

**VALUATION OF GOODS IN COST-EFFECTIVENESS ANALYSIS:
NOTIONS OF OPPORTUNITY COSTS AND TRANSFERABILITY
ACROSS TIME AND COUNTRIES**

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1 Introduction

The overall aim of conducting cost-effectiveness analysis in the health sector is to make a quantitative judgement about the value of inputs and outcomes of different health care programmes or interventions, and represent these inputs and outcomes in a single cost-effectiveness ratio¹. The presentation of cost-effectiveness ratios for every potential health care intervention allows a comparison of the alternative ways of spending limited health sector resources, using the criterion of efficiency, and may contribute to more rational decision making.

On the input side, the summary of a range of health care resources in a single unit of account allows a considerable simplification of the numerator in the ratio. Without such a unit of account, a summary measure of resource use would not be possible due to the heterogeneous nature of the physical units in which health care resources are measured. This process of expressing resources in monetary values is known in economics as **‘valuation’**. Valuation is the third step in the costing process, after cost identification (deciding which resources will appear in the numerator) and cost measurement (measuring the physical quantities of these resources) [1].

In valuing resources in their monetary equivalent, there are several issues that must be addressed. First, what is the value of a resource? To this, the concept of opportunity costs is often referred to, which is theoretically correct, but leaves many questions open to its operationalization. This paper provides a step-to-step approach which guides the analyst through the process of valuing resources using the opportunity cost principles. A second issue concerns the fact that values change over time, and therefore costs expressed in monetary units in one time period may not reflect the value in another time period. A third issue concerns the fact that resources represent different values in different countries, thus raising additional questions for how transfer or international comparison of cost data should be made. These latter two issues have been little addressed in the literature on economic evaluation, and will be discussed in detail in this paper.

In providing recommendations for valuation in cost-effectiveness analysis, in particular for resource-poor countries, it is important to keep in mind the need to develop approaches that can be applied widely in many settings, that do not have stringent data

needs, and that can be applied by non-specialists who do not necessarily have an in-depth understanding of economic principles. However, it is important to sort out first what methods are methodologically correct before asking if they can be applied in practice.

This paper assumes welfarism as the theoretical framework for economic evaluation. This implies that resources are valued from the societal perspective. The choice of an alternative framework, e.g. extra-welfarism or the health maximization approach, would have important implications on the valuation of costs.

The paper is structured as follows. Section 2 addresses the definition and measurement of the economist's definition of cost i.e. 'opportunity cost', discusses recommendations provided by previous costing and CEA guidelines and other key publications. Section 3 provides the step-by-step approach for cost valuation, i.e., detailed instructions for approximating the opportunity cost. Section 4 provides instructions for identifying the appropriate approach for transferring and comparing costs across countries and over time. Section 5 discusses issues raised in this paper, and concludes.

2 Estimation of opportunity cost

2.1 The perspective

What health care costs are depends, as with other goods, on your perspective or viewpoint. The *consumer* sees the cost of health care in terms of the direct price of the health service (user fees, co-payment), their insurance premiums, and how much time and other costs they must sacrifice in order to attend health care. The *health insurance company* or health maintenance organisations sees health care costs as the prices they face of the health care consumed by its members, and the transaction costs of managing their business. The *health ministry* may consider the health system perspective, in which the available health resources in society are defined as those that have an opportunity cost to the production of health. It has been argued by some authors that this approach is more consistent if one chooses to maximize health within a given budget [3-4]. If one accepts welfarism as the theoretical framework for analysis, the viewpoint of *society* should be represented in all analyses conducted and used by public agencies whose primary aim is to maximise (and distribute) public welfare. The societal perspective considers everyone

affected by the intervention and counts all significant costs and resulting health effects, regardless of who experiences the health effects or pays the costs. This perspective is usually proposed for economic evaluation [5-8].

2.2 The concept of opportunity cost

2.2.1 Guidance from social cost-benefit analysis guidelines

Chronologically, the social cost-benefit analysis (SCBA) guidelines preceded the cost-effectiveness analysis (CEA) guidelines, marked by the arrival of the Little-Mirrlees guidelines for project appraisal in 1969 [9], and followed closely by the UNIDO guidelines in 1972 [10]. These guidelines were designed for the evaluation of development projects, and were not specifically targeted at health sector projects². Both guidelines were based on the economic concept of ‘opportunity cost’, i.e. the value to society of a good or service. The terms ‘shadow price’ and ‘efficiency price’ were also used to reflect the opportunity cost, or the true cost (or value) to society [5, 9-11]. The concept of opportunity cost rises out of welfare theory. By using a resource in one activity means that the same resource cannot be used in another activity. The opportunity cost of a resource can be described as the ‘value forgone of not using the same resource in its next best alternative’. The appeal of the concept of opportunity cost is that, when considering the allocation of resources from a societal perspective, the true cost of a resource used in one health care intervention is the loss of not using them in the next most efficient interventions (that were not implemented) [12]. The social cost-benefit analysis literature from the 1970s and following considered it important to distinguish between prices on the one hand (usually determined by a market, but also can be determined from other sources), and economic value on the other. This is because it was recognised that prices available from the market do not necessarily reflect the economic value [6, 9, 10] as shown briefly in the following examples:

- In company or government accounts, buildings and equipment are depreciated over time, so that after a few years they have an accounting value of zero. However, even after this period these items still have a cost from the economic point of view. For example, there is an opportunity cost of using the buildings for tuberculosis control rather than for immunization services, or using an X-ray machine for fractures as opposed to diagnosing tuberculosis. Therefore, a value needs to be established that can be given to capital items even after they have a book value of zero.

- 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. These resources still have an opportunity cost, as they all have alternative uses. Again, a value needs to be established that can be given to donated or reduced-cost items even when the Ministry of Health does not pay for them.
- In many resource markets, there may be distortions that cause the current market prices to diverge from opportunity costs. On the one hand, the observed price can be higher than the opportunity cost, due to monopoly power or taxes/import tariffs, while on the other hand the going price can be lower than the opportunity cost, due to subsidies or 'dumping' of products in the market at below cost. Again, a value needs to be established that more closely reflects the opportunity cost than the observed prices or charges.

2.2.2 Cost-effectiveness analysis guidelines

Although cost-effectiveness analysis has been practised close on three decades, guidelines did not start appearing until the late 1970s, with most appearing after the mid-1980s. To date, there have been numerous cost and cost-effectiveness analysis guidelines published, with a wealth of supporting articles and books. A brief comparison of published CEA guidelines was made recently by Walker (2001) [13], who made a general distinction between guidelines produced in developed countries, and guidelines more relevant to developing countries. The developed country guidelines have clear country origins - Australia [14], Canada [15], the UK [16] and the USA [17-19]. In contrast, the developing country guidelines have a clear disease focus - diarrhoeal diseases [20], immunisation [21], HIV/AIDS [22, 23], tuberculosis [24], and vectors [25]. Also, costing guidelines have been produced for primary health care [26] and safe blood services [27], with particular relevance for developing countries.

One point that all health sector-specific guidelines have in common is that they recommend that resource use should be valued using the guiding principle of opportunity costs. The guidelines recognise that the theoretical proper price for a resource is its opportunity cost, although it is argued that the pragmatic approach to costing is to take existing market prices unless there is some particular reason to do otherwise. In a widely-quoted book on methods for the economic evaluation of health care programmes,

Drummond et al. recommend that in making adjustments to market prices, analysts should be convinced that (1) to leave prices unadjusted would introduce substantial biases into the study, and that (2) there is a clear and objective way of making the adjustments [8]. The BMJ guidelines, on the other hand, omit these recommendations, and suggest that the finance department of particular institutions or national statistics will provide cost estimates for CEA, although the guidelines warn that charges may not reflect costs [16]. The US panel on guidelines for CEA recommends the use of opportunity cost, and adjustment to prices when markets are not perfect [19].

3 The step-by-step approach

In the above sections it was argued that due to the lack of precise information on ‘the next best use of resources’ and the associated value, it is unlikely that most analysts are able to measure the opportunity cost per se, and instead analysts should identify a proxy measure that adequately reflects opportunity cost. The analyst must focus his attention on making adjustments to those prices that are likely to make a difference, and use rough approximations or ignore trivial adjustments that will not make any difference to a decision. In other words “there is an important balance to be struck between analytical elegance and getting on with the job” (Gittinger 1984, page 244)[6].

The step-by-step approach leads the analyst through a number of critical steps to help them identify the appropriate valuation methods for the resource in question. The analyst has to take out transfer payments (3.1), decide on the unit of account (3.2) and adequately value traded goods (3.3) and non-traded goods (3.4). Figure 1 is an aid to this process.

3.1 Transfer payments

Some interventions may result in financial flows within society from the government to individual patients, such as unemployment benefits or sickness benefits. Another example is that some international prices may include transfer payments, such as export taxes or subsidies. Such transfer payments are a cost to the paying government, a gain to the patient, but do not use or create resources. These money streams signify a change in command over resources, not a change in the aggregate value of resources available to society. However, any related administrative costs should be included at least in theory.

3.2 The unit of account

In nearly all economies, domestic market price levels are higher than world market price levels, which may be caused by exchange controls, import quotas, and other trade restrictions. This creates a need to bring all resource inputs to a common basis so that they can be aggregated into an estimate of the costs of a health intervention. To do this, it is necessary to define a unit of account, that is, to choose a *numeraire* or price level – domestic or world market price level – and to choose a currency – national or foreign currency – in which to express all resource inputs.

3.2.1 The numeraire

It is often argued that the world price level is the most appropriate starting point for analysis [9, 28]. The OECD guidelines for project appraisal provide the rationale for using world prices as that “they represent the actual terms on which a country can trade” (Little and Mirrlees 1969) [9].³ Therefore it is logical to assume that all internationally traded goods should be valued at their ‘border’ prices⁴, termed in this paper ‘international prices’. For non-traded goods, Little and Mirrlees argue that they should be similarly valued, “only thus can we ensure that we are valuing everything in terms of a common yardstick” [9]. Thus they recommend to revalue non-traded goods in terms of international prices, taking into account distortions that exist in the domestic goods markets. The amount by which domestic prices exceed international prices depends on the extent of distortion present in the domestic economy. To convert domestic prices to international prices requires application of the ‘conversion factor’, which is the proportion by which domestic prices exceed international prices⁵. To do this for many goods and services is a considerable amount of work, and instead the standard conversion factor can be used, which is defined as the weighted average of all the conversion factors in the economy (for all goods). The standard conversion factor (SCF) can be estimated as the ratio of the value of traded goods and services at the international price level to the value of traded goods and services at the domestic price level, or can be approximated by the weighted average import tariff (Asian Development Bank. Guidelines for the economic analysis of projects. Economics and Development Resource Center, Philippines: Asian Development Bank: 1997). For example, if the average tariff is 25%, the SCF would be 0.8. This approach stems directly from the concept of a second-best shadow exchange rate., which has been proposed to use in this context [28]. While the first-best shadow

exchange rate is that it is calculated on the assumption of optimal trade policies, we define second-best shadow exchange rates as accepting an existing overvaluation of a currency as given, and only making corrections for tariff distortions. This indicates the real foreign exchange loss to a society as a result of the consumption of resources for health interventions.

3.2.2 *The currency*

As well as the numeraire and the value for the standard conversion factor, 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 or donors estimating costs to themselves of health programmes. Domestic currency can be converted in international currency by multiplying the domestic price by the official exchange rate (OER). Note that the currency unit can be chosen independent of the numeraire: costs can be presented in rupees or US\$ at both international as well as domestic prices. Therefore, when the analyst presents the cost data, as well as the currency unit the numeraire must also be stated.

3.3 **Valuation of traded goods**

The first two questions in the step-by-step approach help distinguish whether the good is a traded or non-traded good (Figure 1). In general, a traded good is a resource that *is known to be imported, or could have been imported* (so called potentially traded goods') such as medical equipment, supplies and pharmaceuticals.

3.3.1 *How to value traded goods?*

Traded goods, e.g., 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. Most countries are too small to effect the international price – either for goods they import or export. So the opportunity cost for imported goods can be considered the foreign exchange that leaves the country in order to pay for the inputs – e.g. they should be valued at the international price. 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. That is, the international

market price should be used as a basis for estimating opportunity cost. The international market price should be adjusted to include cost, insurance and freight (CIF) for imported goods and free on board (FOB) for exported goods⁶, if the price does not already reflect these [9, 10] (Table 1).

{Insert Table 1 here}

The c.i.f. price should exclude import duties and subsidies, and include the selling price of the producing country, freight, insurance and unloading charges. The reason for excluding import duties and subsidies from the price is that these are simply transfers from one part of society to another. They do not use resources but transfer the power to use resources from one person to another. 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 which cannot then be used somewhere else.

{Insert Figure 2 here}

Note that may not be appropriate to use the international market price for drugs, supplies, equipment that are domestically produced. Analysts should consider these products as non-traded goods and should use the prices they face in the domestic market, even if they are higher than the international price.

Price variability and product differentiation. Even when international market prices are readily available to the analyst, it is common to find that similar products sold internationally have different prices. The solution depends on the cause of the price variation.

- 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.
- If the variation is due to pure price discrimination, where the same product is sold to different countries at varying prices⁷, the price should be taken that reflects the purchase opportunities of the country in question. If these opportunities are due to

change in the life-time of the project, prices should be up-dated (at that point in time) to account for these price changes.

- If the variation is due to differences in international and domestic distribution costs⁸, the international market price should be chosen to reflect the cost to the country in question. The final price used by the analyst should also reflect the local distribution costs as are likely to occur in the health project under study.

Transfer payments. The issue was already raised that some international prices may include transfer payments, such as export taxes, and to a lesser extent export subsidies. From the SCBA guidelines, it is clear that distortions to the price caused by government trade restrictions or subsidies should be excluded.

Excess profits. The SCBA literature is not clear about identifying and adjusting for excess profits on traded goods. On the one hand, Luce et al [1] argue that no opportunity cost is incurred with income transfers and profits, and should be subtracted from financial costs. The example given is of adjusting for the profits contained within hospital charges using the cost-to-charge ratio; however, for profits on traded goods they are not clear. There are two arguments for including profits in 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, i.e. 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.
- 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 these investment costs in new discoveries. Central to the question whether CEA of interventions using patent 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 to produce 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 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 buyers 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 available yet.

Price availability. Figure 2 distinguishes various sources of data, giving guidance to the analyst for which sources should be approached first.

- The optimal source is when the import price is known at the level of the health project – where it is known with certainty that one has the right price to start with, and also it is easily collected. If the contents of this price are known, such as whether import tariffs are included, then it serves as a basis for adjustment.
- One alternative is to 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 may not take into account CIF or local distribution costs, which should be added. This could be accounted for by adding a percentage of goods, as was e.g. done by Sawert in the WHO tuberculosis guidelines [24], where 15% was added to account for shipping and handling charges, and 10% was added to account for drug distribution costs.
- Another alternative is for the analyst to simply take the price in the accounts of the health facility where their study is. However, the problem with this is that without

further research they may be unaware whether this price reflects the import price, with transfer payments taken out, but this is difficult to find out. The price at the facility may in fact be subsidised (for example, distributed free of charge, or currency conversion is done at the official and not the shadow exchange rate thus giving the good an implicit subsidy), or it may contain a profit element to the distributing agent (such as the central pharmacy). This may work better for medical supplies, which are consumed in the same year as purchase; but for equipment it may mean that prices quickly become out of date. In this case, if no alternative values are available to estimate replacement cost, adjustments by average inflation since purchase can be made.

- As another option, private sources can be used, such as a private pharmacy. While it is certain that these prices will reflect all the value added (such as distribution costs and fees), it will also reflect tariffs and probably excess profits of domestic agents, which should be adjusted for.

3.4 Valuation of non-traded goods

In the application of the step-by-step approach (Figure 1), goods that do not fall under traded goods are termed non-traded goods (NTG) such as labour, utilities, buildings and domestic transport.

3.4.1 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, and so-called shadow wage rates (SWR) could be estimated. Labour has traditionally been broken into two basic categories: scarce labour and labour which is not scarce locally. A third and fourth category, voluntary labour and patient and care-givers time, are also discussed. The distinction between 'scarce' versus 'non-scarce' labour will vary by setting. In some countries, it is not uncommon for doctors and nurses to be unemployed. Similarly, in some countries, unskilled (or low-skilled) labour is in short supply certainly as some times of the year where agriculture is an important activity. Therefore, the analyst should make their own judgements, and justify their choices.

Scarce labour. Scarce 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 fringes 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 better reflected by the salary gross of tax. The SCBA literature clearly states that all taxes are transfer payments and that therefore the opportunity cost of labour is better reflected by the gross salary, and not the salary net of tax. This is in line with the argument that the gross salary can be considered as the total resources that society pays to employ someone. It also builds on the fact that a considerable part of the tax taken from salary will come back to that person in some form (health care, education, public works), as well as pay for the general well being of society (pensions, unemployment benefit). However, the gross salary is not sufficient to estimate the opportunity costs of labour. Fringe benefits should also be added. These include the employers 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 [29].

An important question is what to do about the valuation of expatriate labour employed in a country on salaries which are much higher than those paid to people with similar skills locally. The general answer to this question for Generalized CEA 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 working at the same efficiency levels. 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 been 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. However, this could well overestimate the true opportunity cost of unskilled labour in countries where there are minimum wage laws applying to the urban sector.

Voluntary labour. Although voluntary labour is free to an intervention, it has an opportunity cost in that it could be used in another type of intervention. The opportunity cost of voluntary labour will vary from one volunteer to the next, based on qualifications and experience. The recommendation is to take the wage rate of health personnel who would normally be employed to do the same job, in the absence of the volunteer.

Patient time. Whether costs of patient time for travelling and undergoing the intervention should be included as a cost or as a health effect is an unresolved theoretical issue [19]. If the analyst wishes to include patient time inputs into medical care as a cost, there are a number of alternatives for valuing the opportunity cost of patient time. The most tangible cost is that of lost earnings (where the employee loses), or lost time in employment (where the employer loses), which can be represented by the (shadow) wage rates of individuals (see above).

3.4.2 Utilities

Utilities includes gas, electricity, water, and telephone – services which can be both privately and publicly provided.

Public providers of utilities. Most public providers of utilities in the developing world are in a monopoly position. They often receive large subsidies from the government, and they are likely to operate inefficiently compared to private companies due to the lack of competition and the tendency to greater bureaucracy in government undertakings (without the rigours of the market to trim inefficient procedures). The problem the analyst faces is that without an in-depth knowledge of the accounting and pricing system of such a public utility company, it is not clear how prices are set. Given this uncertainty, and based on the

assumption that utilities represent only a small proportion of total cost, it is recommended to use the charges to the health care provider.

Private providers of utilities. Whether prices charged by private 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 of the companies.

3.4.3 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 [29]. There are two possibilities for the valuation of building or space used by the intervention. The first is to use the annualized value of the building. This is done using the replacement costs of the building, i.e., the cost of constructing a similar building today, and the annualization factor that incorporates the useful life of the building (depreciation) and the opportunity costs (i.e., interest rate) of the funds tied up in this asset. The annualization formula is available elsewhere [26]. The second option is to use the rental value of a similar space in the same location which could provide the same function, e.g., 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.

3.4.4 Transport

The capital costs of vehicle purchase can be treated as traded goods. Some transport operating and maintenance costs are also traded – e.g. fuel and lubricants, spare parts etc. Others, most importantly labour time (both in driving and maintaining vehicles) are considered as non-traded goods. Three types of transport are distinguished for valuation purposes: (1) transportation of health care goods from the port or factory to the health

facility; (2) transportation of health personnel for supervision and administrative purposes or patients for emergency care using medical transport (ambulance); and (3) transportation of patients to health facilities for care seeking.

The first two should be treated in the same way – dividing the inputs into traded and non traded goods and valuing them appropriately. The third group should be treated in the same way in theory, but is more difficult to do in practice. Accordingly, we recommend the following where data can be obtained. If a private family vehicle was used, estimates of fuel costs used in the round trip to the facility should be used. It is not necessary to estimate a depreciation value for the car or maintenance costs as these will be very minimal and can be considered sunk, i.e., will occur any way with or without the intervention. If public means are used the actual fare paid should be used although this is not likely to be totally accurate. If no expenditures were incurred during the trip, e.g., walking or using a private bicycle, no costs should be assigned.

3.4.5 Data sources

Figure 3 distinguishes various sources of data, giving guidance to the analyst for which sources should be approached first. The optimal source is when the price is available from the health project, where it is easily collected. If the resource markets are thought to be relatively undistorted, then this price can be taken to reflect opportunity cost. However, if an adjustment is necessary and the data required to do so is not available, the analyst can either make a best-guess, or can go to the second best method, which is to take the price from other Ministry of Health sources. However, in this case the prices may not reflect well the market faced by the health project, and therefore comparisons will need to be made, with adjustments. In the absence of data from the Ministry of Health, other government sources may be searched, such as the Ministry of Energy (for electricity costs) or the Ministry of Public Works (for building costs). A final source, the private market, should be approached if these other sources fail, but profit margins and non-labour taxes should be allowed for. In the case of buildings, the private sector rental market may be the first-best solution, as rental values reflect more closely opportunity cost than annuitised building costs.

{Insert Figure 3 here}

4. Transferability of unit costs across time and country

Due to a severe shortage of comprehensive cost and cost-effectiveness data sets in most developing countries (as well as developed countries), and the lack of resources to conduct primary research in these same settings, it is necessary to transfer data across time and/or countries.

4.1 Transferability across time

As general price levels increase, there is a need to adjust price or cost information when comparing data from different years. In an example, Kumuranayake [30] shows how inflation makes a difference to what drugs will cost in different years. If the price of drugs was \$140 last year and \$150 this year, this reflects an increase in the real resources used if the inflation was less than the percent change in price $(150-140)/140$, i.e. less than 7.1%. If the inflation were only 5%, the drug price has increased by 2% more than inflation, while inflation were 10%, there would have been a 3% reduction in the price of drugs relative to inflation over the two years. In order to do a realistic comparison across years, or to convert values of resources to one given year, they need to be expressed in the same values (e.g. 2000 dollars); i.e. they need to be valued in *constant* or *real* terms. Money values that are unadjusted for inflation are referred to as *nominal* or *current* prices.

4.1.1 Inflation measures

For consistency and clarity reasons, a single indicator of the inflation rate should ideally be recommended in costing guidelines. There are several possible measures of inflation. The most appropriate inflationary measure for adjusting costs in the health sector is the one which reflects most closely the general price level of health sector resources, or optimally, the price level for the interventions under study [30].

- *The consumer price index* (CPI) reflects the change in the cost to the average consumer of acquiring a fixed basket of goods and services⁹. However, it is questionable if its determinants (i.e. choice of goods and services to include, and the weights used) are reflective of the health costs as a whole. Moreover, the CPI is only appropriate if the price of the resource in question is changing at the rate of the general price inflation [31].

- The *Gross Domestic Product (GDP)* implicit price deflator is defined as the price index that measures the change in the price level of GDP relative to real output. It measures the average annual rate of price change in the economy as a whole. It also takes into account changes in government consumption, capital formation, international trade and final household expenditure, and therefore gives an indication of the direction of an economy (for example, the rate at which it is investing in technology, which is relevant for the health sector). Therefore, it is the broadest-based measure of inflation [30], and our recommended deflator for making health sector cost adjustments over time¹⁰.
- *The rate of wage inflation* reflects the average annual increase in wages throughout the economy, or in specific sectors of the economy (e.g. public service).
- *The rate of inflation of specific product groups* reflect the rate of inflation for individual or groups of products, such as agricultural produce, raw commodities, food.

For specific resources there may be alternative and more specific measures of inflation that may better reflect price movements in these resources. For example, most governments provide information on the average rates of wage increases; these should be available for the public sector and the entire employment sector separately. Therefore, these measures can be used to adjust the wage portion of cost.

Please note that the rate of domestic inflation (either CPI or GDP deflator) may not reflect well the rate of inflation of traded goods on the international market¹¹. Therefore, if the price of traded goods recorded from previous years is adjusted at the domestic inflation rate of a high inflation country, then the prices would be overvalued at today's prices. However, if the inflation-adjusted price is then converted to an international currency, it is possible that there is no distortion, due to devaluation of the domestic currency¹². This may cause the difference to be negligible. It may be preferable that the analyst checks international prices in the current year from available sources, to ensure that the difference is not considerable.

4.1.2 Inflation data source

The main inflation indices such as the CPI are easily available, usually on a quarterly or annual basis, and from widely available printed and electronic sources. Internationally reported inflation rates usually reflect the consumer price index (CPI), but also reported

are changes in the prices of factors of production or food. The GDP deflator is usually reported in more specialist sources, such as the World Development Report (see World Development Indicators on the World Bank web site¹³). The IMF's International Financial Statistics provides quarterly and annual national statistics.

4.2 Transferability across countries

CEA guidelines have warned about making uninformed generalisations [16], and analysts have pointed out in the literature why generalisations are potentially misleading [32-37], but literature in general has not been very explicit on how to actually transfer unit cost estimates.¹⁴ There may be several approaches to transfer unit cost estimates across settings, depending on the available information¹⁵:

4.2.1 Input prices are available

Studies done in one country would show the quantities and prices of inputs in their setting. Analysts in other settings could adjust quantities and prices as they need. No special methods for transferring prices are required.

4.2.2 Input prices are not available but traded and non-traded components are known

Sometimes analysts might 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 in their international price as described above and purchasing power parities (PPPs) could be used to convert prices of non-traded goods.

Traded goods. For traded goods, as there is an international price which in theory applies globally (see caveats above), it is assumed that this same price prevails in all countries. If the analyst has reason to believe that the price would in fact vary, for example due to the wider availability of generic drugs in their own country, or differences in domestic transport costs, then an adjustment should be made.

Non-traded goods. Non-traded goods should be treated differently to traded goods because their prices vary much more between countries, when expressed in a common currency at OER, due to differences in purchasing power. This is evidenced by the different dollar values of many (less tradable) goods, especially human capital (salary levels), when countries from around the world are compared. An international currency unit, such as a US dollar, has different value in different countries at the official exchange

rate – i.e. it can buy different amounts of goods and services. This means that health care will cost different amounts in different countries¹⁶. Therefore, analysts who wish to use cost estimates of non-traded goods of country A as an input to a CEA in country B, need to adjust these data to get the correct ‘opportunity costs’ of the goods in country B. Opportunity costs of a non-traded good in country A can be transferred to opportunity costs of the same good in country B by using the Purchasing Power Parities (PPP). The OECD web site argues that “Purchasing Power Parities are currency conversion rates that both convert to a common currency and equalise the purchasing power of different currencies”.¹⁷ In other words, PPPs eliminate the differences in price levels between countries in the process of conversion. This means that if the official exchange rate was used to transfer the costs of non-traded goods from one country to another, the resulting unit cost would be artificially lower in the country with the higher purchasing power¹⁸.

The analyst should take some shortcomings of the PPP approach into account. First, the goods included in the calculation may not reflect purchasing power differences in all relevant goods to the health care intervention under study. Second, some PPP measures have some traded goods built into them, such as health care specific PPPs. This clearly artificially reduces the purchasing power differences between countries, as the inclusions of traded goods has an equalising effect.

This means that different recommendations are required for different resources:

- Labour: identify the wage differentials between the source and destination countries, and adjust by the factor identified. Take the main categories of health care personnel, and take the average wage for each, ensuring consistency. Alternatively, one could take a range of specific cases (e.g. a 40-year old doctor with 15 years experience; a newly qualified consultant; etc.) in both countries, and compare their wages. If the factor differences vary significantly by staff category, a weighted average should be taken, weighted by the approximate importance of each type of staff member in the overall wage bill. These comparisons will give an average adjustment factor for the labour element of the cost.
- Utilities and buildings: for this, the most easily available and reliable PPPs should be used (see below for data sources).

In concerning oneself with the problem of adjusting for purchasing power differences, the analyst's task could be simplified by the recognition of the similarities of purchasing power between countries of similar level economic development, in particular those countries in the same geographical or trading area. For example, in West Africa, prices may be quite similar between countries for non-traded as well as traded goods. Therefore, in such instances the analyst may not have to consider the use of PPPs.

4.2.3 Input prices are not available 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.

In case cost data is not only to be transferred across countries but also over time, it is recommended to make the time adjustment first, followed by the currency conversion for the reason that it is important to do the currency conversion at current exchange rates. For example, if the unit cost data in the source country are five years out of date, the exchange rate at that date may differ significantly to today's exchange rate, thus giving a misleading value for unit cost.

4.2.4 Source of information:

Official exchange rate. 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 due to government controls, but also due 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 most recent exchange rates.

Purchasing power parity. For OECD countries, rates for the last four years in PPPs are available on the internet¹⁹. Also, the World Bank compares GDP per capita for all

countries at both OER and PPP values²⁰. The World Development Indicators also reports gross national income in international dollars, to allow comparison across countries. This measure is calculated by taking the gross national income in domestic currency and converting it to international dollars²¹ using purchasing power parity rates.

5 Conclusion

This paper argued that the appropriate measure of ‘value’ to be use in cost-effectiveness analysis is the opportunity cost, which follows the rich tradition of social cost-benefit analysis, based on economic theory. Several constraints to measuring the opportunity cost in practice were raised. The most serious constraint are the problems that arise in applying rigidly the definition of opportunity cost as ‘the next best use of resources’, which give rise to a number of complex and data-demanding second-best valuation methods. Combined with a limited research time that analysts devote to collecting and analysing price information in cost-effectiveness analysis, this explains why at present most analysts do little more than take the most available financial prices to value resources in cost-effectiveness analysis.

Therefore, the step-by-step approach 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 and/or time. This paper introduces important terms and concepts for opportunity cost valuation, including the unit of account, choice of numeraire 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.

Table 1. Elements of cost, insurance and freight (c.i.f.) and free on board (f.o.b.)

Item	Element
C.i.f.	<i>Includes:</i> F.o.b. cost at point of export Freight charges to point of import Insurance charges Unloading from ship to pier at port <i>Excludes:</i> Import duties and subsidies Port charges at port of entry for taxes, handling, storage, agents' fees, etc.
F.o.b.	<i>Includes:</i> 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

Taken from Gittinger (1984). Economic analysis of agricultural projects. John Hopkins Press.

Figure 1: Overview of the step-by-step approach to valuation

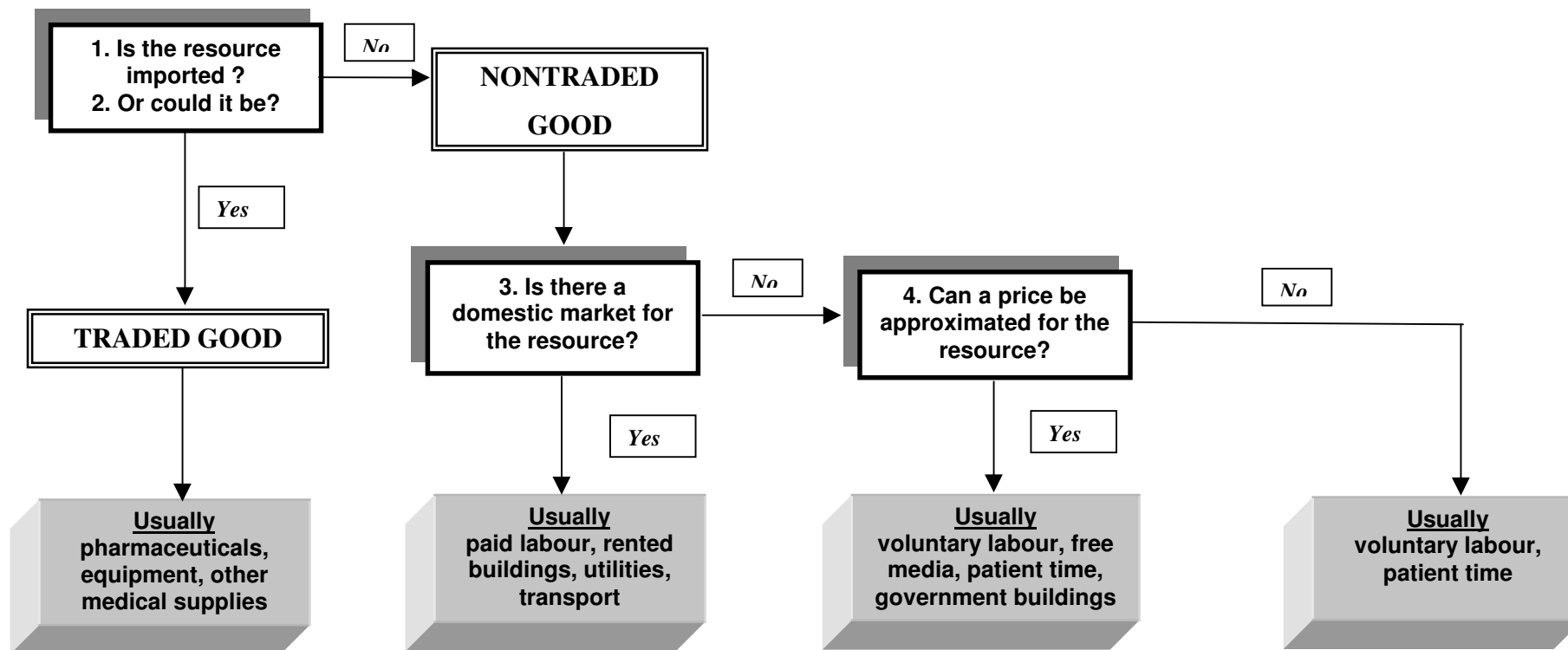


Figure 2: Illustration of the step-by-step approach for identifying the data source and valuation approach for traded goods

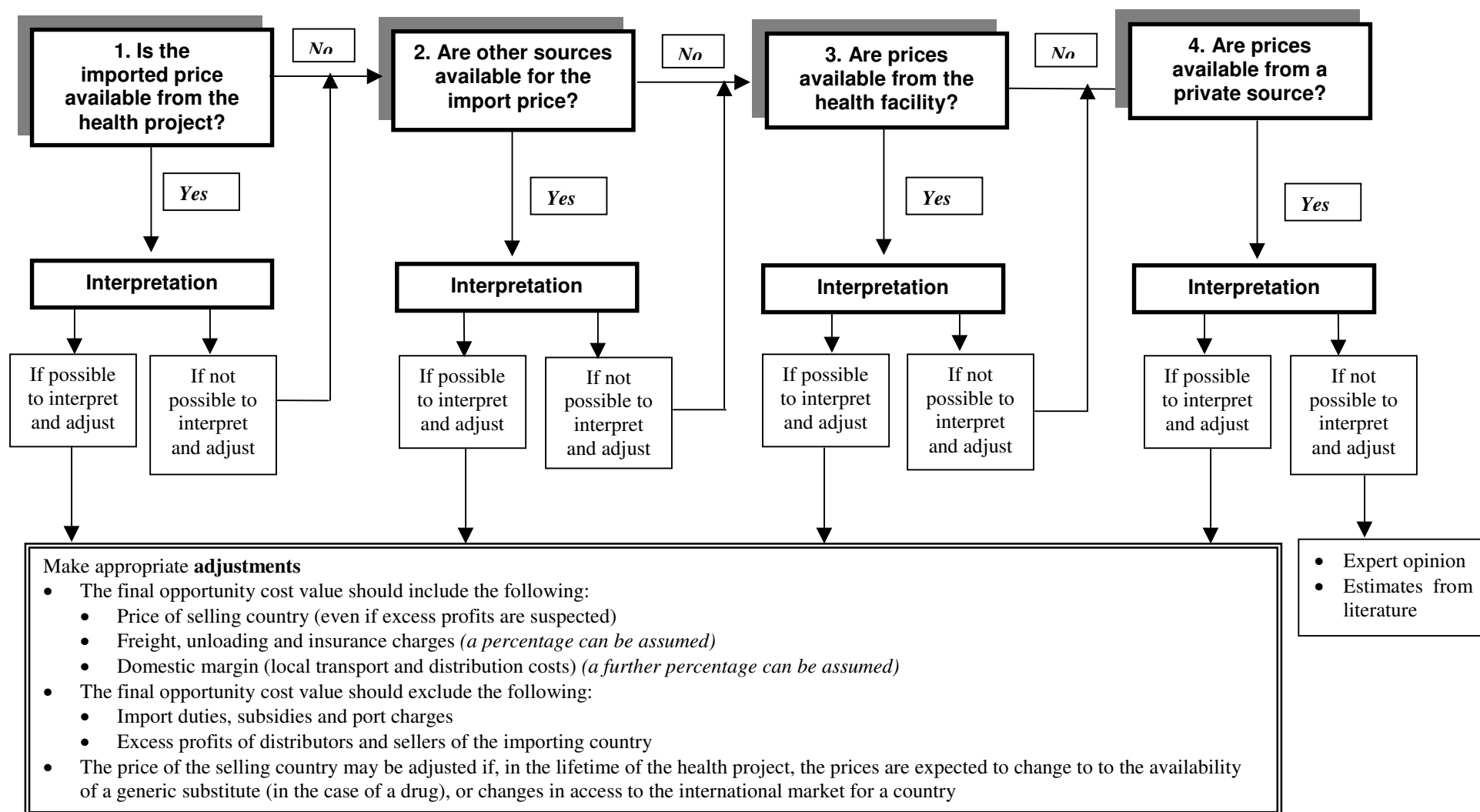
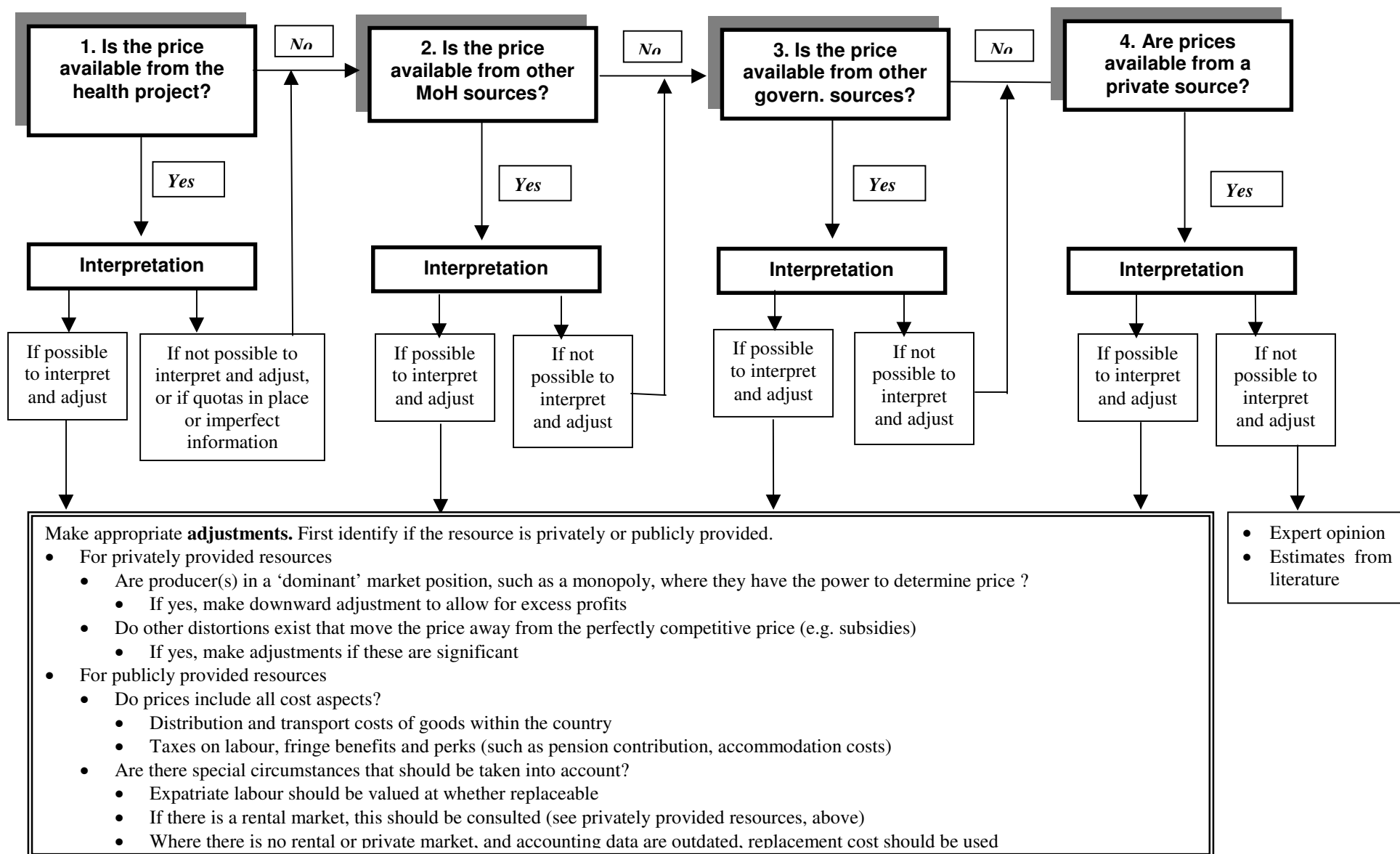


Figure 3: Illustration of the step-by-step approach for identifying the data source and valuation approach for non-traded goods



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¹ Usually with a measure of central tendency – for example, median, confidence interval, standard error, etc.

² The aim of these guidelines was to provide guidance in the evaluation of the costs and benefits of alternative development projects, from the viewpoint of maximising foreign exchange receipts, and thus national income. These two guidelines, and the further refinements that followed, were focused mainly on how resource inputs and resource consequences should be valued from the societal perspective. There are several problems related to the direct use of these guidelines in valuing resources in cost-effectiveness analysis in the health sector. Firstly, the main aim of the OECD and UNIDO guidelines is to show whether development projects are acceptable by the criterion of trade efficiency. This is not the same as the final aim of cost-effectiveness analysis, where the aim is to assess which combination of projects will give the maximum (or optimally distributed) health benefits with a limited budget, and where trade efficiency only matters to the extent that imports are purchased in appropriate quantities to support the health interventions, and that the Ministry of Health has to pay the foreign exchange cost of imported goods. Therefore, to compare health projects in terms of the foreign exchange they *generate* would not be in direct alignment with the aims of health projects, but on the other hand the foreign exchange cost of imported goods is indeed of relevance to the analysis. Secondly, some of the SCBA recommendations for making adjustments to prices to approximate opportunity cost are highly complex, due largely to the many resource and foreign exchange market distortions in developing countries, and the measures that had to be taken to correct for these distortions. In effect, these were manuals written by economists, for economists, and therefore the recommendations could only be used by those who have received an in-depth training in cost-benefit analysis methods.² However, in conclusion, despite its' shortcomings the SCBA literature is highly valuable in choosing optimal valuation methods for CEA guidelines designed for use in the health sector, and this has been reflected in previous cost-effectiveness analysis guidelines.

³ Instead, the UNIDO guidelines recommend to value goods in terms of their domestic prices, which requires a conversion of the prices of traded goods to domestic prices [9,10]. In theory, the choice of numeraire has no impact on the ordering of projects: it purely means that goods valued in domestic prices (UNIDO method) exceeds the value in border prices (OECD method) by the shadow exchange rate factor ($SER_F = SER \div OER$), which is the inverse of the standard conversion factor (SCF) (see below). Therefore, which approach is taken by analysts is not of great significance, and the method chosen depends on the objective of the CEA. The argument for use of international prices is that it is a better measure of opportunity cost as distortions are accounted for more completely, and international prices are recommended as the numeraire in this paper.

⁴ For goods that are imported this means the prices include carriage, insurance and freight. For goods that are exported, this means the prices are 'free on board' – the price at the border of the exporting country.

⁵ The essential idea is that all non-traded goods can be ultimately be broken down in traded goods and labor. For example, local transport by lorry, could be evaluated in terms of driver time, road and vehicle maintenance (non-traded), and fuel (traded). The non-traded aspects can be further sub-classified in terms of traded, non-traded and labor components. Eventually, by continuing to break down the non-traded components, the total value of the non-traded component will be expressed in terms of traded goods – which can then be shadow priced using their border prices – and labor which can be shadow priced using the principles discussed in the sections below. In summary, all non-traded goods are to be expressed in terms of their traded goods components (and labor). Next, these traded goods components need to be converted into border prices by a conversion factor to account for the distortions of their domestic market prices because of import tariffs.

⁶ The FOB price should only be used when it is known that a resource being used in the health care programme is exported by the country of the study. In this case, the opportunity cost represents the lost foreign exchange earnings due to use in the health project instead of export. The FOB price should include the production cost as well as the costs to get the product to the harbour of the exporting country, and includes local marketing and transport costs and local port charges.

⁷ This may occur for one of several reasons. For example, the company exploits a greater willingness to pay in one country; similarly, there may be less price elasticity in some country markets, thus giving the company an opportunity to boost profits by raising prices.

⁸ This is either because the distances are greater, or alternative forms of transport are used, or the cost per kilometre is higher.

⁹ For example, the data source ‘World Development Indicators’ (from the World Bank) uses a Laspeyres index formula.

¹⁰ In some countries health-specific GDP deflators and CPI are available. But because this is not true for most of the countries of the world, we are not recommending that they be used for Generalized CEA

¹¹ This statement does not reflect the price-increasing effects of technology advancement, which has a further inflationary pressure for traded goods.

¹² In high inflation countries the currency devalues by an amount roughly equal to the difference between inflation rates of other major economies and the inflation rate in the domestic economy.

¹³ http://www.worldbank.org/data/wdi2001/pdfs/tab4_14.pdf

¹⁴ There are other issues related to cost data transfer that are not addressed in this paper, namely the differences that exist between settings that cause unit costs to vary irrespective of currency or time period. These differences include, for example, differences in the delivery of health care delivery (such as efficiency, capacity utilisation, types of staff) and differences in the patient profiles, thus leading to different unit costs as well as cost per case (such as cost per admission). These are important aspects in transferring cost data between settings, but are not related to the issue of valuation.

¹⁵ The starting point of analysis is that the cost data source has already been chosen, using a number of criteria to ensure relevance and quality. These include (1) the unit cost estimate is relevant to the type of health care where unit cost is being estimated, and that it comes from a comparable country and level of care in terms of health care delivery; (2) The unit cost estimate meets minimum quality criteria, and it is known what unit cost contains; and (3) Preferably, the unit cost estimates are available in disaggregated form for recalculating and making adjustments.

¹⁶ By no means does this mean that health care is actually cheaper to the government in this country, as health care budgets are often significantly lower too.

¹⁷ For example, when an apple costs Rs. 10 in India, and 1 US\$ in the United States, the PPP for apples equals 1 US\$ = Rs. 10.

¹⁸ ‘Artificially’ in the sense that they are not that low in reality.

¹⁹ <http://www1.oecd.org/std/ppp1.pdf> and <http://www1.oecd.org/std/ppp2.pdf>

²⁰ <http://www.worldbank.org/data/databytopic/GNPPC.pdf> also available from the World Development Report appendix tables

²¹ An international dollar has the same purchasing power over GNI as the U.S. dollar in the United States.