PLANNING MODELS AND DEVELOPMENT POLICY: FOREIGN TRADE AND TRADE POLICY

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Tentative Chapter Outline

PLANNING MODELS AND DEVELOPMENT POLICY

Chapter 1: Introduction

1.1 The Goals of Planning. This section will discuss the objectives and nature of the planning process.

1.2 The Policy Environment. Here we will briefly discuss the nature of economic institutions, policy tools and strategic policy choices in developing countries.

1.3 Planning Models and Economic Policy. This section will review the kinds of models that have been used and their relation to policy analysis. We will discuss in some detail the nature of policy instruments included in different kinds of models.

1.4 The Accounting Framework. This section will discuss the range and types of data required to implement planning exercises. We will develop the Social Accounting Matrix (SAM) as an organizing framework.

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Chapter 5

Foreign Trade and Trade Policy

CHAPTER 5

FOREIGN TRADE AND TRADE POLICY

5.1 Introduction

The general equilibrium model discussed so far was dealing with a closed economy. All commodities were produced and used at home and the only income available in the community was that derived from domestic production and sales. In fact, of course, foreign trade and international capital flows play a major role in all economies. In some countries exports constitute as much as a third of domestic production with imports claiming an equivalent fraction of total expenditure. In only a few countries does the share of foreign trade fall below 10 percent of domestic product.

In developing economies, trade and international capital flows play perhaps an even more crucial role than in advanced industrial economies. While in the latter, the share of trade may often be higher, developing economies are dependent on trade as an important mechanism of real capital formation. Imported capital goods and the modern technology they embody constitute a crucial input into the development process.

More generally, problems of industrialization have almost always been linked to problems of trade. The instruments of trade policy have been used not only for purely trade-related goals, but also as tools of overall development policy. Trade policy variables such as exchange rates, tariffs and quotas are relatively easily manipulated by governments and have the political advantage, for example compared to tax rates, of generating real and obvious benefits for some groups, while imposing costs that are not as easily identifiable and the burdens of which are spread more thinly across society. A good deal of development policy is therefore trade policy. Any planning exercise that does not succeed in incorporating foreign trade and trade policy in the model building effort in a way reflecting the instruments and trade-offs facing the policy-maker is bound to be seriously deficient. It is also clear that trade mechanisms should be modelled in such a way that they do clearly interact with policy instruments that are in fact at the disposal of the policy-maker.

The aim of the present chapter is to introduce foreign trade into the computable general equilibrium framework. We shall discuss how a general equilibrium model can be opened to trade and build up, step-by-step, a specification that allows a realistic and flexible representation of foreign trade and trade policy. Starting out with a presentation of exchange rate determination in a simple model with one non-traded good and several traded goods, the chapter proceeds to discuss alternative ways of modelling the foreign trade sector in applied economy-wide general equilibrium models. A substantial part of the discussion is devoted to a brief survey of the relevant knowledge and insights available from the theoretical literature. This review is important because it is necessary to be able to relate numerical results obtained from large-scale models to the qualitative results of theoretical reasoning. Computable general equilibrium models extend our capacity to understand and analyze reality by allowing us to escape from the restrictiveness of simple two-by-two or three-by-two general equilibrium models or from the limitations of partial equilibrium analysis. But, unless we keep a firm grip on the causal mechanisms that determine particular numerical results, these models can easily degenerate into magic black boxes that, while yielding a mass of quantitative results, do not really add to our understanding of the economic mechanism or to our capacity to improve its performance.

It is with this requirement in mind that we attempt to survey the relevant parts of the "Trade and Welfare" literature and indicate in what sense alternative specifications in a planning model can be expected to lead to different results and policy conclusions. The next two sections are devoted to a discussion of exchange rate determination and trade policy instruments which constitute the new elements brought into the model presented in Chapter 4 as a result of the introduction of foreign trade. Section 5.4 investigates the effects of alternative trade strategies from a comparative static point of view, while the following section extends the discussion to a dynamic framework. Section 5.6 reviews the aggregation problem faced by all economy-wide planning models from the point of view of trade specification. To handle the problem, we explicitly introduce product differentiation into the model. We also critically evaluate the small country assumption on the export side. Finally, section 5.7 summarizes and concludes the chapter.

5.2 The Exchange Rate, Balance of Trade and Normalization

When a general equilibrium model is opened to trade, the chain of causality it embodies usually changes dramatically. While in a closed economy the basic technological and demand variables determine the price system, the situation is quite different in standard models of international trade. Whenever the domestic market is "small" in relation to the world market, it is basically in the international market that prices are determined and the chain of causality now runs from these world prices to domestic factor prices and production patterns. It is true that the chain becomes circular whenever the home country is a "large" country in the world market. In that case domestic technological and taste parameters will influence world market prices and one can no longer talk of a causal chain.

But, with some justification, most planning models consider any one country taken on its own to be too small to affect the terms at which it trades. When the small country assumption is made, any individual country becomes a price taker facing fixed exogenous world prices. The general equilibrium model is then essentially turned on its head; while the relative price system was the final solution determined by the equations of the closed economy model, it becomes exogenous in simple "small" open economy models. The domestic economy must now adjust to the given prices, producing only those commodities that can earn a normal profit and exporting a fraction of them to pay for imports. It is substantially correct to say that while supply and demand determine relative prices in a closed economy, they adjust to world prices in a small open economy model where transport costs for all commodities are assumed to be negligible. The small country assumption is an important one and we shall return to critical appraisal of it below. But for the moment we shall turn to an analysis of the implications it has for the structure of a simple general equilibrium model.

Let us assume that there are n commodities, each associated with one sector of the economy and each at least potentially "tradable" in the international market. Any particular type of commodity has identical characteristics whether it is produced at home or abroad. There are no transport costs or trade restrictions. Of course not all commodities need to be produced at home but we shall assume that at all relevant price configurations, all commodities are demanded at home. Under these circumstances we may write:

$$(5.2.1) \qquad P_i = \Pi_i ER \qquad\qquad i = 1, \ldots, n$$

where P_i are domestic prices, π_i are world prices denoted in "foreign currency" and ER is the exchange-rate.

The first thing to note about this specification is that all domestic prices are fixed in relative terms. We shall always have:

(5.2.2) $P_i/P_j = \Pi_i/\Pi_j$ for all i and j

Now let us impose our usual normalization on the price system:

(5.2.3) $\sum_i P_i\Omega_i = \overline{P}$

Clearly this implies,

(5.2.4) $\sum_i \Pi_i\Omega_i ER = \overline{P}$

and

(5.2.5) $ER = \overline{P}/\sum_i \Pi_i\Omega_i$

The exchange rate in such a model is nothing but the domestic price level divided by the value, in world prices, of a fixed bundle of commodities. Setting the exchange rate or setting the price level is equivalent and we could simply normalize around the exchange rate.

At first one might worry that such arbitrary fixing of the exchange rate (or price level) could lead to disequilibrium in the balance-of-trade. But a moment's thought will show that there cannot be an effective balance-of-trade disequilibrium in the model discussed above. To see this consider a very simple economy with no investment and no intermediate goods in which all income is spent on consumer goods.

We have:

$$(5.2.6) \qquad T_i = X_i - C_i \qquad i = 1, \ldots, n$$

where X_i denotes domestic production, C_i denotes domestic consumption and T_i denotes quantity traded.

If $X_i > C_i$, $T_i > 0$ and the good in question is exported. On the contrary, if $X_i < C_i$, $T_i < 0$ and some of the good in question is imported. A balance-of-trade deficit would imply,

$$(5.2.7) \qquad \sum_i \Pi_i T_i < 0$$

and therefore, multiplying both sides by ER,

$$(5.2.8) \qquad \sum_i P_i T_i < 0$$

But this could only occur if

$$(5.2.9) \qquad \sum_i P_i (X_i - C_i) < 0$$

or

$$(5.2.10) \qquad \sum_i P_i X_i < \sum_i P_i C_i$$

which violates the community's effective budget constraint. People would be spending more, $\sum_i P_i C_i$, than they earn, $\sum_i P_i X_i$.

Similarly a balance-of-trade surplus would imply that $\sum_i P_i X_i > \sum_i P_i C_i$ and people would therefore be hoarding. In our simple model that does not include a monetary asset, this is impossible and Walras' Law implies balance-of-trade equilibrium quite independently of the particular set of relative prices that happens to rule in the world market.

What does all this imply for the domestic labor market? Assuming sectoral capital stocks to be fixed and labor to be the only mobile factor of production within the economy, sectoral demand functions for labor are of the form:

$$L_i = L_i\ (P_i,\ \overline{K}_i,\ W) \tag{5.2.11}$$

or

$$L_i = L_i\ (ER,\ \overline{K}_i,\ W) \tag{5.2.12}$$

since all prices are proportional to the exchange rate. Equilibrium in the labor market requires that:

$$EL = \sum_{i=1}^{n} L_i\ (ER,\ \overline{K}_i,\ W) - \overline{L} = 0 \tag{5.2.13}$$

With ER fixed, this equation can normally be solved for W. Since $\partial L_i/\partial ER > 0$ and $\partial L_i/\partial W < 0$ for all i, the equilibrium relationship between ER and W can be depicted as follows:

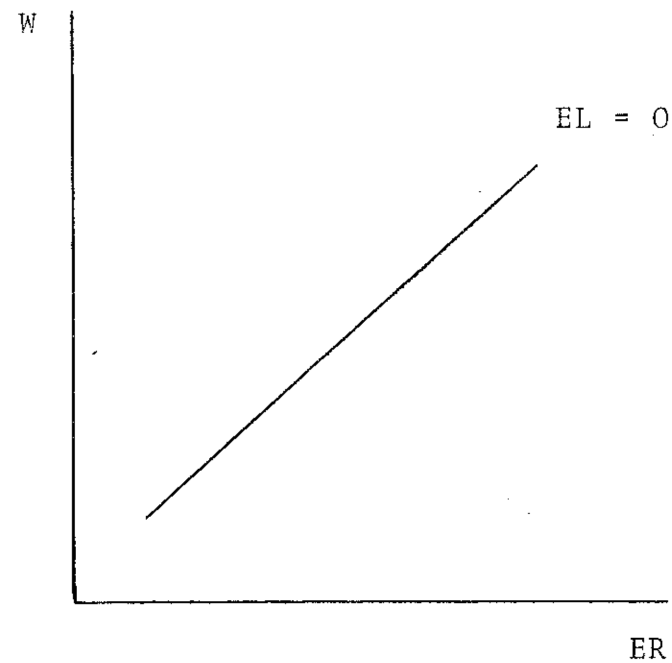

Figure 5.1.1 Finding the Real-Wage in a Simple Open Economy Model Where All Commodities Are Traded

The fixing of the exchange rate (or of the general price-level) determines the wage. Alternatively we could have fixed the wage (i.e., normalized around the wage) and this would determine the exchange rate and the general price level. What we are really solving for in this simple model is of course the real wage.

The discussion above suggests that our model is really much too simple and fails to capture important aspects of reality in which overvalued exchange rates and "distorted" relative prices play such an important role. Observation of the real world suggests that relative prices are far from equal across countries and that domestic price systems have a great deal of independence from world prices even when there is substantial trade.

A first step towards reality has traditionally been taken by introducing a class of "non-tradable" commodities into open economy models. Non-tradable commodities are commodities not subject to international trade because transport costs would be prohibitive. Most services as well as housing and construction fit this category. Non-tradables would typically represent 30% or 40% of total output. Assume for the moment that all such non-tradables have been aggregated into one sector and let this sector be the last of our n sectors. The effective budget constraint now becomes:

$$(5.2.14) \qquad \sum_{i=1}^{n-1} P_i X_i + P_n X_n = \sum_{i=1}^{n-1} P_i C_i + P_n C_n$$

We may therefore have,

$$(5.2.15) \qquad \sum_{i=1}^{n-1} P_i (X_i - C_i) < 0 \rightarrow P_n (X_n - C_n) > 0$$

or

$$(5.2.16) \qquad \sum_{i=1}^{n-1} P_i (X_i - C_i) > 0 \rightarrow P_n (X_n - C_n) < 0$$

Remembering that $X_i - C_i = T_i$ and $P_i = \Pi_i ER$ for all i=1, ... n-1, it is clear that Walras' Law no longer rules out balance-of-trade disequilibria. Equations 15 and 16 may be rewritten, assuming strictly positive prices, as:

$$(5.2.17) \quad \sum_{i=1}^{n-1} \Pi_i T_i < 0 \rightarrow X_n > C_n$$

and

$$(5.2.18) \quad \sum_{i=1}^{n-1} \Pi_i T_i > 0 \rightarrow X_n < C_n$$

Given an arbitrary price system, an excess demand or supply of tradable commodities is offset by an excess supply or demand for non-tradables. Thus we can no longer expect the balance-of-trade to clear at <u>any</u> relative price system. The relative price of non-tradables in terms of tradables now appears as a new significant variable.

To gain a better understanding of the structure of models that include non-tradables, consider a simple economy with n-1 tradable commodities, one non-tradable and labor as the only variable factor of production. Sectoral output depends on the quantity of labor employed and labor is employed up to the point where its marginal value product equals the wage. There is a fixed supply of labor. The domestic consumption demand for each sector's output depends on total income and commodity prices. As previously, sectoral capital stocks are fixed.

The domestic output supply functions may therefore be written as:

(5.2.19) $$X_i = X_i(ER, W, \overline{K}_i) \qquad \frac{\partial X_i}{\partial ER} > 0, \ \frac{\partial X_i}{\partial W} < 0$$

(5.2.20) $$X_n = X_n(P_n, W, \overline{K}_n) \qquad \frac{\partial X_n}{\partial P_n} > 0, \ \frac{\partial X_n}{\partial W} < 0$$

And the effective demand functions are of the form:

(5.2.21) $$C_i = C_i(ER, P_n, W)$$

$$\frac{\partial C_i}{\partial ER} < 0 \quad \frac{\partial C_i}{\partial P_n} > 0 \quad \frac{\partial C_i}{\partial W} < 0 \qquad i=1, \ldots, n-1$$

and

(5.2.22) $$C_n = C_n(ER, P_n, W) \quad \frac{\partial C_n}{\partial ER} > 0 \quad \frac{\partial C_n}{\partial P_n} < \frac{\partial C_n}{\partial W} < 0$$

Note than in increase in W will lead to a rise in the real wage, a fall in employment, a fall in output and therefore a fall in effective income and effective demand. We also assume all goods to be substitutes in demand.

Let us normalize around the wage and thus measure everything in wage units. Equilibrium in the market for foreign exchange requires that,

(5.2.23) $$EF = \sum_{i=1}^{n-1} \Pi_i(X_i - C_i) = 0$$

(5.2.24) $$EF = \sum_{i=1}^{n-1} \Pi_i\{C_i(ER, P_n) - X_i(ER)\} = 0$$

Where EF represents the value of excess demand for tradables, i.e., the trade deficit in world prices.

Equilibrium in the market for non-tradables (which we shall sometimes call home goods) requires that:

(5.2.25) $$EH = (C_n - X_n) = 0$$

(5.2.26) $$EH = \{C_n (ER, P_n) - X_n (P_n)\} = 0$$

Where EH is the excess demand for home goods.

Finally, equilibrium in the labor market requires that the value of excess demand for labor, EL, be zero, i.e.

(5.2.27) $$EL = \sum_{i=1}^{n-1} L_i (ER) + L_n (P_n) - \overline{L} = 0$$

Let us consider the configuration of ER and P_n that would yield equilibrium in the market for home goods. Totally differentiating (26) we get:

(5.2.28) $$dEH = \frac{\partial C_n}{\partial ER} dER + \left(\frac{\partial C_n}{\partial P_n} dP_n - \frac{\partial X_n}{\partial P_n} dP_n \right)$$

and therefore

(5.2.29) $$\left. \frac{dP_n}{dER} \right|_{dEH=0} = - \frac{\frac{\partial C_n}{\partial ER}}{\left(\frac{\partial X_n}{\partial P_n} - \frac{\partial C_n}{\partial P_n} \right)} > 0$$

Expression (29) is positive since the numerator is negative and the denominator positive.

Note that the effective budget constraint implies that

(5.2.30) $$\sum_{i=1}^{n-1} P_i C_i + P_n C_n = \sum_{i=1}^{n-1} P_i X_i + P_n X_n$$

and therefore if EH=0 we will also have $\sum_{i=1}^{n-1} P_i(C_i - X_i) = 0$

and therefore EF=0.

Let us however consider the labor market. Totally differentiating (27) we get:

$$\text{(5.2.31)} \quad dEL = \sum_{i=1}^{n-1} \left(\frac{\partial L_i}{\partial ER} \right) dER + \left(\frac{\partial L_n}{\partial P_n} \right) dP_n$$

and therefore,

$$\text{(5.2.32)} \quad \left. \frac{dP_n}{dER} \right|_{dEL=0} = - \frac{\sum_{i=1}^{n-1} \left(\frac{\partial L_i}{\partial ER} \right)}{\frac{\partial L_n}{\partial P_n}} < 0$$

where $\partial L_i/\partial ER > 0$ and $\partial L_n/\partial P_n > 0$. Since both numerator and denominator are positive, the expression is positive. Overall equilibrium can thus be depicted as the intersection of two curves in (P_n, ER) space as illustrated with arbitrarily drawn linear lines in Figure 5.2.2.

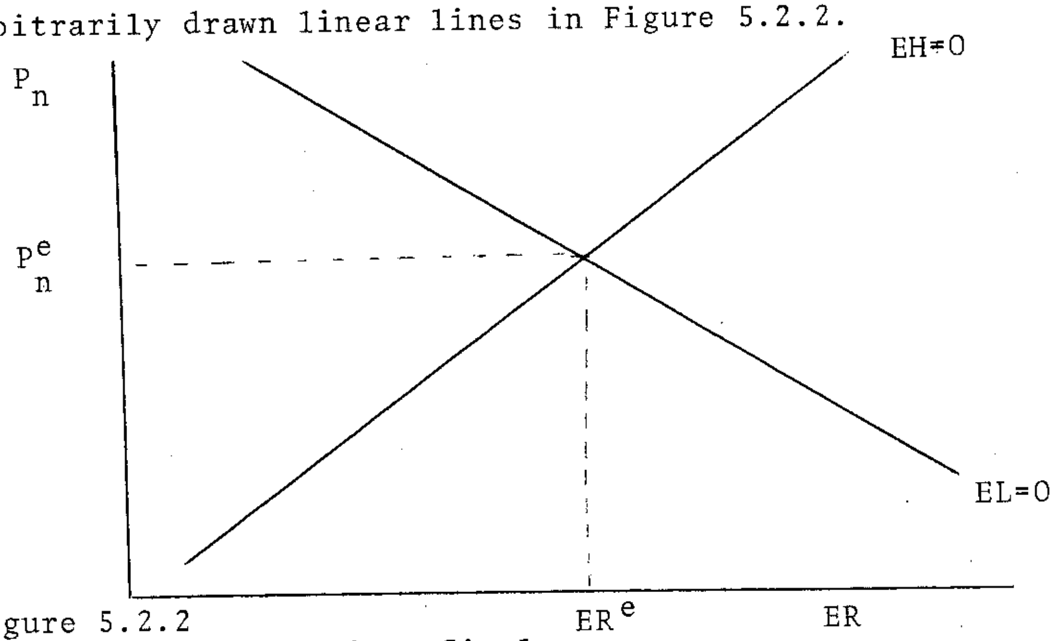

Figure 5.2.2
General Equilibrium in a Simple Model with Tradables, One Home Good and Labor

The simple story behind Figure 2 can be told as follows. Given that W is our numéraire, there exist many combinations of ER and P_n that generate equilibrium in the markets for home goods and foreign exchange. What really matters is the ratio of ER, determining the level of tradables prices to P_n that stands for the level of home goods prices. Balance-of-trade equilibrium is achieved when the value of tradables stands in the right ratio to the value of non-tradables. But it is also clear that too high a combination of P_n and ER along the curve EH=0 will imply a very low real-wage and therefore excess demand for labor. Similarly, too low a combination of P_n and ER implies too high a real wage and will lead to unemployment. There will normally exist only one combination of P_n and ER on EH=0 consistent with the real-wage necessary for labor market clearing. This combination (P_n^e, ER^e) constitutes the general equilibrium solution of the system.

The Normalization Rule

As already noted in Chapter 4, while normalizing around the wage rate is often convenient for theoretical discussion, in actual model building and planning exercises it is much more convenient to normalize around a price index. A normalization is required on models that lack monetary mechanisms in order to be able to determine the price level. As long as no real relative price in the model is fixed, the precise normalization is of little consequence and one could conduct any experiment in terms of price ratios only. But as soon as one wants to actually fix any relative price in the system, the normalization takes on much greater significance. Thus one may want to fix the real wage and give up labor market clearing. If the wage was at the same time our numéraire, the fixing of the real-wage would require the fixing of some additional variable or sets of variables such as an aggregate price index. Similarly if one wanted to fix the exchange rate, it is not clear that fixing the exchange rate in terms of the wage would be a very meaningful way of modelling fixed exchange rates. If, on the other hand, it had been the exchange rate itself that we had normalized around, modelling fixed exchange rates would again require the fixing of some additional variable or price index.

Because real variables are best expressed in terms of a composite price index, it is most convenient to normalize around such a price index. Instead of setting such variables as the wage rate, the exchange rate or the price of any one particular commodity equal to one, it is usually preferable to normalize by setting a price level.
Taking the same normalization equation as in Chapter 4:

(5.2.33) $\sum_i P_i \Omega_i = \overline{P}$

Given such a normalization if we now set W, we are fixing the wage rate and must expect disequilibrium in the labor market. If we set ER, we are fixing the exchange rate and must expect disequilibrium in the foreign exchange market. We shall usually prefer (33) as the normalization rule. The explicit introduction of money could also follow more naturally from this kind of price level normalization. It must however be stressed that normalization rules may have non-trivial consequences and any particular model must be interpreted in light of the normalization chosen. We shall illustrate this necessity by discussing the exact meaning of a **devaluation** in a fixed exchange rate model.

From (2) we have,

$$\sum_{i=1}^{n-1} \Pi_i \Omega_i \; ER + P_n \Omega_n = \bar{P} \tag{5.2.34}$$

and therefore:

$$ER = \frac{\bar{P} - P_n \Omega_n}{\sum_{i=1}^{n-1} \Pi_i \Omega_i} \tag{5.2.35}$$

It follows that the price of the home good is given by:

$$P_n = \frac{\bar{P}}{\Omega_n} - \frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i}{\Omega_n} ER \tag{5.2.36}$$

so that

$$\frac{dP_n}{dER} = -\frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i}{\Omega_n} < 0 \tag{5.2.37}$$

Given our normalization rule an increase in ER, (i.e., a devaluation) will lead to a fall in the absolute price of home goods. The relationship between P_n and ER is a linear one with slope $-(\sum_{i=1}^{n-1} \Pi_i \Omega_i / \Omega_n)$. Since the devaluation increases the price of all tradable commodities, the price of non-tradables must fall if the overall price index is to remain constant. Clearly the smaller the weight of home goods in the commodity basket defining the price level, the more important will be the decline in P_n.

Given our normalization rule an x-percent devaluation will in fact lead to a greater than x-percent change in the price of tradables relative to that of non-tradables. This can be shown by letting $\sigma = \frac{dER}{d(ER/P_n)} \cdot \frac{ER/P_n}{ER}$ measure the elasticity of the response of the exchange rate to a change in the ratio of the price of tradables to non-tradables. Then it can be shown that given the normalization rule adopted in (33)

$$(5.2.38) \qquad \sigma = \frac{\Omega_n P_n}{\overline{P}} < 1$$

This expression shows that the exchange rate adjustment will be smaller, the greater the weight of traded goods in the determination of the price index. This should be noted because often in the literature on devaluation, the exchange-rate is defined to be the ratio of the value of a basket of tradables to the value of a basket of home goods. In our notation:

$$(5.2.39) \qquad ER = \frac{\sum_{i=1}^{n-1} P_i \Omega_i}{P_n \Omega_n} = \frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i ER}{P_n \Omega_n}$$

This definition is itself a normalization. Now, whatever the particular value of ER may be, for (39) to hold we must have:

$$(5.2.40) \qquad \frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i}{P_n \Omega_n} = 1$$

which determines P_n,

$$(5.2.41) \qquad P_n = \frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i}{\Omega_n}$$

Therefore defining the exchange rate as the ratio of the value of tradables to the value of non-tradables, forces one to fix the price of home goods. Alternatively the exchange rate is often only required to be proportional to the ratio of the value of tradables to the value of non-tradables so that a given percentage change in the exchange rate always reflects the same percentage change in this ratio. Under those circumstances we would have:

$$(5.2.41a) \qquad P_n = \lambda \frac{\sum_{i=1}^{n-1} \Pi_i \Omega_i}{\Omega_n}$$

where λ would have to be an arbitrary but constant factor of proportionality. We could set P_n at any arbitrary level, and provided it remained constant, the exchange rate would always be proportional to the ratio of the value of tradables to the value of non-tradables.

It is therefore clear that a given percentage change in the exchange rate, say a 20% devaluation, will represent a different degree of relative price adjustment depending on whether we normalize by requiring the overall price level to remain constant (in which case the price of home goods must fall absolutely) or we normalize by fixing the price level of home goods only. In order to interpret the result of a model correctly, it is important to keep these distinctions in mind.

It should be re-emphasized at this point that we are not telling a monetary story. By normalizing around the overall price level, we are simply implying that the determination of the price level is exogenous to the model. In turn this may be interpreted as implying that monetary policy is fully capable of determining the price level quite independently of any other variable in the system. For example, any changes in the money supply that may be induced by an exchange rate adjustment, are assumed to be fully counteracted by monetary policy. If an overall rate of inflation of 10% is given to a model, an exchange rate adjustment is not allowed to alter this rate. The fact that there must be certain specific monetary mechanisms at work that lead to the 10 percent inflation is undeniable, but they are not explicitly modelled and are assumed to be separable from the rest of the model. We have already argued that such an assumption, hard to maintain in any short-run model, can be justified in planning models focused on the longer run.

5.3 Introducing Trade Policy and Protection

In the previous section we have seen how the introduction of the exchange rate and of exogenous world prices affects the structure of a general equilibrium model. The chain of causality is at least partly reversed, with world prices having a determining influence on domestic prices.

It is by entering this chain at its very beginning that trade policy can be seen to affect the domestic economy. The imposition of a tariff on a category of imports will raise not only the domestic price of the imports in question, but also the price of the domestically produced import competing commodities. Thus, under the small country assumption, the government is seen as having direct control over the relative domestic prices of tradable commodities. This makes trade policy into a very powerful instrument affecting economic structure, growth and income distribution.

There is a large body of literature that analyses the effects of trade policy. This literature is highly relevant for development policy since a great deal of the efforts aimed towards speeding up the process of industrialization are trade related. It is therefore very important to fully incorporate trade policy into economy-wide planning models and let these models be a laboratory where alternative strategies and policy packages can be tried out and their effects quantified. But as already stressed, one must be careful to keep a firm grip on the causal mechanisms that are highlighted by theory when conducting experiments with a CGE model.

It is true that in most of the theory of international trade and commercial policy, all factors of production are assumed to be mobile within the economy so that they are allocated in such a way that the value of a given factor's marginal product is the same across all sectors. With prices determined in world markets and affected by trade policy, the problem facing the economy is to allocate its resources so as to maximize the value of domestic production. If all goods are traded, the problem is formally analogous to the programming problem discussed in the Introduction to Chapter 4 except that all factors of production, including capital, are mobile between sectors.[1/] The resulting concept of comparative advantage therefore usually refers to the very long-run under an optimal factor allocation after all adjustments from changes in trade policy have taken place.

While planning models usually adopt most of the assumptions underlying the Ricardian and Hecksher-Ohlin trade theories, they usually provide a shorter view of comparative advantage by assuming that capital stocks are fixed. The choices facing the economy in the short-run are thereby reduced. It is important to keep this distinction in mind.

The brief survey of trade theory and commercial policy in this and the following sections has the objective of providing a basis for and facilitating the discussion of planning experiments with a CGE model. We shall first indicate how the model can handle the panoply of trade policy instruments in the hands of the government, with particular emphasis on the comparison of partial equilibrium based estimates with those provided by a CGE model. We then move on to examine how trade policy can affect employment, the distribution of income among factors, and welfare.

The most widely discussed means of protection is the tariff. Figure 5.3.1 traces the partial equilibrium effect of a tariff for a single homogeneous product both imported and produced at home, whence its name, an importable product. The domestic product is a perfect substitute for the import. The supply curve of imports is, πS, indicating an infinitely elastic supply of imports (the small-country assumption); and the supply curve of domestic import-competing production S_oS_o traces out the marginal cost of domestic production.

The domestic demand curve is D_oD_o.

The imposition of an <u>ad valorem</u> tariff at the rate CD/OC has the following well-known effects: (1) production effect raising domestic output by AA´;(2) consumption effect lowering imports by BB´;(3) a balance of trade effect reducing imports from AB to A´B´ (4) a revenue effect to the government of JKML; (5) and finally a redistribution effect from consumers to producers in an amount of CDJG. If protection is the sole purpose of imposing the tariff, and the government can finance the subsidy, then it could confer the same amount of protection in terms of the domestic output effect via a subsidy at the same rate, thereby shifting the domestic supply curve down to S_1S_1. The other effects would, of course, be different.

Less discussed, but often more widely used than tariffs, are quantitative restrictions or quotas which are often the main channel through which the government influences the allocation of resources. It is often said that quantitative restrictions can be related to price mechanism devices, such as tariffs, by defining "equivalent" price devices which would result in the same effect on protection. Consider Figure 5.3.2 which depicts the quantity of imports (not importables) so that D_MD_M is now the import demand curve obtained by subtracting domestic demand from domestic supply at each price. Under free trade, the quantity of imports is OB. Let imports

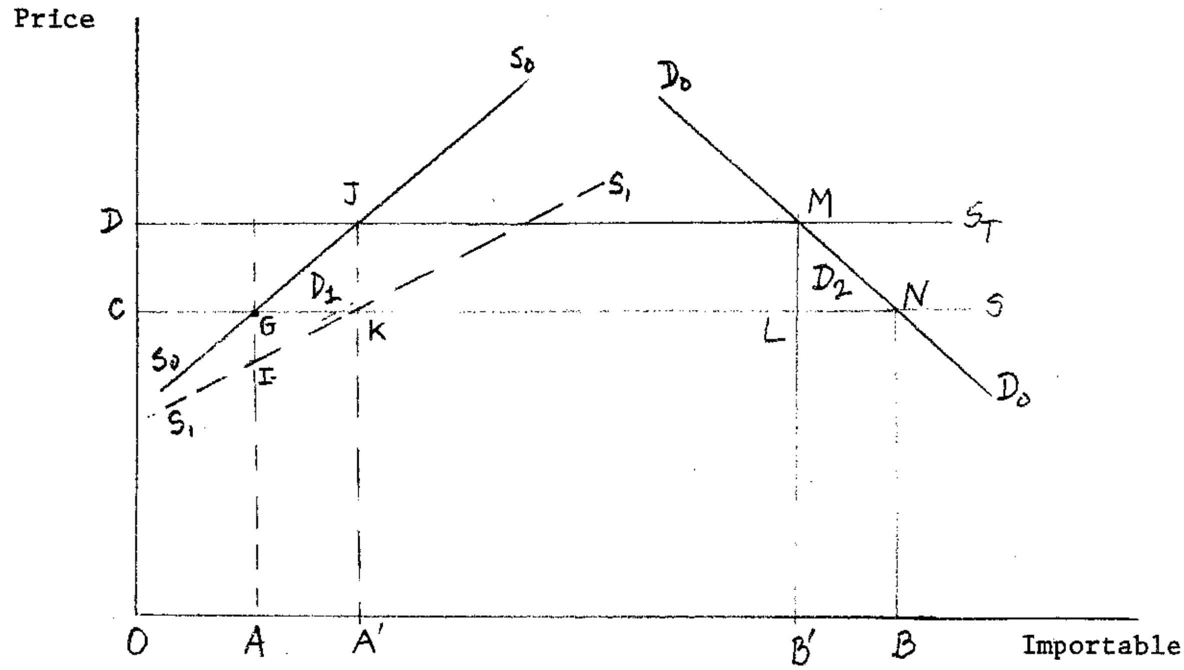

Figure 5.3.1 Protection by Tariff

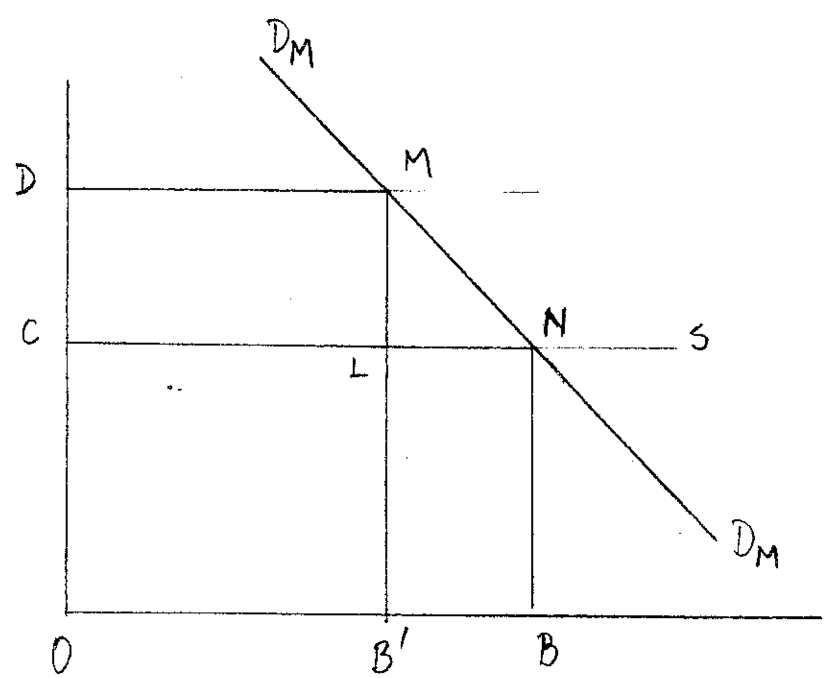

Figure 5.3.2 Protection by Quota

be restricted to OB´ with import licences to this amount awarded to the domestic traders and prices freely flexible in the market. The price to consumers rises to OD, with traders obtaining quota profits in the amount of CDML reflecting the scarcity value of the quota licences. For a given quota, the rents will be larger the lower the elasticities of demand and supply.

It is customary to argue that a tariff at the rate CD/OC would yield the same result except that the quota yields profits to the importers who obtained the licences while the tariff would yield customs revenue. This analogy however is only valid provided that competition prevails before and after the imposition of the quota. In fact, it assumes that import licenses are transferable between firms and that there is a market in licences. In practice it is likely that the imposition of quotas will lead to the establishment of a monopolistic market structure since quotas are often confined to existing firms or are distributed pro rata, i.e. in proportion to existing production levels, and the market for licences may be very imperfect. In this case, if the profit maximizing level of imports is less than the quota level then imports will fall below the quota imposed level, and an indirect effect of the imposition of the quota will be to raise profits above what they would be in the absence of the quota. The point here is that a non-prohibitive tariff does not have the monopoly creating effect of a quota, although it shares with it the import-replacing effect. Thus, a given reduction in imports when achieved by a tariff may be associated with a greater rise in domestic output than when achieved by a quota. It follows that there will be a smaller fall in consumption with a tariff than under a quota so that the domestic price will rise less with a tariff.

Only in the competitive model presented in Figure 5.3.2 is it possible to choose a single tariff rate which would have the same effect as an import quota on the volume and value of imports, on the volume of domestic output and on the domestic price. Even in the simple model this equivalence will only hold statically, since in a dynamic model a constant tariff through time will give rise to an increase in the volume of imports while a constant quota will lead to higher premia (rents) to holders of licences.[2/] One must, therefore, be cautious not to argue that any trade intervention can be limited to price mechanism devices.

Denoting the <u>ad valorem</u> tariff, subsidy, or export tax for sector i by t_i, domestic prices in a tariff-ridden economy are linked to world prices by

(5.3.1) $P_i = \Pi_i \ (1 + t_i) \ ER$

where i denotes the set of tradable sectors. For the small open economy, the world prices Π_i are exogenously fixed so that trade policy fully determines the relative domestic price of tradables. We have

(5.3.2) $$P_i/P_j = \Pi_i\ (1 + t_i)/\Pi_j\ (1 + t_j)$$

since the exchange rate cancels out. The trade taxes are therefore the driving forces of the small open economy model. When sector i exports some of its output, t_i is a subsidy if it is positive or a tax if it is negative. Just as in the case of a tariff, an export subsidy will raise domestic prices above world prices. For an exporter to be indifferent between selling in the domestic market or abroad, which he must be in equilibrium, the world price in domestic currency plus the export subsidy must be equal to the price obtainable in the domestic market. On the contrary, an export tax will force the domestic price below the world price. If, however, one views trade policy as the imposition of export targets (and import quotas), then domestic prices are determined in the domestic market and the trade taxes are determined residually so as to satisfy (2).[3/]

Whether protection is achieved by the price mechanism or by quantitative restrictions, what is of interest to the policy-maker are the resulting quantitative effects on production, consumption and welfare. What has been discussed so far is the rate of protection, not the protective effect. In Figure 1, the rate of protection is $\frac{t}{\pi} = \frac{CD}{OC}$ while the protective effect is $x' = \frac{dx}{X} = \frac{AA'}{OA}$. This supply increase depends on both the rate of protection and the elasticity of supply, e, at point G on S_0S_0. An expression for the percentage increase in output is:

$$X' = \frac{et}{\pi} \quad (5.3.3)$$

where $(\frac{t}{\pi})$ is the proportion by which the tariff raises the domestic price P, above the world price, π.

If one takes into account the fact that commodities enter into the production of other commodities, it is necessary to estimate the protection accorded to a commodity at a given stage of production. One can no longer rely on the nominal rate of protection (NRP) which is the difference between the domestic price and the world market price. Taking Ricardo's famous example of trade in cloth and wine between England and Portugal, one should not refer to a country's comparative advantage in clothing, but indicate separately its advantages and disadvantages in cotton growing, spinning, weaving and clothing manufacturing.

Accordingly, one needs to distinguish between nominal protection, as defined above, and effective protection or protection to value-added. The effective rate of protection (ERP), which expresses the margin of protection on value-added (or net price) in the production process, recognizes the fact that a tariff provides a subsidy to the activity producing the product to which it applies, and imposes a tax on the product of other activities using that product as an input. Denoting by superscripts zero and one the situations before and after the change in tariffs, the general equilibrium ERP for sector j is given by:

$$(5.3.4) \qquad EP_j = V_j^o / V_j^1 - 1$$

where

$$(5.3.5) \qquad V_j^o = \{\pi_j(1 + t_j^o) - \sum_i \pi_i(1 + t_i^o)\} \, ER^o$$

and V_j^1 is defined similarly. The assumptions underlying the use of (4) in the calculations of ERPs in partial equilibrium will now be discussed.

First, a change in protective structure affects the exchange rate. Net effective rates of protection (NERPs) are derived by expressing ERPs at the free trade exchange rate. A change in relative price among tradables will lead to a change in the price level between tradable and home goods if there is a switch in desired expenditures between home goods and tradables. To take an example, suppose that all prices and the exchange rate, ER, are initially equal to 1 and ERP = NRP = 40% for the importable as a result of the imposition of a 40 percent tariff. Suppose that the necessary appreciation of home goods lowers the domestic price of <u>all</u> tradables by 20 percent. Since appreciation affects equally the price of both the exportable and the importable, the ERP still correctly measures the protective margin of the importable relative to the exportable. However, if the price of home goods remains constant, the price of importables has only risen to 1.12, i.e. by 12 percent. Therefore the NEP for sector j is:

(5.3.6) $$NEP_j = (1 + EP_j^1)\ ER^1/(1 + EP_j^o)\ ER^o - 1$$

where the definition of EP_j no longer includes the exchange rate change which has to be estimated independently. Provided this net rate is positive, resources will be attracted into the importable sector from the exportable sector and the home good sector. If some estimates of sectoral supply elasticities are available, one can obtain an expression for the percentage increase in output for sector j in an analogous way to the simple case without intermediate inputs. The expression is:

(5.3.7) $$x_j = e_j\ NEP_j$$

A large number of studies of trade policy in both developed and developing countries have relied on the theory of effective protection. Not only have ERPs been used as indicators of comparative advantage, but also they have been used in deriving estimates of the cost of protection. Effective rates have also been useful in devising guidelines for tariff negotiations and, as will be seen later, for providing guidelines to reform the system of incentives.

The empirical strength of the ERP theory rests on the simplicity of its formulation: the fixity of purchased input coefficients and the absence of factor price effects. These assumptions lie at the heart of the theory. Simple assumptions about non-traded goods, coupled with the assumptions that world prices are fixed, eliminates the impact of demand considerations so that it is easy to measure the production and consumption effects of a tariff separately. The former are given by (7) and the latter by the NRP discussed earlier. As soon as the presence of non-traded goods is recognized, this simple separation of production and consumption effects breaks down since the production and consumption of each non-traded good has to be brought into equilibrium by a relative price adjustment among these goods. Therefore, in the presence of links between non-traded and traded goods--through substitution effects in production and/or consumption--production and consumption effects may no longer be separated for the system as a whole.

Expression (7) has been interpreted to indicate that a ranking of industries according to ERPs, along with information on supply elasticities provides an estimate of the shift in resources following a change in tariff structure.

However, trade theorists have raised objections against this claim pointing out the neglect of factor price effects, substitution possibilities among inputs and the unsatisfactory handling of home goods. They have shown, with the use of simple general equilibrium models, that the neglect of any of these effects is sufficient to invalidate the use of ERP rankings to indicate the relative intensity of resource shifts following a change in tariff structure.[4/] But in the meantime, the ERP methodology has continued to be widely used so it is of great practical importance to find out how useful ERPs are in quantifying these changes in resource allocation. Moreover, it is important, when constructing general equilibrium models, to examine the quantitative differences between the results obtained in a partial equilibrium analysis with those obtained from the model.

Suppose that sectoral technology is described by fixed intermediate input coefficients as assumed in Chapter 4 (and in the ERP methodology) and that output is described by a two-factor CES function of capital and labor with returns to scale, λ_i. A change in tariff structure will alter relative net prices which in turn will affect the firm's demand for factors and hence output supplies. Totally differentiating the factor demand and production function equations yields, <u>after</u> allowing for factor substitution, (5.3.8) $X_i' = \lambda_i(1 - \lambda_i)^{-1}\{V_i' - \theta_{Li}\ W' - \theta_{ki} r'\}$

where primes indicate percentage changes and θ_{ki} and θ_{Li} are the shares of total product (adding up to λ_i) accruing to each factor.

Expression (8) provides a measure of comparative advantage in the long-run when capital is mobile across sectors.The short-run impact effect of a change in trade policy assumes that sectoral capital stocks are fixed so that they drop out in the process of differentiation. Assume for simplicity that returns to scale are constant so that factor payments exhaust the value of total product ($\theta_{ki} + \theta_{Li} = 1$). Then the supply response will be finite despite CRS because in fact there are decreasing returns to scale to the variable factor of production labor and the expression corresponding to (8) is

(5.3.9) $X_i' = \sigma i \frac{\theta_{Li}}{\theta_{ki}} (V_i' - W')$

where σ_i is the elasticity of substitution between capital and labor. Equation (9) is the supply response taking into account changes in the wage rate which are omitted in a partial equilibrium estimation.

This expression is particularly useful to contrast partial and general equilibrium approaches. First, as will be discussed later, it highlights the difficulty of modelling a small open economy under perfect competition when the technology exhibits constant returns to scale (CRS) and the number of traded goods is greater than the number of factors of production. Second, it explains why the ERP methodology "assumes decreasing returns to scale to resources in general"[5/] since under CRS marginal costs would be independent of output levels and the output response to changes in trade policy would be indeterminate. Under perfect competition and with CRS, each sector's long-run supply response to a change in tariffs would be infinite.

Sectoral output changes derived from (8) can be compared with an ERP based prediction as expressed in equation (7). The main differences are the neglect of factor price changes in the partial equilibrium measure and the treatment of non-traded goods. Thus, V_i' is the percentage change in value-added, inclusive of changes in relative prices of non-traded goods, which are not correctly predicted in the expression yielding NEP_i. Moreover, it is unlikely that the estimate of the exchange rate adjustment calculated under partial equilibrium will correspond to that emerging from the CGE model. In general, partial equilibrium-based estimates are fairly accurate predictors of resource pulls for small changes in relative prices. As soon as substantial changes take place, even the refined ERP methodology with data requirements close to those of CGE based estimates does not fare well. Given that the data requirements for a sophisticated study of protection and resource allocation are similar to the data requirements for a CGE model, it seems preferable to use the extended CGE model. Note also that the assumptions about how markets operate are also similar.

The distinction between partial and general equilibrium estimates could also be highlighted by deriving an expression for consumption changes similar to (8). Consumption response to a change in tariff structure would depend upon own-price, cross-price and income elasticities of demand. Again, the partial equilibrium expression would not include the change in relative prices among non-traded goods and would be based on separately provided estimates of income and exchange rate changes.

The introduction of trade policy into the CGE model provides a powerful tool for policy analysis. As indicated in equations (1) and(2)trade taxes are the driving forces in the model for all the sectors which are classified as tradable. However, anticipating some of the discussion in section 5.6, even if the domestic price system is not completely in the hands of policy-makers because domestic and foreign goods are not perfect substitutes, all the qualitative results described will continue to hold. In particular, if domestic and foreign goods are imperfect substitutes in use, a tariff on the foreign good will lead to a substitution away from the foreign good towards the domestic good, thereby raising its domestic price, but by less than the tariff, the exact amount depending on domestic supply elasticities and the elasticity of substitution in use between the import and the domestically produced good. Expressions (7) and (8) indicating domestic supply responses to changes in trade policy remain unchanged with the important qualification that the change in domestic net prices, even in the absence of non-traded goods, can no longer be estimated in partial equilibrium since the domestic price system is no longer rigidly linked to world prices.

By concentrating on the implications of trade policy on economic structure, the discussion so far has abstracted from the important issues of the effects of trade policy on employment, income distribution, and welfare. We now examine these effects and see how a CGE model may be useful in the formulation and implementation of an "optimal" structure of protection.

5.4 The Static Welfare Effects of Trade Policy

The most basic proposition in international trade is that free trade raises the level of potential welfare for a country above the level reached in autarky.[6/] This increase in potential welfare can be further subdivided into the gains from exchange resulting from obtaining goods at a lower price from abroad, and the production gains from specialization in the commodities in which the country has a comparative advantage. Equally well known is the companion proposition that policy-induced distortions in the product markets in the form of tariffs and quotas, and in the factor markets in the form of minimum wages and trade union interventions, reduce the potential welfare gain from free trade.

On the other hand, protective trade policies have played an active role through their strong influence on resource allocation in the developing countries' attempts at increasing their pace of industrialization. Moreover, protection is likely to have substantial effects on the distribution of income among factors of production, especially in the short-run when capital stocks are fixed. In that case, we saw in Chapter 4 that the share of total product accruing to these fixed factors is determined residually and can be viewed as a rent. Clearly, in the short-run changes in the price system will have a strong effect on capitalist income originating in each sector. It is therefore important to see how trade policy should be expected to affect the welfare of particular socioeconomic groups and the level of employment.

Initially, it will be assumed that two factors of production, capital and labor, combine to produce output. We will question how and where the standard results from international trade theory break down when one turns to more elaborate and realistic models, including imperfections in the factor market in the form of wage rigidities, wage differentials, and factor specificity. We then consider how a given set of nonoptimal policies gives rise to welfare losses and discuss how these losses are measured. This discussion will lead into the dynamic interaction between trade policy, factor accumulation and growth so important in the context of industrialization strategies, which will be the subject of the next subsection.

Consider first the standard two-factor two-product

Hecksher-Ohlin model with fixed supplies of both factors, capital, K, and labor, L. Technology is described by linear homogenous production functions. Commodity X_1 is labor intensive relative to X_2 for all equilibrium factor price ratios.[7/] Under these assumptions, there is a one-to-one relationship between commodity price ratios and factor-price ratios, and factor endowments determine full employment outputs.

The relationship between endowments and outputs is depicted in Figure 1. From the familiar conditions that wages are equal to the value of their marginal products under perfect competition and the property that marginal products are homogeneous of degree zero for linear homogeneous production functions, it follows that equilibrium factor price ratios will remain unchanged in the face of changes in relative factor supplies so long as product price ratios are fixed by the small country assumption. Since for linear homogeneous production functions the capital-labor ratios are constant so long as factor price ratios are constant, the raysindicating the equilibrium capital-labor ratios in each industry OX_1 and OX_2 will be independent of factor supplies. The amounts of each of the goods produced will be measured along these rays. The implications for the supply functions are obvious in this simple case with two factors and two commodities: for a given endowment, supplies

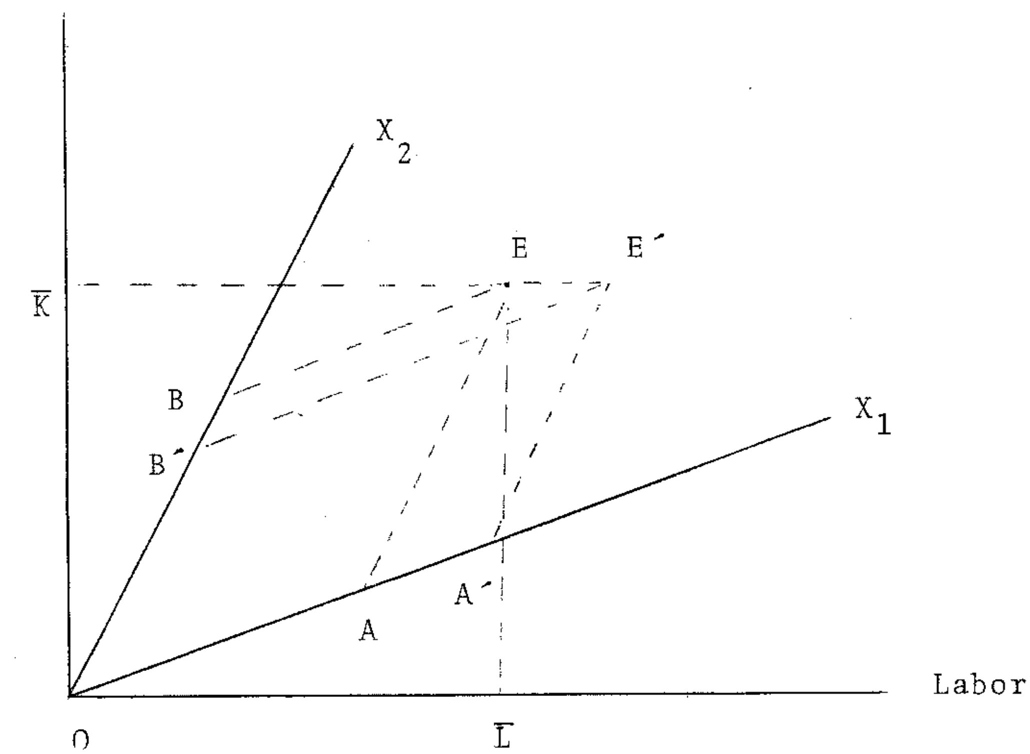

Figure 5.4.1

Factor endowments and outputs in the trade model.

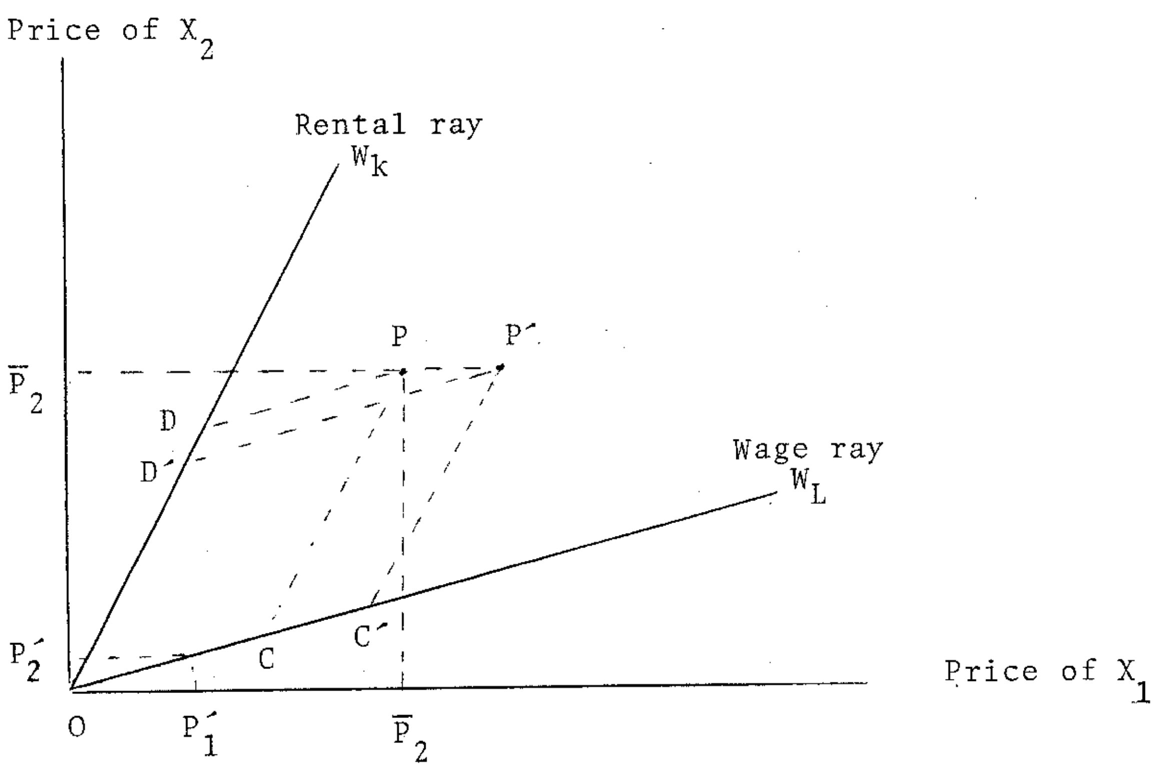

Figure 5.4.2

Commodity prices and factor prices in the trade model.

are determined by the exogenously given product prices.

Starting from the initial endowment E, OA and OB will measure the full employment levels of outputs of X_1 and X_2. An increase in the labor force from E to E´ calls for an expansion of the labor intensive sector from A to A´ and a contraction of the capital intensive good X_2 from B to B´ to maintain full employment of both productive factors. Indeed it is clear from the diagram that (a) the relative increase in X exceeds the relative increase in the labor force, and that (b) the relative contraction of the capital intensive sector exceeds in absolute terms the relative expansion of the labor supply. These results known respectively as the Rybczynski Theorem and the magnification effect {the latter was first noted by Jones (1965)} will be useful later when we discuss the effects of factor accumulation in the context of a growing economy.[8/]

Dropping the assumption of constant relative product prices, what are the effects of a change in trade policy on the distribution of income between capital and labor? From the competitive profit relations price equals unit costs, i.e.:

$$(5.4.1) \qquad P_i = W_i L_i / X_i + r_i K_i / X_i \qquad i = 1, 2$$

Just as the full employment conditions for factors allowed us to relate the physical variables in the model, the zero profit conditions permit us to link the price variables represented by commodity and factor price ratios. If labor were the only factor of production and the wage rate were set to unity, commodity prices would be determined by the labor coefficients in each industry. The wage ray indicates how commodity prices will vary with changes in wages when there are no capital costs and the rental ray provides the same information when there are no labor costs. If commodity prices are given by P, and both capital and labor are productive factors, wages will be given by OC and OD.

Consider now an increase in the price of X_1, the price of X_2 remaining constant. Because X_1 is labor intensive, the relative costs of X_1 (equal to price) can rise relative to the costs of X_2 only if wages increase from OC to OC′ and rents decrease from OD to OD′ to keep the price of Y from rising. Once more the magnification effect is at work since the relative increase in wages $\frac{CC'}{OC}$ exceeds the relative increase in the price of X_1, $\frac{PP'}{PP_2}$. It therefore follows that labor used intensively in industry X_1 whose relative price has risen is better off in real terms.

Unfortunately, this celebrated result, due to Stolper and Samuelson, envisions an economy where factors of production move costlessly and instantaneously between industries.

Clearly this approach is at odds with the basic model presented in Chapter 4 where capital is assumed to be fixed in the short-run, i.e. within each time period. Moreover, we also discussed the important case in LDC's where labor is in infinitely elastic supply at a fixed real wage. How does this departure from the traditional assumptions of perfect factor mobility and fixed factor supplies affect the relationships discussed so far?

To examine the effect of factor specificity assume that there are three factors, two of which are fixed (capitalists in sectors X and Y) and the third (labor) is mobile between sectors. With a rise in the price of X_1, labor gains in terms of X_2 but loses in terms of X_1. In contrast, capitalists in X_1 gain in terms of both commodities while capitalists in X_2 lose in terms of both commodities. What happens to the income of capital as a whole in the short-run cannot be determined a priori, although it is likely to fall if the share of labor in X_1 and the elasticity of the wage with respect to the change in P_1 is large.[9/] When factors of production are quite immobile, a change in protective structure will have a large effect on income distribution and a small effect on resource allocation. It is interesting to note that no matter what the factor intensities are in the two industries, there must be at least one of the three factors whose long-run interest runs counter to its short-run interest. Moreover, this conflict will be substantial if factor intensities between industries do not vary much since in that case small price changes result in large changes in factor incomes.[10/] This result points to a conflict between the short-run "impact" effects of a policy and the long-run effects (after all adjustments in factor allocations have taken place), and is an important feature of the adjustment process which carries over to the more elaborate dynamic CGE models.

Turning to another departure from standard neoclassical assumptions, a crucial characteristic of a developing economy is the presence of highly fragmented and distorted factor markets with high unemployment and large regional and sectoral variations in wages. Before dealing with the set of trade policies recommended to increase the rate of absorption of the labor force, one must see how the economy is affected by an exogenously fixed real wage (above the equilibrium wage) in the entire labor market. Then, as with the case of other factor market imperfections to be discussed later, the transformation curve will depend on market relationships in addition to technology and factor endowments so that it is no longer coincident with the conventional production possibility frontier.

Consider the case of a fixed real wage examined in

Chapter 4. Terms of trade, P_1/P_2, are fixed and factor intensity reversals are assumed to be ruled out so there is a one-to-one relationship between the product price ratio and factor rewards. Therefore, maximum profits can be obtained at the same minimum wage with different levels of employment. The resulting profit maximizing combinations of X_1 and X_2 in the presence of a fixed minimum wage will be situated on the Rybczynski line which is negatively sloped and flatter (steeper) than the terms of trade line if X_1 is labor (capital) intensive.[11/] The transformation curve will therefore have straight line portions because, as noted earlier, the assumption of CRS ensures that factor proportions, and hence marginal rates of transformation, remain constant when factor prices remain unchanged. Raising the relative price of X_1 will shift the Rybczynski line inward until the entire transformation curve is given by a straight line. As one moves down the Rybczynski line towards the horizontal X_1-axis, the amount of employment, L, increases. If capital stocks are fixed, the transformation curve will become convex again because there will be diminishing returns to labor, and it will lie entirely inside the production possibility curve except at the boundaries.

The level of employment in the economy can, therefore, be expressed as:

(5.4.2) $L = a + bX_1$

where X_1 denotes the output of X_1, a is a positive constant, and b is positive or negative according to whether X_1 is labor intensive or capital intensive. For a small open economy with a minimum wage floor there is a relationship between the product price ratio and total employment of labor.

It is important to realize that there will always be a relationship such as (2) between total employment and the supply of commodities, wheneverthe wage is fixed. Of course, the level of employment will depend on the way the wage is fixed. Suppose that the wage is related to the real wage, $\overline{W}_R$ by:

$$(5.4.3) \qquad W = \sum_i P_i \Omega_i \overline{W}_R = \overline{P}\ \overline{W}_R$$

Then it can be shown that if the technology is CES, the level of employment is related to the real wage by

$$(5.4.4) \qquad \overline{L} = \sum_i (\overline{P}\ \overline{W}_R)^{-\sigma_i} (\alpha_i P_i X_i)^{\sigma_i}$$

where, α_i, is the distribution parameter for labor in the production function and, σ_i, is the elasticity of substituion between capital and labor.

Since the total level of employment is variable, the welfare implications of this model will differ from those in the standard neoclassical model in the following sense. If trade leads the country to export the capital intensive good, employment and welfare will decrease. Hence there is an argument for restricting trade even if the country cannot influence its terms-of-trade when there is a minimum wage resulting in unemployment. If exports are labor intensive, as is typically the case in developing countries, a reduction in trade barriers leading to increased specialization will raise employment and welfare.

But we need to question whether the results obtained so far will hold when there are more than two factors of production and many commodities, with some of them non-tradable. It is, of course, true that in a model with more factors of production and a large number of commodities, we cannot be sure that the propositions discussed here will continue to hold. Specialization breaks the crucial link between product price and factor price ratios, and the presence of many factors raises the serious problem that there is no longer a unique association through an intensity condition between a particular commodity and a particular factor. To see this we need to return briefly to a discussion of supply functions.

What are the implications for the supply functions of enlarging the number of commodities produced and the number of factors of production? Consider the causal relations between factor endowments and supplies on the one hand, and between commodity prices and factor prices, on the other. A geometrical description is provided in Figures 1 and 2 for the case of two commodities and two factors. What is crucial to the argument developed so far is the assumption that the number of factors of production is equal to the number of commodities. The algebraic relationships for the many-factor many-commodity case may be easily summarized. Denoting the s^{th} primary factor of production by F_s and its per-unit input into sector i by a_{is}, the full-employment equation implicit in Figure 1 is:

$$(5.4.4) \qquad F_s = \sum_i a_{is} X_i \qquad \begin{array}{l} s = 1, \ldots, m \\ i = 1, \ldots, n \end{array}$$

There will be m such equations, one for each factor of production.

Provided there are as many factors of production as commodities (m = n) it is possible to solve equations (4) and to express commodity supplies in terms of factor endowments and input coefficients. Recall that factor prices are determined by commodity prices via the cost equations (eqs. 1). Letting W_s denote the factor price of the s^{th} factor, perfect competition will result in the selection of the least cost production technique and unit price will equal cost. The zero profit relations for the two-by-two case given in eqs. 1 may be rewritten as:

$$(5.4.5) \qquad P_i \leq \sum_s W_s a_{is} \qquad \begin{array}{l} i = 1, \ldots, n \\ s = 1, \ldots, m \end{array}$$

with equality holding when the commodity is produced. We have first seen that commodity supplies may be expressed as a function of input coefficients which are in turn determined by factor prices. But we saw in Figure 2 that factor prices (and the distribution of income) are determined by commodity prices. Therefore we can write the supply functions as:

(5.4.6) $X_i = g_i\{P_1, \ldots, P_n; F_1, \ldots, F_m\}$

thereby expressing that commodity supplies are dependent upon commodity prices (and endowments).

What happens if m<n? Since the production functions are CRS factor prices are fixed since only one technique of production reflected by the a_{is}'s will be chosen because scale will not have any influence on costs. Take as an example the case of three commodities and two factors. Then from (5) only two commodities prices are needed to determine factor prices. Therefore for each selected supply of commodity 3, a different supply pattern will result, each one consistent with the given prices and input coefficents. There exists an infinity of possible supply patterns all consistent with the same set of commodity prices. The production possibility set will be convex but the surface will contain linear segments. The simplest example is provided by the Ricardian model with two commodities and

one input, labor. In the general case the supply response to price changes will lead to specialization since with exogenously determined product prices, at most m sectors will be able to cover costs.

In the model, specialization will not occur at least in the short-run since each sector has a specific factor of production, capital. The zero profit conditions will always hold since the rents accruing to capital are determined residually, precisely so as to satisfy equation 5 as an equality. However, in the long-run, the reallocation of capital across sectors will tend to equalize rental rates so that only those sectors which cover costs will continue producing. If there are fixed intermediate inputs, as in the specification adopted in Chapter 4, the conclusions are unaffected and one need only replace gross prices, P_i, by net prices, V_i, in the cost and supply equations. If some of the commodities are classified as non-traded, then prices are no longer given and will adjust so that the zero profit conditions will hold.

Of course, this discussion on specialization could have been cast in terms of a programming problem (as was done in the introduction section of Chapter 4) with the number of constraints (m) being less than the number of activities (n). The "make-or-buy" situation would have then been obvious. However, the specification of supply functions has been used instead because it is crucial to much of the discussion on the modelling of the foreign trade sector in Section 5.6.

Returning to the discussion of income distribution, it is the scale of effective rates of protection along with sectoral factor intensity defined to include direct and indirect factor contents which will give some indication of the effects of protection on income distribution. As noted above, the presence of non-traded goods complicates the analysis since a change in trade policy or factor accumulation will lead to an exchange rate adjustment. In turn, if there are cross-price effects in consumption, there will be a desired switch between tradables and home goods. Moreover, as discussed in Section 5.3, there will be changes in relative prices among home goods. In terms of Figure 1, if traded goods are capital intensive in comparison with home goods, an increase in tariffs would shift clockwise the rays OX_1 and OX_2 representing factor proportions since a rise in the price ratio between tradables and home goods lowers the wage rental ratio, thereby inducing both sectors to substitute labor for capital.

Take again the case of raising the tariff uniformly on all imported goods. Assume for simplicity that the tariff proceeds are redistributed to consumers via lump-sum subsidies and that the economy is on its budget constraint (See eqs. 2. 14).

The tariff raises the domestic relative price of importables in terms of exportables by the amount of the tariff. At this point, however, if one can assume that home goods are substitutes for both exportables and importables, there will be an excess demand for non-traded goods. It can easily be shown that the budget constraint and Walras' Law ensure that this excess demand for home goods is exactly equal to the balance of trade surplus valued at domestic, undistorted prices. Letting t denote the ad valorem tariff on imports:

$$(5.4.7) \qquad I \equiv X_n P_n + P_m X_m + P_e X_e + t\Pi_m ER$$

$$(5.4.8) \qquad E \equiv C_n P_n + P_m C_m + P_e C_e$$

Equating (7) and (8) and letting $M = C_m - X_m$ and $E = X_e - C_e$ it can be shown that

$$(5.4.9) \qquad ER\,(\pi_e E - \pi_m M) = P_n (C_n - X_n)$$

To attain equilibrium home goods have to appreciate in terms of <u>both</u> importables and exportables or equivalently--as was demonstrated in the discussion on normalization--the price of both importables and exportables would have to fall equiproportionately in terms of home goods.

Finally, if there is a fixed minimum wage, there will be a relationship between relative prices and total employment so that it will no longer be possible to separate the effects described by the Rybczynski and Stolper-Samuelson Theorems. However, one need not despair. This discussion does not invalidate the conclusions established earlier, but rather indicates that they will be weakened when some of the standard assumptions are lifted. These theorems will provide a useful guide in the interpretation of experiments undertaken with a general equilibrium model featuring many commodities and linkages both on the supply side through interindustry flows and in demand through expenditure and cross-price effects.

We are now in a position to summarize the main conclusions reached by the theory of domestic distortions and see how they may serve as guidelines for policy-based experiments undertaken in a CGE model.

For a perfectly competitive economy with no monopoly power in trade and perfect factor mobility, laissez-faire is Pareto optimal because the economy will operate efficiently, i.e. the transformation curve coincides with the production possibilities frontier. Under these conditions, the first order conditions for an economic maximum will hold for any pair of commodities: DRT = DRS = FRT (where DRT represents the marginal rate of transformation in domestic production, DRS represents the marginal rate of substitution in consumption, and FRT represents the marginal foreign rate of transformation). In the case of two sectors and two factors, these marginal equivalences can be obtained by totally differentiating the production functions, substituting into the resulting expressions the values for marginal products obtained from the first-order conditions and using the factor endowments constraints to obtain:

$$(5.4.10) \qquad -\frac{dx_2}{dx_1} = \frac{V_{x1}}{Vx_2} \left[\frac{\frac{r}{y} dk_{x1} + \frac{w}{y} dL_{x1}}{r_{x1} dk_{x1} + w_{x1} dl_{x1}} \right] = \frac{V^{\pi}_{x1}}{V^{\pi}_{x2}}$$

In this expression V_x and V^{π}_x refer to percent values added at domestic and at world prices respectively. In the absence of both tariffs and monopoly power in trade, the marginal equivalences (DRT = DRS = FRT) will hold if the bracketed expression is equal to unity. If the costs of capital and/or labor are not the same in both sectors, the transformation curve will be inside the production possibility frontier and the product market equivalences will also not hold, since in all likelihood the bracketed expression in (10) will differ from unity. The price line will then intersect the transformation curve and the market exchange ratios will differ from the social opportunity cost ratios.

For policy analysis, what is important is the distinction between differentials which are a cause of distortion and those which are not. Examples of non-distortionary differentials include capital specificity and industrial wages exceeding agricultural wages due to higher costs of urban living or to costs of migration. Even if the quality of labor is identical(which rules out higher urban wages due to returns on investment in human capital), money wages may not be a correct indication of true wages since there are non-market food supplies in agriculture. It is sometimes argued that a rough indicator of the social opportunity cost of labor in urban areas is the wage rate paid in the urban small-scale sector so that the excess of wages over the amount paid in the manufacturing sector represents a distortion. Similarly,cheaper capital for the modern large-scale sector than for small-scale industry and agriculture may be due to the greater risk from lending to small business or small farmers. Yet, on the whole, capital market imperfections caused by government policies tend to make credit to large-scale manufacturing unduly cheap. These distortions in the factor market call for policy intervention.

Therefore, if the marginal equivalences in (10) do not hold, there is a marginal divergence between social and marginal valuations. Figure 3.1 can be used to illustrate such a situation. Let S_1S_1 represent marginal social costs and $S_oS_o$marginal private costs. Laissez-faire is then suboptimal. There is a market imperfection to be corrected, in this case by a subsidy to producers at the rate JK/A′K so as to equate marginal private and marginal social costs. The net social gain is given by the area GIK which is the difference between the cost of imports that are replaced, (AGKA´), and the social cost of protected output, (AIKA´). Given the amount of theoretical work which has gone into the analysis of distortions in the factor market, it is desirable to quantify both the positive and normative effects of these distortions.

The contribution of a CGE model with its emphasis on simulation of market behavior is that it allows an assessment of the effect of these distortions in a framework which is in close agreement with the theoretical model. Indeed, all that needs to be done is to allow the wage rates in each sector (W_{is}) to differ by constants of proportionality (ϕ_{is}) reflecting the extent of distortion. Each sector will have its own wage which will be related to the endogenously determined economy-wide wage for that category of labor by:

(5.4.11) $$W_{is} = \phi_{is} W_s$$

Before stating that these constants can be equalized to unity by policy intervention, one has to be fairly confident that they represent removable distortions.12/

In the previous example, had a tariff been used instead of a subsidy, the production gains would have been the same but a "by-product" distortion would have been introduced on the consumption side since the marginal private and social value of consumption MB´ would exceed the marginal social costs of imports, LB′. Thus the central proposition of the theory of domestic distortions is that the optimal policy intervention involves making the appropriate correction at the point of divergence (first-best). If there are constraints in the choice of policies, one is compelled to move down the hierarchy, adding at each step a by-product distortion as one moves down the hierarchy of policies away from first-best. Similarly, when distortions must be introduced into the economy because the values of certain variables are constrained, the optimal method of doing so is to choose that policy intervention which creates the distortion affecting directly the constrained variable.

For example, consider a country pursuing a strategy of industrialization to foster development of the manufacturing sector which is expected to export a significant share of its output. The typical import-substitution strategy has only offered protection for the home market, failing to encourage exports of manufactures with appropriate subsidies at the same rate. A combination of tariffs and export subsidies would be identical to a production subsidy to manufacturing. (Of course, this ignores by-product consumption effects which may be significant).

There are other important propositions of the theory of domestic distortions which are useful when considering the welfare effects of alternative policy combinations. First, reductions in the degree of distortion are welfare increasing until the distortion is fully eliminated. Second, reduction in the degree of a distortion will not necessarily be welfare increasing if there is another distortion in the economy.

Well-known examples include the dual economy models where profit maximizing takes place in the manufacturing sector while income-sharing in agriculture results in an agriculturalwage being determined by the average product of labor in agriculture. Whether there is surplus labor or not, the urban wage is equated to the rural wage with the result that the advanced sector has to pay a wage which is higher than the opportunity cost of labor. The result here is the same as when both sectors maximize profits but there is a wage differential in favor of manufacturing. In both cases, a subsidy to labor in manufacturing is the first-best policy. If, however, urban unemployment co-exists with a high minimum wage in manufacturing (as in the Harris-Todaro model) the appropriate policy would be to provide a subsidy to labor in manufacturing combined with a restriction of migration out of agriculture. In either case, a tariff to protect manufacturing will not be first-best, but as was shown by Hagen (1958), an appropriate tariff will raise welfare. In the Harris-Todaro case, a tariff which raises employment in the manufacturing sector is likely also to increase welfare even though it is not first-best.

Now return once more to Figure 1 and assume that the tariff is the only available instrument of policy. Then we are in a second-best situation. Given this constraint, there exists a second-best tariff which will be less than the tariff which would completely correct the marginal divergence in production. It will be given by that tariff rate which will equate the marginal production gain with the marginal consumption cost (not drawn in the figure). This second-best tariff is optimal, given the options available.

With these propositions and examples in mind, let us see if one can devise an optimum tariff structure when tariffs, export subsidies and export taxes are the only policy instruments available and the intent of the protective system is to alter domestic economic structure by encouraging value-added in manufacturing at the expense of agriculture. In this case, if there is no particular reason for promoting one industry rather than another, then the optimum tariff structure should provide uniform effective protection to all industries in the manufacturing sector. However, a uniform nominal tariff structure will not generally provide a uniform structure of effective protection. For instance, it is likely that several manufacturing industries will receive inputs from the non-protected exportable sector, agriculture. In that case, to ensure uniform effective protection, manufacturing sectors with relatively low input shares from agriculture should obtain relatively high nominal rates.

Moreover, as soon as uniformity of effective rates requires non-uniformity of nominal rates, the pattern of consumption will be affected within the protected import-competing sector, and it will affect consumption of importables relative to exportables and home goods (if there are any). Therefore, the policy prescription described above will lead to both a production gain and a consumption cost. The problem arises, of course, because tariffs are second-best, (compared with the first-best policy of a subsidy to value-added) when the aim is to encourage manufacturing production only. This consideration will lead to a departure from a uniform effective tariff structure and one must again trade-off consumption and production effects as in the simple second-best case discussed above, except that the situation is now far more complicated.

Further qualifications may be added to illustrate again that there is no short-cut to a proper general equilibrium analysis once it is recognized that an economic system is a complicated construct with vertical and horizontal relationships, as well as distinctions between traded goods and home goods. Other important situations leading to the same conclusions can be mentioned briefly. Suppose first, that some tariffs are not alterable and one wishes to find the optimum tariff structure for the remaining tariffs subject to manipulation by policy. This is again a second-best optimization problem. Since the whole protective structure is not subject to variation, free trade will no longer be optimal for the remaining sectors and the second-best optimum tariffs for industries under consideration should be expressed in terms of effective rates subject to the limitations due to consumption effects discussed above. Suppose next, as is often the case, that the wage in the manufacturing sector exceeds the social opportunity cost of labor and that free trade is ruled out. Since the labor intensities of value-added in the protected sectors will be different, uniform effective protection is no longer optimal and one should provide higher effective rates for the more labor-intensive industries.

One could multiply examples; these should suffice to indicate that there is indeed no simple solution facing the policy-maker. One might be tempted to argue, on the basis of this discussion, that a properly-specified model will provide all the answers. This is a misconception since it is impossible to take all relevant variables and interactions into account. We must not only be selective, but must understand the range of possibilities which exist outside the model if we are to make intelligent recommendations. The kind of well-established propositions discussed in the preceeding pages should assist in this understanding. However, once the basic mechanisms are well understood, a general equilibrium analysis will help to formulate alternative policy packages by identifying some of the more important interactions in the economic system which escape intuition or more narrowly focused analyses.

A lot has been said about welfare effects of alternative trade policies, but nothing has been said about how to quantify them. In a partial equilibrium context, the costs of protection stemming from the deadweight losses in production and consumption (areas D_1 and D_2 in Figure (3.1) are estimated under <u>ceteris paribus</u> assumptions with the help of effective rates of protection, as well as the concepts of producers' and consumers' surplus. These analyses, based on integrals and Hicksian compensation tests, are restricted to small changes in trade policies.[13/] In general, they do not include non-traded goods and are restricted to a few commodities. The advantage provided by a general equilibrium approach is that the underlying demand and supply relationships are explicitly written out and one is no longer restricted to small changes in trade policy. The resulting estimates of the costs of protection, although sometimes expressed in terms of GNP, are usually given in terms of a social utility function.14/ For reasons described in Chapter 6 on income distribution, it is useful to provide estimates of these costs that do not depend upon a utility indicator.

To compare the level of welfare or real income between two sets of alternative trade policies (to be denoted by zero and one respectively), let EXD denote the vector of excess demands so that

$$(5.4.12) \quad EXD \equiv C - X$$

where C and X are the vectors of commodities demanded and produced domestically.15/ The basic criterion with which welfare in situation one is compared with welfare in situation zero involves comparing the value of aggregate demand in each situation using prices in situation one as indicators. Welfare is assumed to have risen in situation one if:16/

$$(5.4.13) \quad P^1C^1 > P^1C^0$$

Making use of the definition of excess demands the welfare criterion can be expressed as

$$(5.4.14) \quad P^1 (EXD^1 - EXD^0) + P^1 (X^1 - X^0) > 0$$

Recalling that the budget constraint states that the value of aggregate excess demand at world prices is zero in both situations and that domestic and world prices are related to each other by equation (3.1), the criterion in (14) can be rewritten as:

$$(5.4.14) \quad -(\pi^1-\pi^0)EXD^0 + t^1\pi^1(EXD^1-EXD^0) + P^1(X^1-X^0) > 0$$

Recalling that positive (negative) elements in the vector of excess demands, EXD, imply that the commodity is imported (exported), each of the terms in expression (14) decomposes the welfare effects of a change in trade policy into three components. The first one of these, reflected in the first term, is the terms of trade effect. Welfare will increase to the extent that the world price falls for commodities which are imported ($EXD_i > 0$) and rises for commodities which are exported ($EXD_i < 0$). The second term measures the change in the volume of trade for all commodities for which domestic prices are separated from world prices by trade taxes. It states that real income will rise (fall) if the level of imports (exports) rises for any commodity worth more at home than on the world markets. Note that a subsidy reduces real income since it is tantamount to giving something away. Finally the third term measures the change in real income attributable to the change in production. This effect cannot be negative since a change in resource allocation would not take place if it were not profitable in the first place. This decomposition measure is useful in that it provides a measure of the relative weight to be attached to the gains (and losses) from changes in trade taxes, terms of trade, and patterns of resource allocation.

5.5 Modelling the Dynamic Effects of Trade Policy

So far we have discussed the specification of trade and trade policy in a static framework without introducing time. But the most interesting aspects of the debate over the appropriate trade strategy for developing countries are related to dynamic problems. The argument for protection, in the context of development, has always been founded on dynamic considerations mostly based on some variant of the "infant industry" argument. However, before examining how some of the dynamic effects of trade policy can be incorporated into the CGE framework, it is useful to see how trade policy affects the rate of growth.[17/]

Consider the standard two-factor two-commodity trade model where the final commodities are the consumption and investment goods. For the moment capital is assumed to be perfectly mobile between sectors. Recall the discussion of the alternative stylized versions of the determinants of aggregate investment presented in Chapter 4. Let us now see how trade policy can affect the rate of growth by considering each one of these versions in turn. Suppose first that the rate of growth of the capital stock is exogenously determined, perhaps by the planning board. In this case, there is no interaction between trade policy and growth since the growth rate of the capital stock is not affected by either the aggregate level of real income or by the different saving propensities of the factors of production. The rate of growth of the economy is independent of trade policy.

Next assume that a constant fraction of national income is saved. Then investment will rise as real income rises so that a change in investment will affect capital accumulation. If the labor force is growing at a constant exogenously determined rate, then an increase in the level of protection (in the absence of other distortions) will lower consumption, inflicting a current welfare loss while the lower investment reduces the rate of growth and so inflicts a future welfare loss.

However, this income effect of protection is supplemented by a relative price effect. Since the proportion of expenditure on investment is constant, a policy which leads to a change in the relative price of investment goods in terms of consumption goods will alter the real amount of investment obtained from a given nominal amount of savings. In the more general case of a model with more than two commodities, a trade policy which, for example, cheapens imports of capital goods through a high tariff on consumer goods will increase the real amount of investment and hence raise the rate of capital formation. In this case a restrictive trade policy would increase the rate of capital accumulation if that effect more than out-weighed the loss in real income due to a restrictive trade policy. However, as we saw in the previous section, such a policy should only be undertaken if the socially desired savings propensity is higher than the private one and if, furthermore, first-best policies for raising investment are not feasible.

The substitution effect just described is further complicated by the presence of home goods. Given that construction activities usually account for between one-third and one-half of total investment, it is important to consider how this mechanism is modified in the presence of a model where a proportion of capital goods are classified as non-traded goods. We saw earlier in Section 5.4 that the imposition of a tariff leads to an excess demand for non-traded goods so that to attain equilibrium non-traded goods have to appreciate in terms of traded goods. Since in the typical CGE model there are no substitution possibilities between different types of investment goods, the positive effect just described above will be weakened, since the imposition of a tariff on consumption goods will indirectly lead to a rise in the price of non-traded construction goods.

Finally consider the third case where investment is determined by the propensities to save out of labor and capital income. Then trade policy will affect capital accumulation in a third way, namely the redistribution effect consequent upon a change in trade policy. This effect was discussed in Section 5.4 and is derived from the Stolper-Samuelson theorem. Then, if capitalists and wage-earners each have constant propensities to save out of income, and provided these propensities are different, a change in trade policy will affect savings and therefore capital accumulation. If investment goods are capital intensive, then a policy which lowers the price of investment goods will reduce investment if capitalists have a higher propensity to save than wage earners.[18] This third effect has to be added to the income and substitution effects to determine the effect of trade policy on capital accumulation and the rate of growth of the economy.

There is another important way in which trade policy is likely to affect the rate of growth. While the orthodox analysis of growth is concerned with steady states where all variables grow at the same rate, CGE models, as well as other applied planning models derive the growth rates of various factors of production from past historical trends. Typically, these data indicate that factors of production are not accumulating at identical rates, reflecting the observation that economies are not in steady state growth. With a CRS production function and abstracting from technical progress, the rate of growth of output is a weighted average of the capital and labor growth rates, where the weights are given by the factor shares. If a change in trade policy affects factor rewards, then the relative importance of each factor in contributing to growth will be altered, and if it raises the share in total product of the faster-growing factor, the rate of growth will rise. 19/

More importantly, since there is technical progress, the rate of growth of sectoral outputs will in addition be affected by the rate of technical progress. One then has to take this effect into consideration and we shall see shortly how the presence of technical progress will--under the usual assumptions about factor mobility in the CGE model--affect the evaluation of trade policies. There is a last point that needs to be mentioned about technical progress: it will affect factor rewards and hence indirectly the rate of capital accumulation if the volume of investment is determined by the marginal propensities to save out of factor incomes.

Nothing so far has been said about the government whose behavior can be explicitly incorporated in the CGE framework. In the theoretical literature, government is usually assumed to redistribute the proceeds from trade taxes in a non-distortionary manner across the economy. In our approach, the government may be considered as another income receiver with its own marginal propensity to save. An increase in protection leads to a redistribution of income towards the government. If the government has a higher marginal propensity to save than other income receivers, then the redistribution effect will be favourable to growth. Conversely, a move away from tariff protection towards protection in the form of quantitative restrictions will have an unfavourable effect on the rate of growth. Finally one should note that the effects of trade policy on the rate of growth will also be influenced by employment considerations if there is a minimum wage in the economy.

All of these considerations point to a potential conflict between static efficiency considerations and the kind of dynamic considerations that are loosely referred to as "infant industry" arguments. But the "infant industry" argument is based on a divergence between static and dynamic effects of trade policy and it emphasizes dynamic considerations. While it is generally recognized that trade distortions have static welfare costs, it is then argued that the dynamic benefits associated with a protectionist trade policy are well worth the static costs. Thus investment should proceed not according to static comparative advantage, but according to long-run dynamic comparative advantage.

What is the nature of the conflict between "static" and "dynamic" comparative advantage? The question has much to do with the functioning of capital markets and the degree of factor mobility.

Assume that all factors are perfectly mobile. Capital in particular is homogeneous and is perfectly mobile across sectors. Suppose at the same time that the production possibility curve of the country in question is shifting in such a way as to lead to shifts in comparative advantage due to differential sectoral rates of technical progress and/or factor accumulation. For example, the country in question may start with a comparative advantage in cotton textiles, but as capital accumulation and technological progress takes place, it may enter a phase where its comparative advantage lies in electrical machinery. Is the fact that a country will develop a comparative advantage in electrical machinery ten years from now a reason to shift present investment away from textiles into electrical machinery and to produce more such machinery today? If capital and other factors are mobile, the answer is clearly no. When and if comparative advantage shifts, capital and production should be shifted to the machinery sector. But there is no reason to do it or encourage it before the shift in comparative advantage occurs. Current prices still provide the best allocation signals.

But now in accordance with the basic CGE model presented in Chapter 4 assume that capital, once installed, is immobile between sectors for the period under consideration and that people have static expectations and do not correctly predict the future, basing their investment decisions on current profit rates. If comparative advantage shifts in an unforeseen fashion, a sequence of investment allocations based on static comparative advantage will turn out to be intertemporally inefficient. Welfare would increase if capital could be shifted into the machinery sector at an earlier stage in anticipation of the coming shift in comparative advantage. The energy crisis may serve as a suggestive and somewhat extreme example of the effects of unforeseen shifts in price and cost structures. Clearly, if somebody had foreseen present oil prices in the early 1960's, a lot more capital could have been shifted into alternative sources of energy and, while this would not have been justified at the "static" prices of the 1960's, it would have turned out to be intertemporally efficient. While the suddenness of the change and the partly political mechanisms involved make oil and energy an extreme example, it helps to underline the issue. When capital is heterogeneousand imperfectly mobile and when the frictionless future markets of general equilibrium theory are absent, the market mechanism cannot be expected to lead to intertemporally efficient growth paths. In a dynamic context, efficiency and comparative advantage must be redefined in dynamic terms. The importance of this factor will depend heavily on the extent of intersectoral factor mobility discussed in the presentation of stage 2 in Chapter 4. It is no longer sufficient to compare static rates of transformation between domestically produced and foreign commodities and insure their equality, but instead dynamic rates of transformation must be equalized. The necessity of minimizing misallocations of investments will be an extremely important policy task in an environment where structuralist constraints make it extremely difficult to "undo" unforeseen errors.

In our example relating to cotton textiles and electrical machinery,one should give up utility today by shifting out of textiles and into machinery until the marginal static cost of doing so equals the marginal dynamic benefit of re-allocating the capital stock in anticipation of a new structure of comparative advantage.

The dynamic inefficiency of myopic markets has always provided one major argument for central planning and government action. The existence of foreign trade does not, per se, add a new qualitative element to the argument. It does, however, increase the degree of uncertainty that is likely to prevail and the extent of dynamic resource misallocation that might occur.

Whether government action is in fact likely to be less myopic than the sum of the expectations of private entrepreneurs is of course an open and often debated question. A lot may depend on the organization and quality of capital markets. In developing economies with rudimentary capital markets, a very strong argument can be made for the government to provide the long-run perspective that is essential for dynamic efficiency. Even in countries with highly developed capital markets, the limitations inherent in futures markets and important differences between the social and the private evaluation of risk, have led many authors to rest the case for central indicative planning on arguments of dynamic efficiency.[20/]

All this does not, of course, constitute a first-best argument for protection and trade intervention. Direct subsidies to stimulate investment in sectors expected to gain comparative advantage in the future would be superior policy tools. But, as already discussed above, tariffs are easily manipulated and convenient policy tools and can contribute to steering investment into the desired channels.

Note that for there to be such dynamic efficiency benefits associated with protection, one does not need to assume the existence of "learning" externalities that are usually discussed in the context of the "infant industry" argument. We have so far stressed the role of imperfect foresight in heterogenous capital good models and argued that such lack of foresight is sufficient for an allocation of investment based on the present structure of comparative advantage to be intertemporally inefficient. "Learning" externalities that would be hard to internalize even with perfect foresight constitute an additional related component of the dynamic argument for protection.

The most common externalities emphasized in the infant industry argument relate first to labor training and the returns from which accrue to the workers themselves while the costs are borne by firms and, second, to accumulation of technical know-how that cannot be internalized and kept by individual firms as well as more general notions of knowledge diffusion and the creation of "modern attitudes" that are taken to benefit society.

These effects are much more difficult to quantify and explicitly introduce into multi-sector planning models. They may, however, be very important, perhaps more important than the more easily modelled effects of differential rates of technical progress and factor accumulation. There is little doubt that these general considerations stressing the need for "modern" attitudes and general diffusion of knowledge have often provided the single strongest impetus for an interventionist trade policy.

It is finally very important to stress that "interventionism" need not imply inward-looking protectionist trade strategies. The dynamic infant industry arguments apply as much or more to infant export industries as they do to infant import competing industries. In the case of export industries, a very important "infant marketing" argument should in fact be added to the traditional "learning by doing" arguments. The situation is quite symmetric--export promotion beyond the static limits of comparative advantage definitely has the same kind of static resource allocation costs as import restrictions. But it may be expected to have the same, or perhaps even more important, dynamic benefits if the sectors emphasized are indeed those that will exhibit comparative advantage in the longer run. Furthermore, the "learning" that takes place through competition in international markets may have benefits that have no counterpart in purely domestic economic activity. Finally, the discipline and competition imposed by a more export and world market oriented strategy may have beneficial effects not only on efficiency but also on the distribution of domestic income.

The real question facing an export-promoting or export-led growth strategy of development relates to the international environment and the terms of trade. It is here that the small country assumption plays a very important role and may in fact be somewhat misleading. We therefore proceed in the next section, to an appraisal of the small country assumption and its role in planning models.

5.6 Imperfect Substitutionand Product Differentiation: The Small Country Assumption Revisited

Throughout the discussion so far, we have followed the standard small country assumption made in international trade theory. It is a simplifying and useful point of departure which allows a clear-cut analysis of the links between foreign trade and the domestic economy. As we saw earlier, domestic prices are determined outside the model, so that the full effects of changes in trade policy are reflected in adjustments of the prices faced by domestic users. The consequences of associating this assumption with the CRS production functions in a multi-sector frame-work havealready been noted in the discussion of supply functions in Section 5.4. Of course in the short-run, the supply functions will be upward sloping since some factors of production are sector specific and will be earning residually determined rents. But, in the long-run the supply functions will tend to be horizontal since all wages will tend to be equalized across sectors and there are fewer factors of production than commodities.

Given the form of the supply functions provided by eqs. 4.4 a question arises regarding the degree of autonomy of the price system so that one is led to question whether the arguments of these functions are exogenously determined through foreign trade, regardless of domestic tastes and technology, as trade theory would lead us to believe.[21/] If the small country assumption is a good empirical approximation of domestic price determination, then under perfect competition, the supply functions are virtually determined by trade policy and the pattern of production in the long-run is entirely in the hands of government policy. The question then is whether the proper arguments figure in the supply functions and whether the "law of one price" prevails. Let us consider briefly some alternatives which have been suggested and see how they affect the supply functions.

The most obvious rectification is the assumption of perfect competition. If it is relaxed then costs of production will depend on output levels. Is this view reasonable? For exports of a few primary commodities a developing country may be expected to exert some monopoly power in world markets. Facing a finite elasticity of demand on the world market, domestic producers are able to price discriminate between sales on the domestic market and sales on the world market. But such an assumption is only valid for a few exports of selected primary commodities. For a small group of manufactures which are exported one could also argue that domestic producers are perfect competitors when they sell abroad and monopolists when they sell on the domestic market. Another interesting variant followed by Staelin (1976) is to assume that producers employ rules of mark-up pricing. All industries sell their output at a given mark-up over marginal costs. This assumption allows the introduction of profits into the model so that producers set output levels in relation to their profits. Thus the reaction of producers to profit yields a finite elasticity of supply when production functions are CRS, since profits enter as arguments in the supply equations.

Another approach, this time assuming perfect competition, is to view efficiency in import-competing industries as a function of total supply. Ali (1976) has constructed a general equilibrium model where the justification for rising industry supply curves is viewed as an aggregation problem. Defining average cost as the domestic factor cost needed to save a unit of foreign exchange, Ali argues that as one moves down the ladder of comparative advantage towards more inefficient firms in the industry, the costs of replacing a unit worth of foreign exchange increases and accordingly results in a decline in efficiency reflected in a decreasing value for the shift parameter entering the sectoral production functions. The resulting form of the production function implies that as output is increased, efficiency declines.

This specification, based on the notion that a sectoral production function does not provide any information about the relative comparative advantage <u>within</u> a sector, has some appeal for developing countries where the use of scarce foreign exchange is likely to have an effect on sectoral efficiency in production.

These approaches provide a useful point of departure from the small country assumption since they draw attention to some important aspects one must keep in mind when modelling the foreign trade sector. Our approach shares common concerns with the determination of the domestic price system and aggregation considerations inherent in economy-wide models. We argue that the assumption of perfect substitutability between domestically produced and foreign goods is very unrealistic in the context of empirical applications undertaken in planning models.[22/] In terms of the language of the planning literature, imports should not be treated as perfectly competitive. Even for such apparently homogenous categories as cotton, iron ore or steel, differences in quality and product characteristics exist and must be expected to lead to price differentials between domestic and foreign goods within any of those commodity categories. But even highly disaggregated economy-wide models cannot be expected to reach a level of sectoral disaggregation where domestic and foreign products are perfect substitutes.

As a result, changes in foreign prices facing domestic users, induced for instance by changes in trade policies, will not result in identical changes in the prices of domestically produced commodities. Consequently, the domestic price system has a greater degree of autonomy than suggested by traditional trade theory so that the arguments of the supply equations derived in Section 5.4 are not entirely exogenously determined for the economy. Price differentials for the "same" product are commonly observed when products are distinguished by country of origin. The fact that price differentials are observed even for very fine commodity classifications suggests that product differentiation is accounting for the observed two-way-trade.[23/] Therefore a country will import a certain type of motor vehicle while it exports another. This could not happen in a model that considers motor vehicles to be a perfectly homogeneous category of commodities since the material balance equations cannot accommodate both endogenous imports and exports of the same homogeneous commodity.

While perfect substitution is emphasized in the theory of international trade, many development planning models in the structuralist and two-gap traditions emphasize the lack of substitution possibilities both among factors of production and between domestic and imported goods. They assume that domestic and imported inputs are perfect complements in production and have to be used in fixed proportions. Imports are viewed as non-competitive. The development process is a succession of structural disequilibria reflected in domestic bottlenecks arising from the limited ability of developing countries to substitute domestic for imported inputs. An essential feature of industrialization involves the substitution of domestically produced goods for foreign produced ones. Note that the specification of imperfect substitution in use accommodates the two extremes of standard trade theory and the popular two-gap approach in the development literature. In that approach it is often maintained that no amount of relative price adjustment can alleviate the foreign exchange gap.[24/] The specification of imperfect substitution will point to some of the conclusions in that approach regarding the effect of increased domestic savings on growth.

A formulation that allows one to keep aggregative commodity categories across countries but introduces product differentiation by country of origin into the structure of demand for commodities in any given country was first proposed and implemented by Armington (1969) in a partial equilibrium framework. Within the framework of a single country model, one defines for each tradable commodity category an "aggregate" or "composite" commodity which is a CES function of commodities produced abroad, that is, imports, M_i, and commodities produced domestically, D_i. The aggregation is given by:

$$(5.6.1) \qquad Q_i = \gamma_i \left[\delta_i M_i^{-\rho_i} + (1 - \delta_i) D_i^{-\rho_i} \right]^{-\frac{1}{\rho_i}}$$

where γ_i, δ_i and ρ_i are parameters and M_i and D_i are like inputs "producing" the aggregate output.[25/] The ratio in which these "inputs" are combined is determined by their relative prices alone, and the sensitivity of their ratio to variations in relative prices varies directly with the elasticity of substitution $\{\sigma_i = 1/(1 + \rho_i)\}$.

Consumer, intermediate and investment demands are assumed to relate directly to the aggregate commodity Q_i. The demands for imports and domestically produced commodities thus become <u>derived</u> demands, in just the same way as the demand for factor inputs is a derived demand in a traditional production model. Given specified prices for the imported and domestic goods, the problem facing the user or buyer is mathematically equivalent to that facing the firm that wants to produce a specified level of output at minimum cost. The solution is to find a ratio of "inputs" (M_i to D_i) so that the marginal rate of substitution (the slope of the iso-output curve for the composite good) equals the ratio of the price of the domestically produced commodity to the price of the imported commodity. Letting P_i^d denote the former domestic good price and P_i^m the domestic price of imports, the familiar first order conditions for a minimum lead as to:

$$(5.6.2) \qquad \frac{M_i}{D_i} = m_i = \left(\frac{P_i^d}{P_i^m}\right)^{\sigma_i} \left(\frac{\delta_i}{1-\delta_i}\right)^{\sigma_i}$$

$$(5.6.3) \qquad \frac{P_i^m}{P_i^d}\frac{M_i}{D_i} = \left(\frac{\delta_i}{1-\delta_i}\right)^{\sigma_i} \left(\frac{P_i^d}{P_i^m}\right)^{\sigma_i - 1}$$

In this form it is clear that value shares are independent of the price ratio if and only if the elasticity of substitution, σ_i, is equal to unity.

Since the aggregation function is linearly homogenous in M_i and D_i it can be rewritten as:

$$(5.6.4) \qquad Q_i = f_i\ (m_i,\ 1)\ D_i$$

Where f_i constitutes the right-hand side of (5.6.1).
If S_i denotes the ratio of the domestic good to the aggregate good in each sector, we may write:

$$(5.6.5) \qquad s_i^d = \frac{D_i}{Q_i} = 1/f_i(m_i,\ 1)$$

Given the prices of imported and domestic goods, there is a corresponding price or "cost" of the aggregate good. Since total expenditure on the aggregate good must equal expenditure on its imported and domestic components, it follows that:

$$(5.6.6) \qquad P_iQ_i = P_i^mM_i + P_i^dD_i$$

when P_i stands for the composite commodity price. Dividing through by Q_i and substituting from (5) above yields:

$$(5.6.7) \qquad P_i = s_i^d (P_i^d + P_i^m m_i)$$

Note that (7) defines the price of the composite commodity for any arbitrary ratio, m_i. It does not, in particular, depend on m_i having been determined optimally. In trade regimes where quantitative restrictions and rationing play an important role, m_i cannot always be expected to reflect desired cost minimizing proportions. However, equation (7) still defines the appropriate composite-good price.

If quantity restrictions are not binding and m_i can be taken to reflect desired proportions, one can obtain P_i as determined by the cost function derived from the CES aggregation function. We will have:

$$(5.6.8) \qquad P_i = \gamma_i^{-1} \{\delta_i^{\sigma_i} P_i^{m\ 1-\sigma_i} + (1-\delta_i)^{\sigma_i} P_i^{d\ 1-\sigma_i}\}^{\frac{1}{1-\sigma_i}}$$

But while (7) above always holds for any import regime, (8) will only hold in the absence of quantitative restrictions that prevent the achievement of desired proportions between imported and domestically produced commodities.

When using a model embodying product differentiation, it is important to remember that the elasticities of substitution specified in the aggregation function refer to substitutability <u>in use</u> and do not, by themselves, determine the sensitivity of the economy to changes in foreign prices and/or the exchange rate. As in the discussion surrounding the difference between the rate of protection and the protective effect, a crucial role is played by supply elasticities. The supply functions for domestically produced goods, X_i, are now given by:

$$(5.6.9) \qquad X_i = g_i \; (P_i^d, \; \ldots, \; P_n^d, \; F_i, \; \ldots, \; F_m)$$

Although the elasticity in use embodied in the aggregation function (1) may be high, as for instance in the case of oil, what will determine the supply response to a change in trade policy is, as in the discussion on protection and resource allocation, the domestic supply elasticity. One can easily imagine a case where M_i and D_i are perfect substitutes in use (i.e., $P_i^d = P_i^m$) and yet the supply response to a change in trade policy given by an expression similarly to equation (3.8) would be zero due to factor immobility in and out of the sector producing that commodity. Therefore the sensitivity of economic structure to trade policy variables depends as much on supply conditions as on the elasticities of substitution in the aggregation functions.

Note that in this analysis, the small country assumption is retained in the sense that the world price of imports remains strictly fixed. It is abandoned only in the sense that domestic prices are no longer fixed by world prices. The introduction of product differentiation should not be expected to alter the qualitative behavior of the model; the theorems of trade theory will continue to hold. But, as noted earlier, the link leading from changes in the prices of importables to domestic variables will be weakened. To take an example, the Stolper-Samuelson theorem will continue to hold, but the quantitative importance of the effects of tariffs on income distribution will be less than in a model that assumes perfect substitutability. To put it somewhat differently, the magnitude of the tariff needed to raise the price of a domestic import-competing commodity by a given percentage will clearly be much greater if there is product differentiation. As the elasticity of substitution increases, the model will start behaving like the pure models of trade theory.

We must now turn to a discussion of the treatment of exports. In expositions of the theory of international trade exports and imports are treated symmetrically since the home country usually faces fixed terms of trade on both the export and the import side. Can this symmetry be carried over to a model specification stressing imperfect substitutability of goods differentiated by country of origin? Unfortunately, the treatment of exports cannot be exactly symmetrical to the treatment of imports because we are not building a multi-country trade model where the demand for one country's exports appears as import demand in another country.[26/]

The supply of domestically produced goods is determined by (9) and the demand for imports by (2). We now turn to an examination of the determinants of exports.

Under the small country assumption, a country's export prices, π_i^e, are fixed in the world market independently of the quantities exported. With a constant exchange rate and subsidies, we must have $P_i^e = \Pi_i^e(1 + t_i)\ ER \leq P_i^d$. If $P_i^e > P_i^d$, no domestic sales would take place and whatever is produced domestically would be exported. This would clearly exert upward pressure on the domestic price. Since no domestic sales would take place until $P_i^e \leq P_i^d$, the domestic price may be expected to rise until at least the equality is satisfied and we would never observe a situation in which $P_i^e > P_i^d$. It is, of course, conceivable that the entire domestic production is exported while domestic demands are being satisfied by imports. We would, in principle, have $P_i^e > P_i^d$ and $D_i = 0$ so that P_i^d has no more function in the model. In fact, given the CES aggregation function that regulates the share of domestically produced output in total use of any commodity, D_i can never fall to zero and we can therefore never have $P_i^e > P_i^d$. The constraints implied by the model on the export side can thus be summarized as follows:

$$(5.6.10) \quad \begin{array}{llll} \text{IF} & P_i^e = P_i^d & E_i \geq o \\ \text{IF} & P_i^e < P_i^d & E_i = o \end{array}$$

This treatment of exports remains faithful to the small country assumption but, as noted above, is inconsistent with the treatment of product differentiation applied to imports. One cannot, strictly speaking, assume that a world price exists for the exports originating from a single individual country. Rather, analogously with the discussion of the price of the composite good (see equation (6)),there is an aggregate world price π_i^W determined by the total expenditure from all countries on all commodities supplied by all producing countries, j, of the commodities aggregated under that category, i. The expression is given by

$$(5.6.11) \quad \pi_i^w Q_i^w = \sum_j E_i^j \pi_i^{e_j}$$

where Q_i^W is an aggregate index and $\pi_i^{e_j}$ is the world price for exports of commodity i from country j which is determined by the familiar trading price relationships described in equation (5.3.1). Dropping superscripts denoting the country of origin, the world price for exports from the domestic country is given by:

$$(5.6.12) \quad \pi_i^e = P_i^e/ER\ (1 + t_i) = P_i^d/ER\ (1 + t_i)$$

It is to be expected that if a change in domestic policy brings about a fall in π_i^e relative to π_i^W the demand, E_i^d, for domestic exports by foreign users will rise. Assuming foreign incomes given, the foreign demand functions for the home country exports are given by

$$(5.6.13) \quad E_i^d = E_i^D \; (\Pi_i^e, \Pi_i^W)$$

Just as the world prices of commodities imported are exogenously determined, so are the fixed average world prices for commodities exported. By themselves, these demand functions are insufficient to determine exports. If we continue to abide by the rule that:

$$(5.6.14) \quad P_i^e \leq P_i^d \qquad \text{with} \quad E_i = 0 \quad \text{if } P_i^e < P_i^d$$

we will be able to determine exports, having added the supply determining mechanism to the demand side. The supply of exports is equal to total domestic production minus domestic use and will therefore normally rise with increases in the domestic price P_i^d which causes total supply to expand but domestic demand (as well as foreign demand) to contract.

Once the small country assumption is abandoned on the export side, the form of the export demand functions (13) becomes very important. The price elasticity of world demand for a particular product should be expected to be greater the more homogeneous the product category considered and the smaller the market share of our country. It is important to note in this context that in a world of differentiated products, the degree of product homogeneity has a more direct effect on price elasticity than the size of the market share.

In empirical applications, further complications are likely to arise. In reality, export prices, P_i^e, and domestic prices, P_i^d, may differ due to product differentiation, (this time between export products and other products within a single domestic sector) as well as to variations in risk, information and other factors. Adopting a less purist but perhaps more realistic approach, empirically one might specify export supply functions of the form:

$$(5.6.15) \quad E_i = E_i^s \left(P_i^e, P_i^d\right)$$

Having specified the form of the export supply functions entering the commodity balance equations, one could drop the requirements that $P_i^e = P_i^d$ whenever $E_i > 0$.

One can note a further complication relating to the lags and delays that are likely to be much more important on the export side then on the import side. While the domestic user can be assumed to adjust rapidly to any relative price change caused by national policy, the foreign buyer of L.D.C. products may respond only after considerable delays, particularly if the country in question is attempting to enter new markets and establish credibility for the quality of its products and the reliability of supply. These factors might be introduced into a trade-focused model by building the proper lag structure into the export demand functions. However, given both the difficulty of econometrically estimating these lag structures and the CGE emphasis on medium to long-term descriptions of the economy, it may be preferable not to include these considerations in the analysis.

5.7 Summary

It is clear that the development of empirically realistic models leads us far away from the simple models of trade theory. Nevertheless, product differentiation on both the import and export side, imperfect adjustment and lags should not be expected to alter the qualitative nature of the various causal mechanisms that are highlighted by trade theory. One can still talk about the static consumption and production costs of protection. Tariffs on relatively capital-intensive import-substituting industries will still lower total employment in a fixed-wage setting and will also alter income distribution. However, dynamic allocation and learning effects may generate benefits that have to be set against the static allocation costs of an interventionist trade policy. In general, these mechanisms, while still operating, will be somewhat harder to trace and quantitatively weaker than in the purer models of trade theory.

The small country assumption, while realistic for imports, is unlikely to describe adequately the determination of export prices. Even small countries face downward sloping demand curves for most of their export products, particularly manufactures. The exact form of these curves is very hard to estimate and involves dynamic adjustment parameters that may generate delayed response to exchange rate and price adjustments. The analysis of trade policy is significantly affected by such weakening of the small country assumption since the terms-of-trade a country faces may now change through changes in export prices. This implies that there exists a first-best argument for export taxes although as long as we retain the small country assumption on the import side, tariffs will never, strictly speaking, constitute first-best policy tools.

The terms-of-trade issue, so crucial in the long debate on trade and development, cannot however be properly analyzed with single country models. It is for this reason that little space has been devoted to the optimum tariff argument which is best examined in a multi-country setting where the impact of multilateral trade negotiations and tariff wars can be analyzed. While one country's big export push may lead to only a very moderate decline in the terms-of-trade, the same strategy centered on the same kind of products adopted by a large number of countries may lead to a collapse in their terms of trade and a reduction in their welfare. Single country models thus are not the proper framework to discuss world-wide trade and development strategies. The best we can hope to achieve with the kind of single country models discussed in this book is to specify trade and particularly the determination of exports in a way that is consistent with expected overall trends in the world economy. To do more, in a formal way, would imply an attempt at modelling the world economy as a whole.

Footnotes

1/ If licences are interchangeable among producers or traders, it is less likely that a monopoly will be created--for further discussion see Corden (1971), Chapter 9, 10.

2/ See Adelman and Robinson (1978) where such a specification is appropriate for Korea.

3/ See Corden (1971) Gruebel and Johnson (1971) and JIE symposium (1973) for an elaboration of these arguments.

4/ H. Johnson, Aspect of the Theory of Tariffs (1971), p. 369.

5/ The alternative ways of treating non-traded goods are discussed in Schweinberger (1976). Comparisons of partial and general equilibrium estimates are to be found in Taylor and Black (1974) and de Melo (1978).

6/ The word potential is used to recall that unless an optimum income distribution policy is maintained throughout, free trade will only be welfare increasing in the Paretian sense if it is accompanied by a suitable system of lump-sum transfers.

7/ If the elasticity of factor substitution is constant and different for the two industries, then a factor intensity reversal can occur but only once. Diagrams 4.1

and 4.2 are used in Caves and Jones (1974).

8/ In a model with one tradable and one home good, factor accumulation would lead to a change in the relative price ratio between the tradable and the home good so that the factor price ratios would change leading to a shift (in the same direction) of both factor intensity ratios O_{kx} and O_{ky}. However the results would essentially remain unaltered.

9/ See Mussa (1974) for a formal analysis.

10/ This should be intuitively obvious from the discussion of the Stolper-Samuelson theorem and from Figure 4.2.

11/ See Breecher (1974) for a detailed analysis and graphical representation.

12/ See Magee's survey (1973) for a complete discussion of factor market distortions in international trade. Note that the gaps between the rays in Figures (4.1) and (4.2) indicate respectively the difference in physical factor intensities and value factor intensities between the two sectors. With factor market distortions the rankings of sectors in terms of physical and value factor intensities may differ so that a rise in the price of X may lead to a decline in the output of X. Also the transformation curve may change curvature although Johnson (1966) has shown that it is unlikely to happen in practice. De Melo (1977b) provides CGE-based estimates of factor market distortions and a review of some empirical evidence.

13/ De Melo (1977a) surveys the different stages in the estimation of the welfare effects of trade distortions and presents some CGE-based estimates.

14/ See Johnson (1965) for a two-commodity model using a social utility function. For multi-sector examples, see Evans (1971) and de Melo (1978). De Melo discusses partial equilibrium estimates and contrasts then with those derived from a Stone-Geary utility function specified in a CGE model.

15/ This presentation comes from Caves and Jones (1974), Chapter 12 Appendix.

16/ See Pearce (1970) Chapters 13 and 14 for a detailed discussion of the use of this criterion when the economy consists of several different consumers.

17/ The following discussion is based on de Melo and Dervis (1977). Corden (1974), Chapter 10 and Findlay (1973), Chapter 8 also discuss the interaction between protection and growth.

18/ See Pattanaik (1974). He provides necessary and sufficient conditions for the opening of a country to trade to lower savings.

19/ Corden (1971) calls this relation the factor-weight effect.

20/ See for instance Malinvaud (1972) Chapter 10.

21/ It is interesting to recall the fears of specialization voiced during the negotiations for the establishment of the EEC.

It turned out that countries do not specialize as readily as one would predict on the basis of standard international trade theory.

22/ Two commodities bearing the same price are homogeneous (perfect substitutes) if when placed on a same shelf the buyer (consumer or producer) is indifferent between them.

23/ Gruebel and Lloyd (1975) found significant two-way trade even at a seven digit SITC classification level. Note, however, that two-way trade can occur even for perfectly homogeneous commodities due to transport or storage costs (e.g. gravel or electricity).

24/ A gap can only exist if a market is not allowed to clear (e.g. a fixed exchange rate) or if, as in the two-gap literature, growth rates are exogenously given from outside the model.

25/ Taylor (1973) and Michalopoulos (1975) have used the same specification in two-gap specifications. General equilibrium applications include Ali (1976), Robinson and de Melo (1976), and Dervis (1977).

26/ For a multi-country model where imports and exports are treated fully symetrically, see De Melo, Dervis, Robinson (1977).

Bibliography

Adelman, I. and S. Robinson (1978), Income Distribution Policy in Developing Countries, Stanford: Stanford University Press.

Ahmed, F. (1974), "Migration and Employment in a Multisector Model: An Application to Bangladesh," Princeton University, unpublished Ph.D. dissertation.

Aitchison, J. and J. A. C. Brown, The Lognormal Distribution, 1957, Cambridge University Press, Cambridge.

Ali, I., "Comparative Advantage and Trade Policy in a General Equilibrium Framework: A Case Study of India," unpublished Ph.D. thesis, 1976, Johns Hopkins University, Baltimore.

Armington, P. (1969), "A Theory of Demand for Products Distinguished by Place of Production," Staff Papers, Vol. 16, pp. 159-178.

Arrow, K. and F. H. Hahn, General Competitive Analysis, San Francisco: Holden-Day, 1971.

Blinder, A., Towards An Economic Theory of Income Distribution, 1975, Cambridge, Massachusetts, M.I.T. Press.

Blitzer, C., Clark, P. and L. Taylor eds., Economy Wide Models and Developing Planning, Oxford University Press, Oxford, 1975.

Breecher, R., "Minimum Wage Rates and the Pure Theory of International Trade," Quarterly Journal of Economics, 1974.

Brown, A. and A. Deaton, "Models of Consumer Behavior," Economic Journal, December, 1972.

Caves, R., and R. Jones, World Trade and Payments: An Introduction, 1974, Little Brown, Boston.

Chakravarty, S., Capital and Development Planning, 1969, M.I.T. Press, Cambridge, Massachusetts.

Champernowne, D. G., "A Model of Income Distribution," Economic Journal, #250, Vol. LXIII, June, 1953, pp. 318-351.

__________________, "A Comparison of Measures of Inequality of Income Distribution," Economic Journal, Vol. 84, No. 336, December, 1974.

Chenery, H. and Uzawa, H. (1958), "Non-Linear Programming in Economic Development." In Arrow, K., Hurwicz, L. and Uzawa, H., Studies in Linear and Non-Linear Programming. Stanford University Press.

Chenery, H. and W. J. Raduchel (1971), "Substitution in Planning Models" in H. Chenery, ed., Studies in Development Planning, Cambridge: Harvard University Press.

Corden, M. (1971), The Theory of Protection. London: Oxford University Press.

__________ (1974), Trade Policy and Economic Welfare. London: Oxford University Press.

Debreu, G. (1961), The Theory of Value

De Melo, J. (1977), "A General Equilibrium Approach to Estimating the Costs of Domestic Distortions," American Economic Review, March.

__________ (1977), "Distortions in the Factor Market: Some General Equilibrium Estimates," The Review of Economics and Statistics.

__________ (1978), "Estimating the Costs of Protection: A General Equilibrium Approach," Quarterly Journal of Economics, May.

__________ (forthcoming), "Tariffs and Resource Allocation in a Walrasian Trade Model," International Economic Review.

De Melo, J. and K. Dervis (1977), "Modelling the Effects in a Dynamic Framework," Journal of Development Economics, Vol. 4, pp. 149-72.

De Melo, J., K. Dervis and S. Robinson (1977), "A Global Model of North-South Trade and Growth," RPOS Discussion Paper No. 72, Princeton University, Princeton, March.

Dervis, K. (1975), "Substitution, Employment and Intertemporal Equilibrium in a Non-Linear Multi-Sector Planning Model for Turkey." European Economic Review, Vol. 6, pp. 77-96.

__________ (1977), "Exchange Rate Adjustment, Trade Policy and Economic Growth: Experiments with a Dynamic General Equilibrium Model of Turkey," ____ Discussion Paper 1976, Princeton University, Princeton, June.

Dervis, K. and S. Robinson (1977), "The Sources and Structure of Inequality in Turkey (1950-73)," July, mimeo.

Dorfman, R., P. Samuelson and R. Solow (1958), Linear Programming and Economic Analysis, Rand, McGraw-Hill, New York.

Evans, D. (1972), A General Equilibrium Analysis of Protection, North Holland Press.

Fei, J. and G. Ranis (1974), "Income Inequality by Additive Components," Discussion Paper 207, EGC, Yale University.

Findlay, R. E. (1974), International Trade and Development Theory, Columbia University Press, New York.

Fishlow, A. (1972), "Brazilian Size Distribution of Income," American Economic Review, Vol. 62, pp. 391-402.

Ginsburgh, V. and J. Waelbroeck (1978), "Computational Experience with a Large General Equilibrium Model," in J. Los, ed., Computing Equilibria, How and Why," Amsterdam, North-Holland.

Graaff, J. (1957), Theoretical Welfare Economics, Cambridge University Press.

Gruebel, H. and H. Johnson (1971), eds. Effective Tariff Protection, (GATT, Geneva).

Hagen, E. (1958), "An Economic Theory of Protection," Quarterly Journal of Economics.

Hahn, F. (1966), "Equilibrium Dynamics in Heterogenous Capital Models," Quarterly Journal of Economics, Vol. 80, p. 831.

Harris, J. R. and M. P. Todaro (1970), "Migration, Unemployment and Development: A Two-Sector Analysis," American Economic Review, Vol LX, No. 1, March.

Johansen, L. (1960), A Multi-Sectoral Study of Economic Growth. North-Holland, Amsterdam.

__________ (1974), A Multi-Sectoral Study of Economic Growth. North-Holland, Amsterdam, 2nd edition.

Johnson, H. (1966), "Factor Market Distortions and the Shape of the Transportation Curve," Econometrica.

__________ (1971), Aspects of the Theory of Tariffs. London: Allen and Unwin.

Jones, R. W. (1965), "The Structure of Simple General Equilibrium Models," Journal of Political Economy, Vol. 73, No. 6, pp. 557-72.

Jorgenson, D. (1963), "Capital Theory and Investment Behavior," American Economic Review, Vol. 53, pp. 247-59.

Journal of International Economics, 1973, No. 3.

Kaldor, N. (1960), "Alternative Theories of Distribution," in Essays in Value and Distribution. New York: Free Press.

Kornai, J. (1971), Anti-Equilibrium: On Economic Systems Theory and the Tasks of Research. Amsterdam: North-Holland Publishing Company.

Lysy, F. and L. Taylor (forthcoming), "A Computable General Equilibrium Model for the Functional Income Distribution: Experiments for Brazil, 1959-71," Chapters 7-10 of a forthcoming book on Brazilian growth and distribution to be edited by L. Taylor.

Magee, S. (1973), "Factor Market Distortions, Production and Trade: A Survey," Oxford Economic Papers.

Malinvaud, E. (1972), Lectures on Microeconomic Theory. Amsterdam: North Holland Publishing Company.

Mangahas, M. (1974), "A Note on Decomposition of the Gini Ratio Across Regions," Research Discussion Paper 74-2, Institute of Economic Development and Research, School of Economics, University of Philippines.

Manne, A., H. Chao and R. Wilson (1978), "Computation of Competitive Equilibria by a Sequence of Linear Programs." Stanford: Stanford University, January (mimeo).

Metcalf, C. E. (1972), An Econometric Model of the Income Distribution. Chicago: Markham Publishing Company.

Michalopoulos, C. (1975), "Production and Substitution in Two Gap Models," Journal of Development Studies, Vol. 11, No. 4, pp. 343-56, July.

Mussa, M. (1974), "Tariffs and the Distribution of Income: The Importance of Factor Specificity, Substitutability and Intensity in the Short and Long Run," Journal of Political Economy, Vol. 82, No. 6, pp. 1191-1203.

Pearce, I. F. (1970), International Trade. Norton: New York.

Pyatt, G. (1976), "On the Interpretation and Disaggregation of Gini Coefficients," The Economic Journal, Vol. 86, No. 342, pp. 243-55.

Pyatt, G. and E. Thorbecke (forthcoming), Planning for Growth, Redistribution and Employment.

Robinson, S. (1975), "Income Distribution and the Social Welfare Function," R.P.E.D. Discussion No. 52, February.

__________ (1976), "A Note on the U Hypothesis Relating Income Inequality and Economic Development," American Economic Review, June.

__________ (1976), "Income Distribution Within Groups, Among Groups, and Overall: A Technique of Analysis," Princeton University, Research Program in Development Studies, Discussion Paper No. 65, August.

Robinson, S. and K. Dervis (1977), "Income Distribution and Socioeconomic Mobility: An Approach to Distribution Planning," Journal of Development Studies, Vol. 13, No. 4, pp. 347-364, July.

Robinson, S. and J. De Melo (1976), "A Planning Model Featuring Trade, Intra-Sector Product Differentiation and Income Distribution," Research Program in Development Studies. Discussion Paper No. 69, November.

Robinson, S. and Byung-Nak Song (1972), "A Dynamic Input-Output Model of the Korean Economy," R.P.E.D. Discussion Paper No. 30, Princeton University, October.

Samuelson, P. (1953), "Prices of Factors and Goods in General Equilibrium," Review of Economic Studies.

Scarf, H. (1973), The Computation of Economic Equilibria. New Haven: Yale University Press.

Schweinberger, (1976), "Non-traded Inputs and the Theory of Effective Protection," Oxford Economic Papers.

Sen, A. K. (1973), On Economic Inequality. New York: Norton.

Stone, R. (1970), Mathematical Models of the Economy and Other Essays. London: Chapman and Hall.

Szal, R. and S. Robinson (1977), Measuring Income Inequality in C. R. Frank, Jr. and R. Webb, eds., Income Distribution: Policy Alternatives in Developing Countries. Washington: Brookings Institution.

Taylor, L. and S. Black (19), "Practical General Equilibrium Estimation of Resource Pulls under Trade Liberalization," Journal of International Economics, Vol. 4, No. 1, pp. 37-58.

Theil, H. (1967), Economics and Information Theory. Amsterdam: North-Holland Publishing Company.

Thurow, L. (1971), "The Income Distribution As a Pure Public Good," Quarterly Journal of Economics, Vol. 85.

Tinbergen, J. (1974), Lessons From the Past. Amsterdam: North-Holland Publishing Company.

United Nations Department of Economics and Public Affairs, Towards a System of Social and Demographic Statistics. New York: United Nations, ST/ESA/STAT/SER.F/18, 1975.