

Chapter Eleven

Economic Prices for Non-tradable Goods and Services



11.1 Introduction

Non-tradable items are those that are not traded internationally. They include items such as services for which the demander and producer are in the same location, and commodities that have low value in relation to either their weight or their volume. In such cases, the transportation charges prevent producers from profitably exporting their goods. Typically, non-tradables include such items as electricity, water supply, all public services, hotel accommodation, real estate, construction, and local transportation; goods with very high transportation costs, such as gravel; and commodities produced to meet special customs or conditions in a particular country.

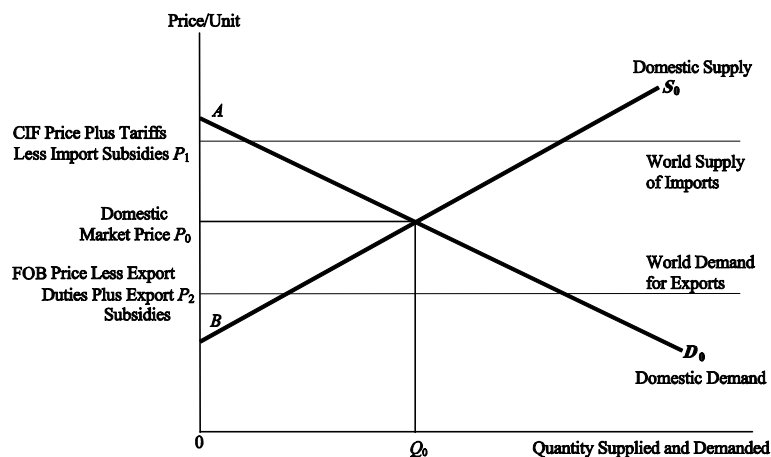
The key element to be borne in mind when considering the tradable or non-tradable classification is where the price for the good (or service) in question is determined. If this determination takes place in the world market, the good should be considered tradable. If the setting of the price takes place through supply and demand in the local market, the good should be considered non-tradable.

High rates of protection can easily cause a good that is internationally tradable to end up being properly classified as non-tradable. One example is rice in Japan, where until recently imports were explicitly forbidden and where the internal price has typically been more than double the international price. Another is grocery items from advanced countries, which often sell in developing-country markets for significant multiples of their free on board (FOB) price. Such high prices, whether caused by tariffs or by the low-volume, high-markup

characteristics of the imported good, lead to situations in which “similar” items produced locally have their prices determined by supply and demand in the local market, well under the “umbrella” price of the imported counterpart, but are still not exported. When the price of locally produced merchandise is well below the “corresponding” local price of imported items, it is quite appropriate to treat local production as non-tradable, despite the anomalous price relationship.

If the cost, insurance, and freight (CIF) price, adjusted to include tariffs, taxes, and import subsidies, is greater than the market price, and no imports of the good are present in the country, then it is clearly a non-tradable good from the point of view of that country, or region of the country. Imports cannot compete with domestic production, at least with the existing level of tariff protection. Alternatively, if the FOB price, excluding export duties but including any export subsidies, is less than the domestic market price of the item, and no exports of the commodity are taking place, then again it is non-tradable. The standard relationships between the adjusted CIF, adjusted FOB, and market prices are illustrated in Figure 11.1 for the case of limestone.

Figure 11.1: World Prices, Domestic Price, and Non-tradable Goods (the Case of Limestone)



As the CIF price, plus tariffs less import subsidies (P_1), on limestone is above the domestic market price (P_0), the domestic demanders will be unwilling to purchase imported limestone. Similarly, since the FOB price, less export duties plus export subsidies (P_2), is less than the market price, domestic producers will be unwilling to sell abroad for a lower price than they can sell to domestic demanders.

11.1.1 Relationship between Tradable and Non-tradable Goods

The distinction between tradable and non-tradable goods is quite naturally right at the core of the field of international economics, and it carries over well to the field of cost-benefit analysis. However, in this area a special case arises with regard to items that have no market prices, but must nevertheless be assigned a value for project evaluation purposes. Examples are the value of time saved as a result of a highway improvement, or the amenity values created by a public park, or other cases in which consumer surplus benefits are assigned on top of actual market prices paid. Such items, as they are not actual outlays (or receipts), are not subject to shadow pricing. However, all actual cash outlays and receipts should in principle be classifiable as referring to one of the two broad categories, tradables and non-tradables.

In order to see how this distinction arises, and how it works, it is useful to describe the development of our professional thinking about project evaluation. The first step in this process involved focusing on the actual imports that were made by a project and the actual exports of its products. The cost of the imports was reduced to the cost of acquiring the foreign exchange needed to buy them, and the value generated by the project's exports was the value of the foreign exchange that they produced. Even at this early stage, there was a clear need to calculate an economic opportunity cost of foreign exchange (EOCFX) in order to accurately reflect the true economic costs (in local currency) of the project's imports and the corresponding true economic benefits of its exports.

However, this was only the first step. It soon became clear that there was also domestic production of many of a country's imported goods and, similarly, domestic use of many of its export products. In these

cases, it really did not matter whether the copper bought by a project was domestically produced or imported; copper bought from a domestic source in the United States would simply lead to somebody else importing an equivalent amount, and wheat demanded by a Canadian project would leave that much less wheat to be exported. Using T_i^d and T_i^s to represent the country's own demand and supply of importable good i , we find that imports of i (M_i) are equal to $T_i^d - T_i^s$. Similarly, using T_j^d and T_j^s to represent the country's own demand and supply for exportable good j , we see that exports of that good (X_j) are equal to $T_j^s - T_j^d$.

Now the country's total imports (M) can be represented as:

$$M = \sum_i T_i^d - \sum_i T_i^s$$

Similarly, its total exports (X) can be represented as:

$$X = \sum_j T_j^s - \sum_j T_j^d$$

The country's balance of trade is accordingly:

$$\begin{aligned} X - M &= \sum_j T_j^s - \sum_j T_j^d - \sum_i T_i^d + \sum_i T_i^s \\ &= \sum_j T_j^s + \sum_i T_i^s - \sum_j T_j^d - \sum_i T_i^d \end{aligned}$$

Here $\sum_j T_j^s + \sum_i T_i^s$ represents the sum of a country's total supplies of all tradables and $\sum_j T_j^d + \sum_i T_i^d$ the sum of its total demands for all tradables.

From here, it follows that when there is equilibrium in a country's

trade balance, there is also equilibrium between that country's total demand and supply for tradables. Similarly, a given deficit ($M - X$) in a country's trade will reflect an excess demand of equal size $(T^d - T^s)$ for that country's total tradables.

These ideas and procedures can then be developed further. It is certainly not enough just to look at the project's own actual imports and actual exports (step one). Nor is it enough to extend this by simply considering the project's direct demand for and supply of tradable goods (step two). What is needed is a further extension to include the project's overall impact on the country's demand and supply of tradable goods (step three).

Although in principle a project may have more reverberations than can be conveniently captured, the basic procedure suggested concentrates on the flows of "receipts" (sales of project output) and expenditures (project outlays for investment activities plus operating costs) over the course of a project's economic life.

The division of project outlays is represented in Table 11.1. When the project purchases tradables directly, the purchases are classified under item 1. This is the case regardless of whether the goods bought were actually imported, or domestically produced items falling into the "importable" category, or domestically produced but falling in the "exportable" category. It is deemed that all three of these categories put pressure on the foreign exchange market, through (a) direct demand, (b) indirect demand, in which others do the importing, or (c) reduced export supply.

When the project purchases non-tradables, the situation is slightly more complicated because there are various ways in which this type of purchase can eventually be reflected in incremental demand for tradables. We first look at that part of the project's non-tradables purchased (d) that ends up as increased output of the goods or services in question. This increased output will be reflected in either increased value added (d_1), or increased tradable inputs (d_2), or increased non-tradable inputs (d_3).

However, this case tells the whole story only when the project's entire demand for non-tradables is met through increases in their supply.

In the typical case, some fraction f_k^d of the project's demand will be

met by squeezing out other demanders for the non-tradable goods and services in question. In looking for the consequences of this process, we must ask about the activities that are stimulated as some of the previous demanders of H^k reassign that demand to other activities. In particular, it must be recognized that some of the relevant substitutes for H^k will themselves be tradable items, while others will, though non-tradable themselves, have tradable inputs. This is why, in Table 11.1, there are two items (e_1 and e_2) representing increases in tradables demand arising from what happens when the project satisfies some of its extra demand for non-tradables by displacing other demands for them.

Table 11.1: Classification of Project Outlays

	<i>Final Classificati on</i>	
	<i>Tradable (T)</i>	<i>Non- tradable (H)</i>
1. Project purchases of tradables		
a. Actual imports by project (M_i)	X	
b. Importable goods produced in the country (T_i^s)	X	
c. Exportable goods produced in the country (T_j^s)	X	

2. Project purchases of non-tradables (H_k^p)		
d. Project demand met through increased domestic supply $(F_k^p - \Delta_k)$		
d_1 value added in activity $k = (v_k \Delta_k)$		X
d_2 tradable inputs into activity $k = a_k(\Delta_k)$	X	
d_3 non-tradable inputs into activity $k = a_{hk}(\Delta_k)$		X
e. Project demand for (H_k^p) met through displacing other demanders $(F_k^p - \Delta_k)$		
e_1 demand displaced into tradable substitutes $b_k(\Delta_k)$	X	
e_2 demand displaced into non-tradable substitutes $b_{hk}(\Delta_k)$		
value added $e_{2v} = v_k b_k(\Delta_k)$		X
tradable inputs $e_{2t} = c_k b_k(\Delta_k)$	X	
non-tradable inputs $e_{2h} = c_{hk} b_k(\Delta_k)$		X

Table 11.2 presents a numerical example that may help to demonstrate that the framework presented here is relatively simple and

straightforward. Here the direct outlays of the project are assumed to be divided 40–60: 40 on direct purchase of tradables and 60 on direct purchase of non-tradables. All of the amount spent on tradables stays there, on the basis that there is presumably no incremental domestic production of tradables arising out of our project’s demand.

Table 11.2: Classification of Project Outlays (Numerical Example)

	<i>Final Classifica tion</i>	
	<i>Tradable (T)</i>	<i>Non- tradable (H)</i>
1. Project Buys Tradable Goods (40)		
a. Actual imports of vehicles	20	
b. Petroleum (an importable) from local sources	15	
c. Cotton (an exportable) from local sources	5	
Sub-total for tradable outlays	40	0
2. Project constructs buildings (non-tradables) (60)		
d. Project demand met through net increase in construction (28)		
d_1 value added in this increase in construction		14
d_2 tradable inputs used in same (materials)	6	
d_3 non-tradable inputs used in same (purchased services)		8
e. Project demand met through displacing other construction (32)		

e_1 demand displaced into tradable substitutes (machinery and equipment)	7	
e_2 demand displaced into non-tradable substitutes (maintenance and repair)		
e_{2r} (materials)	9	
e_{2h} (purchased services)		6
e_{2v} (value added in maintenance & repair)		10
Sub-total for non-tradable outlays	22	38
Totals for project	62	38

The situation is different when it comes to the project's demand for non-tradables. In this case there is every reason to believe that some increased production will be stimulated, but that this will involve greater value added plus greater use of both tradable and non-tradable inputs. Thus, in the example of Table 11.2, we have 60 spent on construction of buildings by the project, of which 28 represents a net increase in construction and 32 represents a displacement of the demand of others. Of the 28 of net increase, 6 is assumed to reflect increased demand for tradable inputs (d_2), while 22 reflects either increased value added in construction (14) or increased use of non-tradable inputs (8).

We now turn to the items representing project demand met through displacing other construction. The issue here is not what resources were used to satisfy the demand before it was displaced. These resources are assumed now to be satisfying the project's demand. The key question is what resources will be used in other places to satisfy the demand of others, which the project has managed to displace.

In item (e) it is assumed that part of this displaced demand (7) moves directly to the purchase of tradable substitutes. The remaining 25 is assumed to be shifted to non-tradable substitutes. However, here it contains three components: tradable inputs (materials) taking 9, non-tradable inputs (purchased services) taking 6, and value added taking 10. Hence, the correct division of the project outlays of 100 is 62 to tradables and 38 to non-tradables, almost the reverse of the initial 40–60

division of the direct expenditures.

With regard to the 60 of non-tradables purchased, the tradable content as a proportion of the total purchased is $T = 22/60 = 0.36$, while for the non-tradable content the proportion is $NT = 38/60 = 0.64$.

11.1.2 Economic Valuation of Non-tradables

The process of estimating the economic costs or benefits of tradable goods is simplified by the assumption that world prices of these goods and services can be taken as given. Unfortunately, the analysis is more complicated for non-tradable goods. However, it is similar to the tradable case when supplies of the non-tradable good in question are highly elastic. In such a case, when more of a non-tradable is purchased by a project, any tax paid on the input's purchase is included in the project's financial cost. Such taxes are excluded from the costs when estimating the economic cost of the input since the tax is not a true economic cost.

When a non-tradable good or service is produced purely by non-tradable inputs, the premium for expenditures on non-tradable goods and services (NTP) (calculated from the estimate of the shadow price of non-tradable outlays, SPNTO) should be added to the net-of-tax financial cost of the item purchased. The estimated value of NTP captures the value of the externalities lost when funds to finance the project's costs are raised from the capital market and the proceeds used to buy non-tradable goods. The converse is also true. The value of NTP also measures the value of the externalities gained per dollar of output produced when the project sells a non-tradable output.

If the project produces or demands a standard non-tradable good with an upward-sloping supply curve and downward-sloping demand curve, the economic value of the good is determined by its demand and supply as well as the impact of the act on the rest of the economy. These cases are discussed in detail in the following sections.

Section 11.2 describes the way in which the economic value of non-tradable outputs can be measured in the case of infinite supply elasticity. Section 11.3 considers the case of a non-tradable good in the standard supply and demand framework. Section 11.4 identifies some unique

features of applying economic prices to the measurement of net economic benefits of a project. Section 11.5 provides an example of how the economic value of a non-tradable project input can be measured. Conclusions are made in the final section.

11.2 The Case of Infinite Supply Elasticity

The simplest case is for a project producing non-tradable outputs, the market supply function of which is infinitely elastic.¹ Electricity projects make an almost ideal case in point, for a number of reasons. First, the true, intrinsic value of electricity to its demanders is quite hard to gauge. Second, electricity projects can take many forms: run-of-the-stream hydro projects, daily reservoirs, seasonal dams, inter-annual storage dams, and many others. Trying to measure the benefits of each such project (heterogeneous even within any one of the listed types) might seem to be a hopeless task. However, such qualms should be allayed once it is realized that the true measure of the benefits of almost any type of electricity project is the alternative cost of generating a similar flow of energy by some more “standard” means.

Standard alternatives exist, and they are in highly elastic supply. They consist of thermal generators of different types, which can closely approximate the type of energy flow that is likely to come from any given “idiosyncratic” project (with its own pattern of costs). The use of data on different types of thermal-generating facilities enables us to give an alternative cost (= economic price) of energy of any given description (base load, peaking capacity, etc.). The economic cost of approximately replicating the energy output of any given new project can then be calculated. When the project is undertaken, its benefit is measured by the alternative cost of generating an equivalent flow of energy by standard

¹ For the supply of the output to be in perfectly elastic supply, it will also require that all the inputs used in producing the output are in perfectly elastic supply. The infinite elasticity assumption is a good approximation of the economic value of a non-tradable good, especially in the long run, which is most relevant for the present analysis.

thermal means. Such costs would be largely for tradable inputs: the generators themselves, the fuel that would be used, etc. Consequently, the foreign exchange costs of the alternatives will have to be inflated to take into account the existence of a foreign exchange premium (FEP). In addition, non-tradable outlays will have to be adjusted to reflect the shadow price applying to them.

The end result of such an exercise would be the economic opportunity cost of providing the same amount of energy as that produced by the project, but by standard thermal means. The new plant, producing output x , would be worthwhile if its cost, appropriately adjusted to reflect economic rather than financial considerations, was less than (or at most equal to) that of its standard thermal alternative.

In this situation, the value assigned to the electricity generated by the new plant is the value of the resources saved by not needing to generate the electricity by alternative means. In the terminology of the three basic postulates of applied welfare economics (Harberger, 1971), this

economic value P_x^e is equal to the supply price of the alternative electricity service, P_x^s . In some situations, the market price P_x^m of this alternative-generation technology may not reflect its true economic price. For example, this economic price would exclude any taxes that might exist on the fuel used by the alternative source of supply. These taxes might include such items as tariffs, excise and value-added taxes on tradable goods, and value-added taxes and excise taxes on non-tradable goods and services. Such taxes on inputs are not a resource saving or cost, but are transfers to the government. This adjustment is equal to $\sum_i a_{ix}^o P_i^m d_i$, where a_{ix}^o is the input-output coefficient of the input i used to produce a unit of x , while P_i^m is the price of a specific input i , and d_i is the tax wedge associated with the use of input i in the production of x . In this case, the economic price of electricity is:

$$P_x^e = P_x^m - \sum_i a_{ix}^o P_i^m d_i \quad (11.1)$$

Note that d_i expresses the tax or subsidy wedge as a fraction of the

market price P_i^m . Suppose the inputs used in the production of electricity by the other electricity suppliers are made up of tradable inputs equal to a proportion (T_x) of the total costs of production and non-tradable inputs equal to a proportion (NT_x) of total costs. In deriving the economic value of a unit of electricity produced by the project, a final adjustment must be made for the FEP on the tradable resources released and the value of the NTP released by the alternative suppliers. In the case of thermal electricity supply, we would expect T_x to be close to 1 and NT_x to be quite small. Of course, $T_x + NT_x = 1$, by definition.

This adjustment is an additional benefit that arises as tradable and non-tradable resources, which are now made available to the economy as a consequence of the new plant's increase in supply. It measures the value of the generalized economic externalities enjoyed by the economy when resources are released as a consequence of the project. The opposite situation would exist if the project were demanding additional electricity that would be entirely supplied by these alternative-generation facilities. Now the generalized externality would be counted as an additional economic cost of the input purchased. To summarize, in this special case of an infinitely elastic supply of alternative production, the economic value of a unit of good x being produced by the project is equal to:

$$P_i^m + T_x P_x + NT_x P_N \quad (11.2)$$

11.3 A Non-tradable Good in the Standard Supply and Demand Framework

Many markets for non-tradables (whether these are items that are produced by a project or goods and services that are purchased to build or operate a project) are characterized by upward-sloping supply curves. This section will first consider the steps in the economic evaluation of an output of a project that changes the price of the good or service. It will then describe the way in which this mechanism can be used to value the economic cost of non-tradable inputs purchased by a project.

11.3.1 Economic Value of a Non-tradable Output of a Project

For some non-tradable goods, the increase in output of a new project will lower the price of the good and hence cause some displacement of alternative sources of supply. At the same time, the lower price will create some incremental demand. This is a natural outcome of the standard supply and demand framework with upward-rising supply and downward-sloping demand curves.² In this case, some fraction of the output of the new project will be reflected in a movement backward along the supply curve of the other sources of supply of the same goods, plus a movement forward along the total market-demand curve for the good in question. The fractions applying to supply and demand (W^s and W^d) can be calculated using the price elasticity of supply (ϵ^s) and demand (η^d) for the goods³ as ~~$W^s = \frac{\eta^d}{\eta^d - \epsilon^s}$~~ and ~~$W^d = \frac{\epsilon^s}{\eta^d - \epsilon^s}$~~ .

The economic prices associated with the changes in supply and demand as a result of a project are measured using the principles of applied welfare economics. Let P_x^s be the supply price per unit produced by those suppliers other than the project, and P_x^d be the demand price per unit by domestic demanders of the good in question (project output plus other supply). The economic price (P_x^e) per unit of a non-tradable good x produced by a project can be measured by a weighted average of its supply price (P_x^s) and the demand price (P_x^d). The weights reflect the responsiveness of existing suppliers and

² Some of the concepts for measuring economic welfare changes are further elaborated in Appendix 11A.

³ The relevant elasticities are those that would characterize the markets in reaction on average over the life of the project.

demanders to changes in the price of the non-tradable good. That is:

$$\frac{P_x^d}{P_x^s} = \frac{W_x^d}{W_x^s} \quad (11.3)$$

where $W_x^s + W_x^d = 1$.

Let us now introduce distortions in the output market for the item. Suppose there is a production subsidy k_x expressed as a proportion of the net-of-subsidy price.⁴ In our terminology, the marginal cost of production is defined as the good's supply price P_x^s . In addition, there is a tax levied at the rate of t_x on the market price P_x^m . This is the price that the supplier receives excluding any taxes that might have been paid by the final consumer. Thus, the supply price and demand price are $\frac{P_x^s}{1+k_x}$ and $\frac{P_x^m}{1+t_x}$, respectively. Equation (11.3) can then be expressed as follows:

$$\frac{P_x^m}{1+t_x} = \frac{P_x^s}{1+k_x} \frac{W_x^d}{W_x^s} \quad (11.4)$$

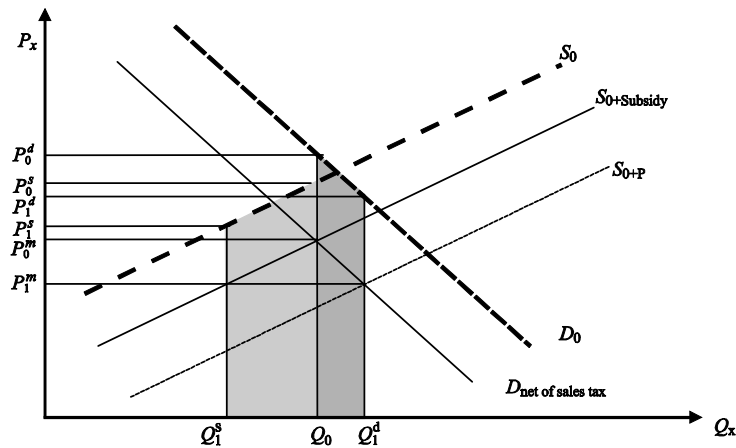
The conversion factor, obtained by dividing the economic value per unit of output, shown in equation (11.4), by its financial price exclusive of tax and subsidy, is equal to 1 plus a weighted average of the distortions in the product in the market, i.e., $\frac{1+t_x}{1+k_x} \frac{W_x^d}{W_x^s}$. However, if the financial price is inclusive of tax, the conversion factor will be equal to $\frac{1+t_x}{1+k_x} \frac{W_x^d}{W_x^s}$. This may seem to be similar to the tradable case, but the issue is more complicated owing to the impact that the project's output has on other distorted markets and the reallocation of resources in the

⁴ If instead, and perhaps more realistically, the subsidy could be provided as a proportion, K'_x , of the total resource costs, then $\frac{P_x^s}{1+K'_x} = P_x^s$, hence $\frac{P_x^m}{1+t_x} = P_x^s \frac{W_x^d}{W_x^s}$.

economy.

In a standard supply and demand framework with upward-rising supply and downward-sloping demand curves, the economic price (P_x^e) of a non-tradable good x can be estimated in a partial equilibrium analysis as a weighted average of the supply price (P_x^s) and the demand price (P_x^d), as expressed in equation (11.4). The supply price of the product is measured by what producers actually receive (i.e., gross of any subsidy and net of any tax). The demand price is measured by what demanders actually pay (gross of tax). Suppose the good x is a telephone service produced by mobile telephones. The supply that the mobile telephone project displaces is likely to be communications services produced by the existing land-line telephones. The existing supply from all sources is assumed to receive a direct subsidy from the government equal to a fraction (k_x) of all their financial costs. Including the items discussed so far, the economic value of good x is shown by the shaded areas of Figure 11.2.

Figure 11.2: Economic Costs of a Project (When a Production Subsidy is Present)



On the demand side of equation (11.4), the amount of income spent on the incremental increase in the quantity of x demanded, measured by $W_x^d P_x^d$, will no longer be spent on other goods and services in the economy. In general, we would expect that some taxes would have been paid on these goods and services that are no longer being purchased. This effect should be captured by adding an economic cost (reducing the benefit) as the taxes associated with purchases of those goods and services are now forgone. Since it is not known precisely where those goods and services would be forgone, an average indirect tax distortion rate (d^*) on these items is assigned. Hence, the offsetting loss in taxes as a result of the diversion of demand toward good x will be $W_x^d P_x^d d^*$. The second term on the right-hand side of equation (11.4) now becomes $W_x^d P_x^d (1 - d^*)$.

If it was known that the additional quantity of the non-tradable good demanded was being drawn from a specific substitute good or service, y , we would want to subtract the tax t_y lost as a result of the reduction in the purchase of this good from that of the additional tax paid, t_x . In this case, the second term on the right-hand side of equation (11.4) would become $W_x^d P_x^d (1 - t_y)$.

Adjustments must also be made to the supply price of producing the good x . However, because different adjustments are required for different types of intermediate inputs used to produce the good x , they will be dealt with in the following subsections.

a) Intermediate Inputs with Infinite Supply Elasticity

Two further adjustments need to be made to the market price of the supply price of this good x in order to derive the value of the resources released by the non-project suppliers of the project output x . First, the supply price in equation (11.4), W_x^s , does not take into consideration any tax distortions (d_i) levied on the intermediate inputs used to produce the existing supply of x that is being partially replaced

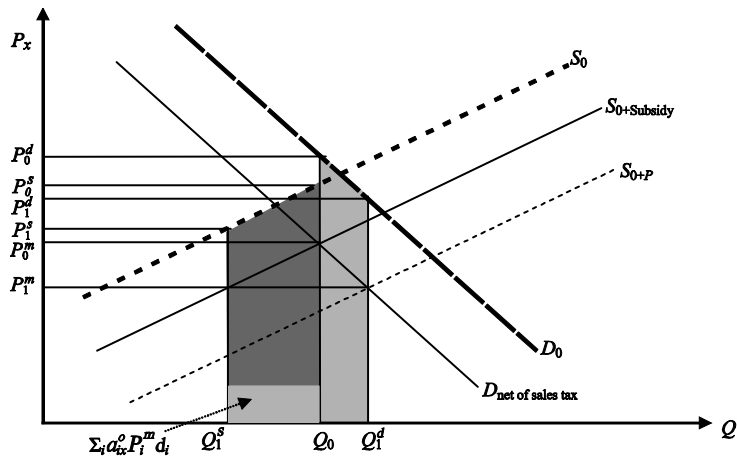
by the project. These inputs will now go elsewhere in the economy to produce other goods and services. However, the value of the resources saved should not include the taxes that will no longer be paid by the non-project suppliers. The composition of these intermediate inputs may differ depending on whether the replaced supply of x was using an identical technology. Often, the technology will be different from that used by the project.

Certainly, the inputs released do not need to be of the same composition as those used by the project (i.e., $\sum_i a_{ix} P_i^m$). Suppose they are $\sum_i a_{ix}^o P_i^m$. In the case in which there are many such intermediate inputs, the adjustment made to the supply side of the economic price of good x of equation (11.4) is $\frac{W_x \sum_i a_{ix}^o P_i^m d_i}{\sum_i a_{ix} P_i^m d_i}$. This adjustment⁵ is shown in the lower part of the shaded area as $\sum_i a_{ix}^o P_i^m d_i$ in Figure 11.3.

The second adjustment that has not been accounted for is the FEP and the NTP associated with tradable and non-tradable components, respectively, of the non-tradable good. These premiums arise because with the reduction in production on the part of the non-tradable suppliers of this good, the demand for tradable inputs will be lower, and hence there is a saving of the FEP associated with this tradable component. The same sort of externality arises when the non-tradable inputs are released by the non-tradable sources of the supply of the good. In this case, it is the externality measured by the premium associated with the estimated value of SPNTO.

Figure 11.3: Economic Benefits of a Project (When a Production Subsidy is Present)

⁵ The value of this tax adjustment, $\frac{W_x \sum_i a_{ix}^o P_i^m d_i}{\sum_i a_{ix} P_i^m d_i}$, is exactly correct only if the tax and subsidy distortions are on tradable inputs or on non-tradable inputs that are in perfectly elastic supply. This issue will be discussed later in this chapter.



It is likely that when the final equilibrium is re-established after the project has been implemented, the ultimate uses of tradable and non-tradable components of intermediate inputs would not be the same as the initial purchases of the intermediate inputs employed to produce the non-tradable good x . However, it is difficult to foresee the final uses of tradable and non-tradable components of intermediate inputs. For all intents and purposes, it is assumed that the composition of tradable and non-tradable components of intermediate inputs remains unchanged. The economic value of the non-tradable good produced would then be adjusted by increasing the cost of the tradable component of the non-tradable intermediate inputs required to produce the good x by the FEP, and the cost of the non-tradable component of the non-tradable intermediate inputs by the NTP. That is:

~~$$P_1^m = P_1^s + \sum_i a_{xi}^t P_i^m + \sum_i a_{xi}^n P_i^n \quad (11.5)$$~~

After taking into account all the repercussions of producing the non-tradable good x in the economy, the economic price of the non-tradable good x can be measured as:

~~$$P_1^m = P_1^s + \sum_i a_{xi}^t P_i^m + \sum_i a_{xi}^n P_i^n$$~~

$$\frac{P_x(1+d_x)}{P} \quad (11.6)$$

Since the financial receipts of the non-tradable good x are $P_x(1+d_x)$, the conversion factor of this product will be:

$$\frac{P_x(1+d_x)}{P} \quad (11.7)$$

b) Intermediate Inputs with Finite Supply Elasticity

Up to this point the assumption has been that the only distorted inputs being used in the production of good x by its non-project suppliers were either internationally traded, or, if non-tradable, in perfectly elastic supply. For those intermediate inputs that are neither internationally traded nor in perfectly elastic supply, a different adjustment is required to eliminate the value of the input distortion from the value of the resources released. In this case the price of the input will be lower as the demand for the input is decreased. As a consequence, both the demand and the supply of the input j will be affected, and the objective here is to measure any distortions associated with the supply and demand sides of the non-tradable intermediate inputs j caused by the additional supply of the project's non-traded good x .

As the project produces more good x , the other producers of x will reduce their supply and hence their purchases of input j . The financial cost of the input j will be $P_j(1+d_j)$. Following the standard supply and demand framework with upward-rising supply and downward-sloping demand curves, because their price of j is now allowed to change, the effect will be a cutback in the supply of j . The economic cost of the input j that is due to its supply response will be measured by the response of the input supply W_j^s multiplied by the price of the input P_j^m , or $W_j^s P_j^m$, where a_{jx}^o is the input-output coefficient of the input j used to produce a unit of x . In the case where there is a subsidy on the

production of j , the economic cost will be measured by $\int_0^k p_j^j(x) dx$, where k_j stands for the subsidy rate.

At the same time, owing to the drop in the price, more of the input j will be demanded by other users of the input. We therefore want to estimate the economic value of the input j in the demand response as

$\int_0^k p_j^j(x) dx$. At the same time there will be an offsetting adjustment owing to the diversion of j to other demanders. If these new

purchasers of j pay the same tax t_j , there will be no net distortion to be deducted as a result of the diversion of the demand for j . However, it might be more appropriate to assume that the average rate of distortion of d^* is paid by the new demanders of this input, since it is not known precisely where those inputs will be finally used. With this adjustment, the net economic value of the input j in the demand response should be

measured by $\int_0^k p_j^j(x) dx - d^* k_j$.

To summarize the above discussion, when the non-tradable input j with a finite supply elasticity is used to produce a non-traded good x , the adjustment to the supply side for the distortions on input j can be measured by the excess of the financial cost of the input j over and above its corresponding economic cost. That is:

$$\int_0^k p_j^j(x) dx - \int_0^k p_j^j(x) dx \quad (11.8)$$

Simplifying equation (11.8) by substituting $P_j^j(1-t_j)$ with $P_j^j(1-t_j)$, the total distortion of tax and subsidy on non-tradable input j will become:

$$\int_0^k p_j^j(x) dx - \int_0^k p_j^j(x) dx \quad (11.9)$$

Both t_j and d^* are positive, and their effect will be to reduce the

economic cost of the final non-tradable good x , while k_j is a subsidy on the non-tradable supply of input j , which is negative and will thus increase the economic cost of the final non-tradable good x .

The symbol d_j can be used to stand for $t_j - k_j$, which is equivalent to the distortions (d_i) associated with the tradable intermediate input i . Thus, equation (11.9) can be written as:

~~$$\dots \quad (11.10)$$~~

That being said, in a more generalized form one would assume that the production of good x by the project leads to the release of some intermediate inputs i_s by the non-project producers with perfect supply elasticity, along with the release of other intermediate inputs j_s with finite supply elasticities. After making all the above adjustments, including accounting for the distortions in the markets for intermediate inputs i and j , the measurement of P_x^e for equation (11.6) will be modified to become:

~~$$\dots \quad (11.11)$$~~

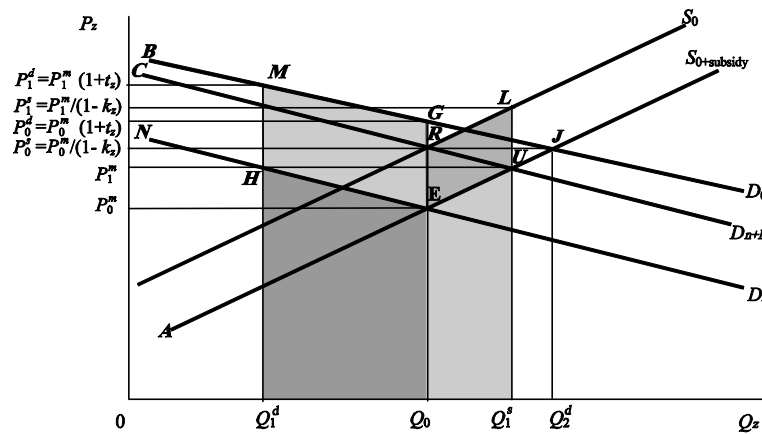
The input-output coefficients in equation (11.11) relate to the factors and factor mix used by the non-project producers of x whose markets are being affected by the project.

11.3.2 Economic Value of a Non-tradable Input Purchased by a Project

Figure 11.4 illustrates a situation in the market for an input z that is used

to produce the good x . This input receives a direct subsidy equal to k_z of its production cost, and when it is sold, this input is subject to a tax of t_z . When the project demands more of this input, its market-demand curve will be shifted from ND_n to CD_{n+p} . This will stimulate additional supply of $(Q_1^s - Q_0)$ and will cause the previous consumers of z to reduce their purchases by $(Q_0 - Q_1^d)$.

Figure 11.4: Economic Costs of a Project (When a Production Subsidy and a Sales Tax Are Present)



The first step in estimating the unit economic cost (P_z^e) of this non-tradable input z that is purchased by the project is to consider cost from the value of the additional resources used by producers to supply more of z and the value placed on the demand from others that has been given up because the price of z has been raised. These two costs are measured by a weighted average of its supply price (P_z^s) and its demand price (P_z^d), respectively. The weights reflect the responsiveness of existing suppliers and demanders to changes in the price of the non-tradable

input. That is:

$$P_z = P_z^0 + \sum_{i=1}^n \lambda_i \frac{\partial P_z^0}{\partial P_i} + \sum_{j=1}^m \mu_j \frac{\partial P_z^0}{\partial P_j} \quad (11.12)$$

where $\lambda_i = \frac{\partial W_i}{\partial P_i}$.

If we account for the market distortions explicitly, then $P_z = P_z^0 + \sum_{i=1}^n \lambda_i \frac{\partial P_z^0}{\partial P_i}$ and $P_z = P_z^0 + \sum_{j=1}^m \mu_j \frac{\partial P_z^0}{\partial P_j}$; hence, equation (11.12) can be written as:

$$P_z = P_z^0 + \sum_{i=1}^n \lambda_i \frac{\partial P_z^0}{\partial P_i} + \sum_{j=1}^m \mu_j \frac{\partial P_z^0}{\partial P_j} + \sum_{k=1}^p \nu_k \frac{\partial P_z^0}{\partial P_k} \quad (11.13)$$

The adjustments to account for the distortions in the prices of the additional inputs used to supply z , or in the price of z when it was previously being purchased elsewhere, are of the same form as in the case of an output x in equation (11.11). Similarly, the adjustments are made for the generalized distortions of the FEP, when there is an impact on the demand or supply of tradable goods, and for the NTP. That is, the term $\sum_{k=1}^p \nu_k \frac{\partial P_z^0}{\partial P_k}$ measures the additional cost associated with the additional tradable inputs that are now demanded because of the project demands for the input z . Likewise, the term $\sum_{l=1}^q \omega_l \frac{\partial P_z^0}{\partial P_l}$ measures the additional cost arising from the increased use of non-tradable inputs as a consequence of the project's purchase of this non-tradable input. The final expression for the estimation of the economic price of input z in its generalized form is identical in form to the estimation of the economic price of an output. It is shown as follows:

$$P_z = P_z^0 + \sum_{i=1}^n \lambda_i \frac{\partial P_z^0}{\partial P_i} + \sum_{j=1}^m \mu_j \frac{\partial P_z^0}{\partial P_j} + \sum_{k=1}^p \nu_k \frac{\partial P_z^0}{\partial P_k} + \sum_{l=1}^q \omega_l \frac{\partial P_z^0}{\partial P_l} \quad (11.14)$$

It is important to note that exactly the same structure and terms are

present in equation (11.14) as in equation (11.11). It does not matter whether a particular good is an input being purchased or an output being produced; its economic value is the same.

11.4 Application of Economic Prices to Estimate the Economic Net Benefits of a Project

Where market distortions take the form of taxes and subsidies that are expressed as a proportion of a price, the natural way to introduce this conversion of financial values into economic values is through the use of commodity-specific conversion factors. In such case, if the rates of distortion do not change, there is a fixed relationship between the real or nominal unit economic value of an item and its financial unit cost to the project. For example, consider a project input, such as electricity or construction services, that will be used over and over again in many projects. If the distortions in the output and input markets can all be expressed as a proportion of P^m , P^d , or P^s , then any one of these prices can be expressed in terms of one of the other prices and the relevant distortions that make them not equal. Hence, it is also the case that, as shown by equation (11.11), the economic price P^e of any good i can be expressed simply as a constant factor multiplied by the financial demand price of the same item. The constant factor will be a function of all the distortions and weights that determine the economic price of the item. This commodity-specific conversion factor CF_i is the ratio of the economic price of i to its tax-inclusive financial price, or its demand price:

$$P_i^e = CF_i P_i^d \quad (11.15)$$

For inputs and outputs where these conditions hold, the economic benefits and costs can be estimated period by period by simply multiplying the financial line items of financial analysis from the total investment point of view by the corresponding commodity-specific conversion factor for that line item. The result is the value of the

economic benefit or the value of the cost item for that period. When all the line items of a financial cash flow analysis are converted to their economic values, it is a relatively simple procedure to subtract the costs from the benefits in order to derive the periodic economic net benefits and the economic net present value of the project.

Of course, when there are distortions such as rationing, quantitative restrictions, and consumer surplus arising from new market entrants, the economic value of the additional consumption will be divorced from the particular financial prices charged. The value of the output of a road, when no tolls are being charged, is a classic example of where the output of the road needs to be evaluated based on the fundamental items that measure the consumers' willingness to pay and the economic value of the resources saved; in this case, these values are completely divorced from what the user of the road pays for the service.

The items where conversion factors cannot be used are usually associated with the outputs of projects. Examples include the benefits of improving a road, of providing access to potable water supplies, and of increasing the reliability of the electricity service. In all these cases, the engineers and sector specialists will often have the professional training required to know how to measure the economic value of the output produced by the project.

A major hurdle to the widespread implementation of economic cost-benefit analysis is the dozens, and sometimes hundreds, of inputs for a single project; the sector specialist often has neither the inclination nor the time to estimate the economic prices of each of these commodities and services. The major advantage of expressing the relationship between the unit economic value and the unit financial value as a conversion factor is that as long as the rates of the distortions do not change, the same conversion factor can be used for the same good across many projects in the country. In addition, the conversion factor is not affected by the rate of inflation. Hence, it can be applied to the nominal financial values of a particular item over time to obtain its nominal economic values through time, or it can be applied to the real values of the same item, and the result will be the real economic value of the item over time.

Furthermore, the nature and magnitudes of the distortions that determine the size of the conversion factor for a particular good or

service can be clearly written as a formula using the relationship shown in equations (11.11) and (11.14). Hence, when it is known that the rate of tax or subsidy has changed, then the conversion factors for the items affected can be readily updated.

11.5 An Illustrative Example

Consider a project in South Africa using bricks as an input, where there are distortions in the markets of bricks, and where, in the markets, two inputs, clay and furnace oil, are used to produce brick.

Assume that the market for bricks is competitive, the market price is subject to a 14 percent general sales tax without any tax credit, and brick producers receive a 15 percent subsidy (k_z) on their total production cost.

In this case, the supply price is expressed as $\frac{P_z - P_z t_z}{1 - k_z}$ because the subsidy is a fraction of the supply price. Without the project, the quantity demanded and supplied in the market is 7 million bricks per

month at a market price (P_z^m) of R0.2 (rand) per brick. Now we introduce a project that requires 300,000 bricks per month. Two of the inputs used in the production of bricks have distortions in their markets: (a) clay, a non-

tradable good, has a 14 percent sales tax levied on its market price (P_{clay}^m)

of R7 per ton,⁶ while (b) furnace oil, an import good, has a subsidy (k_{oil}) of 20 percent on its CIF price of US\$240 per ton. The input-output

coefficient for furnace oil (a_{oilz}) is 180 kilograms of oil per 1,000 bricks

and that of clay (a_{clayz}) is 3.5 tons of clay per 1,000 bricks. The market exchange rate is R9.85 per US dollar.

The weighted-average excise and other indirect tax rate on tradable

⁶ It is assumed that the change in the market price of clay on account of the project's demand is relatively small, thus justifying the use of without-the-project prices, rather than an average of the prices with and without the project.

and non-tradable goods and services in the economy (d^*) is 9 percent.

The economic cost per brick can be estimated using equation (11.14).

Data requirements for estimating the economic price (P_z^e) of a brick used by the project as an input are described below.

a) *Brick*

Step 1: Price Estimation

Since $P_z^m = R0.2$, thus $\frac{P_z^m}{1 - FEP} = 0.2 / (0.85) = R0.2353$

and $\frac{P_z^m}{1 - FEP} \times (1 + P) = 0.2 \times (1.14) = R0.2280$

Step 2: Estimation of the Supply and Demand Weights (W_z^s) and (W_z^d)

For such a production activity, the expected supply response will be small in the short run as most brick-making kilns are usually operating close to capacity. The supply response will be greater in the longer run, and it is expected that a larger proportion of the bricks required by the project will be obtained from additional supplies by existing producers rather than at the expense of existing demanders, who will divert to other sources. Hence, assigning a weight of 0.33 to the demand side (W_z^d) and a weight of 0.67 to the supply side (W_z^s) seems plausible.

Step 3: Tradable, Non-tradable Good Component in Brick Production

In examining the cost components used in the production of bricks, it is assumed that the tradable and non-tradable good components account for 60 percent and 40 percent, respectively, of the market price of bricks. The FEP is equal to 6 percent, and the premium on the purchase or sale of non-tradable goods and services is 1 percent.

Step 4: Product Distortions

The supply price of the newly stimulated supply of brick, as calculated above, is equal to:

$$P_{oil}^m = 0.2 / (0.85) = R0.2353$$

On the demand side, the tax on good t that other demanders will not be paying because they are now buying other goods is partially offset by the taxes they will now pay, d^* . Hence, the opportunity cost of the forgone consumption of others is equal to:

$$P_{oil}^e = 0.2 (1 + 0.14 - 0.09) = R0.21$$

b) *Furnace Oil*

Since furnace oil enjoys a subsidy, its financial market price is different from its economic price, and so an adjustment for this input will have to be made when estimating the economic cost of bricks.

Step 1: Estimating the Market Price

$$\begin{aligned} P_{oil}^m &= \text{CIF price} \times E^m \times (1 - S_{oil}) \\ &= 240 \times 9.85 \times (1 - 0.2) \\ &= R1,891 \text{ per ton} \end{aligned}$$

Step 2: The Economic Cost of Furnace Oil (P_{oil}^e)

$$\begin{aligned} P_{oil}^e &= \text{CIF price} \times E^m \\ &= 240 \times 9.85 \\ &= R2,364 \text{ per ton} \end{aligned}$$

The value of the subsidy per ton of furnace oil is estimated below.

$$\begin{aligned} \text{The value of the subsidy} &= P_{oil}^m - P_{oil}^e \\ &= - \text{CIF price} \times E^m \times S_{oil} \\ &= -240 (9.85) (0.2) \\ &= -R472.8 \text{ per ton} \end{aligned}$$

Thus, the value of the distortion per brick is -R0.0851

$$(\text{= } -a_{oilz} \times R472.8/1,000 = -0.18 \times R0.4728)$$

c) Clay

As clay is subject to 14 percent sales tax, its demand price is different from its market price, and an adjustment for this input is necessary when estimating the economic cost of bricks.

Step 1: Estimating the Demand and Supply Prices for Clay

Since $P_{clay}^m = R7$ per ton, thus $P_{clay}^d = P_{clay}^m (1 + 0.14) = 7 \times (1 + 0.14) = R7.98$ per ton

and $P_{clay}^s = P_{clay}^m (1 - 0) = R7$ per ton

Step 2: Estimation of the Supply and Demand Weights (W_{clay}^s and W_{clay}^d)

If clay is not in short supply, it can reasonably be asserted that the demand for clay derived from the project's demand for bricks will be mostly met from additional supply. Accordingly, a demand weight (W_{clay}^d) of 0.33 and a supply weight (W_{clay}^s) of 0.67 are assigned.

Step 3: The Economic Cost of Clay (P_{clay}^e)

Using clay as an input will lead to additional supply as well as displaced demand for some existing demand. Thus, the value of the distortion created after taking into account all the repercussions of the demand for clay in the economy can be estimated as:

$$\begin{aligned} &= 7\{0.0035 \times [0.67 \times (0.14 - 0) + 0.33 \times 0.09]\} \\ &= 0.0245 \times (0.1235) \\ &= 0.0030 \text{ R/brick} \end{aligned}$$

Taking into account the distortions in the product and input markets,

the economic price per brick by substituting in equation (11.14) yields:

$$\begin{aligned}
 &= 0.67 \times (0.2353) + 0.33 \times (0.2100) - 0.67 \times (-0.0851 + 0.0030) \\
 &+ 0.2 \times 0.6 \times 0.06 + 0.2 \times 0.4 \times 0.01 \\
 &= 0.1577 + 0.0693 + 0.0550 + 0.0080 \\
 &= 0.2900 \text{ R/brick}
 \end{aligned}$$

To estimate the commodity-specific conversion factor for bricks used by the project, we divide the economic price by the financial demand price. Recall that the demand price is inclusive of sales tax. That is:

$$CF = 0.2900/0.228 = 1.27$$

The same methodology can be used to estimate the conversion factors for a series of non-tradable goods and services involved in projects. Project supply or project demand for tradable goods often requires non-tradable services, such as truck transportation services and handling charges, in order to move the goods between the port and the project site. The financial costs of these services must be converted using the respective conversion factors to the economic costs in the economic appraisal.

As mentioned in Chapter 10, for example, the irrigation project in the Visayas of the Philippines is required to import pesticides to improve the farm's productivity. The project will also incur handling charges, dealers' margins, and transportation costs in moving pesticides from the port to the farm. Thus, in addition to 4,239 pesos paid for the duty-paid value of the item, the project will also pay a total of 1,140 pesos for handling and port charges, 475 pesos for transportation costs from the port to the farm

gate, and 200 pesos for dealers' services. Each of these non-tradable service costs presented in the financial cash flow statement must be converted to the economic costs in the economic resource flow statement using their corresponding conversion factors, calculated as outlined in this chapter.

11.6 Conclusion

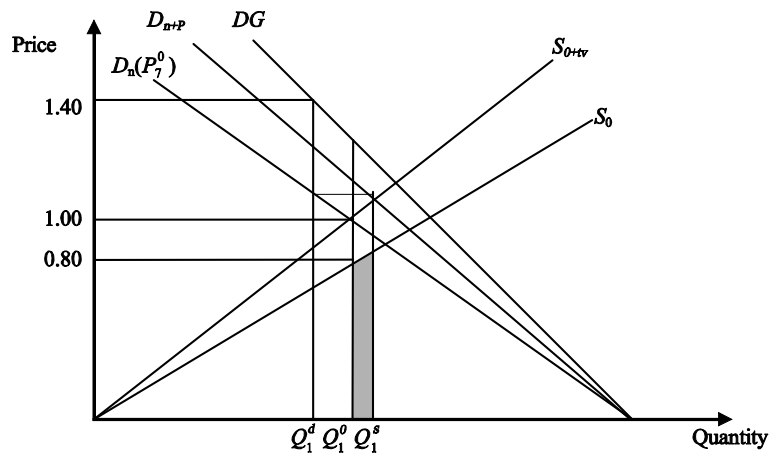
This chapter describes the analytical framework for estimating the economic prices of non-tradable goods and services. Unlike the case of tradable goods, there will be no direct world price, although an equivalency to the world market can be derived. The analysis begins with the case in which a project produces non-tradable outputs, where its market supply function is perfectly elastic, and then moves to the standard case with upward-rising supply and downward-sloping demand curves. The analysis takes into account all repercussions of the project in the economy by capturing all distortions in the direct product and indirect input markets.

Appendix 11A: Choosing the Relevant Distortion

This appendix provides readers with the basic toolbox for analysing very basic supply and demand relationships. We start with a commodity that is subject to both an excise tax and a value-added tax (VAT). We assume that the posted market price is inclusive of VAT (as is the practice in most VAT countries) and that the excise tax is added to the market price as an extra item on the buyer's bill. In short, in this presentation we assume that the VAT is institutionally paid by the supplier, while the excise tax is paid by the demander. The ultimate incidence of these taxes is a separate issue.

This yields the supply and demand scenario shown in Figure 11A. Here, the VAT is 25 percent (on a base price of 0.80), while the excise tax is 40 percent on a base price of 1.00. When a new demand is introduced, say by the project, 70 percent of that demand is met by displacing other demand and 30 percent by generating new increments of supply. In this case, the economic opportunity cost of meeting new demand for this good will be $(0.7 \times 1.40) + (0.3 \times 0.80) = 1.22$.

Figure 11A



$$Q - Q^d = 100 \text{ units}, \quad Q - Q^s = 30 \text{ units}, \quad Q - Q^d = 70 \text{ units}$$

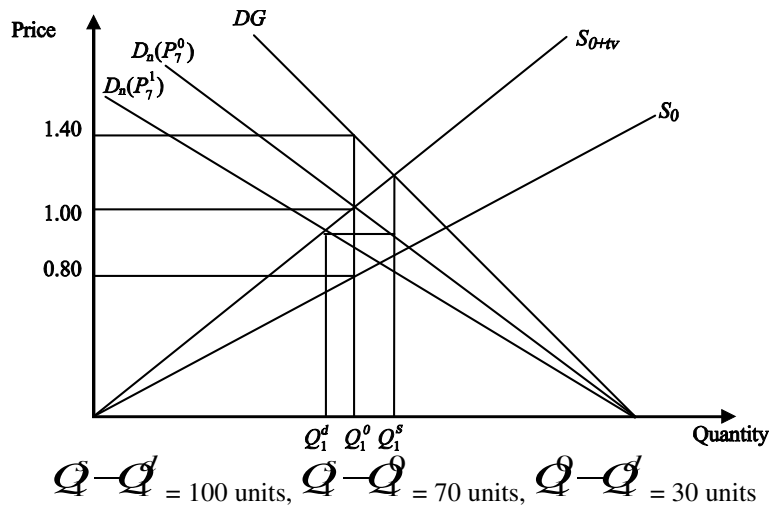
One way to visualize this opportunity cost is to consider that we do not know whether or not the project will be required to pay tax on its purchases. Perhaps, as a government project, it will be exempt from the excise tax, or even from both taxes. As a private project producing for export, it might be exempt from both taxes. The point is that as we try to establish the economic opportunity cost of the product Q_1 , we do not know what taxes the buyer will be required to pay. However, we do know that suppliers will incur a resource cost of 0.80 on the incremental supply and that demanders will be forgoing units of Q_1 that value at (or a bit above) 1.40 on 70 percent of the amounts that the project takes.

Thus it is unambiguously established that the economic opportunity cost of Q_1 is a weighted average of supply and demand prices.

Let us now consider another problem relating to the same market, but with the project in a different area. Its output is a non-tradable good or service Q_7 , and, as a consequence of the project, the total demand for Q_7 increases. A likely scenario is that the price of good Q_7 falls from P_7^0 to P_7^1 . Because good Q_7 is a substitute for Q_1 , when the quantity demanded of Q_7 increases, the demand declines for Q_1 .

Figure 11B illustrates this case for an induced shift in demand (away from Q_1 and toward Q_7) of 100 units. Note in Figure 11B that we can still say (if we want to) that the economic opportunity cost of those 100 units of shifted demand is $(0.3 \times 0.80) + (0.7 \times 1.40) = 1.22$, as before.

Figure 11B



However, this is not an effective way to summarize what is going on. What actually happens is simply a reduction of the equilibrium quantity of Q_1 by 30 units. In the exercise depicted in Figure 11B, certain demanders (call them the shifters) shift 100 units of demand away from Q_1 . In order to buy more of Q_7 , they induce a group of other demanders of Q_1 (call them the stayers) to augment their demand by 70 units. But that change of +70 units by the stayers is more than cancelled out by the -100-unit change produced by the shifters. The end result is a net reduction in demand for Q_1 of 30 units, which necessarily also equals the reduction in supply.

Figure 11C

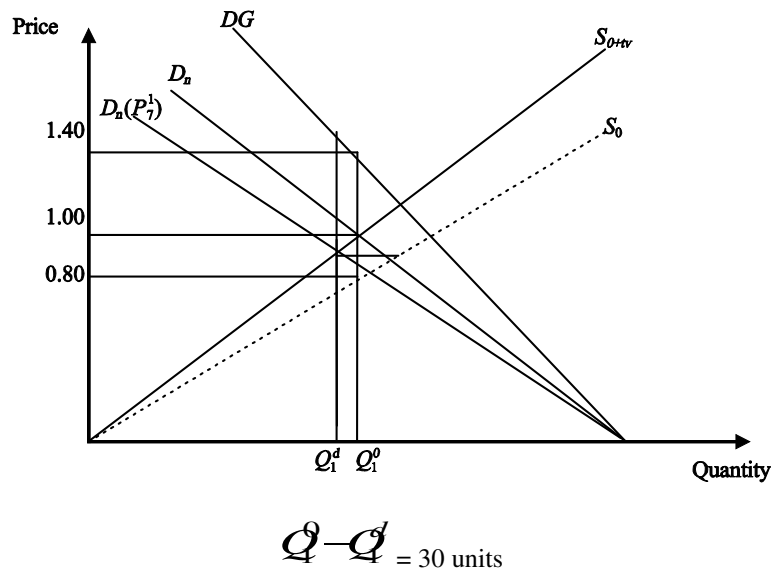


Figure 11C shows a clearer picture of what happens in the market for Q_1 as a consequence of a project-induced increase in demand in the market for Q_7 (the project good). This scenario allows for the induced increase in demand of 70 (by the stayers) to be fully cancelled out by the project-generated reduction in demand for Q_1 of 100 (by the shifters). The net result is a reduction of -30 in the equilibrium quantity of Q_1 , to which a distortion of $0.60 (= 1.40 - 0.80)$ applies. In this case, the distortion effects are not split between a supply change in one direction and a demand change in the other, but are combined into a simple grand distortion (= demand price minus supply price), which applies to the net change in the equilibrium quantity of the good in question (here Q_1).

Note that this example is relevant for all kinds of external effects that take place outside the purview of the project under analysis. In dealing with the current project's demand, we want to separately consider the distortions applying to increased supply and decreased demand (or vice versa). However, in cases where we are examining induced effects in other markets, those effects are necessarily shifts (up or down) in the equilibrium quantity of good Q_i , in whatever market that might be.

The important corollary of this simple lesson is that when there is an increase in demand of, say, 400 for the project good Q_7 , 100 is the result of the shifters substituting away from good 1 and toward Q_7 as a consequence of the project. We do not want to assign an externality of $(1.22 - 1.00) \times (-100)$ of shifted demand for Q_1 . This would equal -22 . Nor do we want to assign an externality of $(1.22 - 0.80) \times (-100)$, which would equal -42 . The correct externality assignment is of $(1.40 - 0.80) \times (-30) = -18$.

Unfortunately, this simple lesson is not widely understood, even among experienced project economists. It follows directly from the standard expression for measuring external effects $\sum D_i \Delta Q_i$, where D_i is the distortion affecting activity i and ΔQ_i is the amount by which the equilibrium quantity of Q_i changes as a consequence of the event being analysed (in this case, our project in the market for Q_7).

Thus, when we consider increases in demand for project output, even if all the increase in demand were to come from Q_1 , that does not mean that a Q_1 distortion should be assigned to that full increase of 400 in demand for Q_7 . In this case, the full Q_1 distortion of 0.60 per unit would be assigned to a shift in equilibrium quantity of Q_1 , equal to -120 [= $0.3 \times (-400)$]. That is, the externality $D_1 \Delta Q_1$ would equal $(0.60) \times (-120) = -72$.

In dealing with the Q_7 market, the project output would be 1,000, of which 600 would be reflected in reduced supply by others and would be assigned a distortion equal to d^* (as those resources find their new equilibrium locations elsewhere). Then we would have 400 of increased output of Q_7 , to which the tax T_7 would apply (i.e., our project's output would be valued at its demand price). Finally, on the externality applying in the market for Q_1 , there would be a Q_1 externality equal to $D_1 \Delta Q_1 = -72$ (= -120×0.60), plus an additional externality of $+120 \times d^*$, as the resources released from Q_1 would be absorbed elsewhere in

the economy.

References

- Curry, S. and J. Weiss. 1993. *Project Analysis in Developing Countries*. New York: St. Martin's Press.
- Dinwiddy, C. and F. Teal. 1987. "Shadow Prices for Non-traded Goods in a Tax-distorted Economy: Formulae and Values", *Journal of Public Economics* 33(2), 207-221.
- 1996. *Principles of Cost-Benefit Analysis for Developing Countries*, Chapter 6. Cambridge: Cambridge University Press.
- Harberger, A.C. 1971. "Three Basic Postulates for Applied Welfare Economics", *Journal of Economic Literature* 9(3), 758-797.
- 1972. "Marginal Cost Pricing and Social Investment Criteria for Electricity Undertakings", *Project Evaluation: Collected Papers*. Chicago: The University of Chicago Press.
- Harberger, A.C. and G.P. Jenkins. 2002. "Introduction", in A.C. Harberger and G.P. Jenkins (eds.), *Cost-Benefit Analysis*. Cheltenham: Edward Elgar Publishing.
- Jenkins, G.P. and M.B. El-Hifnawi. 1993. *Economic Parameters for the Appraisal of Investment Projects: Bangladesh, Indonesia and the Philippines*, report prepared for Economics and Development Resource Center. Manila: Asian Development Bank (December).
- Mishan, E.J. and E. Quah. 2007. *Cost-Benefit Analysis*, 5th edition. London and New York: Routledge.
- Overseas Development Administration (ODA). 1988. *Appraisal of Projects in Developing Countries: A Guide for Economists*, 3rd edition. London: Stationery Office Books.
- Powers, T.A. 1981. *Estimating Accounting Prices for Project Appraisal*. Washington, DC: Inter-American Development Bank.
- Scott, M.F.G., J.D. MacArthur, and D.M.G. Newbery. 1976. *Project Appraisal in Practice*. London: Heinemann Educational.
- Warr, P.G. 1982. "Shadow Pricing Rules for Non-traded Commodities", *Oxford Economic Papers* 34(2), 305-325.