestic price level (United Nations Industrial Development Organization 1972). Nevertheless, it is often argued that international price levels are the most appropriate starting point for analysis (Little and Mirrlees 1969; Hughes 1986), since 'they represent the actual terms on which a country can trade' (Little and Mirrlees 1969), and enable comparability of cost estimates between countries. The opportunity costs of goods and services consumed by an intervention can then be determined by considering the changes in foreign exchange available to the country. The opportunity cost for imported goods can be considered the foreign exchange that leaves the country in order to pay for the inputs, Similarly, the value of an input to an intervention that is produced locally but could be exported is the value that could have been obtained for it on the international market.

Central to the use of international prices is that any tariffs are excluded from the analysis. Tariffs are considered as transfer payments from one part of society to another, and do not consume resources but simply transfer the power to use resources from one person to another. The need to adjust for tariffs has different consequences for different goods, and is further discussed in the sections on 'traded' and 'non-traded' goods below.

In addition to the price level, the currency in which costs are finally measured must be chosen by the analyst. While domestic currency is most useful for local decision makers, prices are often presented in an international currency such as the US$ for the purpose of international comparisons. Domestic currency can be converted into international currency by multiplying the domestic price by the official exchange rate (OER). The decision on currency is independent of that of the price level.

### Valuation of traded goods

A traded good is a resource that is known to be imported, or could have been imported. Traded goods, such as equipment, supplies and pharmaceuticals, are all commodities that are, or could be, available on the international market, and could be available to all countries at an international market price. The international market price should reflect the border price of the country under study, which requires inclusion of cost, insurance and freight (c.i.f.) for imported goods and free on board (f.o.b.) for exported goods. The different elements of c.i.f. and f.o.b. are listed in Table 2.

The reason for excluding import duties and subsidies from the c.i.f. price is that these are transfer payments, and do not constitute a change in resources available to society as a whole. If the good is imported, the costs of local transport and distribution (termed 'domestic margin') should be added to the international price to approximate the local opportunity cost because local transport and distribution does use resources. These costs can be calculated by a method developed by Limão and Venables (2001) and applied by Johns et al. (2002), who estimate the percentage change in price of a good based on the distance it travels, the transportation infrastructure,

**Table 1.** Example of calculating tuberculosis intervention costs in the presence of import tariffs in a hypothetical district[a]

| Type of good | Quantity | Imported | Tariff | International prices | | Domestic prices | |
|---|---|---|---|---|---|---|---|
| | | | | Price level | Total costs | Price level | Total costs |
| Consumables | | | | | | | |
| Drugs (regimen) | 150 | Yes | 20% | $2.0 | $300 | $2.4 | $360 |
| Sputum tests | 300 | No | n.a. | $0.8 | $225 | $1.0 | $300 |
| Equipment | | | | | | | |
| Vehicle[b] | 1 | Yes | 25% | $1200 | $1200 | $1500 | $1500 |
| Personnel | | | | | | | |
| Nurse (FTE) | 2 | No | n.a. | $400 | $800 | $500 | $1000 |
| Total | | | | | $2525 | | $3160 |

[a]The average import tariff in the country is 25%, so the Standard Conversion Factor $= 1/(1+0.25) = 0.8$.
[b]Share of the vehicle used for the intervention.

**Table 2.** Elements of cost, insurance and freight (c.i.f.) and free on board (f.o.b.)

| Item | Element |
|---|---|
| C.i.f. | *Includes:* |
| | F.o.b. cost at point of export |
| | Freight charges to point of import |
| | Insurance charges |
| | Unloading from ship to pier at port |
| | *Excludes:* |
| | Import duties and subsidies |
| | Port charges at port of entry for taxes, handling, storage, agents' fees, etc. |
| F.o.b. | *Includes:* |
| | All costs to get goods on board (still in harbour of exporting country) |
| | Local marketing and transport costs |
| | Local port charges including taxes, storage, loading, fumigation, agents' fees, etc. |
| | Export taxes and subsidies |
| | Project boundary price |

*Source*: Taken from Gittinger (1984).

the average GDP per capita of a country, and other variables relating to the availability of seaports, neighbouring trade partners, etc.

*Price variability and product differentiation*

Even when international prices are readily available to the analyst, it is common to find that similar products sold internationally have different prices. The correct approach depends on the cause of the price variation.

- If the variation is due to price discrimination, where the same product is sold to different countries at varying prices, the price should be taken that reflects the purchase opportunities of the country in question. This also refers to the situation where some (large) countries can buy cheaper drugs than others because of bulk procurement.
- If the variation is due to product differentiation (where products are similar but not identical), some if not all of the price difference may be justified. This may be purely due to quality differences, or differences in the uses and functions of a product. The analyst should use the price of the relevant product.
- If the variation is due to differences in international and domestic distribution costs – either because the distances are greater, or alternative forms of transport are used – the international market price should be chosen to reflect the cost to the country in question. The price used by the analyst should also reflect the local distribution costs as are likely to occur in the health project under study.

*Excess profits*

Excess profits should be treated differently for non-traded and traded goods. For non-traded goods, excess profits can be considered as transfer payments when the production and consumption of the good takes place in the same country. In other words, no opportunity cost is incurred with income transfers between consumers and producers. For this reason, the market price should be adjusted to take out the excess profits.

However, this argument does not hold for traded goods: excess profits are part of the price of the good and therefore contribute to the loss of foreign exchange as a result of consumption of a traded good. The consumption of a traded good implies that society either needs to import the good (which costs foreign exchange) or foregoes exporting the good (which implies foregone earnings on foreign exchange). In both instances, the consumption of the good reflects a real opportunity cost to society in the sense of losing foreign currency.

The situation is more complex for patented products. Some markets exist for the reason that they are the result of market protection given by the patent system. Patents are argued to be a justifiable way of encouraging new discoveries, which is essential in the area of health and medicine, and excess profits can be considered as a way to offset the investment costs in new discoveries, especially related to drugs. Central to the question of whether CEA of interventions using patented drugs should include these excess profits is whether a generic substitute exists and has similar effectiveness:

(1) If a generic substitute exists and has the same effectiveness, then this price should be used. The logic is that CEA aims to inform decision-makers on the efficient use of resources to produce a given output, not including current inefficiencies or sunk costs involved in producing that output. In some settings it might also be useful to show how the cost-effectiveness would alter with the use of the brand-name substitute.
(2) If no generic product exists, or is unlikely to in the life-time of the project, or the health programme does not have access to it, then the price of the patented product should be used. If a generic product is predicted to become available later in the life of a project, then the expected generic price should be used after this time.

This solution reflects the buyer's opportunities: on the one hand, it does not stop health programmes from going ahead where generics can be used instead of branded products; on the other hand, it does not mistakenly support expensive programmes where generics are not yet available.

*Price availability*

Prices may be obtained at the level of the health programme, in which case adjustments may be necessary to account for import tariffs or subsidies. Alternatively, one can make use of published international prices, as available on the web (e.g. for international drug prices: http://erc.msh.org/dmpguide). However, these prices

1. Define price level
2. Distinguish traded and non-traded goods:

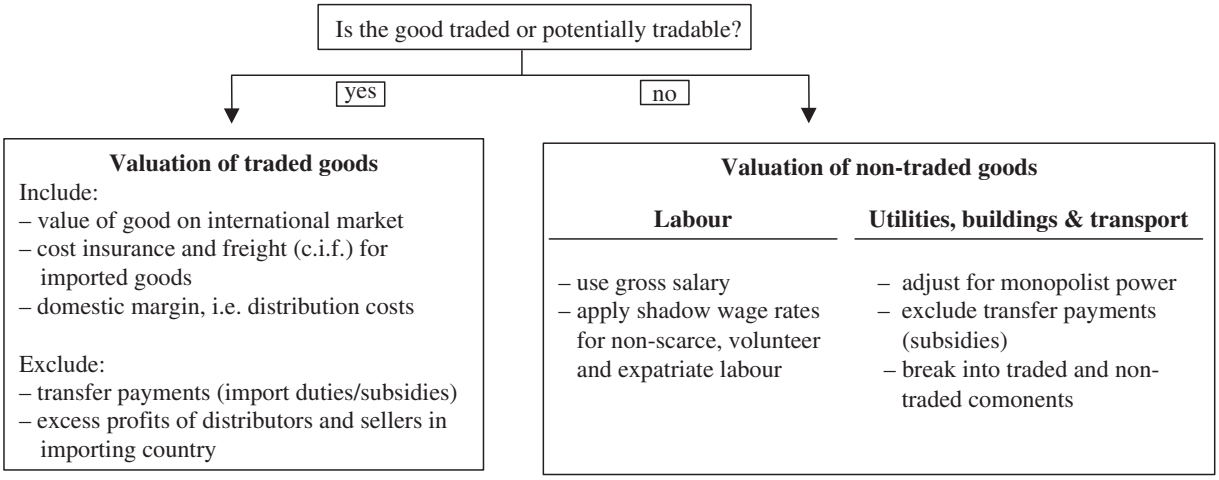


**Figure 1.** Issues to consider in cost valuation

normally do not take into account c.i.f. or local distribution costs, which should be added.

### Valuation of non-traded goods

Goods that do not fall under traded goods are termed non-traded goods (NTG), such as labour, utilities, buildings and domestic transport. Non-traded goods are goods that are domestically produced and which, by nature, cannot be imported or exported. Non-traded goods should be similarly valued at international prices, taking into account distortions that exist in the domestic goods markets: 'only thus can we ensure that we are valuing everything in terms of a common yardstick' (Little and Mirrlees 1969).

The conversion process of domestic prices to international prices rests on the idea that all non-traded goods can be ultimately broken down into traded goods and labour. For example, local transport by lorry could be evaluated in terms of driver time, road and vehicle maintenance (non-traded), and fuel (traded). Eventually, by continuing to break down the non-traded components, the total value of the non-traded component will be expressed in terms of only traded goods and labour. Next, the international price of the traded goods components should be calculated by netting out the tariffs. To do this for many goods and services is a considerable amount of work, and instead a weighed average import tariff can be used to convert domestic prices of non-traded goods into international prices. To this aim, the Asian Development Bank produces the standard conversion factor (SCF), which is the ratio of international to domestic price level, approximated by the weighted average import tariff (Asian Development Bank 1997). For example, if the average tariff is 25%, the SCF would be 0.8.

Table 1 gives an example of how to calculate intervention costs in the presence of import tariffs, for the case of a tuberculosis outreach programme. The impact of the tariff on the costs of traded goods such as drugs and vehicles is straightforward and can be accounted for directly; for the non-traded goods such as sputum tests and personnel, an indirect approach through the SCF is used. There is a clear difference between domestic prices and international prices.

#### *Labour*

Labour market prices might not reflect true opportunity costs. To determine the economic value of labour employed in health interventions, these prices must be adjusted for distortions in the labour market, giving the so-called shadow wage rates.

*Scarce labour*: Scare labour is typically labour which involves skilled workers for which there is little or zero unemployment. For this type of labour, it is recommended to take prevailing market wages and fringe benefits plus the monetary value of housing and other allowances to give an approximation of the opportunity cost. This may well underestimate the true opportunity cost of skilled health workers in countries where the private sector does not function and governments control salaries. The opportunity cost of labour is reflected by the salary gross of tax. Taxes are transfer payments and only change the command over resources in society, not the total amount of societal resources available. For that reason, taxes should not be included as a cost, i.e. they should be ignored. Another way of looking at it is that gross salary equals the societal value of labour, at least at the margin (i.e. the decision to employ a person). Fringe benefits should also be added to estimate the opportunity costs of labour. These include the employer's contributions to social security, other pension plans, health and

life insurance, and perks such as use of a car, free use of accommodation or financial contribution to private accommodation (Levin 1983).

An important question is what to do about the valuation of expatriate labour employed in a country on salaries that are much higher than those paid to people with similar skills locally. The general answer to this question is that it depends on whether the intervention needs this type of labour or whether the expatriate labour could be replaced with local labour having the same qualifications, skills and efficiency. If for some reason the intervention absolutely needs the expatriate labour, they should be considered as traded goods and evaluated accordingly. However, if the intervention would be possible with local labour, and the goal is to evaluate whether an intervention undertaken efficiently is worth doing, then local labour costs should be used.

*Non-scarce labour*: In many countries, unskilled labour is not scarce – there are many more people who postulate for positions in the modern sector than posts available. The cost to the economy of using unskilled labour in a health intervention is the opportunity cost of net output lost elsewhere in traditional economics, or the lost health output that it could have produced in a more narrow interpretation.

Where labour is drawn from rural areas and would alternatively have been employed in agricultural production, the opportunity cost is often taken to equal the value of lost production. An indirect way of estimating this is to use the rural wage rate, adjusting for seasonality. At some times of the year this might be close to zero. Where labour is drawn from urban areas, the economic price of labour in the urban areas can be approximated by estimates of annual incomes in the urban informal sector. The urban formal sector wage rate is likely to be an overestimate, especially where minimum wage laws apply.

*Voluntary labour*: Voluntary labour is, by definition, free to an intervention. If it can be assumed that the intervention will always be able to call on this volunteer labour, it would be valued at zero cost. If not, the cost of employing others to undertake this task should be used – effectively this means that it would normally be valued at the wage rate of health personnel who would normally be employed to do the same tasks.

*Patient time*: Many types of health interventions – such as rehabilitation, prevention or life-saving programmes – can affect the ability of people to work, and through this, the total resources available to society. In the social welfare framework, productivity costs or gains affect the consumption of goods and services and, therefore, social welfare. They should be included in the analysis. In the concept of social welfare, each unit of time would have to be weighted according to the different impacts of each person's production on overall societal output, and also according to who receives the benefit of the additional consumption. However, no appropriate way of measuring these welfare effects is yet available. The application of a shadow wage rate for time at the individual patient level is erroneous, since it does not address the impact on economy-wide changes (e.g. in case of unemployment, there may be no societal production losses because the sick will be replaced by other workers). The friction costs approach takes this into account (Koopmanschap et al. 1995), but remains silent on the question of who is affected by the changes in production, i.e. the rich or the poor. This is important since the marginal utility of an additional unit of consumption is different for the two groups. Any attempt to measure this welfare change in monetary terms would simply introduce noise into the calculations, so it is recommended not to include changes in production, until a correct approach is available.

In general, time costs are unlikely to be substantial, but for certain conditions or interventions, their exclusion may introduce bias into the comparative estimates of cost-effectiveness, for example where people require repeated contacts with the system. A case in point would be treatment for a chronic condition, such as kidney dialysis, where the omission of time costs would undervalue the attractiveness of home dialysis compared to a facility-based intervention. Accordingly, where they are likely to be substantial, the analysts should report them separately (Drummond et al. 1997).

*Utilities*

Utilities includes gas, electricity, water and telephone – services which can be both privately and publicly provided. Whether prices charged by utility providers reflect opportunity cost depends mainly on whether the provider is operating as a monopolist, as a colluding partner in an oligopolistic market (a few large providers who can maintain high prices), or whether the market is competitive. This can be easily determined through a basic knowledge of the utility sector. If some degree of competition does not exist, some downward adjustment should be made for estimated profit margins and/or inefficiencies of the companies.

*Buildings*

It could be argued that in the short-term, there are not many alternative uses of health care facilities, and therefore the opportunity cost of these buildings is zero or close to zero. However, in the longer term, there are options for alternative uses, such as use in other public activities, or sale to the private sector. Therefore, it is not right to give buildings used for health care a zero cost (Levin 1983). One approach is to use the annualized value of the building, which incorporates the replacement costs of the building, its useful life and the opportunity costs of the funds tied up in this asset (Creese and Parker 1994). Another approach is to use the rental value of a similar space in the same location which could provide the same function, for example, a private clinic or hospital. The rental value incorporates both the depreciation and the opportunity costs of the asset. However, this method is only appropriate if competitive rental markets exist,

which is certainly not the case in the rural areas of many of the poorest countries of the world. As a result, the former method is recommended.

*Transport*

The capital costs of vehicle purchase can be treated as traded goods. Some transport operating and maintenance costs are also traded, such as fuel and lubricants, spare parts etc. Others, most importantly labour time (both in driving and maintaining vehicles), are considered as non-traded goods. To value transport costs, all inputs should be classified into traded and non-traded goods and be valued appropriately. However, in some instances, this will be difficult and a price (e.g. a bus fare) can be used to approximate transport costs.

## Transferability of unit costs across settings

Many developing countries do not have the resources available to carry out CEA for many interventions, and could benefit from analysis performed in other (neighbouring) countries. There are many barriers to extrapolating cost-effectiveness results from one setting to another (Mason 1997; Bryan and Brown 1998), but methodological guidance to overcome these barriers is largely lacking. Intervention costs can vary between countries because of many factors, but this section concentrates on differences in unit costs only. Unit costs can refer to prices of goods in the most disaggregated form (factor prices), or to goods in aggregated form (price of services, e.g. outpatient visits). Different approaches are relevant for different aggregation levels of information available.

Before detailing these approaches for adjusting unit costs from other settings, however, it is important to note that these adjustments do not account for possible differences in physical resource use per unit of output. Differences in physical resource use per unit of output may occur for several reasons, for example, due to differences in relative factor prices, different technologies or different levels of production efficiency (Hutton et al. 2004). Therefore, in adjusting only for unit costs, adjustments to total costs may be incomplete, and therefore misleading. While accounting for these variations is not dealt with further in this paper, awareness of such differences by the analyst is important in order to inform whether further adjustments are necessary beyond the unit cost adjustments.

### Input prices are available at the disaggregate level

When studies have used the ingredient approach, thus reporting quantities and prices of all factor inputs separately, analysts in other settings could adjust for identified differences in these quantities and prices. For example, if separate information is available on wages, then the approach is to identify the wage differentials between the source and destination countries, and adjust by the factor identified. In order not to create additional heavy burden on the analyst, it is recommended to take the main categories of health care personnel, using the average wage for each. These comparisons will give an average adjustment factor for the labour element of the cost.

### Input prices are not available at the disaggregate level but traded and non-traded components are known

Sometimes analysts may not have the price/cost information for their own setting. In that case, the distinction between traded and non-traded goods should be made, and traded goods should be valued at their international price as described above. The prices of non-traded goods can vary considerably between countries when expressed in a common currency at the official exchange rate, due to differences in purchasing power. Purchasing power parities (PPP) could be used to convert prices of non-traded goods, taking into account these differences. PPP reflects the relative value of a basket of goods in one country compared with another: by multiplying the costs of a non-traded good in country A by the PPP (between country A to B), the value of the inputs in country B can be approximated. It should be noted that the goods included in the calculation may not reflect purchasing power differences in all goods relevant to the intervention under study.

### Input prices are not available at the disaggregate level and traded and non-traded components are unknown

Some unit costs might not be available in a local setting and it would be very complicated to break them into their traded and non-traded components. An example is the unit cost per inpatient bed day. In these cases, PPPs could be used to translate unit costs from another setting and would give at least an approximation of local costs. This is not an ideal solution because it is often very difficult to tell from the published literature if the reported unit costs of inpatient days include all relevant costs and have been valued appropriately. Furthermore, if unit costs of the base country include traded goods, then transferring the traded good component of unit cost at PPP would lead to an incorrect transfer of this component in the target country. Adam et al. (2003) have made available country-specific estimates of costs of inpatient days and outpatient services based on a combination of PPP and econometric techniques.

### Sources of information

Official exchange rates are the simplest to collect in that they are easily available on a daily basis in many publications and newspapers around the world. One issue that the analyst might face is the fluctuations in currency markets, which may be due not only to government controls, but also to the volatile nature of currency markets, caused by currency speculation and rapid changes in confidence in countries and regions. The analyst is recommended to use the rate that best reflects

the long-term exchange situation, which is most likely reflected by the average exchange rate for the last year.

Purchasing power parities for countries of the Organisation for Economic Co-operation and Development (OECD) are available on the internet at <http://www1.oecd.org/std/ppp1.pdf> and <http://www1.oecd.org/std/ppp2.pdf>. Also, the World Bank compares Gross Domestic Product (GDP) per capita for all countries at both official exchange rate and PPP values at <http://www.worldbank.org/data/databytopic/GNPPC.pdf>.

## Conclusion

The methodological framework described in this paper is formulated to provide a clear and practical means of valuing opportunity cost, as well as to clarify the appropriate approach to transfer costs across countries. This paper has introduced important terms and concepts for opportunity cost valuation, including the choice of price level and currency, the standard conversion factor, and the distinction between traded goods and non-traded goods. These issues are particularly important where resource-poor countries are concerned, due to the widespread occurrence of failing exchange rates and markets, volunteer labour, scarce data and the need to 'borrow' data from other countries.

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