

**COST-BENEFIT ANALYSIS FOR INVESTMENT DECISIONS,
CHAPTER 9:**

***THE SHADOW PRICE OF FOREIGN EXCHANGE
AND NON-TRADABLE OUTLAYS***

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ABSTRACT

The economic cost of capital, as measured in Chapter 8, deals with the intertemporal comparisons. It links the annual flows of benefits and costs over a project's life to its initial capital investment. In the present chapter we deal with another facet of the act of raising project funds from the country's capital market. This facet concerns the distortions that are affected not intertemporally but at the same moment that the funds are raised. Investment and consumption expenditures by others in the market are displaced by the very act of raising the project's funds in the capital market. As a consequence, the government loses tariff revenue plus value added and other indirect taxes. These losses must be counted in the economic evaluation of any project, in addition to those linked to the spending of project funds on tradable or non-tradable goods and services, and in addition to the intertemporal distortions captured by the economic opportunity cost of capital. The existence of these indirect taxes on domestic and trade transactions, the economic value of foreign exchange differs from the market exchange rate and there will be a tax externality associated with expenditures on nontradables. This chapter has provided an analytical framework and a practical approach to the measurement of the economic cost of foreign exchange and the shadow price of non-tradable outlays.

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CHAPTER 9

The Shadow Price of Foreign Exchange and Non-Tradable Outlays

9.1 Introduction

The economic cost of capital, as measured in Chapter 8, deals with the intertemporal comparisons.¹ It links the annual flows of benefits and costs over a project's life to its initial capital investment. In the present chapter we deal with another facet of the act of raising project funds from the country's capital market. This facet concerns the distortions that are affected not intertemporally but at the same moment that the funds are raised. Investment and consumption expenditures by others in the market are displaced by the very act of raising the project's funds in the capital market. As a consequence, the government loses tariff revenue plus value added and other indirect taxes. These losses must be counted in the economic evaluation of any project, in addition to those linked to the spending of project funds on tradable or non-tradable goods and services, and in addition to the intertemporal distortions captured by the economic opportunity cost of capital

The starting point of this exercise is the calculation of the economic opportunity cost *or shadow price* of foreign exchange (EOCFX) and the shadow price of non-tradable outlays (SPNTO). Before starting, we want to make clear that at that point we are

¹ The issue of how project funds are raised has been source of constant discussion and debate. Our position -- which we believe to reflect a pretty close consensus among experienced practitioners -- is that one is very well advised to choose a standard type of sourcing for project funds, and that capital market sourcing is clearly the best candidate to serve as this standard. The next alternative would be sourcing from tax revenues -- but here there are a thousand alternative ways to get extra tax money, each involving a different weighted average of distortions. Capital market sourcing, by contrast, works on the basis of additional pressure in the capital market. We expect that an added demand for funds will have much the same effects regardless of whether the government is raising money to build dam, or a private firm is borrowing to renew its stock of trucks, or a group of consumers is borrowing to finance a joint vacation trip. The capital market does not "see" the purpose for which the funds will be used, it simply "feels" the added pressure. It is thus the forces of the market that ultimately determine what expenditures will be displaced. We thus proceed on the assumption of a standard pattern of distortions that are involved in the actual act of displacing consumption and investment (dealt with in the present chapter) plus a standard pattern of intertemporal distortions, impacting the economic opportunity cost of capital -- the rate of return -- dealt with in the preceding chapter.

accounting for the distortions involved in sourcing the money for our expenditures, and in causing equilibrium to be maintained in the market for foreign exchange, but we are explicitly not counting the distortions that are entailed (or engendered) as we spend that money, either on tradables, (for which the economic cost of foreign exchange captures the sourcing distortions), or on non-tradables, (for which the sourcing distortions are captured by the shadow price of non-tradable outlays). The procedure leading to EOCFX captures those distortion costs that are triggered each time money is sourced in the capital market and spent on tradables. Similarly, the calculation of SPNTO captures the distortion costs that are engendered each time money is sourced in the capital market and spent on nontradables. But once we are at that stage, the repetitive aspect vanishes. One project might buy an import good with an 80% tariff plus a 20% value added tax; another might import everything free of tariff and VAT; yet another might buy locally a taxed export product, leading to a loss of tax revenue by the government. It is similar with non-tradable goods; we may spend our money on items that are heavily taxed, lightly taxed, heavily subsidized, lightly subsidized or not subsidized or taxed at all. In all such cases, the analysis of each project must cover the specific distortions involved in the spending of project money, but this must be done separately, as part of the study of each project's costs and benefits -- it cannot be incorporated in a standardized measure like EOCFX or SPNTO.

Our cost-benefit analytical framework is developed to convert the financial receipts and expenditures of a project into values that reflect their economic worth. The financial analysis uses the market exchange rate to convert the foreign currency values of traded goods into units of domestic currency. The market exchange rate, however, usually does not reflect the economic value to the country of foreign exchange. In any such case, the conversion from foreign to domestic currency units should be done using EOCFX – the economic opportunity cost of foreign exchange, also known as its shadow price. The shadow price of foreign exchange is also needed for the valuation of the tradable inputs that are used directly or indirectly in the production of the non-tradable goods and services.

The most common source of a difference between the economic value and the market rate for foreign exchange stems from tariffs and non-tariff barriers. In a similar vein, we must incorporate export taxes and subsidies. These trade and other indirect tax distortions give rise to economic externalities every time that foreign currency is either extracted from or injected into the foreign exchange market.

To demonstrate how the economic value of foreign exchange may differ from its market value, we begin by considering a case in which it is the market exchange rate that moves to bring about an equilibrium of demand and supply. We also assume that the country cannot significantly influence the world prices of its exports or its imports. Under these conditions, we can measure the quantities of different traded goods in units of “dollar’s worth”, simply by counting copper in units of half a pound when its world price is \$2.00 per pound, wheat in units of one quarter bushel when its world price is \$4.00 per bushel etc. In this way the demand and supply curves for importables and exportables can be aggregates spanning many different commodities.

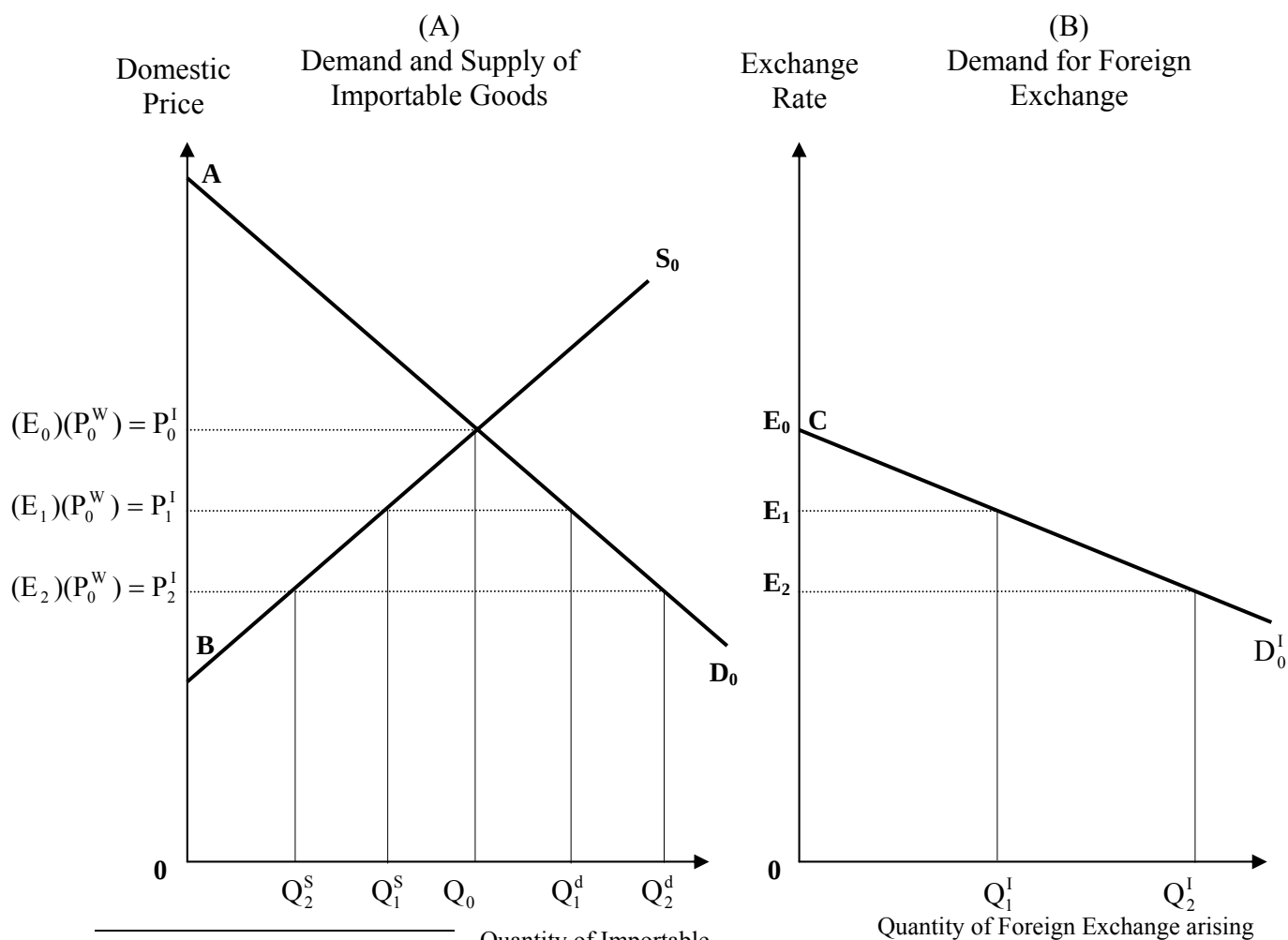
9.2 Determination of the Market Exchange Rate

Defining the exchange rate as the number of units of domestic currency per unit of foreign currency, the domestic prices of tradable goods will be linked positively to the market exchange rate. As the demand for foreign exchange is linked to the demand for imports, the quantity of foreign exchange demanded will fall as the market exchange rate rises and vice versa. This is illustrated in Figure 9.1 (A and B). In panel A the demand for importable goods (AD_0) is juxtaposed to the domestic supply of importables (BS_0). The definition and implication of importable (and exportable) goods will be elaborated in the next chapter.

For any given set of world prices for importable goods [assumed fixed at (P^w_0)], the domestic price will fall from $(P^I_0$ to $P^I_2)$ as the market exchange rate falls from E_0 to E_2 . At each level of the exchange rate, the demand for foreign exchange is equal to the

difference between the demand for importable goods and the domestic supply of these goods.² When the exchange rate is at E_0 there will be no net demand for foreign exchange, because domestic production will be equal to the demand for these goods. As the exchange rate falls, the demand for importables will increase from Q_0 to Q_2^d while their domestic supply will fall from Q_0 to Q_2^s . Hence, imports will flow into the country to fill this gap. When the quantity of imports is measured in units of foreign exchange, the demand for foreign exchange will increase with the fall in the exchange rate as shown by the curve CD_0^I in Figure 9.1B.

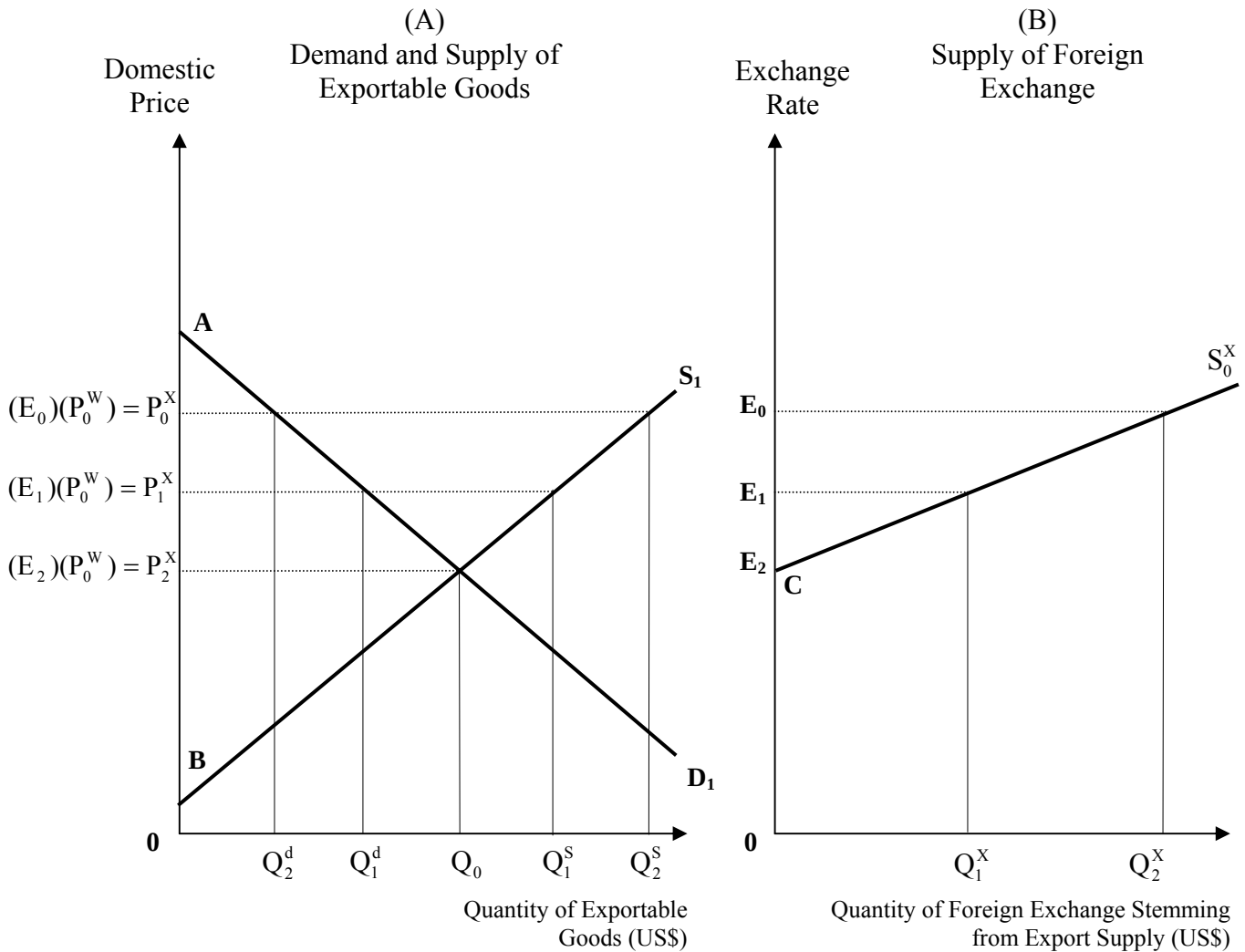
Figure 9.1: Importable Goods and the Demand for Foreign Exchange



² Since the demand for imports is an excess demand function, the elasticity of demand for importable goods (US\$) will be greater than the elasticity of demand for foreign exchange (US\$) even when the domestic supply of these items is completely inelastic.

In a similar fashion, the supply of foreign exchange is derived from the domestic supply and demand for exportable goods. Because the world prices of these goods are fixed, their domestic prices will be tied to the country's exchange rate. An increase in the exchange rate will lead to an increase in the domestic price of each item, which will in turn cause the supply of exportable goods to increase. The relationship between the demand and supply of exportable goods, and the supply of foreign exchange, is illustrated in Figure 9.2.

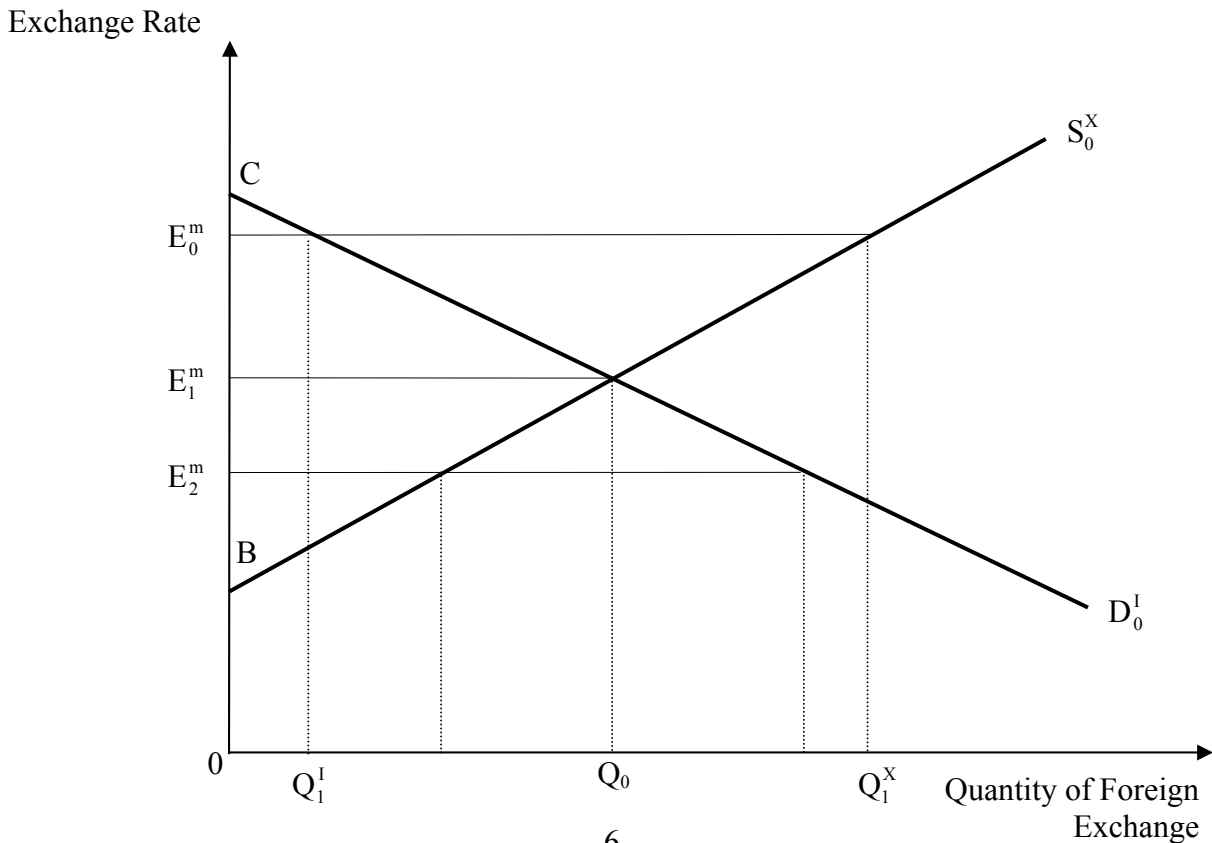
Figure 9.2: Exportable Goods and the Supply of Foreign Exchange



When the exchange rate is above E_2 , the supply of exportable goods (denoted by the curve BS_1) will be greater than the domestic demand for these goods (curve AD_1). Hence, exports will amount to $Q^s_1 - Q^d_1$ when the exchange rate is E_1 . These sales of exports abroad can also be expressed as the country's export supply curve, which is a function of the market exchange rate as shown in Figure 9.2B.

Determination of the equilibrium exchange rate requires that the quantity of foreign exchange demanded be equal to the quantity supplied. Combining Figures 9.1B and 9.2B into Figure 9.3 we find an equilibrium market exchange rate of E^m_1 . At an exchange rate of E^m_0 , there will be an excess supply of foreign exchange equal to $Q^x_1 - Q^l_1$ while at exchange rate of E^m_2 there will be an excess demand of $Q^l_2 - Q^x_2$. These situations can represent equilibria so long as capital movements or other transfers are present to finance the difference. Otherwise, market forces will lead to equilibrium at E^m_1 .

Figure 9.3: Determination of the Market Exchange Rate



$$Q_2^x$$

$$Q_2^I$$

9.3 Derivation of the Economic Price of Foreign Exchange

For an economy that has no taxes, subsidies, or other distortions on the demand or supply of its tradable goods, the equilibrium market exchange rate (E^m_1) will be equal to the economic cost of supplying an additional unit of foreign exchange. E^m_1 will also reflect the economic benefits of a marginal increase in the consumption of whatever goods or services might be purchased with an extra unit of foreign exchange. With the introduction of tariffs or subsidies on one or more tradable goods, however, a divergence will arise between the market price of foreign exchange and its economic value expressed in units of the domestic currency of the country.

Traditionally the study of the economic price of foreign exchange has been carried out using a partial-equilibrium analysis. Such studies looked only at the demand for imports and the supply of exports, giving no consideration to any externalities that might occur as the funds to buy imports are acquired or the funds generated by exports are deployed.³ In this chapter we first present the traditional, partial-equilibrium derivation of the economic cost of foreign exchange. Then the analysis is extended using a framework that takes into account how funds for buying imports are sourced, and /or how funds generated by exports are disposed of.⁴

9.3.1 A Partial Equilibrium Analysis

Nearly all countries levy tariffs on at least some imports, and one sometimes also finds

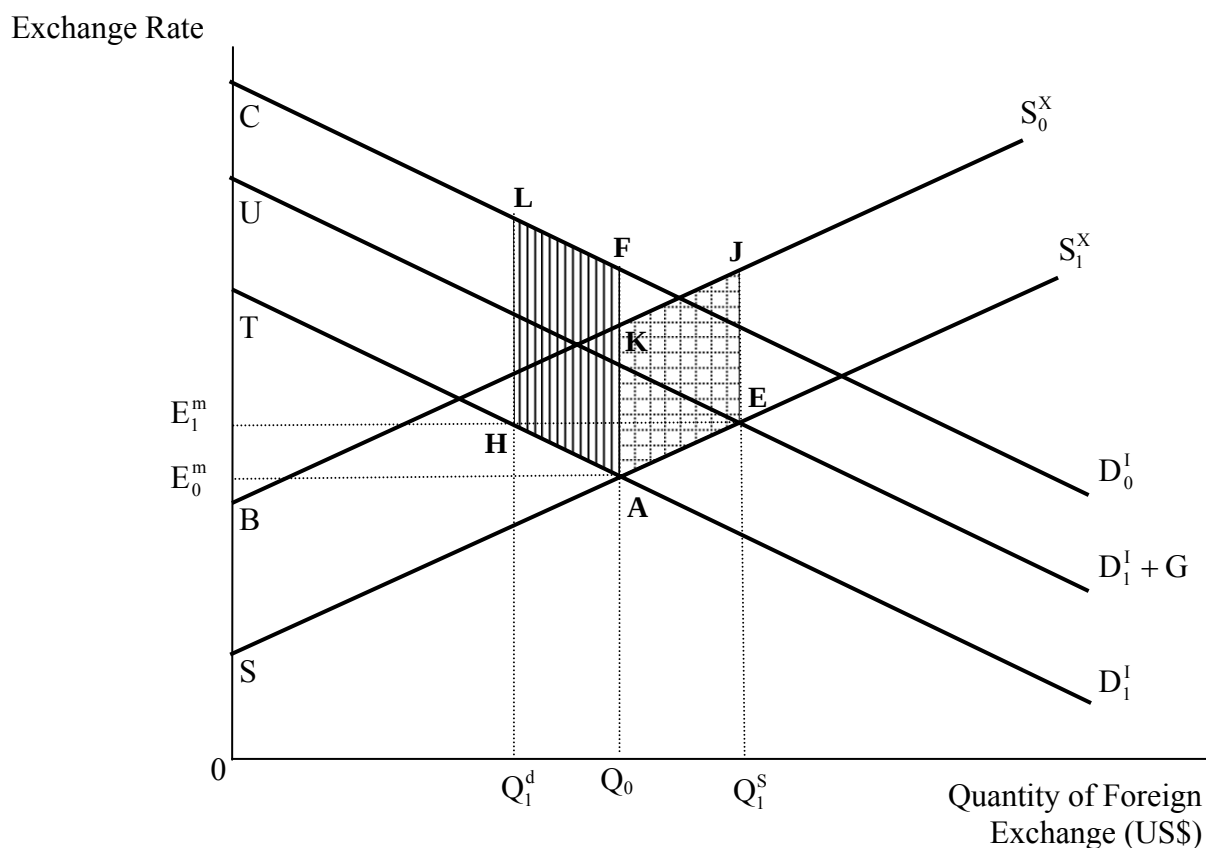
³ Harberger, A.C., "Survey of Literature on Cost-Benefit Analyses for Industrial Project Evaluation", United Nations Inter-Regional Symposium in Industrial Projects Evaluation, Prague, (1965); Bacha, E. and Taylor, L., "Foreign Exchange Shadow Prices: a Critical Review of Current Theories", *Quarterly Journal of Economics*, (1971); UNIDO, *Guideline for Project Appraisal*, New York: United Nations Publications, (1972); Fane, G., "The Social Opportunity Cost of Foreign Exchange: A Partial Defence of Harberger et al.", *Economic Record*, (December 1991).

⁴ Blitzer, C., Dasgupta, P. and Stiglitz, J., "Project Appraisal and Foreign Exchange Constraints", *Economic Journal*, (1981); Jenkins, G.P. and Kuo, C.Y., "On Measuring the Social opportunity Cost of Foreign Exchange", *Canadian Journal of Economics*, (1985); and Harberger, A.C. and Jenkins, G.P., "Introduction" edited by Harberger, A.C. and Jenkins, G.P., *Cost-Benefit Analysis*, Cheltenham: Edward Elgar Publishing Limited, (2002); Harberger, A.C., Jenkins, G.P., Kuo, C.Y. and Mphahlele, M.B., "The Economic Cost of

subsidies or taxes on exports. Here, we will first examine the relationship between the market exchange rate and its economic value for the case where there is a uniform tariff on imports and a uniform subsidy for exports.

The tariff will bring about a divergence between the domestic valuation of imports (willingness to pay) given by the demand curve CD^I_0 in Figure 9.4 and the demand for foreign exchange, shown by the curve TD^I_1 . Consumers' evaluation of these imports does not change when the tariff is imposed. Nevertheless, the amount of foreign exchange they are willing to pay the foreign supplier will fall because they have to pay the tariff to their own government in addition to the cif cost of the item to the importer. Thus, tariffs cause the economic value of foreign exchange to be greater than the market exchange rate.

Figure 9.4: Determination of the Economic Cost of Foreign Exchange with Tariffs and Subsidies



Foreign Exchange for South Africa", *The South African Journal of Economics*, Vol: 71:2, (June 2003).

A subsidy on the sales of exports will lower the financial cost of producing an item, as seen from the point of view of the domestic supplier. However, the economic resource cost of production is still measured by the before subsidy supply curve BS^x_0 while the price at which producers are willing to export their goods is given by the curve SS^x_1 which includes the effect of the subsidy. Hence, subsidies will increase the supply of foreign exchange and cause the market exchange rate to be less than the economic cost of foreign exchange.

In such circumstances, the market exchange rate (E^m_0) will be determined by the interaction of the demand for foreign exchange (given by the net of tariff demand for imports TD^I_1) and the subsidized supply of foreign exchange SS^x_1 (arising from the supply of exports). The intersection of these two curves at point A in Figure 9.4 will determine the initial market exchange rate (E^m_0). At this exchange rate, the amount of foreign exchange bought or sold in the market is Q_0 units. The value consumers place on the goods, which can be purchased with a unit of foreign exchange, includes the tariffs they pay. This value is shown as the distance Q_0F . At the same time, the resources required to produce an additional unit of foreign exchange is reflected by the height of the supply curve that would have existed if there were no subsidy BS^x_0 , or the distance Q_0K . The existence of the subsidy means that producers will be induced to use a greater value of resources to produce an additional unit of exports than E^m_0 , which is the market value of the foreign exchange that the country receives from its sale.

Now let us consider what economic costs are incurred when a project requires G units of additional foreign exchange. We here neglect to inquire how the funds were raised that are used to purchase this foreign exchange (the traditional partial-equilibrium assumption). On this assumption all the foreign exchange bought by the project is generated through a rise in its domestic price. This is shown in Figure 9.4 by the shift in the demand curve for foreign exchange, from D^I_1 to $D^I_1 + G$. However, the demand curve D^I_1 still measures what people, other than the project, are willing to pay net of the tariff for each successive unit of foreign exchange. The project's action will cause the exchange rate to be bid up from E^m_0 to E^m_1 . This creates an incentive for exports to

expand and for consumers to decrease their demand for imports.

Producers of exportable items will supply additional foreign exchange of $Q_1^s - Q_0$ as the market exchange rate increases from E_0 to E_1 . The producers receive additional subsidy payments of $AKJE$ that will be spent on factors of production and intermediate inputs. The total value of resources required to produce this incremental output is given by the area $Q_0KJQ_1^s$. At the same time, consumers reduce their demand for imports (foreign exchange) by $Q_0 - Q_1^d$. As they reduce their purchases of imports they will also reduce their expenditures on import duties shown by $HLFA$. These import duties reflect part of what consumers are willing to pay for the imports they are giving up. Hence, the total economic value of the reduction in consumption is $Q_1^dLFQ_0$.

Combining the resource cost of the additional supply of exports with the reduction in consumer benefits from the cutback in consumption, we find that the total economic cost of the foreign exchange used by the project is equal to the sum of the two areas $Q_0KJQ_1^s$ and $Q_1^dLFQ_0$. Algebraically, the value of these two areas can be expressed as:

$$\text{Economic Cost of Foreign Exchange} = E^m Z (Q_1^s - Q_0) + E^m T (Q_0 - Q_1^d) \quad (9.1)$$

where E^m is the market exchange rate, Z is the subsidy per unit of exports and T is the tariff per unit of imports.

Expressing equation (9.1) in elasticity form, the economic cost of foreign exchange on a per unit basis (E^c) can be calculated as follows:

$$\begin{aligned}
E^e &= \frac{e^x E^m Q^x (1 + k) - \eta^l (Q^l) E^m (1 + t)}{e^x Q - \eta^l (Q^l)} \\
&= E^m \cdot \left[1 + \frac{e^x k - \eta^l (Q^l / Q^x) t}{e^x - \eta^l (Q^l / Q^x)} \right] \quad (9.2)
\end{aligned}$$

where e^x is the supply elasticity of exports, η^l is the demand elasticity for imports, Q^l is the quantity of foreign exchange required to pay for imports, and Q^x is the quantity of foreign exchange earned from exports. Here k represents Z/E^m_0 , the amount of subsidy expressed as a fraction of the initial equilibrating exchange rate. Likewise, t represents T/E^m_0 .

Equation (9.2) shows that the traditional measure of the economic cost of a unit of foreign exchange is equal to the market exchange rate plus (less) the net revenue loss (gain) experienced by the government in tax revenue from the adjustment of the demands and supplies of tradable goods that accommodate the increase in demand for foreign exchange by the project. This economic cost of foreign exchange is often expressed in project evaluation as a ratio to the market exchange rate, (E^e/E^m) . The percentage by which E^e exceeds E^m is typically referred to as the foreign exchange premium. To get the economic price of any given importable good its cif value (measured at the market exchange rate) is simply augmented by the foreign exchange premium), i.e., multiplied by E^e/E^m . For an exportable good it is the fob price (measured at the market exchange rate) that is augmented by the exchange premium to arrive at its economic value.

Suppose we are using an importable good that has a financial cost of \$150, inclusive of a 20 percent tariff that has been levied on its cif price. As the tariff payment is not a resource cost to the economy the value of this item net of tariff, \$125, is the cost that must be paid in foreign exchange. Assume that the value of E^e/E^m is 1.10. In this case, to arrive at the economic value of the item (\$137.50), its net of tax cost \$125 is adjusted by

1.1. The adjustment in this case lowers the economic cost to the project of this item below its financial cost, hence increasing the net benefits of the project.

This process of adjustment eliminates \$25 of financial cost, while at the same time imposing \$12.50 of additional cost to reflect the additional economic value the foreign exchange has over and above its financial cost.

The object of this type of adjustment is to see to it that a project's use or generation of foreign exchange is priced to reflect its economic opportunity cost. For tradable goods the total conversion factor for a good is made up of two parts: (i) an *adjustment* factor this is specific to the good which eliminates from the financial costs any taxes that are directly levied on the item and (ii) the premium reflecting the degree that the economic cost of foreign exchange exceeds its market value ($E^e/E^m - 1$).

9.3.2 The Economic Cost of Foreign Exchange and the Shadow Price of Non-Tradable Outlays Using Funds from the Capital Market

To this point the estimation of the economic price of foreign exchange has *explicitly* not taken into account how the funds *are sourced* by the project to purchase the foreign exchange. The issue was raised and examined by Blitzer, Dasgupta and Stiglitz when alternative fiscal instruments such as income or commodity taxes were used as ways to finance a project.⁵ Jenkins and Kuo also estimated the foreign exchange premium for Canada by developing a multi-sector general equilibrium model and assuming the *funds were* raised through a personal income tax.⁶ These assumptions are nevertheless not consistent with the economic opportunity cost of capital, where the capital market is postulated to be the source of funding for the project.

⁵ Blitzer, C., Dasgupta, P. and Stiglitz, J., "Project Evaluation and the Foreign Exchange Constraints", *Economic Journal*, (1981).

⁶ Jenkins, G.P. and Kuo, C.Y., "On Measuring the Social Opportunity Cost of Foreign Exchange", *Canadian Journal of Economics*, (May 1985).

The act of raising funds in the capital market will reduce the demand for goods and services in distorted as well as undistorted markets, in both the tradable and non-tradable sectors. Hence, externalities are generated by the act of raising funds in the capital market. We here explore how the traditional measure of the economic opportunity cost of foreign exchange has to be modified in order to take these additional externalities into account.

Once the focus is broadened to include externalities generated by the act of raising the funds involved (by whatever means) it becomes clear that one must treat the purchase of nontradable goods in a fashion similar to tradables, as there will typically be a difference between the financial cost and economic cost of outlays on nontradables. The percentage difference between these financial and economic costs will be referred to here as the premium on non-tradable outlays, PNT.

The estimation of the economic opportunity cost of foreign exchange and the shadow price of nontradable outlays is carried out here using a three-sector general equilibrium framework in which the funds used to finance the purchase of tradable and nontradable goods are obtained via the capital market.⁷ The three sectors are importable, exportable and non-tradable goods and services. Distortions such as tariffs, value-added taxes and subsidies are also present in the model. As before, the capital market is taken as the standard source of project funds, and the external effects involved in sourcing will be the same regardless whether these funds are spent on either tradables or nontradables.

When a project is financed by extractions from the capital market, there are three alternative sources for these funds. First, other investment activities may be abandoned or postponed. Second, private consumption may be displaced as domestic savings are stimulated. Third, increased foreign savings (capital inflows) may be generated in response to additional demand pressure in capital market. Different sets of the external effects will be involved, depending on the particular sources (e.g., domestic vs. foreign) from which the funds were drawn and the types of expenditures made (e.g., tradable vs. non-tradable).

⁷ Harberger, A.C. and Jenkins, G.P., "Introduction" edited by Harberger, A.C. and Jenkins, G.P., *Cost-Benefit Analysis*, Cheltenham: Edward Elgar Publishing Limited, (2002).

In order to cover all aspects of the problem, four source-use combinations are here considered. The alternative sources are the domestic and foreign capital markets. The alternative uses represent project spending on tradables and non-tradables. We begin by considering the case of sourcing the funds from in the local capital market.

Domestically Sourced Funds Used to Purchase Inputs

When funds are extracted from the domestic capital market to finance the purchase of project inputs, there will be a displacement of investment or private consumption expenditures. These investment and consumption expenditures would otherwise have been made on importable goods, exportable goods and non-tradable goods. The ultimate quantitative impacts on the demand in the market for these three broad classes of goods will also depend on whether the project uses the funds to purchase tradable or non-tradable goods.

Funds Used only to Purchase Tradable Goods

When funds from the capital market are used to purchase importable goods, the natural result would be a net excess demand for tradables together with a net excess supply of non-tradables. To eliminate this disequilibrium, the exchange rate has to rise, causing the price of tradables relative to non-tradables to increase. As a consequence, the domestic demand for importables and exportables will decline and that for non-tradables will rise. At the same time, the producers of importables and exportables will find it profitable to produce more, and producers of non-tradables will produce less. The process will continue until a new equilibrium is reached in which there will be no excess demand or excess supply in the system.⁸ In other words, the exchange rate will adjust so as to ensure

⁸ This follows from properties of demand functions that the weighted sum of all the compensated price elasticities of demand (and supply) across all of the goods will always be equal to zero. That is, the real exchange rate will adjust until there is no excess demand (supply) for tradable and non-tradable goods in the system. This can be expressed as follows:

$$(\partial Q_{d,i}/\partial E) dE + (\partial Q_{d,e}/\partial E) dE + (\partial Q_{d,nt}/\partial E) dE = 0;$$

$$(\partial Q_{s,i}/\partial E) dE + (\partial Q_{s,e}/\partial E) dE + (\partial Q_{s,nt}/\partial E) dE = 0$$

Where E denotes foreign exchange rate; $Q_{d,i}$, $Q_{d,e}$, and $Q_{d,nt}$ stand for the demand for importable, exportable and non-tradable goods, respectively; $Q_{s,i}$, $Q_{s,e}$, and $Q_{s,nt}$ stand for the supply of importable, exportable and

that there is no excess supply of tradable goods market in the final equilibrium.

In the market for non-tradables, the reduction in demand caused by the initial capital extraction is somewhat offset by an increase in the quantity demanded (substitution effect) due to the decrease in their relative price. Similarly, the supply of non-tradable goods responds to the depressed market by contracting. Resources are released from the non-tradables sector will be used to help accommodate the increased demand in for tradables. Readers should recall that this entire analysis is carried out on the assumption of full economic equilibrium in the presence of existing distortions. Under this assumption, the total resources released from the non-tradable goods sector must equal the resources required for the additional production of importable and exportable goods.

In the case where funds are raised in the domestic capital market and spent on domestically produced exportable goods, the impact on the exchange rate turns out to be exactly the same as the case where the funds are spent on the purchase of importable goods.

Funds Used only to Purchase Non-tradables

In this case, the capital extraction plus the spending of all the funds on non-tradable items results in an excess demand for non-tradables. At the same time there is a reduction of spending on tradables due the extraction of funds via the capital market. To reach a new equilibrium, the relative price of non-tradables will have to increase, inducing resources to move from the tradables to the nontradables sector. This adjustment process is the reverse to that described in the case of funds spent on tradable goods.

Foreign Funds Used to Purchase Inputs for Project

When foreign funds are used to finance the project's inputs, the results are quite different

non-tradable goods, respectively.

In addition, the extraction of funds via the capital market results in a reduction in demand in both the tradable and non-tradable goods sectors. The reduction in demand for non-tradable goods will discourage their production until their supply equals their demand. This ensures that the following equation in the non-tradable goods sector is satisfied:

$$(\partial Q_{d,nt}/\partial B) dB + (\partial Q_{d,nt}/\partial E) dE - (\partial Q_{s,nt}/\partial E) dE = 0,$$

where dB stands for the amount of funds raised in the domestic capital market.

from the case treated above. Now there is no initial displacement of investment and consumption of tradable and non-tradable goods due to the capital extraction.

Moreover, when funds come from abroad to purchase tradable goods, no excess demand is generated for either foreign or domestic currency. However, when foreign sourced funds are spent on nontradables this will generate an increase in their relative price. At the new equilibrium, the supply of nontradables will have increased, and that of tradables will have decreased.

9.4 General Equilibrium Analysis: A Diagrammatic and Numerical Illustration

In this section concrete exercises are presented in order to illustrate how the general analysis can be put into practice. In doing so the two alternative sources of funds will be examined separately. We begin with the case of sourcing of project funds in the domestic capital market.

9.4.1 Sourcing of Funds in the Domestic Capital Market

Figure 9.5A shows the total supply and demand for tradable goods in an economy as a function of the real exchange rate (E). For the moment, we assume that there are no distortions in either sector.

(i) Impacts of Project Demand with No Distortions

If the project demand for tradable goods is 600, we do not assume that we move upward on the price axis to point E_u as shown in Figure 9.5A, where there is a gap of 600 between T_O^S and T_O^D , the quantities of tradables demanded and supplied.⁹ Instead we must take into account the fact that in raising 600 of funds in the capital market we have displaced the demand for tradables by some fraction (say $2/3$) of this amount, and the

⁹ This is analogous to what was done in the partial-equilibrium scenario, where the sourcing of the funds was not considered.

demand for non-tradables by the rest (the other 1/3).

Our scenario, then, is that we shift the demand curve for tradables to the left by 400, and simultaneously insert a wedge of 600 representing the purchase of tradable goods to be used in the project, between that new demand T^D_1 and the supply curve of tradables T^S_0 . As all the 600 is spent on tradable goods, the demand for tradables shifts from T^D_1 to T^D_2 . At the exchange rate of E_0 there is now an excess demand for tradables of $Q^T_2 - Q^T_0$ or 200. Simultaneously, in the non-tradable goods market (Figure 9.5B), there is an excess supply, also of 200 ($(Q^{NT}_0 - Q^{NT}_1) = 200$). As a result, the real exchange rate rises from E_0 to E_1 . The 600 of tradables resources used by the project comes from three different sources -- a backward shift of tradables demand of 400, a movement backward along the “old” demand for tradables of 120 and a movement forward of 80 along the supply curve of tradables.¹⁰ In the non-tradable goods market, due to the decline in its prices relative to tradable goods, demand will increase by 120, as shown in Figure 9.5B. The net reduction in the demand for non-tradable goods becomes 80. In final equilibrium the supply of non-tradable goods will be reduced by 80 and the resources released from this sector will be absorbed in the expansion of the tradables sector.

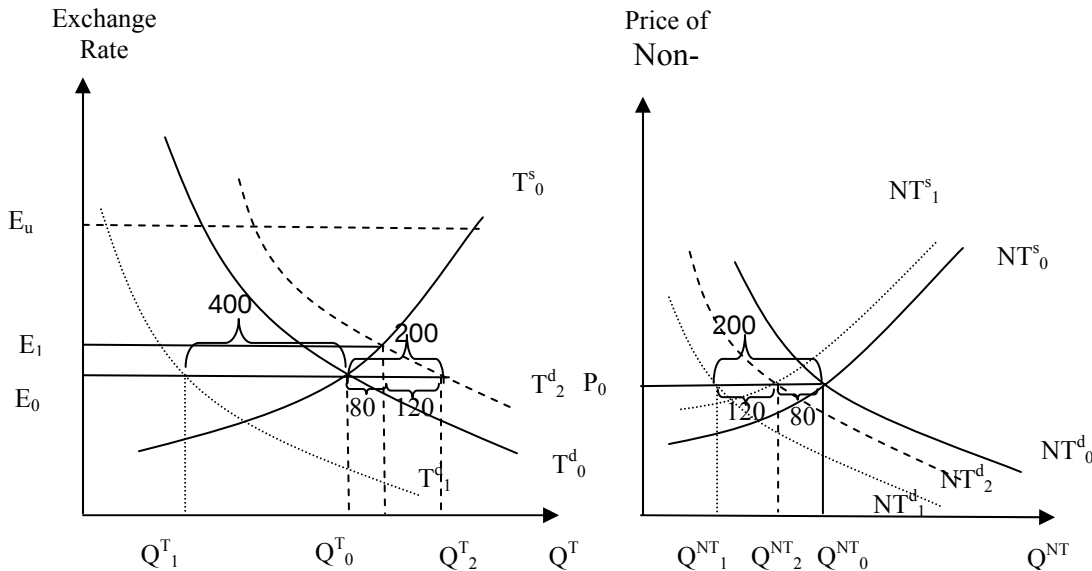
¹⁰ This assumes that $|\eta^d_T| = 1.5 \epsilon^s_T$ where η^d_T denotes the demand elasticity for tradable goods while ϵ^s_T denotes the supply elasticity of tradable goods.

Figure 9.5

Impact of Domestically Sourced Funds Used to Purchase Tradable Goods

A. Tradable Goods

B. Non-tradable Goods

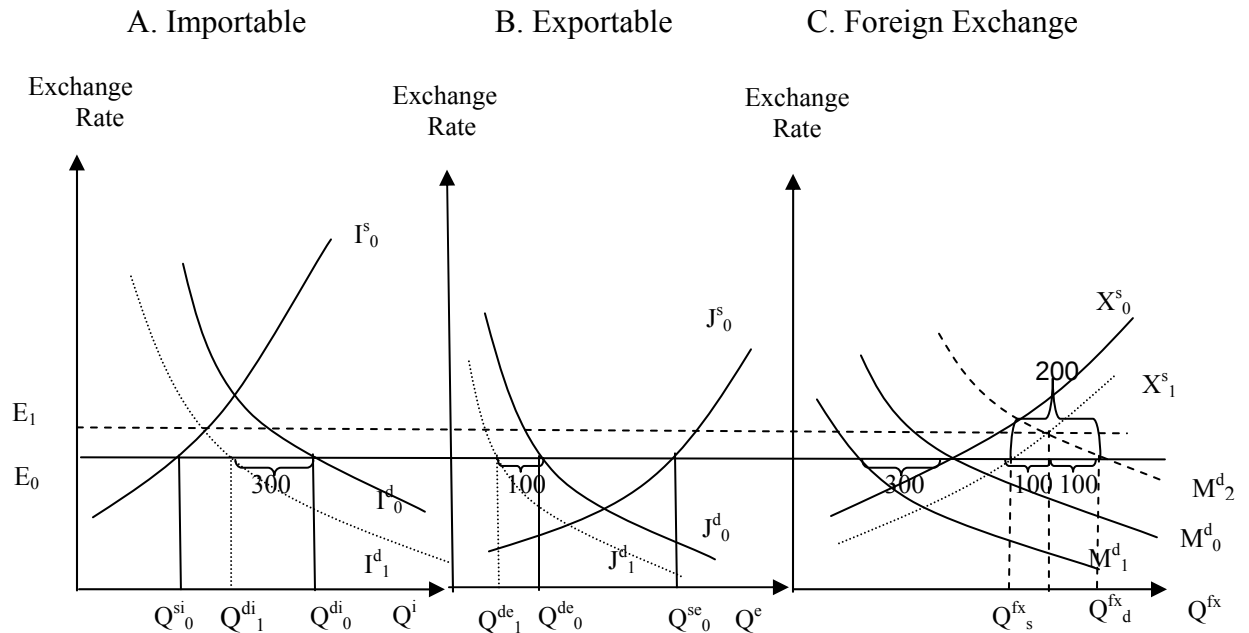


We will be able to use Figure 9.5 for a whole series of exercises, each involving a different set of distortions. In order to be able to do this, we have to interpret the demand and supply curves as being net of any distortions that are present in the system -- in particular, the demand for imports and the supply of exports are those which describe the market for foreign exchange. Thus, the import demand curve will be defined as being net of import tariff distortions and the export supply curve as being net of any export subsidy. Likewise, the demands for tradable and non-tradable goods will be defined to be net of the value added tax distortion. (When we make this assumption we are in no way constraining people's tastes or technologies. It should be clear, however, that we are not allowed, when we use this artifice, to trace the economy's reaction to the imposition of new tariffs or value added or other taxes or distortions). Readers can think of Figure 9.5 as representing the net position of different economies with different tax setups, but which happen to have the same set of "market" demand and supply curves for foreign currency, for tradables and for non-tradables.

Figure 9.6 tells the same story as Figure 9.5 but with important additional details. The connection between the two is the famous national accounting identity $(X^s - M^d) = (T^s - T^d)$, where X^s is the supply function of exports and M^d the demand function for imports. The shift of 400 in the demand for tradables has now to be broken down into a portion (here -300) striking the demand for importables and its complement (here -100) striking the demand for exportables, as shown in panels A and B. These components cause corresponding shifts in the import demand curve (shifting to the left by 300) and the export supply curve (shifting to the right by 100) as shown in panel C. With the purchase of 600 of importable goods there is an excess demand for foreign exchange of $Q_d^{fx} - Q_s^{fx}$ or 200. The exchange rate will rise to E_1 . This will cause the supply of export to increase by 100 and the demand for import to decrease by 100.¹¹

Note, however, that the movement along the supply curve of exports (+100) is different from the movement along the total supply curve of tradables (+80), and similarly that the movement along the demand function for imports (-100) is different from that along the demand for total tradables (-120). This simply reflects the fact that the demand for imports is an excess-demand function $I^d - I^s$, where I stands for importables, and that the export supply is an excess-supply function $J^s - J^d$, where J stands for exportables. The demand for tradables T^d is equal to $I^d + J^d$ and the supply of tradables T^s equals $I^s + J^s$.

¹¹ Assume that $|\eta_m^d| = \varepsilon_x^s$ where η_m^d denotes the demand elasticity for imports while ε_x^s denotes the supply elasticity of exports.

Figure 9.6: Foreign Exchange Markets

Thus, if we are asked, where did the 600 of foreign exchange come from, in order to meet our project's demand? We can actually respond with two equally correct answers. We can say that it came 520 from reduced demand for tradables and 80 from increased tradables supply. Or we can equally well respond that it came from a displacement in other imports of 400 and an increase in actual exports of 200. Both answers are correct, and if we do our calculations correctly, one will never contradict the other.

(ii) Introducing Import Tariffs

Suppose now that the only distortion present in this economy is a uniform import tariff (τ_m) of 12%. Given the shifts depicted in Figure 9.6, we have that the reduction in other imports (400) is twice as large as the increase in export supply. Our calculation of the economic opportunity cost of foreign exchange (E_e) would be:

$$E_e = 0.67 E_m(1.12) + 0.33 E_m = 1.08 E_m$$

The shifts depicted in Figure 9.6 are due to the way in which the money for the project

was obtained (or “sourced”), or is deemed to have been sourced. We here operate on the assumption that the standard source of funds at the margin is the capital market. When funds are withdrawn from the capital market, we assume here that they came either from displaced domestic investment or from newly stimulated domestic saving (displaced consumption). Later, we will bring in a third source -- capital flowing in from abroad -- to complete the picture.

In Figure 9.6 we show how this displacement of spending through the “sourcing” of the project’s funds is reflected in the demand for tradables taken as an aggregate (Figure 9.5A), and the demand for imports and the supply of exports considered separately (Figure 9.6C). Figure 9.5A is built on the assumption that the “sourcing” of 600 of project funds displaces tradables demand by 400 and non-tradables demand by 200. The reduction of 400 of demand for tradables is broken down into 300 affecting the demand for importables I^d and 100 affecting the demand for exportables J^d (see Panels A and B of Figure 9.6). These moves in turn are reflected in a leftward shift of the demand for imports ($M^d = I^d - I^s$) and in a rightward shift in the supply of exports ($X^s = J^s - J^d$). Because of these relations -- imports being one of excess demand, exports one of excess supply -- there is no reason why the slope of the X^s curve should be the same as that of the T^s curve, nor why there should be any similarity between the slope of T^d and that of M^d . Thus no contradiction is involved when the residual “gap” of 200 is filled 40% by a movement forward along T^s and 60% by a movement backward along T_0^d , while at the same time the filling of the same gap entails movements of equal amounts (100 each) forward along X_0^s and backward along M_0^d .

(iii) Introducing Value Added Taxation

For the most part, the literature on cost-benefit analysis has ignored value added taxation, and even indirect taxation in general, in its methodology for calculating the economic opportunity cost of foreign exchange and/or related concepts. Perhaps this is because value added taxes did not even exist before 1953, while the methodology of cost-benefit

analysis has roots going back far earlier. Also, many expositions of the value added tax treat it as a completely general tax, applying equally to all economic activities. This may have led cost-benefit analysts to assume that all sorts of resource shifts could take place as a consequence of a project without causing any net cost or benefit via the VAT, because the same rate of tax would be paid (on the marginal product of any resource) in its new location as in its old.

Our own real-world experience has led us to conclude, however, that the above assumption is grossly unrealistic. In the first place, value added taxes never strike anywhere near 100% of economic activities -- education, medical care, government services in general, the imputed rent on owner-occupied housing, plus all kinds of casual and semi-casual employment -- all typically fall outside the VAT net, even in countries which pride themselves on the wide scope of their value added taxes. In the second place, and partly for the reason just given, the effective average rate of value added taxation is typically much higher for the tradable goods sector than it is for non-tradables. Our work in Argentina and Uruguay, both of which at the time had “general” value added taxes of around 22%, suggested that actual collections are compatible with “effective” VAT rates of about 20% for tradables and of about 5% for non-tradables. In the exercise that follows we will use these VAT rates, together with an assumed general import tariff of 12%, to recalculate the economic opportunity cost of foreign exchange plus a new, related concept, the shadow price of non-tradable outlays.

The formal exercise to be performed is already illustrated in Figure 9.5. We assume we are raising 600 in the domestic capital market and spending it on tradable goods. In the process we displace 400 of other (non-project) imports, on which the tariff is 12%. The result is a distortion “cost” of 48 ($= .12 \times 400$). In addition we must take into account what is happening with respect to the value-added tax. In the tradables sector, non-project demand is displaced to the tune of 520 -- 400 from the leftward shift of demand due to the sourcing of project funds in the capital market, and 120 from the movement back

along T_O^d , which should be interpreted as a demand substitution away from tradables and toward non-tradables. The net result of all of this is a distortion cost of 104 ($= .2 \times 520$).

Finally, we turn to the non-tradables sector, whose movements are depicted in Figure 9.5B. The initial downward shift in the demand for non-tradables can be inferred to be 200, as 600 of funds was assumed to be raised in the capital market, of which 400 came from a downward shift of tradables demand. On the substitution side, we have the reflection of the downward movement of 120 in tradables demand (along the demand curve T_O^d). As this substitution is away from tradables it must be toward non-tradables. This leaves a net reduction of demand of 80 in the non-tradables market. The distortion cost here is 4 ($= .05 \times 80$), reflecting the effective VAT rate of 5%.

To close the circle we perform a simple consistency check. We have seen that, for the tradables, other demand is down by 520, and supply is up by 80. The difference here is represented by our project's own demand of 600, here assumed to be spent on tradables. So we have supply equal to demand, in the post-project situation, in the tradables market. Similarly, we have the supply of non-tradables down by 80 (reflecting the release of resources to the tradables sector), matched by a decline of 80 non-tradables demand, as shown in the previous paragraph.

To get the foreign exchange premium we simply add up the three types of distortion costs 156 ($= 48 + 104 + 4$) and express the result as a fraction of the 600 that our project is spending on tradable goods and services. Thus we have a premium of $156/600$, or 26%. Hence $E_e = 1.26 E_m$.

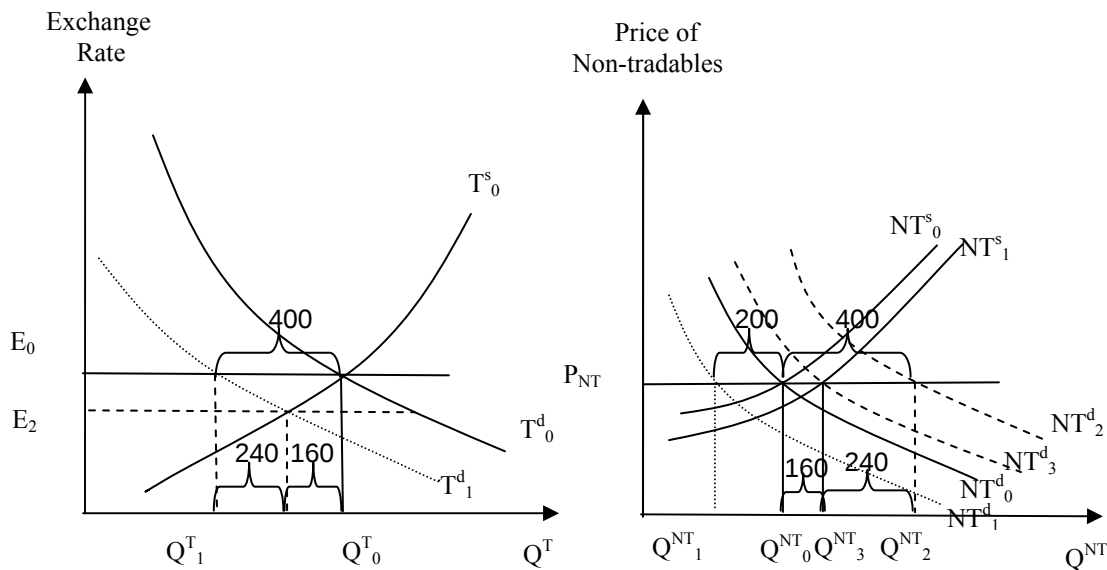
The related concept that we must now explore is the shadow price of non-tradables. To obtain this we perform an exercise quite similar to the one we have just completed, simply altering the assumption about how the money is spent. We can use Figure 9.7 to describe this case. Instead of assuming that project demand of 600 enters in the tradables

market to bid up the real exchange rate to E_1 , we instead have zero project demand for tradables, but the same “sourcing” shifts as before. The demand for non-tradable goods shifts from NT^d_1 to NT^d_2 . At the exchange rate E_0 , there is an excess supply of tradable goods of 400 ($Q^T_0 - Q^T_1$) and an excess demand for non-tradable goods of 400 ($Q^{NT}_2 - Q^{NT}_0$). This will cause the market exchange rate to fall to E_2 , resulting in an increase of the demand for tradable goods by 240 and a decrease in the demand for non-tradable goods by 240. At the same time, there will be a reduction of tradable goods supply by 160 – these resources being released in order to expand the production of non-tradables (to meet the incremental demanded due to their relative price decline).

Figure 9.7**Impact of Domestically Sourced Funds Used to Purchase Non-tradable Goods**

A. Tradable goods

B. Non-tradable Goods



The move from the initial equilibrium at E_0 to the new one of E_2 , entails a net reduction of 100 in total imports (and also in non-project imports because the project is here demanding only non-tradables). On this the distortion cost is 12 ($= 100 \times .12$) from the 12% import tariff. In the tradables market the gap of 400 which exists at E_0 between T^s_0

and T_1^d , must be closed by moving along both curves.¹² Starting from the initial point at E_0 , the gap of 400 will be met by an increase of 240 along T_1^d , and by a decline of 160 along T_0^S . With a value added tax of 20% on tradables demand, we have a distortion cost of 32 ($= 160 \times 0.2$). (Tradables demand has shifted to the left by 400 and moved to the right along T_1^d , by 240.)

In the non-tradables market, we have a shift to the left of demand equal to 200 (from sourcing 600 in the capital market) plus the introduction of a new demand of 600. At the original real exchange rate E_0 this means a gap of 400 will be opened between supply and demand. The elimination of that gap entails the movement of the real exchange rate down to E_2 . In the process “old” non-tradables demand will decline by 240 (the counterpart of the movement from E_0 to E_2 along T_1^d) and non-tradables supply will increase by 160 (the counterpart of the movement along T_0^S between E_0 and E_2). So altogether we have a reduction of old non-tradables demand by 440. Applying the VAT rate of 5% to this decline, we have a distortion cost of 22 ($= .05 \times 440$).

Our total distortion cost in the case of project demand for non-tradables is thus 66 ($= 12 + 32 + 22$). Distributing this over a project demand for non-tradables of 600 we have a percentage distortion of 11%, and a shadow cost of project funds spent on non-tradables equal to 1.11 times the amount actually spent.

Consistency checks can now easily be made for this case. In the tradables market, supply has dropped (from the initial point E_0) by 160, moving along T_0^S , and demand has dropped by a like amount (a “sourcing” shift downward by 400, plus an increase along T_1^d of 240). In the non-tradables market we have 160 of extra resources, plus displaced demand of 440 (200 from the downward shift of non-tradables demand due to “sourcing”

¹² The example of the movements along T_1^d and T_0^S , between E_2 and E_0 , shows that this gap of 400 will be

of the funds to be spent, plus 240 of reduced non-tradables demand as people moved downward from E_0 to E_2 along T_1^d). Together, these are sufficient to free up the 600 of non-tradables output that our project is here assumed to be demanding.

(iv) *Introducing Value-Added-Tax Exclusions (Credits) for Investment Demand*

In the real world, most value added taxes are of the consumption type, and are administered by the credit method. In calculating its tax liability, a firm will apply the appropriate VAT rate to its sales, then reduce the resulting liability by the tax that was already paid on its purchases. In the consumption type of tax, this credit for tax already paid applies both to current inputs and to purchases of capital assets. In this way, investment outlays are removed from the base of the tax.

At first glance it would appear easy to correct our previous figure to accommodate this additional nuance, simply by scaling down the distortion costs we originally attributed to the VAT. On second thought, the matter is not quite so simple, for investment and consumption are likely to be very differently affected by the act of raising funds in the capital market on the one hand, and the process of demand substitution in response to real exchange rate adjustments, on the other. In particular, one should expect a large fraction (we here assume 75%) of the funds raised in the capital market to come at the expense of displaced investment, while a considerably smaller fraction would seem to be appropriate when a standard, price-induced substitution response is considered (we here use an investment fraction of one third). Thus, rather than a single adjustment to account for the crediting of tax paid on investment outlays, we have to make two adjustments -- one adjusting downward by 75% the distortion costs linked to the VAT in the response to the raising of project funds in the capital market, and the other, adjusting downward by one third the distortion costs (or benefits) associated with the readjustment of relative prices so as to reach a new equilibrium.

closed by a movement of 240 along T_1^d , and of 160 along T_1^s .

Tables 9.1 and 9.2 provide a very convenient format in which to make these adjustments. At the same time they can be used to show how the opportunity cost of foreign exchange and the shadow price of non-tradable outlays are modified as additional complications are introduced. The figures in the table correspond exactly to those underlying Figures 9.5-9.7 and embodied in our earlier calculations. There are three columns under the general rubric of distortion cost. In the first of these, only a 12% import tariff is considered. The point to be noted here is that even with this superclean and simple assumption, there is a need to allow for a shadow price of non-tradables outlays (see the first column under distortion costs in Table 9.1). In the second column a value added tax of 20% in tradables ($v_t = .2$) and of 5% on non-tradables ($v_h = .05$) is introduced. This yields precisely the numbers that emerged from the two exercises we have already conducted incorporating a value added tax.

Finally, in the third column under distortion costs we build in the exclusions (credits) for investment outlays. It is for this purpose that we have segmented the changes into two sets -- the first associated with the sourcing of project funds in the capital market, and the second linked with the substitution effects emanating from the real exchange rate adjustment corresponding to each case. Readers can verify that in the upper panels of Tables 9.1 and 9.2, the distortion costs linked to “tradables demand” and to “non-tradables demand” are reduced by 75% as one moves from the second to the third “distortion cost” column. Likewise, in the lower panels of these tables, the corresponding distortion costs are reduced just by one third as one moves from the second to the third distortion cost column.

This simple process of accounting for the crediting of investment outlays under the value added tax has a major effect on the calculation of the economic opportunity cost of foreign exchange and on the shadow price of non-tradable outlays. The former moves from $1.26 E_m$ to $1.1375 E_m$, while the SPNTO moves from 1.11 to 1.0175.¹³

¹³ The general formulae for calculating the economic values of the economic opportunity cost of foreign exchange and the shadow price of non-tradable outlays are presented in Appendix 9A. That appendix covers the cases of both domestic and foreign sourcing.

Table 9.1

**Calculation of the Economic Opportunity Cost of Foreign Exchange:
600 of Project Funds Sourced in Capital Market and Spent on Tradables**

				τ_m v_t	τ_m v_h	τ_m v_t v_h	e_{is} e_{ia}
<u>Change Due To Capital Market Sourcing</u>	Impact on Demand and Supply	(exclusion for investment $e_{is} = 0.75$)	Applicable Distortion	τ_m Alone	τ_m v_t v_h	τ_m v_t v_h	e_{is} e_{ia}
Tradables Demand	-400	$v_t = .20$		n.a.	-80	-80	-20
Import Demand	-300	$\tau_m = .12$		-36	-36	-36	-36
Export Supply	+100	-		n.a.	n.a.	n.a.	n.a.
Non-tradables Demand	-200	$v_h = .05$		n.a.	-10	-10	-2.5
<u>Change Due To Real Exchange Rate Adjustment</u>		(exclusion for investment $e_{ia} = 0.33$)					
Tradables Demand	-120	$v_t = .20$		n.a.	-24	-24	-16
Tradables Supply	+80	-		n.a.	n.a.	n.a.	n.a.
Import Demand	-100	$\tau_m = .12$		-12	-12	-12	-12
Export Supply	+100	-		n.a.	n.a.	n.a.	n.a.
Non-tradables Demand	+120	$v_h = .05$		n.a.	+6	+6	+4
Non-tradables Supply	-80	-		n.a.	n.a.	n.a.	n.a.
<u>Total Distortion Costs (-), Benefit (+)</u>				-48	-156	-156	-82.5
<u>Distortion Cost/ Project Expend. = Premium on Tradables Outlays</u>				.08	.26	.26	.1375
<u>Ratio of Economic to Market Exchange Rate</u>				1.08	1.26	1.26	1.1375

Table 9.2
Calculation of the Shadow Price of Non-tradable Outlays:
600 of Project Funds Sourced in Capital Market and Spent on Non-tradables

			Applicable Distortion	τ_m Alone	τ_m v_t v_h	τ_m v_t v_h e_{is} e_{ia}
<u>Change due to Capital Market Sourcing</u>	Impact on Demand and Supply	(exclusion for investment $e_{is} = 0.75$)				
Tradables Demand	-400	$v_t = .2$	n.a.	-80	-20	
Import Demand	-300	$\tau_m = .12$	-36	-36	-36	
Export Supply	+100	-	n.a.	n.a.	n.a.	
Non-tradables Demand	-200	$v_h = .05$	n.a.	-10	-2.5	
<u>Change due to Real Exchange Rate Adjustment</u>		(exclusion for investment $e_{ia} = 0.33$)				
Tradables Demand	+240	$v_t = .20$	n.a.	+48	+32	
Tradables Supply	-160	-	n.a.	n.a.	n.a.	
Import Demand	+200	$\tau_m = .12$	+24	+24	+24	
Export Supply	-200	-	n.a.	n.a.	n.a.	
Non-tradables Demand	-240	$v_h = .05$	n.a.	-12	-8	
Non-tradables Supply	+160	-	n.a.	n.a.	n.a.	
<u>Total Distortion Costs (-), Benefit (+)</u>			-12	-66	-10.5	
<u>Distortion Cost/Project Expend. = Premium in Non-tradable Outlays</u>			.02	.11	.0175	
Shadow Price of Non-tradable Outlays			1.02	1.11	1.0175	

9.4.2 Sourcing of Funds in the Foreign Capital Market

The analysis of this section is built on the assumption that all of the project's funds are drawn from the external capital market. We do not consider this to be a realistic assumption except in rare cases (a point to be treated below) but it is an extremely useful expository device. Our plan is to calculate in this section the premia on tradables and non-tradables outlays on the assumption of sourcing in the external market, and then form a weighted average in which the premia applying to domestic sourcing and to foreign sourcing are combined, using weights designed to simulate the way natural market forces would respond to an increased demand for funds by the country in question.

Table 9.3 is presented in the same format as Tables 9.1 and 9.2. It differs only in that the project funds are assumed to be sourced in the external capital market instead of the domestic market. The first point to note is that we have no table dealing with the premia that apply when funds that are raised abroad are spent on tradables. The reason is that in such a case there should be no repercussion in the domestic market. If the funds are spent on imports, that simply means an extra truck or electric generator or ton of coal arrives at the country's ports. If the funds are spent on exportables that means that at the prevailing world prices of those exports (assumed to be determined in the world market and beyond the influence of the country in question), the country's exports will be reduced in the amount of the project's demand. Hence there is no variation of any distorted local market incidental to the spending of foreign-sourced funds on tradable goods.¹⁴

¹⁴ Readers should be aware that in developing the economic opportunity cost of foreign exchange and the shadow price of non-tradable outlays, we do not incorporate the distortions that apply to the products on which project funds are spent. These are taken into account as aspects of project's budgeted spending on specific items. Even with a uniform tariff, project imports often enter the country duty free (especially when imported by government agencies). More generally, we must know the specific imports of a project before we can determine what tariff rate applies. The case is similar with the value-added and other indirect taxes. We take all relevant distortions into account at some point in the analysis. The question is not whether we count them but where. The whole concept of economic opportunity costs and shadow prices presupposes that essentially the same pattern of distortions is involved each time a certain operation (e.g., spending project funds on tradables or non-tradables) takes place. The use of E_c and SPNTO represents a shorthand way of taking into account such repetitive patterns of distortions. Hence in calculating them we want to include all relevant parts of such a repetitive pattern. But we do not want to take into account idiosyncratic distortions -- i.e., those that depend in the particular pattern in which project funds are spent. These come into the cost-benefit calculus at the point where these specific outlays are treated.

The situation is quite different when money from abroad is allocated to the purchase of non-tradables. As shown in Figure 9.8, this would be reflected in an excess supply of foreign exchange, together with an excess demand of 600 in the non-tradables market. This situation is quite analogous to that at E_2 in Figure 9.7 which represents an excess demand for non-tradables of 400. So we expect the same kind of story as is told in Table 9.2, except that we do not have the distortion costs stemming from sourcing in the domestic capital market (and shown in the upper panel of Table 9.2). And, of course, the story of the bottom panel of Table 9.2 has to be augmented by 50% to reflect an excess non-tradables demand of 600 rather than 400. To meet this demand in the non-tradables market, 600 of foreign exchange must be converted to local currency. This entails stimulating imports by 300 (along the demand curve for imports) and displacing exports by a like amount (along the supply curve of exports). These movements are shown under import demand and export supply in panel C. The real exchange rate moves to a level E_3 as the same as shown in panel A, which entails a movement of 360 forward along the demand curve for tradables and one of 240 downward along the supply curve of tradables.

We thus have 240 less of tradables being produced, hence 240 more of non-tradables. And we have 360 more of tradables being demanded. This uses up 360 of the 600 of foreign exchange that came in to finance the project. The other 240 replaces the reduction in tradables supply, just mentioned.

Figure 9.8

Impact of Funds Borrowed from Abroad and Used to Purchase Non-tradable Goods

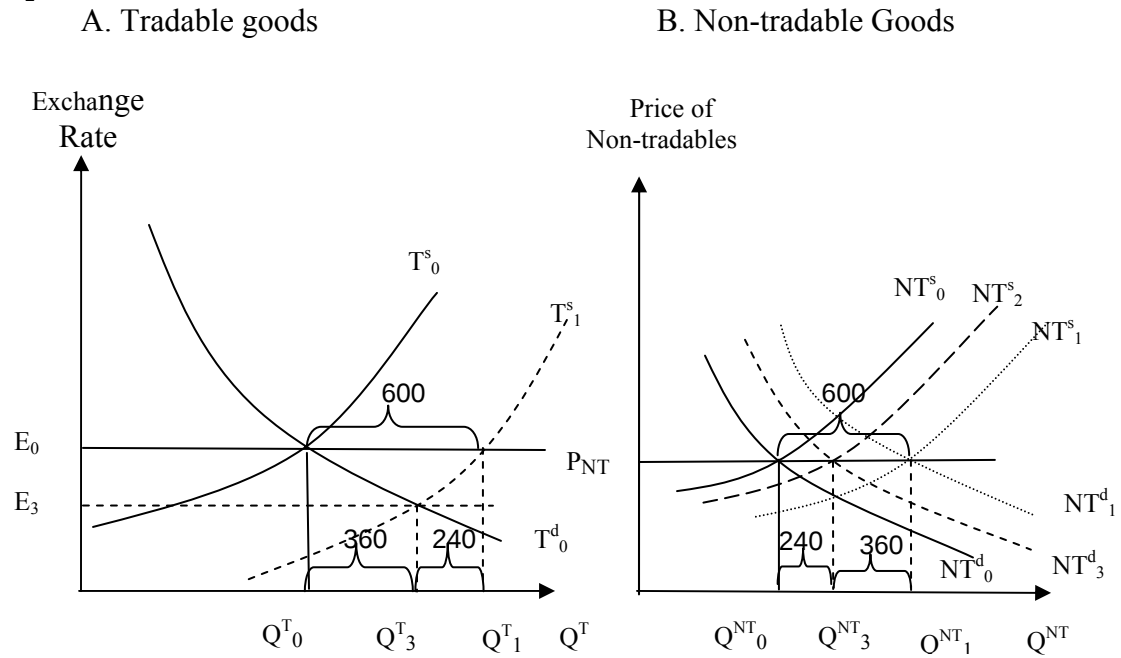
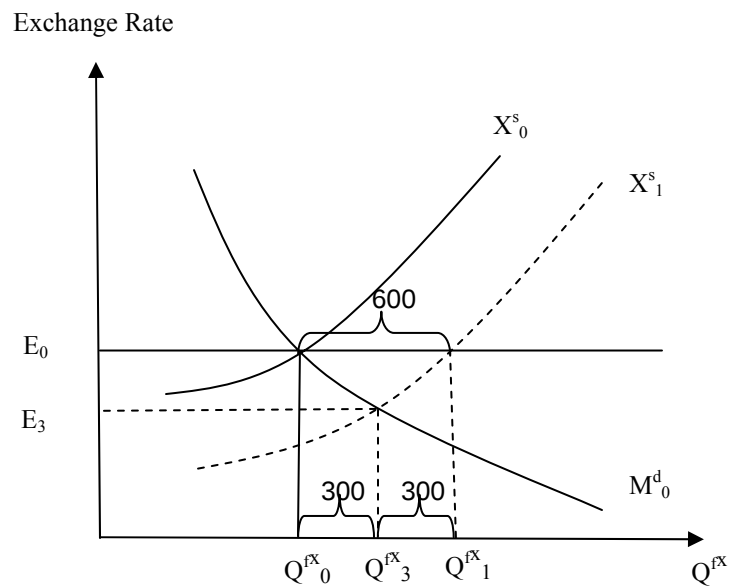


Figure 9.8

Impact of Funds Borrowed from Abroad and Used to Purchase Non-tradable Goods

C. Foreign Exchange Market



The 600 of project demand for non-tradables is met from the 240 of increase in their supply, plus the 360 induced reduction in their demand (the counterpart of the increase in demand for tradables induced by the fall in the real exchange rate from E_0 to E_3). The same gap of 600 which is closed by an increase of 300 in imports and a fall of 300 (panel C) in exports is reflected in an increase of 360 in total tradables demand and a fall of 240 in total tradables supply, as shown in panel A. These being substitution effects, they are reflected in moves of equal magnitude and opposite sign for the non-tradables (panel B).

Table 9.3 should be easy to interpret. It follows exactly the same principles as Tables 9.1 and 9.2. The only notable feature of Table 9.3 is that, rather than distortion costs, we obtain in each case an external benefit from the use of foreign-sourced funds in order to purchase non-tradables. In the example of Table 9.3, we have an external benefit of 6% of the expenditure on non-tradables when there is only a 12% tariff, a 15% benefit with that tariff plus a value added tax ($v_t = .20$; $v_h = .05$) with no credit in investment goods purchases, and a 12% percent benefit in the final case, when such a credit is given. All this comes from the facts that: a) there is no external effect linked with the actual sourcing of the (foreign) funds in this case; b) that there is an unequivocal benefit (tariff externality) from the increase in imports that this case entails; and c) that the demand substitution involves more spending on tradables with a higher VAT ($v_t = .20$) and less (substitution-induced) spending on non-tradables with a lower VAT ($v_h = .05$).

Table 9.3
Calculation of Shadow Price of Non-tradables:
600 of Project Funds Sourced abroad and Spent on Non-tradables

			τ_m	τ_m	τ_m
				v_t	v_h
	Impact on	Applicable	τ_m	v_t	e_{is}
	Demand and	Distortion	Alone	v_h	e_{ia}
	Supply				
<u>Change Due To</u>		(exclusion for			
<u>Capital Market</u>		investment			
<u>Sourcing</u>		$e_{is} = 0.75$)	n.a.	n.a.	n.a.
<u>Change Due To Real</u>		(exclusion for			
<u>Exchange Rate</u>		investment			
<u>Adjustment</u>		$e_{ia} = 0.33$)			
Tradables Demand	+360	$v_t = .2$	n.a.	+72	+48
Tradables Supply	-240	-	n.a.	n.a.	n.a.
Import Demand	+300	$\tau_m = .12$	+36	+36	+36
Export Supply	+300	-	n.a.	n.a.	n.a.
Non-tradables Demand	-360	$v_h = .05$	n.a.	-18	-12
Non-tradables Supply	+240	-	n.a.	n.a.	n.a.
<u>Total Distortion Costs (-),</u>			+36	+90	+72
<u>Benefit (+)</u>					
<u>Distortion Cost/ Project Expend.</u>			-.06	-.15	-.12
<u>= Premium on Non-tradables Outlays</u>					
<u>Shadow Price of Non-tradable Outlays</u>			0.94	0.85	0.88

9.4.3 Sourcing of Funds from both Domestic and Foreign Capital Markets

In Table 9.4 we combine Tables 9.1, 9.2 and 9.3, calculating weighted average premia for tradables and non-tradables outlays. We use weights $g_d = .7$ and $g_f = .3$, indicating a

70/30 split as between domestic and foreign sourcing of funds. These weights may appear arbitrary, but in principle one should think of them as market-determined. A simple supply and demand exercise, with many suppliers meeting a total demand, leads to the prediction that an increment of demand may in the first instance fall on one supplier or another, but market equilibrium requires that in the end, all suppliers will move upward along their supply curves from the old to the new equilibrium price. The distribution of the increased quantity among the different suppliers thus depends on the slopes of the supply curves from different sources.

We follow the same logic in thinking of the distribution of sourcing between the domestic and the foreign capital markets. We profoundly reject the idea that developing countries face an infinitely elastic supply curve of funds at the world interest rate (or at the world interest rate plus a specified country risk premium). The implications of such a setup are far too strong for us (and for most economists familiar with developing countries) to accept. For example: a) even government investments financed in the first instance by borrowing in the domestic capital market will in the end be effectively financed from abroad; this means no crowding out of domestic investment via the local capital market; b) any new increment to public or private saving will end up abroad; c) any new increment to public or private investment will end up being financed from abroad; d) the economic opportunity cost of public funds is simply the world interest rate (plus a country-risk premium, where applicable).

Rather than try to live with the above unrealistic implications of a flat supply curve of funds facing the country, we postulate an upward rising curve. This means that funds drawn from the capital market are effectively sourced from: a) displaced other investments, b) newly stimulated domestic savings (displaced consumption), and c) newly stimulated “foreign savings”, i.e., extra foreign funds obtained by moving forward along the supply curve of such funds, facing the country.

Table 9.4
Weighted Average Premia with “Standard” Capital Market Sourcing

Applicable Distortions	Project Funds Sourced From:		
	Domestic Capital Market	Foreign Capital Market	Both Markets $g_d=.7, g_f=.3$
$\tau_m = .12$			
Project Funds Spent on:			
Tradables	.08	0	.056
Non-tradables	.02	-.06	-.004
$\tau_m = .12, v_t = .20, v_h = .05$			
Project Funds Spent on:			
Tradables	.26	0	.182
Non-tradables	.11	-.15	.032
$\tau_m = .12, v_t = .20, v_h = .05, e_{ih} = .75, e_{ia} = .33$			
Project Funds Spent on:			
Tradables	.1375	0	.09625
Non-tradables	.0175	-.12	-.02375

Notes: g_d : fraction of project funds effectively sourced in the domestic capital market;
 g_f ($=1-g_d$): fraction of project funds effectively sourced in the foreign capital market.

Items a) and b) were incorporated in the analysis of Tables 9.1 – 9.2. The effects of item c) are traced in Table 9.3. Table 9.4 joins the two types of sourcing on the assumptions indicated.¹⁵ It is interesting to note that within each panel of Table 9.4, the difference between the premia on tradables and non-tradables remains the same as one moves from one sourcing to another. This makes perfect sense. In the middle column we have the polar cases, of 600 being spent on tradables or on non-tradables, with no distortion costs associated with the sourcing of project funds. The benefits appearing there (as negative premia for non-tradables outlays) represent the net externality linked to closing an excess demand gap of 600 in the non-tradables market. This same gap is split, in the cases of

¹⁵ An added implication of an upward rising foreign supply curve of funds is that the marginal cost of funds lies above the average cost, i.e., above the interest rate actually paid. It is this marginal cost which is averaged in, along with the estimated marginal productivity of displaced investment and the marginal rate of time preference applicable to newly stimulated saving, in order to obtain the economic opportunity cost of capital -- i.e., the appropriate rate of discount for public-sector projects.

Tables 9.1 and 9.2 between an excess supply of 200 in the first case and an excess demand of 400 in the second.

9.5 Country Studies: Shadow Price of Foreign Exchange and Non-tradable Outlays for South Africa

South Africa is a small, open and developing country. This section provides the empirical estimation of the shadow price of foreign exchange and non-tradable outlays for South Africa using the general equilibrium framework developed in the previous section.¹⁶ The key parameters used in the estimation include:

- Project funds sourced in capital markets: domestic market (g_d) = 74%, foreign market (g_f) = 26%.
- Of funds sourced in the domestic market, 61.4% comes from displaced demand for tradables, 38.6% from the displacement of nontradables demand.
- In the capital extraction, the fraction of the displaced goods that come at the expense of displaced investment (e_{is}) is 84.4%. In the case of the substitution effect due to change in relative prices between tradables and non-tradables, the corresponding fraction that belongs to investment goods (e_{ia}) is 19.6%.
- Distortions:
 Effective tariff rate (τ_m) = 3.60%;
 Value added tax rates: tradables (v_t) = 11.36%, non-tradables (v_h) = 6.54%;
 Excise duty rates: tradables = 5.63%, non-tradables = 0%;
 Subsidy rate as a percentage of gross value added = 0.60%.

¹⁶ The empirical results in this section are obtained from Harberger, A.C., Jenkins, G.P., Kuo, C.Y. and Mphahlele, M. B., "The Economic Cost of Foreign exchange for South Africa", *South African Journal of*

The values of the externalities created by project funds spent on tradables and non-tradables depend on the weights at margin given to various sources of funds. They are summarized in Table 9.5. Using 74% as the fraction of project funds sourced in the domestic capital market and 26% as the fraction sourced in the foreign market, we estimate the economic opportunity cost of foreign exchange to be approximately 6 percent higher than the market exchange rate. The corresponding shadow price of non-tradable outlays is about 1 percent. This suggests that the additional cost of using, or the benefit from generating, foreign exchange in South Africa would be approximately 6 percent of the market value of tradable goods. At the same time, there is one percent premium on the expenditures or receipts of non-tradable goods. These figures represent the value of the generalized distortions that are created by differences between the economic and the market value of expenditures on tradable and non-tradable goods, respectively.

Table 9.5
Premia for Tradable and Non-tradable Outlays in South Africa
(percentage)

Funds drawn from	Funds Spent on Tradables	Funds Spent on Non-tradables
Domestic Capital Market	- 8.21	- 3.06
Foreign Capital Market	0	+5.15
Both Markets (a weighted average)	- 6.08	- 0.93

9.6 Conclusion

This chapter has provided an analytical framework and a practical approach to the measurement of the economic cost of foreign exchange. Because of the existence of indirect taxes on domestic and trade transactions, the economic value of foreign exchange differs from the market exchange rate.

Thus when moving from the financial to the economic flows of costs and benefits of a project deriving from the tradables sector, we must introduce adjustments to account for the difference between the economic opportunity cost of foreign exchange and the market exchange rate. At the same time we must adjust the cost and benefit flows related to nontradables so as to reflect the shadow price of nontradable outlays.

The analysis of this chapter began with a resume of the traditional partial-equilibrium framework, in which the demand and supply for the tradable goods or services are not affected by the way in which project funds are raised. It then moved to a general equilibrium analysis which additionally took into account the sourcing of the funds to finance the project's purchases. In the process, it became clear that adjusting for the sourcing of funds entails premia (or discounts) not only for the economic value of foreign exchange but also for nontradables outlays.

This general equilibrium framework was illustrated by examples in which import tariffs, value added taxes and investment credits were sequentially introduced. Additionally, two types of sourcing (domestic and foreign) of project funds were examined. These illustrations showed how the needed adjustments varied from case to case. Finally, this framework was applied to the estimation of the economic opportunity cost of foreign exchange for South Africa. The resulting estimate of the foreign exchange premium was approximately six percent of market value of tradable goods. The corresponding premium for non-tradable outlays was about one percent. These figures represent the value of the generalized distortions in South Africa that are created by differences between the market and the economic value of expenditures on tradable and non-tradable goods, respectively, when the funds used to make these expenditures are sourced from the capital market, with 26 % of the funds coming (directly or indirectly) from abroad.

Appendix 9A

A General Form for Estimating the Economic Value of Foreign Exchange and Non-tradable Outlays

General expressions for estimating the economic value of foreign exchange (E_e) and non-tradable outlays (SPNTO) have strong advantages over numerical exercises. Hence we here present them, together with numerical checks based on the exercises of Tables 9.1 and 9.2.

Definitions:

- s_1 : share of project funds sourced by displacing the demand for importables,
- s_2 : share of project funds sourced by displacing the demand for exportables,
- s_3 : share of project funds sourced by displacing the demand for non-tradables,
- f_1 : fraction of a gap between the demand for imports and the supply of exports that is closed by a movement along the demand function for imports as the real exchange rate adjusts to bring about equilibrium,
- δ_1 : fraction of a gap between the demand and the supply of tradables that is closed by a movement along the demand function for tradables as the real exchange rate adjusts to bring about equilibrium,
- c_1 : fraction of the change in value added stemming from a capital market intervention, that takes the form of consumption goods and services,
- c_2 : fraction of the change in value added stemming from an equilibrating real exchange rate adjustment that takes the form of consumption goods and services.

Table 9A summarizes the general expressions for the premia on tradables and non-tradables outlays. This table follows the same sequence as Tables 9.1 and 9.2 -- i.e., first the case of a uniform tariff (τ_m) as the only distortion is treated; second, the value added taxes v_t and v_h on tradables and non-tradables are added to τ_m , but with no credit for

outlays on investment goods. Finally, the credit for such outlays is added, with the realistic assumption that investment goods will represent a higher fraction of the spending that is displaced by sourcing in the capital market than they will of spending that is displaced or added via price-induced substitution effects.

Table 9A
Expressions for Premia on Tradables and Non-tradables
(Project Funds Sourced 100% in Domestic Capital Market)

With Uniform Import Tariff (τ_m) Alone:

$$\begin{aligned}\text{Premium on Tradables} &= (s_1 + f_1 s_3) \tau_m \\ \text{Numerical Check:} & .08 = [0.5 + 0.5(.33)](0.12)\end{aligned}$$

$$\begin{aligned}\text{Premium on Non-tradables} &= [s_1 - f_1(s_1 + s_2)] \tau_m \\ \text{Numerical Check:} & .02 = [0.5 - 0.5(.67)](0.12)\end{aligned}$$

With Uniform Import Tariff (τ_m) Plus Value Added Taxes (v_t and v_h)
(No Credit for Investment Goods)

$$\begin{aligned}\text{Premium on Tradables} &= (s_1 + f_1 s_3) \tau_m + (s_1 + s_2) v_t + s_3 v_h + \delta_1 s_3 (v_t - v_h) \\ \text{Numerical Check:} & = .08 + (.67)(0.2) + .33(0.05) + 0.6(.33)(0.15) \\ & .26 = .08 + .1333 + .0167 + .03\end{aligned}$$

$$\begin{aligned}\text{Premium on Non-tradables} &= [s_1 - f_1(s_1 + s_2)] \tau_m + (s_1 + s_2) v_t + s_3 v_h - \delta_1 (s_1 + s_2) (v_t - v_h) \\ \text{Numerical Check} & = .02 + .1333 + .0167 - (.6)(.67)(0.15) \\ & .11 = .02 + .133 + .0167 - .06\end{aligned}$$

With Uniform Import Tariff (τ_m) Plus Value Added Taxes (v_t and v_h)
(With Credit for Investment Goods)

$$\begin{aligned}\text{Premium on Tradables} &= [(s_1 + f_1 s_3) \tau_m] + c_1 [(s_1 + s_2) v_t + s_3 v_h] + c_2 [\delta_1 s_3 (v_t - v_h)] \\ \text{Numerical Check:} & = .08 + (.25)[.1333 + .0167] + (.67)(.03) \\ & .1375 = .08 + .0375 + .02\end{aligned}$$

$$\begin{aligned}\text{Premium on Non-tradables:} &= [s_1 f_1 (s_1 + s_2)] \tau_m + c_1 [(s_1 + s_2) v_t + s_3 v_h] - c_2 [\delta_1 (s_1 + s_2) (v_t - v_h)] \\ \text{Numerical Check:} & = .02 + (.25)(.1333 + .0167) - .67[.6(.67)(.15)] \\ & .0175 = .02 + .0375 - .04\end{aligned}$$

Note: $c_s = (1 - e_{is})$; $c_a = (1 - e_{ia})$.

Table 9B
Expressions for Premia on Tradables and Non-tradables
(Project Funds Sourced 100% abroad)

Table 9B simply codifies the results of Table 9.3, presenting general expressions for the premia, together with numerical checks to link the results to Table 9.3.

With Uniform Import Tariff (τ_m) Alone

Premium on Tradables	= zero
Premium on Non-tradables	= $-f_1 \tau_m$
Numerical check	$-.06 = -(.5)(.12)$

With Uniform Import Tariff (τ_m) Plus Value Added Taxes (v_t and v_h)
(No Credit for Investment)

Premium on Tradables	= zero
Premium on Non-tradables	= $-f_1 \tau_m - \delta_1 (v_t - v_h)$
Numerical Check	$-.15 = -(.5)(.12) - (.6)(.15)$

With Uniform Import Tariff (τ_m) Plus Value-Added Taxes (v_t and v_h)
With Credit for Investment

Premium on Tradables	= zero
Premium on Non-tradables	= $-f_1 \tau_m - c_a \delta_1 (v_t - v_h)$
Numerical Check	$-.12 = -(.5)(.12) - (.67)(.6)(.15)$

Note: $c_s = (1 - e_{is})$; $c_a = (1 - e_{ia})$.

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