ESSAYS IN ECONOMIC ASPECTS OF PROTECTION

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CHAPTER 1

INTRODUCTION

Since the Second World War, the world economy has grown rapidly in terms of the volume of trade and gross world product. World trade has grown faster than gross world product and has been one of the principal stimulants to the world economy; see GATT (1987) for a further discussion.

The Australian economy seems to be an exception to the general rule. While Australia has grown steadily over the last 40 years, its performance has not fully reflected the trend of the world economy. Thus far, Australia has avoided the worst possible scenario of becoming an Argentina; nevertheless, Australia’s growth is far lower than that of its neighbours, Japan, the Republic of Korea, Taiwan, Hong Kong and Singapore. Moreover, the share of trade in GDP and Australia’s importance in world markets have both declined; see Anderson and Garnaut (1987) for more details.

A number of recent studies have analyzed the factors affecting Australia’s economic performance; see Robertson (1978), Kasper et al. (1980), Gruen (1986), FitzGerald and Urban (1987) and Dowrick and Nguyen (1987), among others. With the exception of Dowrick and Nguyen, there seems to be a consensus that Australia’s economic performance has not been satisfactory. These studies identify Australia’s poor trade performance as one of the major factors explaining her sliding economy. Contributing to the
problem is Australia's reliance on exports of primary products, the demand for which grows only slowly. In addition, Australian governments have pursued inward-looking policies such as import protection. These policies have the unintended consequences of hurting the efficient exporting sector, thus contributing to the poor trade performance. For the history of Australian import protection, see Brigden et al. (1929), Lloyd (1978) and Glezer (1982).

This thesis deals with the economic effects of protection in Australia. The effects of protection continue to be not well understood. The visible benefits and hidden costs all too often make protection politically attractive. The irony is that in almost all cases, protection is not effective in meeting its stated objectives. For instance, boosting employment in import-competing industries can be better achieved through other policies (e.g. by cutting wages or by subsidizing employment). To a first approximation, protection involves income transfers which are a zero-sum game (when we include the deadweight losses also, the net effect is negative). Consequently, when one sector receives protection, there is always the unintended outcome of hurting the unprotected sectors. This study highlights these implicit (or hidden) costs of protection.

This thesis is made up of five chapters including this introduction. Each chapter is a separate essay and self contained. Nevertheless, all chapters are interrelated in the sense that they have a common theme, viz. the implicit costs of protection. In addition, the analytical framework is closely related to that

In Chapter 2 we study the incidence of protection by surveying the literature from a cost-benefit perspective. It attempts to clarify the costs of protection in terms of factors, sectors and regions. The general finding of this chapter is that protection always has unintended effects. For example, the actual amount of protection delivered to an industry is shown to be less than the amount intended and the unprotected sectors bear the burden.

In Chapter 3 we attempt to estimate the reduction in the volume of exports due to import protection. The basic idea is that trade balance equilibrium implies that any reduction in imports due to protection concurrently causes exports to fall. We use Sjaastad's (1980) simple model of import demand and export supply. Sjaastad's empirical findings for Argentina show that about 50 percent of the decrease in Argentine trade between the 1930s and the 1970s is due to increased protection. However, when this model is applied to Australia, the results are not completely satisfactory.

Chapter 4 analyzes the transfers amongst sectors which occur as a result of protection in Australia. We find that exporters lose about 1.5 percent of GDP or $4.5 billion in 1988. Consumers gain from the lower relative prices of exportables and the government revenue from import duties (which is assumed to be redistributed back to consumers); they lose on account of the higher prices of importables. We find that on balance consumers are net beneficiaries from protection in Australia.

Finally, in Chapter 5 we examine the implications of a booming
export sector for the rest of the economy. We emphasize the parallels between the effects of a booming sector and those of trade policy. More formally, there is a duality between the quantity effects of the boom and the price effects of protection. Using an extension of the Clements and Sjaastad (1984) framework, we define the tariff-equivalent effects of a boom and present illustrative computations of their sizes. We demonstrate that a boom in a new type of export has effects on traditional exporters which are equivalent to a tariff increase; and that the export boom has effects on the import-competing sector which are the same as a tariff decrease.
CHAPTER 2

THE INCIDENCE OF PROTECTION

2.1 INTRODUCTION

As the resources of an economy are finite, any policy designed to stimulate one sector or activity must necessarily involve the imposition of a penalty on the others. To put it another way, these policies involve a reshuffling of resources, towards the protected sector or activity, away from all others. The only way to liberate resources from unprotected sectors is to impose additional taxes in one form or another on these sectors; in many cases, these taxes will not be explicit, only implicit. Consequently, there are winners and losers from all forms of government intervention.

In this chapter, we apply this simple but fundamental idea to study the effects of import protection. We do this by surveying the main strands of the literature from a cost-benefit perspective. We start in Section 2.2 with a partial equilibrium analysis which is familiar from textbooks, followed by Sections 2.3 and 2.4 in which a general equilibrium analysis of protection in the long run (when all factors are fully mobile across sectors) and in the short run (when there is some immobility), respectively, are outlined. Section 2.5 reviews the sector approach to protection, and Section 2.6 contains an empirical analysis of the regional incidence of
2.2 THE PARTIAL EQUILIBRIUM EFFECTS OF A TARIFF

The partial equilibrium approach to the analysis of the effects of a tariff originates from Marshall (1956). Although it is only a partial approach, it is still very useful as it clearly explains the economic effects of a tariff.

Corden (1957) was the first to use the now familiar partial equilibrium diagram to analyze the effects of a tariff. However, it is Johnson (1960) who demonstrated its practical applicability to the measurement of the costs of a tariff. There have been many applications of this approach to calculate the costs of protection, for example, Basevi (1968), Stern (1964) and Magee (1972). Corden (1975) surveys this research.

The approach is as follows. Figure 2.1 shows the supply curve (S) and the demand curve (D) of a good in the domestic market. Before the imposition of a tariff, the price of a good is the world price $P$. At $P$, the total consumption of the good is $OQ_0$, comprising domestic production $OQ_1$ and imports $Q_1Q_0$. Here, consumer surplus is given by $bde$, while producer surplus is $abc$.

We assume that the importing country is small, so that its actions have no effect on world prices. The imposition of a tariff of $ST$ per unit raises the initial price from $P$ to $P+T$. Due to the tariff, consumption of the good falls to $OQ_2$. The domestic production of the good increases to $OQ_3$, while imports fall to...
FIGURE 2.1
PARTIAL EQUILIBRIUM APPROACH
The loss of consumer surplus as a result of the tariff is $Q_3Q_2$. The government collects revenue equal to $gfji$ and the producers of import-competing goods gain $hgcb$ in the form of higher producer surplus (i.e. rents). As the area $hgcb$ is a transfer from consumers to producers, it is the amount remaining, $gic$, that is the production cost of the tariff. If the country had imported the amount $Q_1Q_3$ of the good instead of producing it at home, its cost would be $ciQ_3Q_1$ instead of $cgQ_3Q_1$. In this sense, the excess cost $gic$ is the production cost of the tariff. A similar analysis of netting out the transfers reveals that the area $fdj$ is the consumption cost of the tariff. The deadweight (or welfare) loss of the tariff is the sum of the two triangles $gic$ and $fdj$, which are due to the misallocation of resources.

According to this analysis, we see that a tariff has the following effects:

- The domestic price of the good increases and its consumption falls;
- Imports fall;
- Domestic production of the good increases;
- The government receives some tariff revenue;
- There is a deadweight loss to the economy as a result of the misallocation of resources.

In this partial equilibrium approach, it is the consumers who
bear the burden of protection by paying the higher internal price of the good. A partial offset to this loss is the gain to producers in the form of a higher producer surplus and the gain to the government in the form of higher revenue. But this offset is only partial, causing the tariff to have a net cost to the economy as a whole. It should be noted that if the country is really "small", foreign exporters will be indifferent to the tariff although their exports to the country fall.

2.3 A GENERAL EQUILIBRIUM ANALYSIS

One of the standard general equilibrium models of international trade is that of Heckscher and Ohlin (H-O). For a textbook presentation of the model, see Caves and Jones (1981). This model links a country's factor endowments with its pattern of trade. According to the 2×2×2 version of the model (two countries, two factors of production and two goods), a country exports the good intensive in its abundant factor. Thus, if for example the country is well endowed with land, the model predicts that it will export products such as wheat which is land intensive. Conversely, it will import products such as motor vehicles which are intensive in other factors of production.

Stolper and Samuelson (1941) analyzed the effects of a tariff on income distribution using this general equilibrium framework. They showed that the tariff hurts the abundant factor and favours the scarce factor. This is known as the Stolper-Samuelson theorem.
To prove this theorem, let there be two factors of production, labour and capital (including land); two commodities, wheat and motor vehicles; different factor intensities for the two commodities; linear homogeneous productions subject to diminishing returns; and incomplete specialization in production. Also, full employment of factors, perfect competition and perfect mobility of factors are assumed. The Stolper-Samuelson theorem can then be explained with the standard box diagram given in Figure 2.2.

The endowments of factors are measured on the horizontal and vertical axes of Figure 2.2. The contract curve $O'O'$ gives optimal allocations of factors as the pattern of production is varied. Along $O'O'$, the ratio of the marginal productivities of the two factors in wheat is equal to that in motor vehicles, so that it is not possible to increase production of one good without decreasing production of the other. In this sense, the factor combinations are optimal along the contract curve. Points on the contract curve furthest from each origin represent a greater level of production of the good which has zero production at that origin. The production of wheat is measured from the lower left-hand corner and that of motor vehicles from the upper right-hand corner. The slope of the ray from the origin to a point on the contract curve represents the factor intensity. For instance, at $F$, the capital and labour used are $ON$ and $OR$ for wheat and $O'N'$ and $O'R'$ for motor vehicles. Production of wheat at $F$ is more labour intensive than at $T$ since the ray $OF$ is steeper than $OT$. Also, with the contract curve lying below the diagonal, it indicates that wheat is the capital intensive good and motor vehicles the labour intensive
FIGURE 2.2
STOLPER-SAMUELSON'S DIAGRAM

Labour

Wheat (Exportable)

Capital
good.

Under the assumption that the country is capital abundant, the H-O model predicts that wheat (the capital intensive good) will be exported and motor vehicles (the labour-intensive good) will be imported. The imposition of an import tariff on motor vehicles stimulates domestic production of that good and attracts resources from the other sector. Hence, if F in Figure 2.2 is the free trade point, the effect of the tariff is to shift the economy down 00' in a south-westerly direction, to say T. At T, there is now greater production of motor vehicles and less production of wheat.

The movement from F to T involves both sectors becoming more capital intensive. That is, the ray OT is flatter than OF; and similarly, 0'T is flatter (with respect to the motor vehicle's origin 0') than 0'F. This means that the marginal physical productivity of labour increases in both sectors. In other words, real wages rise in terms of both goods; no matter what labour consumes, its real income has unambiguously risen.

A similar argument shows that the real income of capital unambiguously falls with the imposition of the tariff. Consequently, the tariff benefits the scarce factor (labour) and hurts the abundant factor (capital). This is the Stolper-Samuelson result.
2.4 THE TARIFF AND SHORT-RUN CAPITAL SPECIFICITY

The Stolper-Samuelson theorem refers to the long run since it allows full mobility of factors between industries. However, in the short run, some factors, especially capital, are not fully mobile. Because of this immobility, the effects of the tariff on income distribution in the short run will be different to the predictions of the Stolper-Samuelson theorem.

The diagrammatic approach in Figure 2.3 is used by Mussa (1974) to analyze these effects. The length of the horizontal axis represents the total amount of labour available in the economy and is assumed fixed. The value of the marginal product of labour (VMPL) in motor vehicles is shown on the left vertical axis, while the right axis gives the VMPL in wheat. Competition ensures that wages are equal to the VMPL, and the mobility of labour equalizes wages in the two industries. Let the initial price of motor vehicles relative to that of wheat be \( P_1 \) (which, with free trade, equals the world price ratio \( P_m^*/P_w^* \)). The curve \( VMPL_m(P_1) \) is plotted relative to the motor vehicles origin \( O_m \) and is the demand curve for labour by the motor vehicles industry. This curve is associated with the initial relative price \( P_1 \). The negative slope of \( VMPL_m(P_1) \) implies that the VMPL declines as the quantity of labour employed in motor vehicles increases. Similarly, the curve \( VMPL_w \) is drawn relative to \( O_w \) and it shows the value of the marginal product of labour in the production of wheat. This curve also shows the VMPL decreasing with increases in the quantity of labour employed in wheat. Since the total supply of labour in the
FIGURE 2.3
MUSSA'S DIAGRAM
economy is constant, the demand curve for labour in wheat is the supply curve of labour facing the motor vehicles industry. Similarly, the demand curve for labour in motor vehicles is the supply curve of labour for wheat.

With free trade, point 'a' represents equilibrium with wage rate \( W_1 \). At \( W_1 \), the motor vehicles industry uses \( Q_m L_1 \) of labour, while the wheat industry takes the rest of the labour force, \( L_1 Q_w \). The income of labour in the motor vehicles and the wheat industries are \( Q_m W_1 a L_1 \) and \( L_1 ac_0 \), respectively. The incomes of capital are \( fW_1 a \) and \( bac \), respectively. These are expressed in terms of the numéraire of the analysis, wheat.

When we impose a tariff \( t \) on the import of motor vehicles, the relative price will increase from \( P_1 \) to \( P_2 \) [\( = (1 + t)P_m/P_w \), where \( t \) is the ad valorem tariff rate and where we have assumed that world prices are constant]. Accordingly, the demand curve for labour in motor vehicles will shift up proportionately from \( VMPL_m(P_1) \) to \( VMPL_m(P_2) \). At the initial wage level, \( W_1 \), there is now an excess demand for labour from the motor vehicles industry of \( L_1 L_3 \). Ultimately, \( L_1 L_2 \) amount of labour will be drawn from the wheat industry by bidding up the wage to \( W_2 \).

The tariff on motor vehicles attracts labour from the wheat industry. Releasing labour, with the capital stock constant, will cause the marginal productivity of capital in wheat to fall. On the other hand, the inflow of additional labour into motor vehicles, with the usage of capital constant, causes the marginal productivity of labour to fall in that sector. The increased employment of labour in motor vehicles will increase the return to
capital in motor vehicles, while the return to capital in wheat falls. The total income of capital employed in wheat is lowered from $bac$ to $bed$ in Figure 2.3. Consequently, the loss of income (in terms of wheat) to capital employed in wheat due to the tariff is edca. The gain in income (in terms of wheat) to capital in the motor vehicles industry is $geW_2 - faW_1$. The income to capital in motor vehicles in terms of motor vehicles increases as the marginal productivity of capital has risen. Also, the income to capital in motor vehicles in terms of wheat rises as the price of wheat remains constant. Consequently, the real income of the owners of capital in motor vehicles increases unambiguously; i.e. the change in their real income is independent of what they consume.

The real income of capital employed in wheat also falls unambiguously in terms of both goods. Firstly, there is the fall in the marginal productivity of capital in wheat due to the outflow of labour to the motor vehicles industry. Hence, the real return to capital (the marginal physical product) in wheat in terms of wheat falls. Secondly, the price of motor vehicles increases due to the tariff, causing the real income of capital in wheat in terms of motor vehicles to fall. However, it can be shown that the fall in income to capital in wheat in terms of motor vehicles is larger than the fall in terms of wheat.

Since we assume that labour is fully mobile in a perfectly competitive market, the one wage level will prevail in both industries. The real wage in terms of wheat has risen from $W_1$ to $W_2$ in Figure 2.3. The increasing marginal productivity of labour in wheat and the constant price of wheat are the reasons for the
rise in the real wage in terms of wheat. However, wages in terms of motor vehicles falls as the marginal productivity of labour in that industry falls with the expansion of the industry. Thus, the net position of labour is dependent on its consumption pattern. For example, if labour consumes relatively more motor vehicles than wheat, then it would be worse off with the tariff. Table 2.1 summarizes the changes in real incomes resulting from the tariff.

Unlike the Stolper-Samuelson theorem which allows full mobility of capital, we reach different conclusions here. Table 2.2 compares the changes in the real income of factors in the short run (from the above analysis) and long run (from the Stolper-Samuelson theorem) resulting from the imposition of the tariff on motor vehicles. In the long run, labour (the scarce factor) gains and capital loses unambiguously. In the short run, however, the real income of the immobile factor (capital) depends on what happens to the industry in which it is located. Thus, as a consequence of protection, the real income of capital in the protected industry (i.e. motor vehicles) increases, while that in the unprotected industry declines. In addition, the real income of labour is now dependent on consumption patterns; in other words, it is now an index number problem.
TABLE 2.1
CHANGES IN REAL INCOMES AS A RESULT OF AN IMPORT TARIFF
IN THE SHORT RUN

<table>
<thead>
<tr>
<th>Real Income in Terms of</th>
<th>Motor vehicles</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital in Motor Vehicles (Import-competing)</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Capital in Wheat (Export industry)</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Labour</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>

TABLE 2.2
CHANGES IN REAL INCOMES AS A RESULT OF AN IMPORT TARIFF
IN THE SHORT AND LONG RUN

<table>
<thead>
<tr>
<th>Length of Run</th>
<th>Short Run (Capital immobile)</th>
<th>Long Run (Capital mobile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>↑ in motor vehicles</td>
<td>↓</td>
</tr>
<tr>
<td>Labour</td>
<td>↓ in wheat</td>
<td>↑</td>
</tr>
<tr>
<td></td>
<td>? (index number problem)</td>
<td>↑</td>
</tr>
</tbody>
</table>

Motor vehicles are importable and are relatively labour intensive.
2.5 SJAASTAD AND CLEMENTS' MODEL

In a series of papers, Sjaastad (1979), Sjaastad (1980), Sjaastad and Clements (1981), and Clements and Sjaastad (1984) developed a simple general equilibrium model which explores the ultimate effects of protection on the various economic sectors. Unlike the previous analyses, which investigated the effects of protection on the welfare of economic factors, Sjaastad and Clements dealt with the effects on different sectors.

The economy is divided into three sectors, namely, home goods (or non-traded goods), importables and exportables. Suppose we have a structure of protection such that the uniform tariff equivalent is 100 percent. This raises the internal price of importables and shifts demand away from importables toward home goods and exportables. On the other hand, producers now find it advantageous to produce more importables, so that the production of home goods and exportables are likely to decline relative to importables. However, Clements and Sjaastad implicitly assumed that there is no substitution between exportables and importables in consumption and production. Consequently, the reduction in the supply of and the increase in the demand for home goods results in an upward pressure on the price of home goods. The effect of the tariff is thus to inflate the price of home goods. Suppose that the price of home goods rises by 70 percent following the imposition of the 100 percent tariff. Assuming that the country is too small to affect world prices, the domestic price of importables relative to the price of exportables rises by the full amount of
the tariff (100 percent) as the nominal price of exportables remains unchanged. However, the internal price of importables has risen by about 30 percent (= 100 - 70) relative to home goods, while the internal price of exportables has fallen by about 70 percent relative to home goods.

Although the tariff in the above example is nominally paid by importers, the resulting change in relative prices is such that, in effect, 70/100 or about 70 percent of the protection is an implicit tax on exports. Only the remaining 30 percent is an implicit subsidy to domestic producers of importables. 70 percent of the tariff is perceived by exporters as a reduction in their purchasing power over home goods; and the income generated in the import-competing sector has increased by only 30 percent in terms of its purchasing power over home goods. Thus, it is the export sector which bears the bulk of the burden of protection given to the import-competing industries in this example. This burden on exporters will take the form of increasing costs. These cost increases take the form of higher wages and other costs tied to home goods, exchange rate appreciation and higher costs of imported inputs.

True protection is defined as the tariff-induced rise in the internal price of importables relative to home goods. This measures the ultimate position of firms in the import-competing sector as a result of protection. In the above example, true protection is 30 percent. Clearly, true protection is far less than the nominal rate of protection (100 percent) as the increase in the cost of home goods erodes much of the initial beneficial
effects of protection for the import-competing sector. As home goods are mostly labour-intensive services, as an approximation we can identify the price of home goods with wages. Consequently, in the above example, the 100 percent tariff causes wages to increase by 70 percent.

The extent to which the price of home goods rises obviously depends on substitutability in consumption and production. When importables and home goods are close substitutes in demand and production, there can only be a small change in the internal price of importables relative to home goods. The major effect of the tariff on relative prices will be to reduce the internal price of exportables relative to both importables and home goods. In this situation, the burden of the import protection is borne almost entirely by the exporters. Protection acts in exactly the same way as would an export tax.

On the other hand, if exportables and home goods are close substitutes in demand and production, the tariffs will increase the internal price of importables relative to both exportables and home goods, granting protection to the import-competing activities at the expense of both home goods and exportables. In this case, the burden is shared by the exporters and the home goods sector. Therefore, the shifting of protection, or of the incidence of protection, depends on the substitutability amongst importables, exportables and home goods.

Figure 2.4, which is from Clements and Sjaastad (1984), demonstrates the basic mechanism whereby tariffs act as an export tax. The import demand and the export supply curves are
FIGURE 2.4
SJAASTAD-CLEMENTS' DIAGRAM

Relative Price of Exportables

Relative Price of Importables

Exports

Imports

IV

H

M

I

D'

D

D''

P^0(1+t)/P_h

P^0/Ph

M_1

M_2

M_0

X

X_1

X_2

X_0

B''

B'

B

P^0/P^0_e

P^0/P^0_e

45°
illustrated in quadrants I and III, respectively. The 45° ray in quadrant II represents trade balance equilibrium - the combinations of exports and imports which yield balanced trade. The line labelled HH in quadrant IV is known as the home goods schedule. It represents combinations of the prices of exportables and importables (both in terms of home goods) which clear the home goods market.

Before the imposition of a tariff, the initial prices of imports and exports are \( \frac{P_m^0}{P_h^0} \) and \( \frac{P_e^0}{P_h^0} \), which are associated with imports of \( M_0 \) and exports of \( X_0 \), respectively. Since imports \( M_0 \) and exports \( X_0 \) meet at the point B on the 45° ray in quadrant II, trade balance is in equilibrium. Assuming income is equal to expenditure, Walras' law implies that the 45° line also represents equilibrium in the home goods market. Given the initial equilibrium prices \( \frac{P_m^0}{P_h^0} \) and \( \frac{P_e^0}{P_h^0} \), the point D on the HH schedule corresponding to these prices is a point which clears the home goods market. In quadrant II, all points below the 45° line represent a trade surplus while all points above the line represent a trade deficit. Similarly, all points above the HH schedule such as D', which corresponds to B' in quadrant II, represent a surplus, while points below the HH schedule represent a trade deficit.

Now suppose the country imposes a tariff of rate \( t \) on imports. This initially raises the relative price of imports from \( \frac{P_m^0}{P_h^0} \) to \( \frac{P_m^0(1+t)}{P_h^0} \). Imports decrease from \( M_0 \) to \( M_1 \). As the relative price of exports is initially constant (at \( \frac{P_e^0}{P_h^0} \)), the volume of exports is also unchanged. Accordingly, the fall in imports has the effect
of generating a surplus in the balance of trade. This is represented by the point $B'$ in quadrant II of Figure 2.4. In other words, there is an excess supply of traded goods. This excess supply corresponds to an excess demand for non-traded goods, represented by the point $D'$ in quadrant IV.

To eliminate the excess demand for home goods, their relative price will have to rise. Suppose the price of home goods rises from $P_h^0$ to $P_h^1$. As a result, the relative prices of imports and exports fall from $P_m^0(1+t)/P_h^0$ and $P_e^0/P_h^0$ to $P_m^0(1+t)/P_h^1$ and $P_e^0/P_h^1$, respectively. This reduces exports from $X_0$ to $X_2$, while imports rise from $M_1$ to $M_2$. These changes bring the economy back to equilibrium again as represented by the point $B''$ lying on the 45° line in quadrant II. This point corresponds to $D''$ on the home goods schedule in quadrant IV.

The fall in the relative price of exports resulting from the imposition of the tariff is the way in which protection taxes exporters. Sjaastad and Clements (1981) found that for a number of countries, the elasticity of this relative price with respect to the internal relative price of importables is consistently larger than .5. In other words, more than half of the burden of protection is borne by the exporting sector.

We shall return to this model in Chapters 4 and 5 where it will be applied to the Australian case.
2.6 REGIONAL ASPECTS OF THE INCIDENCE OF PROTECTION

Since each of the six states in Australia have different economic structures, the effects of protection will not be identical for each state. In this section, we review simulation results from the ORANI model of the Australian economy relating to the regional effects of protection; see Dixon et al. (1982) for details of ORANI.

(i) The National Effects

Table 2.3, which is from Dixon et al. (1979), shows the effects of a 25 percent tariff increase on the Australian economy. As can be seen, protection causes the consumer price index and the capital goods price index to rise. These price rises cause the cost of inputs used in all industries to increase. Assuming that there is 100 percent wage indexation based on the consumer price index, the higher cost of living raises wages. The export sector, which is unable to pass on these cost increases, experiences a contraction. Thus, aggregate exports as well as imports fall as a result of the tariff increase. Exports and imports both fall by 1.9 percent, so that the tariff has a negligible effect on the balance of trade.

Note also from Table 2.3 that the tariff has little effect on aggregate employment. These results show that the tariff only affects the distribution of jobs: it redistributes employment away from the unprotected industries to the protected ones. Thus, the
### TABLE 2.3
THE NATIONAL EFFECTS OF A 25 PERCENT TARIFF INCREASE

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate Employment</td>
<td>-.001</td>
</tr>
<tr>
<td>Employment by Occupation</td>
<td></td>
</tr>
<tr>
<td>Professional White Collar</td>
<td>-.029</td>
</tr>
<tr>
<td>Skilled White Collar</td>
<td>.073</td>
</tr>
<tr>
<td>Semi and Unskilled White Collar</td>
<td>.021</td>
</tr>
<tr>
<td>Skilled Blue Collar (Metal and Electrical)</td>
<td>.251</td>
</tr>
<tr>
<td>Skilled Blue Collar (Building)</td>
<td>.107</td>
</tr>
<tr>
<td>Skilled Blue Collar (Other)</td>
<td>.189</td>
</tr>
<tr>
<td>Semi and Unskilled Blue Collar</td>
<td>.101</td>
</tr>
<tr>
<td>Rural Workers</td>
<td>-.986</td>
</tr>
<tr>
<td>Armed Services</td>
<td>.000</td>
</tr>
<tr>
<td>Aggregate Exports (foreign currency value)</td>
<td>-1.863</td>
</tr>
<tr>
<td>Aggregate Imports (foreign currency value)</td>
<td>-1.899</td>
</tr>
<tr>
<td>Balance of Trade</td>
<td>.010*</td>
</tr>
<tr>
<td>Index of Consumer Prices</td>
<td>1.641</td>
</tr>
<tr>
<td>Capital Goods Price Index</td>
<td>2.232</td>
</tr>
</tbody>
</table>

* Units: billions of 1968-69 Australian dollars.

Source: Dixon et al. (1979, p. 20).
types of labour used intensively in protected industries (e.g. Metal and Electrical labour) gains at the expense of labour employed in exporting industries (e.g. rural workers).

(ii) The Regional Effects

Column (2) of Table 2.4 illustrates the effects on employment in each state resulting from the 25 percent tariff increase. Columns (3) and (4) give the net subsidy equivalents (NSE) per capita for the Manufacturing and Agriculture sectors in each state. The NSE is the money equivalent of the effective rate of assistance given to an industry. As can be seen, the NSE per capita in Victoria for the manufacturing and agricultural sectors are $619 and $53, respectively.

It is to be noted that the NSE's differ greatly across states. These disparities reflect differences in the structure of the state economies. The Western Australian, Queensland and Tasmanian economies have a concentration of activities in the agricultural and mineral sectors which are generally export-oriented and receive low levels of protection. By contrast, Victoria and South Australia rely heavily on import-competing manufacturing industries such as transport equipment and textiles. The New South Wales economy is highly diversified and comprises virtually all import-competing and export industries; no one industry dominates. The 25 percent tariff increase delivers the largest employment gains to the most highly protected states, Victoria and South Australia. On the other hand, the less protected states such as
TABLE 2.4
EMPLOYMENT EFFECTS AT THE STATE LEVEL OF A 25 PERCENT
TARIFF INCREASE AND NET SUBSIDY EQUIVALENTS

<table>
<thead>
<tr>
<th>State</th>
<th>Percentage Change In Employment</th>
<th>Manufacturing 1982-83</th>
<th>Agriculture 1983-84</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>NSW (incl. ACT)</td>
<td>.06</td>
<td>387</td>
<td>37</td>
</tr>
<tr>
<td>Vic</td>
<td>.53</td>
<td>619</td>
<td>53</td>
</tr>
<tr>
<td>Qld</td>
<td>-.70</td>
<td>224</td>
<td>56</td>
</tr>
<tr>
<td>SA (incl. NT)</td>
<td>.25</td>
<td>413</td>
<td>52</td>
</tr>
<tr>
<td>WA</td>
<td>-.60</td>
<td>227</td>
<td>44</td>
</tr>
<tr>
<td>Tas</td>
<td>-.22</td>
<td>241</td>
<td>52</td>
</tr>
<tr>
<td>Australia</td>
<td>.05*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The minor difference between Table 2.3 and Table 2.4 for Australian employment is due to different weighting schemes.

Source: Column (2) is from Dixon et al. (1979, p. 34) and columns (3) and (4) are from Economic Planning Advisory Council (1986, p. 17).
Queensland and Western Australia experience job losses.

Table 2.5 analyses the regional effects of protection from a slightly different perspective. This table, from Economic Planning Advisory Council (1986), shows the effects on industry outputs by state of (i) a 20 percent across-the-board tariff cut; and (ii) sectorial plans. The sectorial plans involve a gradual reduction of assistance to the passenger motor vehicles and the textiles, clothing and footwear industries. As shown in the last row of Table 2.5, Victoria is the only state to lose from the tariff cut in terms of reduced Gross State Product. Note, however, that the gains to the other states outweigh Victoria's loss; this is reflected in Australia's GDP increasing as a result of the tariff cut. Consequently, the Victorians could be compensated for their losses by the other states.

As would be expected, the tariff cut causes the outputs of Agriculture and Mining to increase. On the other hand, the outputs of the heavily protected manufacturing industries of textile, Clothing and Footwear, Motor vehicles and Transport Equipment, fall. Note also that the output of Services in Victoria fall, while in the rest of Australia, it increases.

Taken as a whole, the results in this section confirm the previous sector approach by showing that the exporting states are disadvantaged by the protection of the import-competing industries.
TABLE 2.5
OUTPUT EFFECTS OF A 20 PERCENT ACROSS-THE-BOARD TARIFF CUT PLUS SECTORAL PLANS
(percentage change)

<table>
<thead>
<tr>
<th>Sector</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NSW</td>
</tr>
<tr>
<td>Agriculture, forestry and fisheries</td>
<td>3.0</td>
</tr>
<tr>
<td>Mining</td>
<td>3.3</td>
</tr>
<tr>
<td>Manufacturing:</td>
<td></td>
</tr>
<tr>
<td>- Textiles, clothing and footwear, motor-vehicles and transport equipment</td>
<td>-5.8</td>
</tr>
<tr>
<td>- Other manufacturing</td>
<td>1.1</td>
</tr>
<tr>
<td>- Total manufacturing</td>
<td>.2</td>
</tr>
<tr>
<td>Services</td>
<td>.2</td>
</tr>
<tr>
<td>Gross State Product/Gross Domestic Product</td>
<td>.4</td>
</tr>
</tbody>
</table>

Notes: NSW includes ACT and SA includes NT.

CHAPTER 3

PROTECTION, THE VOLUME OF TRADE
AND RELATIVE PRICES

3.1 INTRODUCTION

It is a well known fact that the effect of import protection is to rob Peter to pay Paul. Not only do import tariffs, quotas and the like reduce imports, they also decrease the country's exports. The reason is that the trade balance represents the excess of output over total expenditure (or absorption) and there can be absolutely no presumption that protection (which changes relative commodity prices) has any systematic effect on the relation between income and expenditure. Consequently, if protection reduces imports, it must also reduce exports. In other words, import protection is an export tax.

In this chapter, we present a model of the effects of protection on the volume of trade, both imports and exports. A previous application of that model to Argentina, reviewed in this chapter, reveals that about 50 percent of the reduction in that country's trade over the last four decades is due to Argentine protection. In other words, about half the decline in Argentine exports has been self-inflicted. This is a startling result.

In this chapter, we also apply this model to Australia. Although the structure of the Australian economy is similar to that
of Argentina in many ways (exports from both countries are mainly primary products and both have pursued import-replacement policies), the results for Australia are much less satisfactory than those for Argentina. Future research could analyze why Australia is different in this respect.

This chapter also contains empirical results regarding the effects of import protection on the internal structure of relative prices in the two countries. The results show that in both countries, protection has a large impact on the price of home (or non-traded) goods. Since home goods are mainly services which tend to be labor-intensive, as an approximation, we can identify the price of home goods with wages. Consequently, a major way in which the protection tax is transmitted to exporters in Australia and Argentina is by inflating wages (and other costs) in general.

3.2 SJAASTAD'S MODEL

The following model is based on Sjaastad (1980). The model is a general equilibrium one with three broad classes of goods: exportables, importables and home goods. In what follows, we set out (i) the structural import demand and export supply equations; (ii) the reduced form versions of these equations; and (iii) an interpretation of the equations.
(i) The Structural Import Demand and Export Supply Equations

Import demand is the excess demand for importables, and depends on the two relative prices $p_1 = p_m/p_e$ and $p_2 = p_h/p_e$, where $p_m$ is the internal price of importables, $p_e$ is the internal price of exportables and $p_h$ is the price of home goods. The demand for imports also depends on aggregate real production $y$ and the aggregate real expenditure $y_e$. The demand function is assumed to be linear in logarithms, and the logarithm of a variable will be denoted in upper case (e.g. $M = \ln m$, where $m$ is a quantum index of imports). Omitting the error term for simplicity, the import demand function is thus specified as

$$M = \alpha + \beta P_1 + \gamma P_2 + \eta Y_e + \varepsilon Y.$$  (3.1)

Similarly, the export supply function (the excess supply of exportables) is specified as

$$X = \alpha' + \beta' P_1 + \gamma' P_2 + \eta' Y_e + \varepsilon' Y.$$  (3.2)

The coefficients $\eta$ and $\varepsilon$ in equation (3.1) are expected to be positive and negative, respectively. In other words, part of an increase in expenditure will be devoted to importables, increasing the excess demand thereof; and at least part of an increase in aggregate real output can be expected to appear in the form of greater domestic production of importables. Similarly, $\eta'$ and $\varepsilon'$ in equation (3.2) are expected to be negative and positive,
respectively.

Since we define $P_1$ as $\ln(p_m/p_e) = (P_m - P_e)$ and $P_2$ as $\ln(p_h/p_e) = (P_h - P_e)$, we can calculate the relevant substitution effects as follows:

$$
\frac{\partial M}{\partial P_m} = \beta \leq 0; \quad \frac{\partial M}{\partial P_h} = \gamma \geq 0
$$

$$
\frac{\partial M}{\partial P_e} = -\beta - \gamma \geq 0; \quad \text{which implies } |\beta| \geq \gamma,
$$

$$
\frac{\partial X}{\partial P_e} = -\beta' - \gamma' \geq 0; \quad \frac{\partial X}{\partial P_h} = \gamma' \leq 0
$$

$$
\frac{\partial X}{\partial P_m} = \beta' \leq 0.
$$

The expected signs reflect the assumption of no complementarity.

When the home goods market is in equilibrium, aggregate real expenditure $y_e$, can be defined as follows:

$$
(3.3) \quad y_e = y + (m' - x'),
$$

where $m'$ and $x'$ are the respective values of imports and exports in domestic currency but at external prices (before tariffs and subsidies). Therefore, $(m' - x')$ is the trade balance measured in domestic currency. By definition,

$$
(3.4) \quad Y_e = \ln(y + m' - x')
$$

$$
= \ln(y + m' - x') - \ln y + \ln y
$$

$$
= Y + \ln\{y + m' - x')/y\}
$$

$$
= Y + \ln\{1 + (m' - x')/y\}
$$

$$
= Y + (m' - x')/y
$$

$$
= Y + BT,
$$
where $BT = (m' - x')/y$ is the trade balance expressed as a fraction of GDP; and the second last step follows from $\ln(1 + x) \approx x$ for small $x$.

By substituting (3.4) into (3.1) and (3.2), we obtain

\begin{align*}
(3.1') & \quad M = a + \beta P_1 + \gamma P_2 + (\eta + \epsilon)Y + \eta(BT) \\
(3.2') & \quad X = a' + \beta' P_1 + \gamma' P_2 + (\eta' + \epsilon')Y + \eta'(BT).
\end{align*}

Equations (3.1') and (3.2') are the import demand and export supply equations, respectively, when the home goods market is in equilibrium.

(ii) The Reduced Form Import Demand and Export Supply Equations

If we subtract (3.2') from (3.1') and rearrange it, we obtain the following equation:

\begin{equation}
(3.5) \quad P_2 = k_1 + \left[\frac{\beta' - \beta}{\gamma - \gamma'}\right] P_1 + \left[\frac{1}{\gamma - \gamma'}\right] (M - X) + \left[\frac{\eta' + \epsilon' - \eta - \epsilon}{\gamma - \gamma'}\right] Y + \left[\frac{\eta' - \eta}{\gamma - \gamma'}\right] BT,
\end{equation}

where $k_1 = (a' - a)/(\gamma - \gamma')$ is a constant. The symmetry condition $\partial M/\partial P_e = -\partial X/\partial P_m$ implies $\beta' - \beta = \gamma$. The absence of complementarity means $\gamma' < 0$ and $\gamma > 0$, so the coefficient of $P_1$ in (3.5) is

$$\frac{\beta' - \beta}{\gamma - \gamma'} = \frac{\gamma}{\gamma - \gamma'}.$$
which clearly lies between zero and unity. This coefficient is what Sjaastad and Clements (1981) call \( \omega \), the shift coefficient.

To eliminate \( P_2 \) from (3.1') and (3.2'), we substitute (3.5) into (3.1') and (3.2') to obtain

\[
(3.6) \quad M = k_2 + A_1 P_1 + A_2 Y + A_3 (B T) + A_4 (M - X)
\]

\[
(3.7) \quad X = k_3 + B_1 P_1 + B_2 Y + B_3 (B T) + B_4 (M - X)
\]

where \( k_2 \) and \( k_3 \) are constants and

\[
A_1 = \frac{\beta' \gamma - \beta \gamma'}{\gamma - \gamma'};
\]

\[
A_2 = \frac{\gamma(\eta' + \epsilon) - \gamma' (\eta + \epsilon)}{\gamma - \gamma'};
\]

\[
A_3 = \frac{\eta' \cdot \gamma'}{\gamma' - \gamma'};
\]

\[
A_4 = \frac{\gamma}{\gamma - \gamma'};
\]

\[
B_1 = A_1;
\]

\[
B_2 = A_2;
\]

\[
B_3 = A_3; \text{ and}
\]

\[
B_4 = A_4 - 1.
\]

Equations (3.6) and (3.7) represent the reduced form of the model, which expresses import demand and export supply in terms of
the exogenous variables. Note that since the coefficients are either identical or characterized by simple cross-equation constraints, equations (3.6) and (3.7) are not independent. It should be noted that in those equations, the two variables \((M - X)[= \ln m - \ln x = \ln(m/x)]\) and BT are different. The variable \((M - X)[= \ln(m/x) = \ln(1 + (m - x)/x) \approx (m - x)/x]\) is a version of trade balance measured as a quantum index, whereas \(BT = (m' - x')/y\) is measured in value terms. In addition, BT is deflated by income whereas \((M - X)\) by a quantum index of exports.

(iii) Interpretation of the Coefficients of the Reduced Form Equations

Since we are assuming the absence of complementarity between tradeables and non-tradeables, the denominator of all the \(A_i\) and \(B_i\) coefficients, \((\gamma - \gamma')\), is non-negative. Hence the numerators determine the signs of the coefficients.

The numerator of the coefficient of \(A_1\) in (3.6) is \(\beta'\gamma - \beta\gamma'\). Since no complementarity is assumed, both \(\beta'\) and \(\beta\) are negative. Furthermore, as \(\gamma' \leq 0\) and \(\gamma \geq 0\), it follows that the numerator \((\beta'\gamma - \beta\gamma')\) is negative. Thus, \(A_1 < 0\), implying that an increase in the price of importables in terms of exportables discourages the demand for imports.

The sign of the income coefficient \(A_2\) (similarly \(B_2\)) is not evident. Although we expect that \(\eta > 0\), \(\epsilon < 0\), \(\eta' < 0\) and \(\epsilon' > 0\), we are unable to sign \((\eta' + \epsilon')\) and \((\eta + \epsilon)\). Turning to \(A_3\) (similarly \(B_3\)), this coefficient is a weighted average of \(\eta\) and \(\eta'\).
As $\eta'$ and $\eta$ have opposite signs, the signs of the coefficients of the DT variable are indeterminate. Finally, the coefficient $A_4$ is expected to be positive as $\gamma = \partial M / \partial P_r > 0$.

3.3 PROTECTION AND THE VOLUME OF TRADE IN ARGENTINA

Sjaastad (1980) uses various forms of equation (3.7) with and without a lagged dependent variable to analyze the effects of protection on the volume of trade in Argentina. The inclusion of the lagged dependent variable is to test for the possibility of slow adjustment. In this section, we present an overview of his results.

(i) The Initial Trade Function

The initial ordinary least squares estimates of equation (3.7) are shown in Table 3.1. The coefficient of the relative price $P_1$ has the expected negative sign and is significant for each equation presented in the table. The elasticity of trade with respect to $P_1$ is estimated at approximately -.35 (the average of the six values of the coefficient given in Table 3.1). This implies that a 10 percent uniform tariff, for example, will reduce the physical volume of trade in Argentina by about 3.5 percent.

The coefficients of the income variable range from 1/3 to 2/3, and are significantly different from zero and unity. These indicate that trade grows with output, but less than
### TABLE 3.1

THE ARGENTINE TRADE FUNCTION, 1935-79

\[ X = \text{CONSTANT} + B_1P_1 + B_2Y + B_3(BT) + B_4(M - X) + B_5X_{-1} \]

<table>
<thead>
<tr>
<th>Eq.</th>
<th>( P_1 )</th>
<th>( Y )</th>
<th>( BT )</th>
<th>( M - X )</th>
<th>( X_{-1} )</th>
<th>( R^2 )</th>
<th>( DW )</th>
<th>Durbin's h</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1.1)</td>
<td>-0.492</td>
<td>0.637</td>
<td>-</td>
<td>-0.654</td>
<td>-</td>
<td>0.77</td>
<td>0.49</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(4.91)</td>
<td>(10.29)</td>
<td>(7.59)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.2)</td>
<td>-0.429</td>
<td>0.647</td>
<td>5.09</td>
<td>-</td>
<td>-</td>
<td>0.75</td>
<td>0.54</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(4.21)</td>
<td>(9.95)</td>
<td>(6.98)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.3)</td>
<td>-0.495</td>
<td>0.657</td>
<td>-0.432</td>
<td>-0.706</td>
<td>-</td>
<td>0.77</td>
<td>0.49</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(4.78)</td>
<td>(10.08)</td>
<td>(2.01)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.4)</td>
<td>-0.245</td>
<td>0.342</td>
<td>-</td>
<td>-0.431</td>
<td>0.543</td>
<td>0.89</td>
<td>1.66</td>
<td>1.37</td>
</tr>
<tr>
<td></td>
<td>(3.08)</td>
<td>(5.16)</td>
<td>(6.23)</td>
<td></td>
<td>(6.31)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.536)</td>
<td>(0.748)</td>
<td>(0.943)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.5)</td>
<td>-0.200</td>
<td>0.321</td>
<td>3.32</td>
<td>-</td>
<td>0.581</td>
<td>0.88</td>
<td>1.77</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>(2.48)</td>
<td>(4.66)</td>
<td>(5.62)</td>
<td></td>
<td>(6.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.477)</td>
<td>(0.766)</td>
<td>(7.92)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1.6)</td>
<td>-0.253</td>
<td>0.346</td>
<td>-1.281</td>
<td>-0.583</td>
<td>0.537</td>
<td>0.89</td>
<td>1.67</td>
<td>1.36</td>
</tr>
<tr>
<td></td>
<td>(3.10)</td>
<td>(5.14)</td>
<td>(2.05)</td>
<td></td>
<td>(6.11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.546)</td>
<td>(0.747)</td>
<td>(-2.76)</td>
<td></td>
<td>(-1.26)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T ratios are given in the first set of parentheses and long-run values in the second.
proportionately. In addition, the estimates of the long-run elasticity of trade with respect to income are substantially higher than the corresponding short-run elasticities where a lagged dependent variable has been added (equations 1.4-1.6).

The coefficients of \((M - X)\) and BT show mixed results. When both variables appear in the equation, the BT coefficient is not significant, whereas the coefficient of \((M - X)\) retains its significance. When they appear alone, both are highly significant, indicating the existence of multicollinearity.

(ii) An Alternative Trade Function

To test for a nonlinear relationship between \(X\) and \(P_1\), a squared price term is added to the equation to give

\[
X = \text{constant} + B_1 P_1 + B_1'(P_1)^2 + B_2 Y + B_3 BT + B_4 (M - X) + B_5 X_{-1}.
\]

The OLS results are shown in Table 3.2. Note that the squared term is always significant, indicating the importance of the nonlinearity.

The elasticity of trade with respect to the relative price \(P_1\) is now \(\frac{\partial X}{\partial P_1} = B_1 + 2B_1' P_1\). As the estimates of \(B_1\) are negative and those of \(B_1'\) positive, it follows that the elasticity declines (in absolute value) as \(P_1\) rises; that is, as more barriers to trade are imposed, the proportionate effect on the volume of trade declines. This is a highly plausible result.
### Table 3.2

**An Alternative Argentine Trade Function, 1935 - 79**

\[ X = \text{CONSTANT} + B_1 P_1 + B_1 (P_1)^2 + B_2 Y + B_3 (DT) + B_4 (M - X) + B_5 X_{-1} \]

<table>
<thead>
<tr>
<th>Eq.</th>
<th>( P_1 )</th>
<th>((P_1)^2)</th>
<th>( Y )</th>
<th>( DT )</th>
<th>((M - X))</th>
<th>( X_{-1} )</th>
<th>( R^2 )</th>
<th>( DW )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2.1)</td>
<td>.566 (6.00)</td>
<td>.593 (3.20)</td>
<td>.683 (11.83)</td>
<td>-</td>
<td>-577 (7.09)</td>
<td>-</td>
<td>.82</td>
<td>.70</td>
</tr>
<tr>
<td>(2.2)</td>
<td>.519 (5.61)</td>
<td>.679 (3.67)</td>
<td>.700 (11.92)</td>
<td>4.52</td>
<td>-</td>
<td>-</td>
<td>.81</td>
<td>.73</td>
</tr>
<tr>
<td>(2.3)</td>
<td>.549 (5.79)</td>
<td>.613 (3.21)</td>
<td>.688 (11.64)</td>
<td>1.32</td>
<td>-416 (1.27)</td>
<td>-</td>
<td>.81</td>
<td>.70</td>
</tr>
<tr>
<td>(2.4)</td>
<td>-305 (3.73)</td>
<td>.304 (2.05)</td>
<td>.404 (5.73)</td>
<td>-</td>
<td>.415 (6.21)</td>
<td>.478 (6.87)</td>
<td>.90</td>
<td>1.67</td>
</tr>
<tr>
<td>(2.5)</td>
<td>-276 (3.33)</td>
<td>.356 (2.33)</td>
<td>.396 (5.45)</td>
<td>3.24</td>
<td>-</td>
<td>.499 (5.49)</td>
<td>.89</td>
<td>1.71</td>
</tr>
<tr>
<td>(2.6)</td>
<td>-306 (3.68)</td>
<td>.299 (1.95)</td>
<td>.404 (5.66)</td>
<td>-357 (.16)</td>
<td>.458 (1.62)</td>
<td>.477 (6.87)</td>
<td>.90</td>
<td>1.68</td>
</tr>
</tbody>
</table>

See notes to Table 3.1.
Using equations (2.4) and (2.5) of Table 3.2, the long-run elasticities of trade with respect to $P_1$ are:

Trade elasticity implied by eq (2.4) = $-0.584 + 1.164P_1$ and
Trade elasticity implied by eq (2.5) = $-0.551 + 1.422P_1$.

To evaluate these expressions, Sjaastad uses averages of $P_1$ at the beginning and end of the period:

<table>
<thead>
<tr>
<th>Year</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935 - 39</td>
<td>-0.508</td>
</tr>
<tr>
<td>1970 - 79</td>
<td>0.174</td>
</tr>
</tbody>
</table>

Using these values in the above two equations, we obtain

<table>
<thead>
<tr>
<th>Year</th>
<th>1935 - 39</th>
<th>1970 - 79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade elasticity implied by eq (2.4)</td>
<td>-1.175</td>
<td>-0.381</td>
</tr>
<tr>
<td>Trade elasticity implied by eq (2.5)</td>
<td>-1.273</td>
<td>-0.304</td>
</tr>
</tbody>
</table>

Thus in the 1930s, the volume of trade was highly responsive to change in commercial policy, with the elasticity in excess of unity. By the 1970s however, this elasticity had fallen by a factor of about 3 with the erection of protective policies. Note
that the average elasticity in Table 3.1, \(-0.35\), is quite close to the above elasticities for the 1970s.

(iii) Implications for Commercial Policy

If commercial policy causes \(P_1\) to change by \(\Delta P_1 = (P_1)_1 - (P_1)_0\), then from the alternative trade function, the change in exports is

\[
\Delta X = B_1(\Delta P_1) + B_1'(\frac{(P_1)_1^2}{2} - \frac{(P_1)_0^2}{2}).
\]

Using the above averages of \(P_1\), \(-0.508\) and \(0.174\), as \((P_1)_0\) and \((P_1)_1\), respectively, in (3.8), together with the long-run estimates of \(B_1\) and \(B_1'\) from equation (2.4) of Table 3.2, we obtain

\[
\Delta X = -0.584(0.174 + 0.508) + 0.582 [(0.174)^2 - (-0.508)^2]
= -0.531.
\]

This means that exports fall by more than 50 percent. Applying the same procedure with the coefficient estimates from equation (2.5) of Table 3.2, we obtain

\[
\Delta X = -0.537.
\]

Sjaastad argues that the above changes in the relative price of importables is due to increased protection. Accordingly, the above analysis indicates that about 50 percent of the decrease in
Argentine trade has been due to increased protection. In other words, about half the decline in Argentine exports has been self-inflicted, due to import protection ultimately squeezing firms out of the export business. This is a striking conclusion.

3.4 THE AUSTRALIAN DATA

In this section, we present the Australian data and their sources. These data will be used in the next section.

The basic data are derived from Sjaastad and Clements (1981). However, instead of using their quarterly data, we convert them to an annual basis to give 31 observations, 1949/50 - 1979/80, by simply averaging the quarterly prices. The price of home goods $p_h$ is defined as the wholesale price index, while $p_e$ is the export price index and $p_m$ is the index of import prices. Table 3.3 lists all the data.

Figure 3.1 plots the three nominal prices against time. As can be seen, the broad trends in the prices are all quite similar. Note in particular that the import price index and home goods price index are very similar. This implies that importables and home goods are highly substitutable, which results in their relative price being roughly constant. Note also the volatility of the export price index, due largely to the specialization of Australia in primary product exports.
### Table 3.3
THE BASIC AUSTRALIAN DATA

<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal Price Indices</th>
<th>Value of</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Home goods $p_h$</td>
<td>Exports $p_e$</td>
<td>Imports $p_m$</td>
</tr>
<tr>
<td>1949/50</td>
<td>59.3</td>
<td>96.5</td>
<td>63.0</td>
</tr>
<tr>
<td>1950/51</td>
<td>72.9</td>
<td>164.8</td>
<td>82.0</td>
</tr>
<tr>
<td>1951/52</td>
<td>88.8</td>
<td>119.1</td>
<td>92.3</td>
</tr>
<tr>
<td>1952/53</td>
<td>96.8</td>
<td>121.6</td>
<td>87.3</td>
</tr>
<tr>
<td>1953/54</td>
<td>91.7</td>
<td>119.5</td>
<td>85.7</td>
</tr>
<tr>
<td>1954/55</td>
<td>91.4</td>
<td>108.6</td>
<td>86.9</td>
</tr>
<tr>
<td>1955/56</td>
<td>95.4</td>
<td>100.1</td>
<td>89.2</td>
</tr>
<tr>
<td>1956/57</td>
<td>101.4</td>
<td>111.7</td>
<td>90.9</td>
</tr>
<tr>
<td>1957/58</td>
<td>98.1</td>
<td>96.9</td>
<td>92.6</td>
</tr>
<tr>
<td>1958/59</td>
<td>93.2</td>
<td>85.4</td>
<td>92.8</td>
</tr>
<tr>
<td>1959/60</td>
<td>95.8</td>
<td>95.3</td>
<td>93.5</td>
</tr>
<tr>
<td>1960/61</td>
<td>95.6</td>
<td>90.1</td>
<td>94.9</td>
</tr>
<tr>
<td>1961/62</td>
<td>94.1</td>
<td>91.6</td>
<td>95.1</td>
</tr>
<tr>
<td>1962/63</td>
<td>93.0</td>
<td>95.9</td>
<td>95.6</td>
</tr>
<tr>
<td>1963/64</td>
<td>93.8</td>
<td>108.0</td>
<td>95.9</td>
</tr>
<tr>
<td>1964/65</td>
<td>95.4</td>
<td>99.9</td>
<td>97.5</td>
</tr>
<tr>
<td>1965/66</td>
<td>98.2</td>
<td>102.3</td>
<td>99.4</td>
</tr>
<tr>
<td>1966/67</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1967/68</td>
<td>99.8</td>
<td>95.2</td>
<td>99.0</td>
</tr>
<tr>
<td>1968/69</td>
<td>102.3</td>
<td>97.4</td>
<td>100.5</td>
</tr>
<tr>
<td>1969/70</td>
<td>105.8</td>
<td>98.0</td>
<td>103.5</td>
</tr>
<tr>
<td>1970/71</td>
<td>101.6</td>
<td>95.7</td>
<td>108.1</td>
</tr>
<tr>
<td>1971/72</td>
<td>104.3</td>
<td>99.5</td>
<td>115.0</td>
</tr>
<tr>
<td>1972/73</td>
<td>119.9</td>
<td>127.7</td>
<td>113.7</td>
</tr>
<tr>
<td>1973/74</td>
<td>140.8</td>
<td>152.7</td>
<td>132.2</td>
</tr>
<tr>
<td>1974/75</td>
<td>134.6</td>
<td>172.0</td>
<td>189.4</td>
</tr>
<tr>
<td>1975/76</td>
<td>145.3</td>
<td>178.0</td>
<td>214.8</td>
</tr>
<tr>
<td>1976/77</td>
<td>166.9</td>
<td>196.1</td>
<td>246.8</td>
</tr>
<tr>
<td>1977/78</td>
<td>180.8</td>
<td>202.5</td>
<td>279.9</td>
</tr>
<tr>
<td>1978/79</td>
<td>244.3</td>
<td>235.3</td>
<td>308.5</td>
</tr>
<tr>
<td>1979/80</td>
<td>310.1</td>
<td>289.1</td>
<td>405.3</td>
</tr>
</tbody>
</table>

NOMINAL PRICES OF HOME GOODS, EXPORTS AND IMPORTS:
AUSTRALIA, 1949/50 - 1979/80

PRICE OF HOME GOODS
PRICE OF IMPORTS
PRICE OF EXPORTS

FIGURE 3.1
The behaviour of the relative prices can be seen more clearly in Figure 3.2 and 3.3. Figure 3.2 plots \( \ln(p_m/p_e) \) and \( \ln(p_h/p_e) \) against time. As can be seen, there is quite a bit of variability in these relative prices. Figure 3.3 plots \( \ln(p_h/p_m) = \ln(p_h/p_e) - \ln(p_m/p_e) \) against time. Except for the second half of the 1970s, the price of home goods in terms of importables is quite stable, again suggesting a high degree of substitutability between the two types of goods.

Figure 3.4 is the scatter plot of \( \ln(p_h/p_e) \) against \( \ln(p_m/p_e) \). As can be observed, the relationship between the two relative prices is approximately linear. Figure 3.5 depicts the same information, except that it is now plotted in terms of price changes over time rather than in levels. This graph reaffirms the approximate linear relationship.

Figure 3.6 plots exports and imports in current prices. Although both exports and GDP have grown, the proportion of exports in the GDP generally has declined. Figure 3.7 plots this proportion. The high values in the 1950s illustrate the effects of the Korean war boom. Since then, the ratio has declined and has seemed to stabilize at a bit below 15 percent. The declining export share could be attributed to an increase in Australian trade barriers.

The derived data to be used in the econometric analysis are shown in Table 3.4. All variables are as defined in Section 3.2.
RELATIVE PRICES OF HOME GOODS AND IMPORTS:
AUSTRALIA, 1949/50 - 1979/80

\[ P_1 = \ln(p_m/p_e) \]

\[ P_2 = \ln(p_i/p_e) \]

FIGURE 3.2
SCATTER PLOT OF \( P_2 \) AGAINST \( P_1 \):
AUSTRALIA, 1949/50 - 1979/80

\[
P_1 = \ln(p_m/p_e) \\
P_2 = \ln(p_h/p_e)
\]

\[
P_2 = -0.075 + 0.627P_1 \\
(0.109)
\]

\( R^2 = 0.53 \)  \( DW = 0.43 \)

Standard Error in Parenthesis

FIGURE 3.4
SCATTER PLOT OF $\Delta P_2$ AGAINST $\Delta P_1$:
AUSTRALIA, 1950/51 - 1979/80

$\Delta P_1 = \ln(p_m/p_e) t - \ln(p_m/p_e) t-1$
$\Delta P_2 = \ln(p_h/p_e) t - \ln(p_h/p_e) t-1$

$\Delta P_2 = 0.002 + 0.716\Delta P_1$

$R^2 = 0.56$  $DW = 1.92$

Standard Error in Parenthesis

FIGURE 3.5
EXPORTS AND IMPOTS IN CURRENT PRICES:
AUSTRALIA, 1949/50 - 1979/80

FIGURE 3.6
SHARE OF EXPORTS IN GDP:
AUSTRALIA, 1949/50 - 1979/80

FIGURE 3.7
### TABLE 3.4

**THE DERIVED DATA: AUSTRALIA, 1949/50 - 1979/80**

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports /GDP</th>
<th>DT</th>
<th>X</th>
<th>M</th>
<th>M - X</th>
<th>Y</th>
<th>P₁</th>
<th>P₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949/50</td>
<td>.232</td>
<td>-.027</td>
<td>2.507</td>
<td>2.735</td>
<td>.228</td>
<td>8.538</td>
<td>-.350</td>
<td>-.487</td>
</tr>
<tr>
<td>1950/51</td>
<td>.287</td>
<td>-.075</td>
<td>2.470</td>
<td>2.864</td>
<td>.394</td>
<td>8.822</td>
<td>-.696</td>
<td>-.816</td>
</tr>
<tr>
<td>1951/52</td>
<td>.182</td>
<td>.097</td>
<td>2.410</td>
<td>3.092</td>
<td>.682</td>
<td>8.892</td>
<td>-.255</td>
<td>-.294</td>
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\[ BT = (\text{Imports} - \text{Exports})/\text{GDP}, \ X = \ln(\text{Exports}), \ M = \ln(\text{Imports}), \ Y = \ln(\text{GDP}), \ P₁ = \ln(pₘ/pₑ) \text{ and } P₂ = \ln(pₕ/pₑ). \]

Source: Calculated from Table 3.3.
3.5 PROTECTION AND THE VOLUME OF TRADE IN AUSTRALIA

In this section, we use the Australian data to estimate the trade equation derived in Section 3.2. According to the data given in Figure 3.7, the ratio of exports to GDP declined until the late 1960s and then increased slowly. Accordingly, the regressions have been run in two parts, from 1949/50 to 1966/67 (18 observations) and 1967/68 to 1979/80 (13 observations).

The results for the first sub-period (for 1949/50 - 1966/67) are shown in Table 3.5. The coefficients of the relative price variable $P_1$ range from -.17 to .10. In equations 5.2, 5.3, 5.4 and 5.6 of the table, the relative price coefficient is negative and takes an average value of -.12. This average value implies that the elasticity of trade with respect to $P_1$ is -.12, indicating that a 10 percent uniform tariff, for example, will reduce the real volume of trade in Australia by about 1.2 percent. These coefficients, although of the correct sign, are not highly significant.

The coefficients of the income variable $Y$ range from .68 to .77, and are highly significant. In other words, a 10 percent increase in income will increase the real volume of trade by about 7 percent. Hence in Australia, the volume of trade grows less than proportionately with output. This could also explain the declining share of exports in GDP.

The coefficients of $(M - X)$ and BT are significant when they appear alone. However, both are less significant when they appear together. This indicates that there is multicollinearity between
TABLE 3.5
THE AUSTRALIAN TRADE FUNCTION, 1949/50 - 1966/67

\[ X = \text{CONSTANT} + B_1 P_1 + B_2 Y + B_3 (BT) + B_4 (M - X) + B_5 X_{-1} \]

<table>
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<th>( BT )</th>
<th>( (M - X) )</th>
<th>( X_{-1} )</th>
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- \( t \) ratios are given in the first set of parentheses and long-run values in the second.
the two variables. The lagged dependent variable is always insignificant. Evidently, trade flows fully respond within one year to changes in the independent variables.

The regression results for the latter sub-period (1967/68 - 1970/80) are shown in Table 3.6. The coefficients of the relative price variable \( P_1 \) vary from -.56 to .53. The coefficients of the income variable range from .11 to .28. The lagged dependent variables are now more significant than before.

Finally, the results of the whole period, 1949/50 - 1970/80, are shown in Table 3.7. The coefficients of the relative price variable \( P_1 \) range from -.26 to .31. All except one is positive. Generally speaking, these results are not as satisfactory as those in Tables 3.5 and 3.6. This would seem to confirm that the two sub-periods represent different regimes and should be kept separate.

3.6 PROTECTION AND RELATIVE PRICES IN ARGENTINA

Sjaastad (1980) analyses the effects of protection on the structure of relative prices in Argentina. In this section, we review his results.

Sjaastad estimates a modified version of equation (3.5):

\[
(3.9) \quad P_{2t} = \text{constant} + \omega'P_{1t} + \beta P_{2t}^2 + \gamma(f_t \cdot P_{1t})
+ \lambda P_{2,t-1} + (\text{GDP + trade balance terms})
\]
TABLE 3.6

\[ X = \text{CONSTANT} + B_1 P_1 + B_2 Y + B_3 (BT) + B_4 (M - X) + B_5 X_{-1} \]

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- See notes to Table 3.5.
TABLE 3.7
THE AUSTRALIAN TRADE FUNCTION, 1949/50 - 1979/80

\[ X = \text{CONSTANT} + B_1 P_1 + B_2 Y + B_3 (BT) + B_4 (M - X) + B_5 X_{-1} \]

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See notes to Table 3.5.
where \( f \) is the percentage in total imports of intermediate and capital goods. As can be seen, equation (3.5) is modified by (i) including a lagged dependent variable to allow for partial adjustment; and (ii) adding \( P_1^2 \) and \( (f \cdot P_1) \) to capture a nonlinear response.

Table 3.8 contains the results. The long-run estimates of \( \omega \) range from .38 to .48 for the equations in linear form. When the squared relative price is introduced, its coefficients are significant. This indicates the presence of nonlinearity. The introduction of \( (P_1)^2 \) produces the marginal values of \( \omega, \omega_M \). This \( \omega_M \) shows how an increment to existing protection is distributed between an increment to the implicit tax on imports and an increment to the true protection for import-competing activities. Differentiation of equation (3.9) with respect to \( P_1 \) when \( \gamma = 0 \) gives

\[
\frac{\partial P_2}{\partial P_1} = \omega_M = \omega' + 2\beta P_1.
\]

Hence, the coefficients \( \omega' \) and \( \beta \) given in Table 3.8 indicate that \( \omega_M \) is a declining function of the level of protection.

However, it is the average of \( \omega, \omega_A \), that indicates to what extent the tariff barriers constitute an implicit tax on exports. This average value hence determines the consequences of a reduction in protection. To estimate \( \omega_A \), further assumptions about the structure of protection are required; see Sjaastad (1980) for details.
TABLE 3.8
THE ARGENTINE INCIDENCE EQUATIONS, 1935 - 79

\[ P_{2t} = \text{CONSTANT} + \omega'P_{1t} + \beta P_{2t}^2 + \gamma(f_t \cdot P_{1t}) + \lambda P_{2,t-1} + (\text{GDP} + \text{TRADE BALANCE TERMS}) \]

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<th>( \gamma )</th>
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<td>-</td>
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<td>.38</td>
<td>.56</td>
<td>.84</td>
</tr>
<tr>
<td>(8.2)</td>
<td>OLS</td>
<td>.278&lt;br&gt;(4.36)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.421&lt;br&gt;(3.23)</td>
<td>.48</td>
<td>.64</td>
</tr>
<tr>
<td>(8.3)</td>
<td>CORC</td>
<td>.418&lt;br&gt;(5.62)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.42</td>
<td>.70</td>
<td>1.66</td>
</tr>
<tr>
<td>(8.4)</td>
<td>OLS</td>
<td>.416&lt;br&gt;(7.52)</td>
<td>-.296&lt;br&gt;(2.68)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.62</td>
<td>1.03</td>
</tr>
<tr>
<td>(8.5)</td>
<td>OLS</td>
<td>.322&lt;br&gt;(4.87)</td>
<td>-.207&lt;br&gt;(1.88)</td>
<td>-</td>
<td>-</td>
<td>.341&lt;br&gt;(2.55)</td>
<td>.49</td>
<td>.66</td>
</tr>
<tr>
<td>(8.6)</td>
<td>CORC</td>
<td>.466&lt;br&gt;(6.04)</td>
<td>-.219&lt;br&gt;(1.72)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.72</td>
<td>1.77</td>
</tr>
<tr>
<td>(8.7)</td>
<td>OLS</td>
<td>1.094&lt;br&gt;(4.13)</td>
<td>-.0109&lt;br&gt;(2.62)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.66</td>
<td>.90</td>
</tr>
<tr>
<td>(8.8)</td>
<td>OLS</td>
<td>.882&lt;br&gt;(3.17)</td>
<td>-.008&lt;br&gt;(2.10)</td>
<td>.308&lt;br&gt;(2.36)</td>
<td>1.27</td>
<td>.71</td>
<td>1.34</td>
<td></td>
</tr>
<tr>
<td>(8.9)</td>
<td>CORC</td>
<td>1.286&lt;br&gt;(3.67)</td>
<td>-.0126&lt;br&gt;(2.38)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>.78</td>
<td>1.99</td>
</tr>
</tbody>
</table>

OLS = ordinary least squares; CORC = Cochrane-Orcutt estimation procedure. t ratios are given in parentheses.
In the upper panel of Table 3.9, we show the long-run average and marginal values of $\omega$ implied by equations (8.4) - (8.6) of Table 3.8. The estimates of $\omega_A$ for equations (8.4) - (8.6) are all greater than those of equations (8.1) - (8.3) in Table 3.8, where no distinction is made between marginal and average values. In other words, neglecting the nonlinearity leads to underestimation of the average values of $\omega$.

Sjaastad (1980) introduces the second method to capture the nonlinearity of the effect of $P_2$ on $P_1$ by introducing the variable $f\cdot P_1$, where $f$ is the percentage of total imports accounted for by intermediate and capital goods. The greater the protection, the larger the share of intermediate and capital goods in total imports. For 1935 - 39, $f = 47.5$ percent, while for 1970 - 76, that fraction had grown to 74.1 percent. As can be seen from Table 3.8, the coefficient of the term $f\cdot P_1$ is negative and significant. The negative coefficient again implies that $\omega$ declines as protection increases. The lower panel of Table 3.9 gives the long-run $\omega$'s corresponding to these equations. For 1935-39, the estimates of $\omega$ based on equations (8.7) - (8.9) are quite similar to those for $\omega_A$ and $\omega_M$ for equations (8.4) - (8.6). During the 1970s, however, the former estimates are much lower than the latter estimates of $\omega_A$, but similar to those of $\omega_M$. 
TABLE 3.9
ESTIMATES OF LONG-RUN INCIDENCE PARAMETER, ARGENTINA, 1935 - 79

<table>
<thead>
<tr>
<th>Table 3.8 equation number</th>
<th>Period</th>
<th>1935 - 39</th>
<th>1970 - 79</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \omega_M = \omega_A )</td>
<td>( \omega_M )</td>
<td>( \omega_A )</td>
</tr>
<tr>
<td>(8.4)</td>
<td>.72</td>
<td>.31</td>
<td>.52</td>
</tr>
<tr>
<td>(8.5)</td>
<td>.81</td>
<td>.38</td>
<td>.59</td>
</tr>
<tr>
<td>(8.6)</td>
<td>.69</td>
<td>.39</td>
<td>.54</td>
</tr>
<tr>
<td>(8.7)</td>
<td>.58</td>
<td></td>
<td>.29</td>
</tr>
<tr>
<td>(8.8)</td>
<td>.67</td>
<td></td>
<td>.33</td>
</tr>
<tr>
<td>(8.9)</td>
<td>.69</td>
<td></td>
<td>.35</td>
</tr>
</tbody>
</table>
3.7 PROTECTION AND RELATIVE PRICES IN AUSTRALIA

Sjaastad and Clements (1981) carry out an analysis of protection and relative prices in Australia which is similar to the Argentine material of the previous section. In this section, we give a brief overview of the Australian results.

Sjaastad and Clements (1981) use the following version of equation (3.5):

\[
\Delta P_{2t} = \text{constant} + \omega' \Delta P_{1t} + \lambda \Delta P_{2,t-1} + \text{seasonal dummies.}
\]

This is a first-difference version of equation (3.5) with the variables \(Y\) and \(BT\), suppressed.

Estimates of equation (3.10), from Sjaastad and Clements (1981), are presented in Table 3.10. These are obtained with quarterly Australian data; these data are the quarterly versions of the annual data presented in Table 3.3. As can be seen, the long-run values of \(\omega\) are around .7. These indicate that about 70 percent of the burden of protection falls on exporters in Australia.

Recall that Figure 3.4 is a scatter of \(P_2\) against \(P_1\) with the annual Australian data. The observations are scattered around an upward sloping least-square regression line. The slope of this line is .63 with a standard error of .11. As the data in Figure 3.4 are annual, this slope can be interpreted as a rough estimate of the long-run value of the incidence parameter \(\omega\). It is reassuring that this value is not grossly inconsistent with the
values of this parameter presented in Table 3.10. The same is also true for Figure 3.5 which is based on annual data in first-differences.
### TABLE 3.10

**THE AUSTRALIAN INCIDENCE EQUATIONS, MARCH 1950 - JUNE 1980**

\[ \Delta P_{2t} = \text{constant} + \omega'\Delta P_{1t} + \lambda \Delta P_{2,t-1} + \text{seasonal dummies} \]

<table>
<thead>
<tr>
<th>Eq.</th>
<th>Estimation technique</th>
<th>( \omega' )</th>
<th>( \lambda )</th>
<th>Long-run ( \omega )</th>
<th>( R^2 )</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10.1)</td>
<td>OLS</td>
<td>.685</td>
<td>-</td>
<td>.69</td>
<td>.59</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(12.69)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10.2)</td>
<td>CORC</td>
<td>.689</td>
<td>-</td>
<td>.69</td>
<td>.67</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(13.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10.3)</td>
<td>OLS</td>
<td>.638</td>
<td>.213</td>
<td>.81</td>
<td>.63</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(12.04)</td>
<td>(3.61)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(10.4)</td>
<td>CORC</td>
<td>.690</td>
<td>.032</td>
<td>.71</td>
<td>.67</td>
<td>1.96</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(13.02)</td>
<td>(.42)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See notes to Table 3.8.
CHAPTER 4

WHO PAYS FOR PROTECTION IN AUSTRALIA?

4.1 INTRODUCTION

Who pays for protection? The intelligent layperson might well argue that the answer is very straightforward: It is the importer who pays for import tariffs and the like as it is he or she who writes the cheque payable to the Collector of Customs. As is well known in economics, however, that is only part of a long story. It is likely that the importer will be able to pass on most, if not all, of the import duties to his or her customers in the form of higher prices. Thus, consumers of imports pay for protection in the form of higher prices. But this is still only an intermediate step in a long process as many consumers are also wage earners. Wage earners will push for higher wages (and other forms of compensation) to counter the higher cost of living. In addition, many other types of costs and charges are tied to the cost-of-living index, so that these other costs will also be inflated as a result of protection. Other consumers who may be pensioners would be likely to lobby the government for increases in their pensions to maintain the real value of what they see as their justifiably deserved welfare payments. Consequently, protection will have the effects of increasing wages and other costs and charges, as well as the country's welfare bill, which means higher
taxation.

How do these effects impinge on industry at home? The firms in the import-competing sector clearly gain from import protection as it has the effect of raising the internal prices of the competing imports. However, there is an offset to this beneficial effect on account of the fact that the costs of the import-competing firms will also rise. Costs increase because protection has the effect of increasing wages, as well as other costs and taxation, as indicated above. The net position of the import-competing firms depends on the balance between their higher revenues and higher costs. As a result, the calculation of the net position requires further analysis.

However, the position is quite unambiguous for the country's exporters: They lose. The exporters are hit with the higher costs in exactly the same way as are the firms in the import-competing sector. However, there is no offsetting benefit for exporters. Most exporters sell in highly competitive world markets which are characterized by near-perfectly elastic demand schedules. Consequently, the price received by exporters is entirely outside their control, implying that there is no scope for passing on cost increases in the form of higher prices. The exporters are squeezed by protection.

These ideas have been elaborated in a simple and concise manner in a book by Clements and Sjaastad (1984). They developed a simple general equilibrium model which emphasises the shifting of the burden of protection from one sector to another. The model makes possible the measurement of the ultimate effects of
In a straightforward manner. In this chapter, we apply the model to measure the ultimate effects of protection in Australia. This analysis enables us to measure the transfers of income from one sector to another resulting from protection.

The structure of this chapter is as follows. Section 4.2 sets out the Clements-Sjaastad model. Section 4.3 contains the application to Australia. This includes a discussion of the structure of the Australian economy; the measurement of protection; and the measurement of the transfers implicit in Australian protection, which is summarized in the form of a transfer matrix (giving the income transfers from sector i to sector j, where i, j = import-competing firms, exporters, consumers and taxpayers). The key finding of this section is that Australian exporters are subject to a tax of about 1.5 percent of GDP as a result of protection. Concluding comments are given in Section 4.4.

A shorter version of this chapter appeared in Choi and Cummings (1986).

4.2 THE MODEL

The model is from Clements and Sjaastad (1984) and it is about the inter-sectoral transfers of income arising from protection. It is only concerned with the transfers, ignoring any deadweight or welfare costs of protection.
(i) True Tariffs and Subsidies

Protection policy can be described as protecting certain industries relative to others. The Clements and Sjaastad model studies the change in the relative prices arising from protection. The analysis of the change in the relative prices gives rise to the concept of true protection to each economic agent, which leads to the transfers amongst economic agents.

It can be shown that (in the absence of complementarity) the price of home goods is related to commercial policy as follows:

\[ d = s + \omega (t - s), \]

where
\[ d = \text{proportional increase in the price of home goods;} \]
\[ s = \text{weighted average subsidy equivalent of the export subsidies and other forms of assistance to exporters;} \]
\[ t = \text{weighted average tariff equivalent of the actual \textit{ad valorem} tariffs and other forms of assistance to firms in the import-competing sector;} \]
and \( \omega \) is a coefficient lying between 0 and 1.

From equation (4.1), if \( t = s \), we have \( t = s = d \) which is the same as a devaluation of \( 100 \times t \) percent when trade is balanced. In other words, if we try to protect all, we end up protecting no one as all relative prices are unaffected.
Equation (4.1) can be rearranged as follows:

\[ d = \omega t + (1 - \omega)s \]  

This equation shows that the increase in the home goods price is a weighted average of the equivalent import duty and export subsidy. The coefficient \( \omega \) is known as "the shift coefficient". It indicates the degree of substitution possibilities amongst the three sectors; this ultimately determines the incidence of protection. For example, if \( \omega \) is zero, we have \( d = s \) which implies that home goods and exportables are perfect substitutes. Here the incidence of protection is equally shared by producers of home goods and exportables. At the other extreme, if \( \omega = 1 \), then (4.1') gives \( d = t \) which implies that home goods and importables are perfect substitutes and the incidence of protection is entirely borne by exporters.

Choosing units so that all prices under free trade are unity, we define the true tariff \( t^* \) and the true subsidy \( s^* \) as the change in the internal prices of importables \( (P_m) \) and exportables \( (P_e) \), respectively, relative to that of home goods \( (P_h) \):

\[
(4.2) \quad t^* = \frac{\Delta(P_m/P_h)}{1+t} = \frac{(1+t)/(1+d) - 1}{1} = \frac{(t-d)/(1+d)}{1} 
\]

\[
(4.3) \quad s^* = \frac{\Delta(P_e/P_h)}{1+s} = \frac{(1+s)/(1+d) - 1}{1} = \frac{(s-d)/(1+d)}{1} 
\]
These expressions for the true tariff and true subsidy give us a very important policy implication. From equation (4.1),

\[ \omega = \frac{(d-s)}{(t-s)}. \]

Thus,

\[
\omega t^* + (1-\omega)s^* \\
= \left[ \frac{(d-s)}{(t-s)} \right] \left[ \frac{(t-d)}{(1+d)} \right] + \left[ 1 - \frac{(d-s)}{(t-s)} \right] \left[ \frac{(s-d)}{(1+d)} \right] \\
= \left[ \frac{(d-s)}{(t-s)} \right] \left[ \frac{(t-d)}{(1+d)} \right] + \left[ \frac{(t-d)}{(t-s)} \right] \left[ \frac{(s-d)}{(1+d)} \right] \\
= 0,
\]

where the first step follows from (4.2) and (4.3). Thus, we have

\[(4.4) \quad \omega t^* + (1-\omega)s^* = 0.\]

In words, a weighted average of the true tariff and true subsidy is zero. Given that \( \omega \) only depends upon substitution effects, \( t^* \) and \( s^* \) cannot be chosen independently. In other words, the policy maker can only choose the true tariff or the true subsidy, but not both because he does not control \( \omega \). To illustrate, if the policy maker wishes to deliver a certain amount of true protection to the import-competing industries of \( t^*_1 > 0 \), then this necessarily means that exporters will have to be taxed at the rate

\[ s^*_1 = \frac{-\omega}{(1-\omega)} t^*_1 < 0. \]
The difference between true and nominal protection for the import-competing sector is

\[ t^* - t = \frac{(t-d)}{1+d} - t \]
\[ = \frac{-(1+t)d}{1+d} . \]

Similarly, the difference between the true and nominal export subsidy is

\[ s^* - s = \frac{(s-d)}{1+d} - s \]
\[ = \frac{-(1+s)d}{1+d} . \]

If \( t > 0 \) and \( s > 0 \), then the two differences are both negative since \( d \), the change in the price of home goods, is positive [see (4.1')]. Thus, true protection is less than nominal protection. It is only when \( d = 0 \) that true protection is identical to nominal protection.

(ii) Transfers Amongst Economic Agents

Nominal protection does not reveal the ultimate effects on the real income of the various economic agents. True protection is, however, well-suited to measure these effects. In this sub-section, we use the concept of true protection to form a transfer matrix which gives all the effects of protection in transferring income from sector \( i \) to \( j \) of the economy. The true
tariff and subsidy rates will be used to study the income transfers resulting from protection.

We define the production and consumption of importables and exportables and imports and exports in units of GNP at world prices:

\[
\begin{align*}
q_x(t, s) &= \text{value of production of exportables;} \\
q_m(t, s) &= \text{value of production of importables;} \\
m(t, s) &= \text{value of imports;} \\
x(t, s) &= \text{value of exports;} \\
C_m(t, s) &= [m(t, s) + q_m(t, s)] \\
&= \text{value of consumption of importables; and} \\
C_x(t, s) &= [q_x(t, s) - x(t, s)] \\
&= \text{value of consumption of exportables.}
\end{align*}
\]

All of the above are functions of several variables, including domestic relative prices. For expositional simplicity, we have suppressed all other variables except \( t \) and \( s \), the uniform tariff and export subsidy equivalent of all forms of protection. For notational convenience, we suppress the variables \( t \) and \( s \) as arguments of \( q_x, q_m, C_x, C_m, x \) and \( m \). Economic agents are classified into the five overlapping groups, exporters, import-competing firms, consumers, taxpayers and the government. As the effects of nominal protection \( t \) and \( s \) can be exactly replicated by imposing \( t^* \) and \( s^* \) (with the price of home goods remaining constant), we shall analyze the implicit transfers in terms of \( t^* \) and \( s^* \).
From the relationship between the true tariff and the true subsidy given in equation (4.4), the true export subsidy $s^*$ or the true tax $-s^*$ can be represented as

$$-s^* = \omega t^*/(1-\omega).$$

If we impose an export tax of $-s^*$ on the export sector, exporters lose income in proportion to the quantity that they produce. Hence, their total loss is

$$-s^* q_x = -s^* (C_x + x) = \omega t^* q_x/(1-\omega).$$

This exporter's loss is transferred to consumers in the form of paying less for exportables and to the government in the form of tax revenue. Consumers get a net transfer from the exporters equal to

$$-s^* C_x = \omega t^* C_x/(1-\omega).$$

The government's revenue from the export tax is

$$-s^* x = \omega t^* x/(1-\omega).$$

If the import-competing sector receives true protection at the rate $t^*$, they will gain income in proportion to the value of the
The gain of the import-competing sector comes entirely at the expense of consumers. It takes the form of consumers paying higher prices for importables. The government also gains from the tariff in the form of tariff revenue,

\[ t \cdot q_m \]

Hence, the consumer's total transfers to the import-competing sector and the government is:

\[ t \cdot q_m + t \cdot m = t \cdot c_m \]

The government collects a total amount of \( wt \cdot x/(1-\omega) + t \cdot m \) from the protection policy, \( t \cdot m \) coming from consumers and \( wt \cdot x/(1-\omega) \) from exporters. However, assuming that this additional government revenue is used to reduce other forms of existing taxation, this will be transferred back to taxpayers so that they gain \( t \cdot [m + \omega x/(1-\omega)] \). Therefore, the government will not have a net gain from protection.

The transfers between the economic agents are summarized in the form of a matrix in Table 4.1. The final column represents the total transfers from each sector and the final row shows the total transfers to each sector. The column for taxpayers serves to
TABLE 4.1
INTER-SECTORAL TRANSFERS ARISING FROM PROTECTION
(as fractions of GDP)

<table>
<thead>
<tr>
<th>From</th>
<th>Import-</th>
<th>Competing Firms</th>
<th>Consumers</th>
<th>Taxpayers</th>
<th>Government</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exporters</td>
<td>0</td>
<td>wt*C_x/(1 - (\omega))</td>
<td>0</td>
<td>wt*x/(1 - (\omega))</td>
<td>wt*q_x(1 - (\omega))</td>
<td></td>
</tr>
<tr>
<td>Consumers</td>
<td>t*q_m</td>
<td>-</td>
<td>0</td>
<td>t*m</td>
<td>t*C_m</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>0</td>
<td>t*[m + wx/(1 - (\omega))]</td>
<td>-</td>
<td>t*[m + wx/(1 - (\omega))]</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>t*q_m</td>
<td>wt*C_x/(1 - (\omega))</td>
<td>t*[m + wx/(1 - (\omega))]</td>
<td>t*[m + wx/(1 - (\omega))]</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Source: Clements and Sjaastad (1984, p. 60)
record the transfer from the government of the higher revenue from commercial policy back to taxpayers.

(iii) The Real Income of Consumers

We see from Table 4.1 that if \( t^* > 0 \), exporters lose and that those in the import-competing sector gain as a result of protection. We shall now consider the effects of protection on the real income of consumers. There are two effects here which go in opposite directions.

First, consumers gain from lower internal prices of exportables as a result of the export tax-s. Their gain is equal to

\[
\omega t^* C_x/(1-\omega)
\]

Second, they are taxed as a result of protection by having to pay higher prices for importables. This tax is equal to

\[
t^* C_m
\]

Combining the consumers' gain and loss of real income, their net position as a result of protection is

\[
T_c = \omega t^* C_x/(1-\omega) - t^* C_m \\
= t^* [\omega C_x - (1-\omega)C_m]/(1-\omega)
\]
If $T_c$ is positive, on balance, consumers gain from protection. As $t^*$ and $(1-\omega)$ are both positive, $T_c > 0$ when $[\omega C_x - (1-\omega)C_m] > 0$. This condition may be expressed as

$$\omega > C_m/(C_m + C_x).$$

In words, if the shift coefficient exceeds the share of importables in the total consumption of tradeables, then consumers gain from protection.

(iv) The Real Income of Consumers and the Government

Under the assumption that the additional government revenue gets transferred back to consumers in the form of reductions in existing taxes (or that the government supplies useful services to consumers), we can consolidate these two sectors into the category consumers cum taxpayers.

The government revenue from protection is

$$T_t = t^* [m + \omega x/(1-\omega)] = t^* [\omega x + (1-\omega)m]/(1-\omega).$$

Hence, consumers cum taxpayers' total net gain is

$$T_t + T_c = t^* [\omega x + (1-\omega)m]/(1-\omega) + t^* [\omega C_x - (1-\omega)C_m]/(1-\omega) = t^* [\omega q_x - (1-\omega)q_m]/(1-\omega).$$

Consumers cum taxpayers experience a net gain if $T_c + T_t > 0$. 
As $t^*$ and $(1-\omega)$ are both positive, $T_c+T_t > 0$ if $[\omega q_x - (1-\omega)q_m] > 0$, i.e. if

\[(4.6) \quad \omega > q_m/(q_m + q_x).\]

In words, if the shift coefficient exceeds the share of importables in the total production of tradeables, then consumers \textit{cum} taxpayers are net gainers from protection.

(v) Are Conditions (4.5) and (4.6) Likely to Be Satisfied?

For a given value of $\omega$, condition (4.5) is more likely to be satisfied when $C_m/(C_m + C_x)$ is low. That is, when the share of importables in the total consumption of tradeables is low; or, in other words, when the share of exportables is high. Consequently, condition (4.5) will be satisfied in countries where goods which are exported are also heavily consumed domestically. This is unlikely to be the case in countries like Chile and Australia where exports are dominated by primary products, the domestic demand for which is not significant. On the other hand, condition (4.5) is likely to be satisfied in a country like Argentina where there is substantial domestic consumption of beef, which is a major export.

Condition (4.6) is likely to be satisfied in most countries since $\omega$ almost always exceeds .5 and domestic production of exportables is generally larger than the domestic production of importables. However, if import substitution is virtually complete and domestic production of exportables is very low, condition (4.6)
can be reversed and consumers *cum* taxpayers would fail to gain from protection.

4.3 APPLICATION TO AUSTRALIA

This section has seven parts. First, the data for the construction of the Australian transfer matrix are presented. Second, we present the average nominal rates of assistance for imports and exports. Third, we compute the true tariff and true export tax for Australia. Fourth, we consider the question, do Australian consumers gain from protection? Fifth, we consider the position of consumers *cum* taxpayers. Sixth, we present the Australian transfer matrix. Finally, we show that nominal protection with wages increasing has exactly the same economic effects as does true protection with wages constant.

(i) The Structure of the Australian Economy

To classify goods into exportables, importables and home goods, we use industries shown as components of gross domestic product (GDP) as given in *Australian National Accounts: Gross Product by Industry* (ABS Cat. No. 5211). Australian gross domestic product is divided into twelve industries:

(1) Agriculture, Forestry, Fishing and Hunting

(2) Mining
We classify as traded goods (1) Agriculture, Forestry, Fishing and Hunting, (2) Mining and (3) Manufacturing. The remaining industries (4) - (12) can be regarded as home goods (non-traded). This classification is based upon Goldstein and Officer (1979).

Within the traded goods category, we classify (1) Agriculture, Forestry, Fishing and Hunting and (2) Mining as exportables. We divide up the manufacturing industry into exportables, importables and home goods; see Appendix for details. The resulting classification of GDP by industry is shown in Table 4.2. Total home goods production in 1979-80 is $81,415 million. The production of exportables and importables are $19,896 and $14,395 million, respectively. During the same year, exports and imports are $18,579 and $15,828 million, respectively (see ABS, 1982b, p.38). We can convert these values into fractions of GDP by dividing them by $114,464 million, GDP in 1979-80. This yields:
### TABLE 4.2
GDP BY INDUSTRY: AUSTRALIA, 1979-80

<table>
<thead>
<tr>
<th>Industry</th>
<th>GDP by Industry at Current Prices ( $ million )</th>
<th>Percentage of Total GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Exportables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture, Forestry, Fishing and Hunting</td>
<td>7,799</td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>7,468</td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4,629</td>
<td></td>
</tr>
<tr>
<td><strong>Total Exportables</strong></td>
<td>19,896</td>
<td>17</td>
</tr>
<tr>
<td><strong>II. Importables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>14,395</td>
<td>13</td>
</tr>
<tr>
<td><strong>II. Home Goods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4,570</td>
<td></td>
</tr>
<tr>
<td>Electricity, Gas and Water</td>
<td>3,309</td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>7,315</td>
<td></td>
</tr>
<tr>
<td>Wholesale and Retail Trade</td>
<td>15,995</td>
<td></td>
</tr>
<tr>
<td>Transport storage and Communication</td>
<td>7,947</td>
<td></td>
</tr>
<tr>
<td>Finance</td>
<td>12,053</td>
<td></td>
</tr>
<tr>
<td>Public Administration and Defence</td>
<td>4,634</td>
<td></td>
</tr>
<tr>
<td>Community Services</td>
<td>11,971</td>
<td></td>
</tr>
<tr>
<td>Entertainment, etc &amp; Personal Services</td>
<td>4,603</td>
<td></td>
</tr>
<tr>
<td>Ownership of Dwelling</td>
<td>9,018</td>
<td></td>
</tr>
<tr>
<td><strong>Total Home Goods</strong></td>
<td>81,415</td>
<td>71</td>
</tr>
<tr>
<td>Custom Duties</td>
<td>1,538</td>
<td></td>
</tr>
<tr>
<td>Less Imputed Bank Service Charge</td>
<td>2,780</td>
<td></td>
</tr>
<tr>
<td><strong>GDP</strong></td>
<td>114,464</td>
<td>101</td>
</tr>
</tbody>
</table>

Source: ABS, Australian National Accounts: Gross Product by Industry 1980-81, Table 4.3, and Appendix.
Share of exportables production in GDP

\[ \frac{19,896}{114,464} = .17 \]

Share of importables production in GDP

\[ \frac{14,395}{114,464} = .13 \]

Share of home goods production in GDP

\[ \frac{81,415}{114,464} = .71 \]

Share of exports in GDP

\[ \frac{18,579}{114,464} = .16 \]

Share of imports in GDP

\[ \frac{15,828}{114,464} = .14 \]

We also have:

Share of exportables consumption in GDP

\[ c_x = q_x - x = .17 - .16 = .01 \].
Share of importables consumption in GDP

\[ C_m = q_m + m = 0.13 + 0.14 = 0.27. \]

The above information illustrates the structure of the Australian economy. As is usual in most countries, production of home goods accounts for the largest fraction of GDP. What distinguishes the Australian economy is its emphasis on exports and also the negligible domestic consumption of exportables. This reflects, of course, the fact that Australia's main exportables are mineral and agricultural products.

(ii) Nominal Protection

According to the Industries Assistance Commission Annual Report 1982-83 (I.A.C. 1983), the average nominal rate of assistance given to Australian manufacturing industries was 15 percent in 1979-80. This is the amount of assistance provided to the processes undertaken by an activity, industry etc. by measures such as tariffs, quotas, subsidies and other forms of protection, expressed as a percentage of the value of the activity. We take 15 percent as the nominal *ad valorem* tariff equivalent of all forms of import protection. The precise average nominal rates of assistance for exports is not available. However, in 1975-76, the average nominal rates of assistance for exports of manufactured goods was 4 percent (I.A.C., 1978, Table 2.2.3). The agricultural sector, which we classify as exportables, received an average nominal
assistance rate of 3 percent in 1979-80 (I.A.C., 1982, Table A1.3.2). Assuming that there is no assistance for the exports of mining products, we can measure the approximate average nominal rate of assistance for all exports as shown in Table 4.3. As can be seen, the weighted average rate is 1.3 percent. We shall thus use 1 percent as the approximate rate of nominal assistance given to Australian exporters, i.e. \( s = .01 \).

(iii) The True Tariff and The True Export Tax

Given \( t = .15 \) and \( s = .01 \), and using the Clements and Sjaastad \( \omega \) value for Australia of .7 (for the estimate of \( \omega \), see Sjaastad and Clements, 1981), the effect of protection on the price of home goods (wages) is

\[
d = \omega t + (1 - \omega)s
= .7( .15) + ( 1 - .7)( .01)
= .105 + .003
= .108.
\]

Thus, nominal protection inflates nominal wages by almost 11 percent.

The true tariff \( t^* \) and the true export subsidy \( s^* \) are:

\[
t^* = (t-d)/(1+d) = (.15-.108)/(1+.108) = .042/1.108 = .038;\\
s^* = (s-d)/(1+d) = (.01-.108)/(1+.108) = -.098/1.108 = -.088.
\]
<table>
<thead>
<tr>
<th>Industry</th>
<th>Value of Production ($million)</th>
<th>Share in Total Exportables</th>
<th>Nominal Rate of Assistance (Percent)</th>
<th>Weighted Average (3)x(4) (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>7,799</td>
<td>.39</td>
<td>3</td>
<td>1.17</td>
</tr>
<tr>
<td>Mining</td>
<td>7,468</td>
<td>.38</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>4,629</td>
<td>.23</td>
<td>.4</td>
<td>.09</td>
</tr>
<tr>
<td>Total</td>
<td>19,896</td>
<td>1.00</td>
<td></td>
<td>1.26</td>
</tr>
</tbody>
</table>

Source: As for Table 4.2; I.A.C. Annual Report 1977-78, Table 2.2.3; and I.A.C Annual Report 1981-82, Table A1.3.2.
In words, the structure of protection in Australia implies a true tariff of 3.8 percent and a true export tax of 8.8 percent. As can be seen, true protection given to the import-competing sector is much less than nominal protection of 15 percent. The export tax of almost 9 percent is substantial and represents fairly harsh and discriminatory treatment of a highly efficient sector of the Australian economy.

(iv) Do Australian Consumers Gain from Protection?

We use the above data to check whether or not condition (4.5) holds. If it does, then Australian consumers gain from protection. The share of imports in total consumption is

\[ \frac{C_m}{C_m + C_x} = \frac{.27}{.27 + .01} = .96. \]

As this is greater than \( \omega = .7 \), we conclude that condition (4.5) is not satisfied, so that consumers do not gain from protection. Australian consumers do not gain simply because they are heavy consumers of importables and light consumers of exportables. Consequently, for consumers the tax base is high, while the base for the subsidy is low.
(v) The Position of Consumers and the Government in Australia

Next, we use (4.6) to test whether consumers cum taxpayers gain from import protection. The share of importables in the total production of tradeables is

\[ \frac{q_m}{q_m + q_x} = \frac{.13}{.13 + .17} = .43. \]

Thus, as \( \omega = .7 > .43 \), condition (4.6) is satisfied. In other words, consumers cum taxpayers experience a net gain from protection. To put it yet another way, exporters lose more than import-competing firms gain. Given an \( \omega \) value of .7, greater production of exportables (\( q_x = .17 \)) than importables (\( q_m = .13 \)) implies that consumers cum taxpayers experience a net gain from import protection.

(vi) The Transfer Matrix

Given the previous information, we now construct the transfer matrix for Australia using the expressions given in Table 4.1.

The net loss of income for exporters (as a fraction of GDP) is

\[ \omega t \frac{q_x}{(1 - \omega)} = \frac{.7 \times .038 \times .17}{(1 - .7)} \]

\[ = .00452/.3 = .01507. \]
Consumers get a transfer from exporters of

\[-s^* C_x = \omega t^* C_x/(1-\omega) = (0.7 \times 0.038 \times 0.01)/(1 - 0.7) = 0.0027/0.3 = 0.00089.\]

The government revenue from the export tax is

\[\omega t^* x/(1-\omega) = (0.7 \times 0.038 \times 0.16)/(1 - 0.7) = 0.00426/0.3 = 0.01419.\]

The total gain of the import-competing sector comes at the expense of consumers who pay higher prices for importables. This gain is

\[t^* q_m = 0.038 \times 0.13 = 0.00494.\]

The tariff revenue collected by the government is

\[t^* m = 0.038 \times 0.14 = 0.00532.\]

Therefore, the total transfer from consumers to others is

\[t^* C_m = t^* q_m + t^* m = 0.00494 + 0.00532 = 0.01026.\]

The government's total gain from protection is

\[t^*[m + \omega x/(1-\omega)] = 0.038[0.14 + (0.7 \times 0.16)/(1 - 0.7)] = 0.01951.\]
However, as we assume that this additional government revenue is used to reduce other forms of taxes, this becomes a gain to taxpayers. All these results are summarized in Table 4.4. As can be seen, the gross gain to consumers \( \textit{cum taxpayers} \) is \( .09 + 1.95 = 2.04 \) percent of GDP in 1979-80. Due to the higher internal prices of importables, consumers lose 1.02 percent, causing the net gain to consumers \( \textit{cum taxpayers} \) to be \( 2.04 - 1.02 = 1.02 \) percent of GDP.

(vii) Nominal Protection with Wages Increasing has the Same Effects as True Protection with Wages Constant

We have presented the transfers resulting from protection in terms of the true tariff \( t^* \) and the true export subsidy \( s^* \). As true protection embodies the change in wages resulting from nominal protection, it is unnecessary to explicitly consider the effects of the resulting changes in wages. That is to say, the transfers stemming from the wage changes are already taken into account. In this sub-section, we elaborate this idea by showing that the transfers resulting from true protection are identical to those resulting from nominal protection and the associated change in wages.

We use Australia's nominal protection of \( t = .15 \), \( s = .01 \) and \( \omega = .7 \) for our numerical illustration. Given these, we have:

\[
d = \omega t + (1 - \omega)s = .7 \times .15 + (1 - .7) \times .01 = .108 .
\]
TABLE 4.4
INTER-SECTORAL TRANSFERS ARISING FROM PROTECTION:
AUSTRALIA, 1979-80
(As percentages of GDP)

<table>
<thead>
<tr>
<th>From</th>
<th>Import-Competing Firms</th>
<th>Consumers</th>
<th>Taxpayers</th>
<th>Government</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exporters</td>
<td>0</td>
<td>.09</td>
<td>0</td>
<td>1.42</td>
<td>1.51</td>
</tr>
<tr>
<td>Consumers</td>
<td>.49</td>
<td>-</td>
<td>0</td>
<td>.53</td>
<td>1.02</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>0</td>
<td>1.95</td>
<td>-</td>
<td>1.95</td>
</tr>
<tr>
<td>Total</td>
<td>.49</td>
<td>.09</td>
<td>1.95</td>
<td>1.95</td>
<td></td>
</tr>
</tbody>
</table>
In words, nominal wages rise by 10.8 percent. The true tariff and export tax are:

\[
\begin{align*}
t^* &= (t-d)/(1+d) = .038; \\
s^* &= (s-d)/(1+d) = -.088.
\end{align*}
\]

Consider now two alternative commercial policy packages:

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>s</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package 1</td>
<td>15</td>
<td>.01</td>
<td>.108</td>
</tr>
<tr>
<td>Package 2</td>
<td>.038</td>
<td>-.088</td>
<td>0</td>
</tr>
</tbody>
</table>

These two packages have identical effects on internal relative prices. This can be seen as follows:

\[
\begin{align*}
P_m/P_e & = \frac{1 + .15}{1 + .01} = 1.14 & P_m/P_h & = \frac{1 + .15}{1 + .108} = 1.038 & P_e/P_h & = \frac{1 + .01}{1 + .108} = .912 \\
P_m/P_e & = \frac{1 + .038}{1 - .088} = 1.14 & P_m/P_h & = \frac{1 + .038}{1} = 1.038 & P_e/P_h & = \frac{1 - .088}{1} = .912
\end{align*}
\]

In the above, we have chosen units such that all nominal prices are unity under free trade. Clearly, the two sets of commercial policies are equivalent. Another way of stating this is to say
that if we imposed \( t = .038 \) and \( s = -.088 \), then wages would indeed be constant:

\[
d = \omega t + (1 - \omega)s = .7 \times .038 + (1 - .7)(-.088) = 0.
\]

As all relative prices are the same under the two packages and as the transfers depend only on the relative prices, it follows that the transfers must also be the same. Consequently, our transfer matrix computed from \( t^*, s^* \) and \( d = 0 \) is exactly the same as that which would be obtained by using instead \( t, s \) and \( d = \omega t + (1 - \omega)s \).

4.4 CONCLUDING COMMENTS

In this chapter, we have used the Clements-Sjaastad (1984) model to answer the question, who pays for protection? This model draws a sharp distinction between the initial effects of protection and the ultimate effects. The initial effects are related solely to the nominal rates of assistance, which are determined by policy makers. Many of these initial effects are passed onto other economic agents, so that the ultimate effects of protection are in all probability quite different from the initial effects. Just as who bears the economic incidence of a certain tax is almost always different from who writes the cheque to pay the tax, so are the ultimate effects of protection different from nominal protection.

The ultimate effects of protection are summarized by what is
known as the "true" rates of protection, or true protection for short. True protection depends on the structure of the economy, something which is not under the control of policy makers. Consequently, true protection may well be substantially different from nominal protection, implying that the ultimate effects of protection can be very different from what policy makers believe them to be. This indeed seems to be the case as Clements and Sjaastad (1984) have found that in a number of countries, protection acts as a substantial implicit tax on the countries' exporters; and it would be very surprising to find governments knowingly pursuing policies which discriminate against the country's exports.

The Clements-Sjaastad model was applied to Australia where the nominal tariff-equivalent of all forms of import protection is 15 percent and the nominal subsidy-equivalent of all forms of assistance for exports is 1 percent. This application revealed that these policies inflated nominal wages and other costs by 11 percent and that true protection received by the import-competing firms is only 4 percent. Therefore, the effect of nominal protection on wages erodes much of its protective effect for the import-competing sector. Furthermore, the application also revealed that the exporters are subject to a true rate of "assistance" of -9 percent, i.e. they are subject to a fairly substantial implicit tax. The mechanism by which the tax is transmitted to the exporters is via higher wages, which, in turn, inflate the whole cost structure of the export sector. As exporters face near-perfectly elastic demand conditions, they
cannot pass on to their customers these cost increases; they just have to absorb them.

We then used these true rates of protection to calculate the resulting income transfers. We found that import-competing firms gain about .5 percent of GDP and exporters lose 1.5 percent of GDP. Interestingly, consumers are net gainers from protection. Although they lose as they pay higher internal prices for importables, there is an offsetting gain from the lower prices of exportables and the government revenue from protection. This latter effect exceeds the former, so that consumers experience a net gain. This gain is equal to about 1 percent of GDP. Consequently, the conclusion is that exporters are the sole losers from the protection. As GDP for 1983-84 is $187.4 billion (ABS, 1985, p.27), the exporters' loss of income of 1.5 percent of GDP is equivalent to about $2.8 billion in 1983-84. This estimate is consistent with other studies which used the large general equilibrium ORANI model (see Choi and Cummings, 1986).
APPENDIX

The classification of manufacturing industries into exportables and home goods is given in Table A1. The total value added of manufacturing in 1979-80 is $25,614 million (ABS, 1981). Using the value added for exportables and home goods industries within the manufacturing sector, given in Table A1, the value added for importables within the manufacturing industry is $25,614 - $5,025 - $4,961 = $15,628 million.

The contribution of the manufacturing sector to GDP in 1979-80 is $23,594 million (ABS, 1982a). We divide this total into exportables, importables and home goods by using the shares in total value added as follows:

<table>
<thead>
<tr>
<th>Manufacturing Sector</th>
<th>Value-Added</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$million</td>
<td>Share</td>
</tr>
<tr>
<td>Exportables</td>
<td>5,025</td>
<td>.1962</td>
</tr>
<tr>
<td>Importables</td>
<td>15,628</td>
<td>.6101</td>
</tr>
<tr>
<td>Home Goods</td>
<td>4,961</td>
<td>.1937</td>
</tr>
<tr>
<td>Total</td>
<td>25,614</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Thus, the production of manufacturing exportables is $4,629 million, importables $14,395 million and home goods $4,570 million. These are the figures used in Table 4.2 of the text.
## TABLE A1
CLASSIFICATION OF MANUFACTURING INDUSTRIES: AUSTRALIA, 1979-80

<table>
<thead>
<tr>
<th>Industry Description</th>
<th>ASIC Code</th>
<th>Value Added ($million)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exportables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat products</td>
<td>211</td>
<td>1,051</td>
</tr>
<tr>
<td>Food Products N.E.C</td>
<td>2171,2174,2175,2176</td>
<td>752</td>
</tr>
<tr>
<td>Prepared Fibres</td>
<td>2343,2344</td>
<td>129</td>
</tr>
<tr>
<td>Chemical Fertilizers</td>
<td>2751</td>
<td>190</td>
</tr>
<tr>
<td>Basic Iron and Steel</td>
<td>294</td>
<td>1,686</td>
</tr>
<tr>
<td>Other Basic Metals</td>
<td>295</td>
<td>987</td>
</tr>
<tr>
<td>Agricultural Machinery</td>
<td>3361</td>
<td>230</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>5,025</td>
</tr>
<tr>
<td><strong>Home Goods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fruit and Vegetable Products</td>
<td>213</td>
<td>287</td>
</tr>
<tr>
<td>Flour and Cereal Products</td>
<td>215</td>
<td>212</td>
</tr>
<tr>
<td>Bread Cakes, Biscuits</td>
<td>216</td>
<td>488</td>
</tr>
<tr>
<td>Soft Drinks, Cordials etc</td>
<td>2185</td>
<td>191</td>
</tr>
<tr>
<td>Beer and Malt</td>
<td>2186,2187</td>
<td>349</td>
</tr>
<tr>
<td>Joinery and Wood Products</td>
<td>2555</td>
<td>234</td>
</tr>
<tr>
<td>Newspapers and Books</td>
<td>2641,2642,2643,2644</td>
<td>1,508</td>
</tr>
<tr>
<td>Paints, Varnishes</td>
<td>2762</td>
<td>165</td>
</tr>
<tr>
<td>Soap and Detergent</td>
<td>2765</td>
<td>195</td>
</tr>
<tr>
<td>Clay Prods, Refractories</td>
<td>286</td>
<td>334</td>
</tr>
<tr>
<td>Cement</td>
<td>2871</td>
<td>150</td>
</tr>
<tr>
<td>Ready-Mixed Concrete</td>
<td>2872</td>
<td>118</td>
</tr>
<tr>
<td>Concrete Products</td>
<td>2874</td>
<td>147</td>
</tr>
<tr>
<td>Ship and Boat Building</td>
<td>3241,3242</td>
<td>241</td>
</tr>
<tr>
<td>Locomotives</td>
<td>3243</td>
<td>342</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>4,961</td>
</tr>
</tbody>
</table>

Source: ABS, Manufacturing Establishments: Details of Operations by Industry Class, Australia 1979-80, Table 1.
CHAPTER 5

THE ECONOMICS OF BOOMING SECTORS

5.1 INTRODUCTION

Consider a small open economy in which there is suddenly an unexpected discovery of resources. These resources can be exported or used to replace existing imports. What are the implications of this "resources boom" for the rest of the economy, the other traded goods in particular? This question is addressed by what is known as the economics of booming sectors and was motivated by the discovery of natural gas in the Netherlands in the 1970s and oil in the North Sea. As such a boom is generally thought to have negative effects on other exporting industries and the import-competing sector, this phenomenon is known in Europe as the "Dutch Disease" and "De-industrialization" (see Blackaby, 1978, and Darker and Brailovsky, 1981).

In Australia, serious analysis of a resources boom was initiated in a highly influential paper by Gregory (1976). Gregory had the important insight that a resources boom squeezes the traditional exporters in much the same manner as does an increase in import tariffs; and that the boom also squeezes firms in the import-competing sector in the same way as does a reduction in tariffs. In this chapter, we use this insight to analyze the effects of a resources boom by using the incidence of protection
analytical framework. Our analysis is complementary to Gregory's in that it uses a simple general equilibrium framework to derive many of Gregory's results in a straightforward manner.

This chapter proceeds as follows. The remainder of this section is devoted to a survey of the main Australian contributions to the topic, starting with Gregory. Section 5.2 uses a novel diagrammatic analysis of a resources boom. This analysis is formalized and elaborated further in Sections 5.3 and 5.4. In these two sections, we also use the model to illustrate the likely quantitative sizes of the various effects of the boom by carrying out some simple numerical computations.

A Brief Review of the Australian Literature

In this sub-section, we survey various qualitative analyses dealing with the economic effects of a minerals boom on other sectors, especially for Australia. There is now a considerable amount of literature dealing with various effects of a resources boom on Australian society (see, Harris and Taylor, 1982; Smith, 1983; Lloyd, 1984; Cook and Porter, 1984; and Maddock and Mclean, 1984). However, this sub-section is only concerned with the narrower aspects of the boom, viz., the changes in prices and production.

Gregory's (1976) paper is the first analytical study of the effects of a minerals boom in Australia. His study concludes
that a minerals boom hurts the import- competing and the traditional exporting sectors. In what follows, we give an overview of Gregory's contribution.

The vertical axis of Figure 5.1 shows the price of traded goods relative to that of non-traded goods; the quantity of traded goods is measured on the horizontal axis. The initial import demand and export supply curves are \( M_0 \) and \( X_0 \), respectively. Equilibrium in this model is where exports equal imports, i.e. trade balance equilibrium. Thus, \( E_0 \) is the initial equilibrium. At \( E_0 \), the price and the quantity of traded goods are \( P_0 \) and \( Q_0 \), respectively.

The emergence of a new export sector shifts the export supply curve from \( X_0 \) to \( X_1 \), the horizontal difference between the two curves being the additional volume of new exports. If the demand curve for imports does not shift, the new equilibrium is at \( E_1 \), where the balance of trade is again in equilibrium. At \( E_1 \), the price of traded goods has declined from \( P_0 \) to \( P_1 \), while the volume of traded goods has risen from \( Q_0 \) to \( Q_1 \).

Since the price of traded goods relative to that of non-traded goods is the real exchange rate, this price decline is equivalent to a real appreciation of the exchange rate. This real appreciation would occur through either a decline in the price of traded goods (i.e. a nominal appreciation) or an increase in the price of non-traded goods (i.e. inflation) or a combination of both.

Although the total volume of exports and imports has increased from \( Q_0 \) to \( Q_1 \), the volume of traditional exports has declined by
FIGURE 5.1
GREGORY'S DIAGRAM

Relative Price of Tradeables to Non-Tradeables

Quantity of Exports, Imports
Q_0 - Q_2 as a result of the lower price P_1. The lower price of tradeables also means that the domestic import-competing sector faces an increase in competition from the larger volume of imports. Therefore, Gregory's study indicates that the relative price of non-traded goods rises, causing the production of traditional traded goods (import-competing goods and traditional exportables) to decline. The magnitude of the adjustments depends on the size of the boom and the elasticities of export supply and import demand.

Many extensions of Gregory's analysis have now emerged. We now summarize some of the more important. Snape (1977) introduces a general equilibrium model using the production possibility frontier diagram. He concludes that (i) the production of tradeables as a whole (traditional and non-traditional) will increase; (ii) the relative price of non-tradeables will increase; and (iii) the production of non-traded goods could increase or decrease as a result of the minerals boom. These results are illustrated in Figures 5.2 and 5.3 which are from Snape (1977).

In Figure 5.2, the curve RS is the initial production possibility frontier. The initial equilibrium for production and consumption is at the point W, where P_0 represents the relative price of non-tradeables and I_0 is an indifference curve. The minerals boom shifts the production possibility curve from RS to RS'. The new production possibility curve RS' is drawn in a very special way as it has shifted horizontally by the same amount for each value of non-tradeables production. Such a shift occurs only when the additional production of tradeables uses only mineral
FIGURE 5.2
SNAPE'S FIRST DIAGRAM
resources, and not the other factors used in the production of non-tradeables. In this case, the marginal cost of tradeables is unchanged at any given level of non-tradeables production. In other words, the minerals boom is like a gift to the economy in the sense that it would not affect the production of non-tradeables. Accordingly, the distances \( W \_e \) and \( SS' \) are the same. The slope of \( RS' \) at a point due east of \( W \) (i.e. \( W \_e \)) will be the same as the slope of \( RS \) at \( W \). All points on \( RS' \) to the north-west of \( W \_e \) correspond to a flatter slope than at \( W \_e \) (and \( W \)), implying that the relative price of non-tradeables increases.

The outward shift of the production possibility frontier implies that real income rises so that the consumption of each good will change according to demand patterns. If non-tradeables have a zero marginal propensity to consume, then their consumption remains unchanged with the higher income and the new equilibrium point is \( W \_e \). However, if non-tradeables are normal goods, as seems more reasonable, the new equilibrium lies on \( RS' \) somewhere above \( W \_e \), indicating higher consumption of non-tradeables. Consequently, the relative price of non-tradeables increases.

A similar argument establishes that when traded goods are non-inferior, the new equilibrium point must lie between \( W \_n \) and \( W \_e \). This shows that (i) the relative price of non-tradeables rises; and (ii) production of both non-tradeables and tradeables rises.

The previous argument was based on the rather special nature of the shift of the production possibility frontier. A more likely shift in the production possibility frontier is shown in Figure 5.3. Here the gap between \( RS \) and \( RS' \) widens as non-tradeables
FIGURE 5.3
SNAPE'S SECOND DIAGRAM
production decreases. Such a shift occurs when the production of new tradeables uses factors employed in non-tradeables. Also, the marginal cost of tradeables for a given production of non-tradeables decreases with the boom, so that the slope at \( W_e \) is flatter than that at \( W \). It is possible for the new equilibrium to lie south of \( W_e \) such as the point \( W' \). At \( W' \), consumption of non-tradeables has fallen relative to the point \( W \), while income has increased. Does this imply that non-tradeables are necessarily inferior? The answer is no as the price of non-tradeables has also increased in going from \( W \) to \( W' \) (the slope at \( W' \) is flatter than that at \( W \)).

Figure 5.3 therefore establishes that production of non-tradeables may fall even though their relative price rises. Although the higher income stimulates the demand for non-traded goods, the rise in their marginal cost at their old production level \( W \) reduces it.

While Gregory (1976) and Snape (1977) considered only the supply side shock in their analyses, Stoeckel (1979) considered a minerals boom in terms of a demand shock as well as a supply shock. His is a computable general equilibrium model with five sectors, namely, Agriculture, Mining, Manufacturing Exports, Manufacturing Importing-Competing and Services. The model also allows for income effects, variable terms of trade and interindustry flows.

Stoeckel used his model to simulate the effects of a boom in two ways: (i) an outward shift in the domestic supply curve of mining products; and (ii) an increase in the export demand for mining products. The first corresponds to Snape's analysis.
described above. Stoeckel found that when the source of the growth is a domestic supply shift, the output of the import-competing sector expands slightly. The income effect and the terms of trade effect operate favourably for the import-competing sector. Not only is the import-competing sector the largest user of mining output, it also supplies goods to the mining sector. Thus, the import-competing sector benefits from the minerals boom in two ways. First, it supplies additional output to the mining sector, so that it gains on this count. Second, as the small country assumption is relaxed in Stoeckel's model, the greater level of mineral exports causes their price to fall; this lower price of mining products benefits the import-competing sector as it uses these goods as inputs. It is to be noted that this expansion of the import-competing sector is in direct contrast to Gregory's result. The output of the agriculture and the manufacturing-exporting sector falls, while production of non-traded goods (i.e. services) increases when the minerals boom takes the form of a supply shift.

When the boom operates through an increase in foreign demand for mineral exports, rather than by new discoveries, the effects are somewhat different. Now, the import-competing sector contracts along with agriculture. This is Gregory's result.

Before concluding this brief survey of the Australian literature, it should be mentioned that there are several other important contributions to this literature. These include Corden (1981, 1982, 1984), Corden and Neary (1982), Long (1983), Cook and Porter (1984), Cassing and Warr (1985) and Murray (1985).
5.2 A DIAGRAMMATIC ANALYSIS

In this section, we use the geometric approach introduced by Dornbusch (1974) to analyze the general equilibrium effects of an autonomous increase in exports; see also Clements (1985) and Murray (forthcoming). We start by briefly setting out a simple general equilibrium model and then proceed to introduce the export boom. In subsequent sub-sections, we show that the export boom is equivalent to a tariff decrease insofar as the import-competing sector is concerned; and that it is equivalent to a tariff increase from the viewpoint of traditional exporters. These results follow from the fact that the export boom has the effect of increasing the supply of traded goods, which means that their relative price (in terms of home goods) must fall. This reduction in the price of traded goods obviously hurts the existing producers of such goods, namely, the traditional exporters and firms in the import-competing sector.

(i) The General Equilibrium Linkages Between the Prices of Traded and Nontraded Goods

Figure 5.4, which is from Clements and Sjaastad (1984), is made up of four quadrants. Quadrant I shows the import demand schedule, labelled \( MM \), which gives the relationship between the relative price of imports \( P_m/P_h \) (where \( P_h \) is the price of home goods) and the volume of imports \( M \). This schedule slopes downward.
FIGURE 5.4
TRADE AND RELATIVE PRICES

Relative Price of Imports

Relative Price of Exports

Volume of Exports

Volume of Imports

$P_e^0/P_h^0$

$P_m^0/P_h^0$

$45^\circ$

$X$

$I$

$II$

$III$

$IV$

$A$

$B$

$C$

$E_0$

$M_0$
as a reduction in the relative price of importables stimulates the demand for imports.

When the price of imports is \( P_m^0/P_h^0 \), imports are \( M_0 \). For trade balance to be in equilibrium, exports must equal imports. This is represented in quadrant II of the diagram which has a 45° line, indicating the equality of the value of exports and imports where units are chosen such that the world prices of exports and imports are both unity. From quadrant II, exports must be \( E_0 (= M_0) \); for this volume of exports to be supplied, their relative price must be \( P_e^0/P_h^0 \), as shown in quadrant III where XX is the export supply curve.

Finally, in quadrant IV, the relative prices of imports and exports, \( P_m^0/P_h^0 \) and \( P_e^0/P_h^0 \), are brought together at the point A. The schedule \( HH \) is constructed by taking different values of the relative price of imports and deriving the resulting equilibrium relative price of exports. Consequently, \( HH \) gives the equilibrium pairs of relative prices. The schedule \( HH \) is known as the home goods schedule as at all points along it, the market for home goods clears. This can be seen by noting that in deriving the point A on \( HH \), the market for the traded goods clears; thus, by Walras' law, the other market, that of home goods, also clears.

One other aspect of quadrant IV of Figure 5.4 also needs to be noted. All points to the left of the \( HH \) schedule represent a trade surplus. Consider the point B, having the same relative price of imports as at A but a higher price of exports. This higher price
stimulates exports which, coupled with constant imports (as their price is constant), leads to the point \( C \) in quadrant II, corresponding to a surplus. The point \( B \) therefore is a position of trade balance surplus; all points to the left of \( HH \) have this property. Conversely, all points to the right of \( HH \) represent a trade deficit.

Figure 5.5 gives a "flipped-over" version of quadrant IV of the previous diagram. Now points to the right of \( HH \) correspond to surpluses and points to the left deficits. Figure 5.5 also contains two rays from the origin labelled \( OR \) and \( OR' \). The slope of the ray \( OR \) is the internal relative price of traded goods \( \frac{P^0_m}{P^0_e} \).

The overall initial equilibrium in the economy pertains at the intersection of \( OR \) and \( HH \), i.e. at the point \( D \). The equilibrium relative prices are \( \frac{P^0_m}{P^0_h} \) and \( \frac{P^0_e}{P^0_h} \).

The effects of the imposition of a tariff can be easily represented in Figure 5.5. The tariff increases the internal relative price of traded goods to \( \frac{P^0_m(1+t)}{P^0_e} \), where \( t \) is the tariff rate. This has the effect of rotating the ray \( OR \) anti-clockwise to \( OR' \). The overall equilibrium shifts from \( D \) to \( F \), with the relative price of imports increasing to \( \frac{P^0_m(1+t)}{P^1_h} \) and that of exports falling to \( \frac{P^0_e}{P^1_h} \). Note that the relative price of imports does not increase by the full amount of the tariff as this would mean that the equilibrium point is \( G \) rather than \( F \). Clearly, as long as \( HH \) is not vertical, \( F \) and \( G \) do not coincide. The reason why the relative price of imports does not increase by the full amount of the tariff is that the price of home goods also rises. This price has to rise as it is the mechanism which chokes off exports; trade
FIGURE 5.5
TARIFFS AND RELATIVE PRICES

Relative Price of Imports

\[ \frac{P^o(1+t)}{P^l} \]

\[ \frac{P^o}{P^o} \]

Relative Price of Exports

\[ \frac{P^o}{P^l} \]

\[ \frac{P^o}{P^o} \]
balance equilibrium requires that exports must fall with the imposition of the tariff as imports fall.

(ii) The Effects of an Export Boom

Figure 5.6 is the same as Figure 5.4 except for the addition of a new export supply curve and a new home goods schedule. The original export supply, import demand and home goods schedules are \( X_0X_0, MM \) and \( H_0H_0 \), respectively. Let us assume that the initial equilibrium prices before the export boom are \( p^{0e}/p^0_h \) and \( p^{0m}/p^0_h \), so that exports are \( E_0 \) and imports \( M_0 \).

The effect of the export boom is to shift the export supply curve from \( X_0X_0 \) to \( X_1X_1 \), the vertical difference between the two curves being the additional production of exports. At a given relative price of exports, exports are larger after the boom. This shift of the export supply curve causes the home goods schedule \( H_0H_0 \) to shift to \( H_1H_1 \) to restore equilibrium.

In Figure 5.6, the new equilibrium prices after the export boom are \( p^{0e}/p^1_h \) and \( p^{0m}/p^1_h \); the volume of exports is \( E_1 \) and \( M_1 \) is the volume of imports. Although exports has risen from \( E_0 \) to \( E_1 \), the volume of traditional exports has dropped from \( E_0 \) to \( E_2 \). The excess of total exports over traditional exports, \( E_1 - E_2 \), is the volume of new exports. The reason for the fall in traditional exports is that this sector is squeezed by the higher price of home goods, i.e. wages. The higher wage costs faced by exporters cannot be passed on to their customers as we assume that the country is small, possessing no monopoly power in international trade.
FIGURE 5.6
THE EXPORT BOOM, TRADE AND RELATIVE PRICES
The boom causes wages \((P_h)\) to rise from \(P_h^0\) to \(P_h^1\) while the internal price of exports remains constant. The cause of the increase in wages is simple: the additional supply of exports has the effect of increasing the supply of traded goods relative to that of home goods. Consequently, the price of traded goods in terms of home goods must fall, a fall which is brought about by a wage rise. To put it another way, the increase in exports must be matched by a corresponding increase in imports in order to maintain trade balance equilibrium. The way imports are stimulated is to have a fall in their relative price, i.e. a fall in \(P_m/P_h\); again, this adjustment is brought about by domestic wages rising.

As stated previously, the export boom shifts the export supply schedule, and consequently, the home goods schedule shifts in towards the origin. Figure 5.7 depicts the effects of the additional exports on the relative prices of importables and exportables. Going back to Figure 5.5, we recall that points below the home goods schedule \(H_m\) represent a trade balance deficit. Consequently, the shift in this schedule displayed in Figure 5.7 can be interpreted as stating that values of \(P_m/P_h\) and \(P_e/P_h\) which would have previously meant a trade balance deficit are now consistent with trade balance equilibrium.

As can be seen in Figure 5.7, the export boom has the effect of shifting in the home goods schedule to \(H_1H_1\), so that the overall equilibrium moves from the point \(E\) to \(J\). The relative prices of exportables and importables fall from \(P_e^0/P_h^0\) and \(P_m^0/P_h^0\) to \(P_e^0/P_h^1\) and \(P_m^0/P_h^1\) respectively. Accordingly, the boom hurts both the traditional exporters and the firms in the import-competing sector.
FIGURE 5.7
THE EXPORT BOOM AND RELATIVE PRICES

Relative Price
of Imports

Relative Price
of Exports
(iii) The Export Boom is Equivalent to a Tariff Reduction for the Import-Competing Sector

We now show how the export boom has exactly the same effects on internal relative prices as does an import tariff. As far as the import-competing sector is concerned, the effect of the export boom is equivalent to a reduction in import protection as the relative price of imports (and importables) has declined. In Figure 5.7, the relative price of imports falls from $P^m/P^h$ to $P^{1}\over P^{1}_{m}$, which causes the import-competing sector to be worse off. In Figure 5.8, we show that the same relative price of imports would be obtained in the absence of an exports boom by having a tariff reduction such that the ray OR (whose slope is $P^m/P^e$) rotates clockwise to OR'. The new equilibrium point G corresponds to the same relative price of imports as does J. The amount of the tariff reduction is aG/Gb. Thus, we have shown that the export boom is equivalent to a tariff reduction from the perspective of the firms in the import-competing sector.

(iv) The Export Boom is Equivalent to a Tariff Increase for the Traditional Exporters

In contrast to the import-competing sector, the declining price of exports resulting from the boom is equivalent to an increase in import protection as far as the traditional exporters are concerned. In Figure 5.7, the relative price of exports falls
FIGURE 5.8
THE EXPORT BOOM AND THE IMPORT-COMPETING SECTOR
from \( \frac{p_e^0}{p_h^0} \) to \( \frac{p_e^0}{p_h^1} \). In Figure 5.9, we show that the same relative price of exports would be obtained in the absence of a boom by having a tariff increase such that the ray OR (whose slope is \( \frac{p_e^0}{p_m^0} \)) rotates anti-clockwise to OR". The new equilibrium point G' corresponds to the same relative price of exports as does the original point J. The amount of the tariff increase is cd/de.

(v) Exchange Rate Appreciation

We have seen that the export boom has the effect of lowering the relative prices of the two traded goods, \( \frac{p_e}{p_h} \) and \( \frac{p_m}{p_h} \). This has the effect of squeezing both the traditional exporters and those firms in the import-competing sector. This lowering of the prices of the traded goods can be described as a real appreciation of the exchange rate since domestic costs rise relative to the nominal exchange rate. An appreciation of the nominal exchange rate with domestic costs held constant would have exactly the same effect on relative prices.

This is illustrated in Figure 5.10, which is the same as Figure 5.7 with one exception. Previously, in Figure 5.7, in going from the point E to J, we held the nominal prices of traded goods constant at \( p_m^0 \) and \( p_e^0 \), and the export boom had the effect of increasing wages from \( p_h^0 \) to \( p_h^1 \). Now, in Figure 5.10, we assume that for some reasons or other, nominal wages are fixed. In such a case, the nominal prices of the traded goods must fall equiproportionally. The internal prices of these goods equal the
FIGURE 5.9
THE EXPORT BOOM AND TRADITIONAL EXPORTERS
FIGURE 5.10
THE EXPORT BOOM AND THE EXCHANGE RATE

Relative Price of Imports

\[ \frac{p_m^0}{p_h^0} \]

\[ \frac{p_e^0(1+r)}{p_h^0} \]

\[ \frac{p^0}{p_e^0} \]

\[ \frac{p^0}{p_h^0} \]
external prices times the exchange rate,

\[ P_m = S P^*_m; \quad P_e = S P^*_e, \]

where \( S \) is the exchange rate, defined as the domestic currency cost of a unit foreign exchange, and the asterisk denotes an external price. As both \( P^*_m \) and \( P^*_e \) are fixed for a small economy, an exchange rate appreciation (a fall in \( S \)) is required to lower \( P_m \) and \( P_e \).

In such a case, the movement from the point \( G \) to \( J \) in Figure 5.10 implies an appreciation of the nominal exchange rate by \( r \times 100 \) percent, where \( r < 0 \), and

\[ 1 + r = \frac{OJ}{OG}, \]

i.e.

\[ r = \frac{OJ}{OG} - 1 = \frac{-GJ}{OJ}. \]

We have considered two situations which bring about the equilibrating change in relative prices: (i) full adjustment of wages with the nominal prices of traded goods fixed; and (ii) full adjustment of the exchange rate with nominal wages fixed. Obviously, any linear combination of these two extremes would suffice to change relative prices.

In concluding this sub-section, it is to be stressed that what the export boom brings about is an adjustment in relative prices. The boom, which is a real change, affects only relative prices.
There can be absolutely no implications of the export boom for any nominal prices, including the exchange rate, as the model is entirely non-monetary. One can obtain such implications only by taking some nominal price to be constant, so that the only way that relative prices can change is by changes in other nominal prices.

5.3 A FORMAL MODEL

As shown in the previous section, the emergence of a new export sector has implications for the other sectors which are equivalent to changes in protection and the exchange rate. In this section, a simple algebraic model is constructed to explicitly show these effects. We use this model for some illustrative numerical calculations.

(i) The Model

The model has three building blocks: (a) import demand; (b) export supply; and (c) trade balance equilibrium.

(a) Import Demand

Using a hat to denote proportional change ($\hat{x} = dx/x$), we specify import demand as follows:
(5.1) \[ \hat{M} = \alpha(\hat{P}_m - \hat{P}_h) + \beta \hat{y}, \quad \alpha < 0, \beta > 0, \]

where \( M \) is the volume of imports; \( \hat{P}_m - \hat{P}_h \) is the change in the relative price of imports; \( \hat{y} \) is the change in real income; \( \alpha \) is the price elasticity of demand and \( \beta \) is the income elasticity.

(b) Export Supply

We write \( X \) for the volume of total exports, consisting of traditional and new exports. The expansion of the new exports is associated with the boom. The export supply function is

(5.2) \[ \hat{X} = \lambda(\hat{P}_e - \hat{P}_h) + \gamma, \quad \lambda > 0, \]

where \( \lambda \) is the price elasticity of supply of traditional exports. Also included in (5.2) is a shift term \( \gamma > 0 \), which represents the autonomous increase in exports; \( \gamma \times 100 \) is the percentage increase in exports on account of the export boom.

(c) Trade Balance Equilibrium

For trade balance equilibrium, exports must equal imports, which we write in change form,

(5.3) \[ \hat{M} = \hat{X}. \]
(ii) Solving the Model

The endogenous variables of the model are \( \hat{M}, \hat{X} \) and \( \hat{P}_h \). We now solve the model to obtain expressions for these variables. Substituting (5.1) and (5.2) into (5.3) and rearranging yields

\[
\hat{P}_h = \left[ \frac{\lambda}{\lambda - \alpha} \right] \hat{P}_e - \left[ \frac{\alpha}{\lambda - \alpha} \right] \hat{P}_m - \left[ \frac{\beta}{\lambda - \alpha} \right] \hat{y} + \left[ \frac{\gamma}{\lambda - \alpha} \right].
\]

Substituting the right-hand side of (5.4) for \( \hat{P}_h \) in (5.1) yields the solution for imports,

\[
\hat{M} = \frac{\alpha \lambda}{\lambda - \alpha} \left[ \hat{P}_m - \hat{P}_e \right] + \frac{\lambda \beta}{\lambda - \alpha} \hat{y} - \frac{\alpha \gamma}{\lambda - \alpha}.
\]

Similarly, substituting (5.4) in (5.2) yields

\[
\hat{X} = -\frac{\lambda \alpha}{\lambda - \alpha} \left[ \hat{P}_e - \hat{P}_m \right] + \frac{\lambda \beta}{\lambda - \alpha} \hat{y} - \frac{\alpha \gamma}{\lambda - \alpha}.
\]

To interpret equation (5.4), we note that when \( \hat{y} = \gamma = 0 \), this equation can be expressed as

\[
\hat{P}_h = \omega \hat{P}_m + (1 - \omega) \hat{P}_e,
\]

where

\[
\omega = \frac{\alpha}{\lambda - \alpha}.
\]
is the elasticity of wages with respect to the internal price of imports. Thus, if an import duty increases $P_m$ by 15 percent and the internal price of exports remains unchanged, then wages ($P_h$) would rise by $\omega \times 15$ percent. It is to be noted that $\omega$ defined in (5.8) is a positive fraction. According to equation (5.7), $P_h$ is a weighted average of $P_m$ and $P_e$: Thus, the change in wages is bracketed by the changes in the internal prices of imports and exports. We will return to $\omega$ below.

(iii) The Effects of the Export Boom

From equation (5.4), *ceteris paribus*, the effect of the $\gamma \times 100$ percent autonomous increase in exports on wages is

(5.9) $P_h = \frac{\gamma}{\lambda - \alpha} > 0$,

where the positive sign follows from $\gamma > 0$, $\lambda > 0$ and $\alpha < 0$. Is this rise in wages greater or less than the autonomous increase in exports $\gamma$? Clearly, this depends on whether or not $(\lambda - \alpha)$ is less or greater than unity. As $\lambda$ is the export supply elasticity and $-\alpha$ is the absolute value of the import demand elasticity, it follows that wages will rise by less than the autonomous increase in exports when the sum of the export supply elasticity and the absolute value of the import demand elasticity is greater than unity. The intuition is that the greater the elasticities, the smaller will be the change in prices (wages) required to re-establish equilibrium after the export boom.
If commercial policy and the exchange rate remain unchanged, then this increase in wages causes the relative prices of both the traded goods to fall equiproportionally:

\[ (5.10) \quad \hat{P}_m - \hat{P}_h = \hat{P}_e - \hat{P}_h = - \frac{\gamma}{\lambda - \alpha} < 0. \]

The effect of the decrease in the relative price of imports on the volume of imports is

\[ (5.11) \quad \hat{M} = - \frac{\alpha \gamma}{\lambda - \alpha} > 0, \]

which follows from (5.1) when \( \hat{y} = 0 \). The effect on traditional exports is, from (5.2),

\[ - \frac{\lambda \gamma}{\lambda - \alpha} < 0. \]

Adding to this the expansion of the new exports, the total change in exports is

\[ (5.12) \quad \hat{X} = - \frac{\lambda \gamma}{\lambda - \alpha} + \gamma = \gamma \left[ 1 - \frac{\lambda}{\lambda - \alpha} \right], \]

\[ = \gamma \left[ 1 - \frac{\alpha}{\lambda} \right] = \gamma \omega > 0, \]

where the fourth step is based on (5.8) and the positive sign follows from \( \gamma > 0 \) and \( 0 < \omega < 1 \). Consequently, the export expansion of \( \gamma \times 100 \) percent has the effect of choking off traditional exports equal to \( -(\gamma \omega - \gamma) \times 100 = \gamma (1 - \omega) \times 100 \).
percent. Thus, a boom which initially increases total exports by \( \gamma \times 100 = 20 \) percent in the form of new exports would have the effect of decreasing traditional exports by \( 20 \times (1 - .7) = 6 \) percent when \( \omega = .7 \). Total exports would rise by \( 20 - 6 = 14 \) percent, comprising the 20 percent increase due to new exports and the 6 percent fall in exports of the traditional variety.

(iv) The Tariff Equivalences of the Boom

From the viewpoint of the traditional exporters, the export boom has the same effect on relative prices as does an increase in import protection. Conversely, for firms in the import-competing sector, the boom has the same effects as a reduction in import protection. In this sub-section, we use the model to work out these equivalences.

(a) Traditional Exports

The relative price of traditional exports falls as a result of the export boom. From (5.10),

\[
(5.13) \quad \hat{P}_e - \hat{P}_h = -\frac{\gamma}{\lambda} \frac{\alpha}{\alpha} < 0.
\]

We now derive an expression for the import tariff that would yield the identical fall in this relative price. This is the tariff-equivalent of the export boom from the viewpoint of the traditional exporters.
Going back to (5.7), in the absence of the boom, wages are related to the internal prices of the two traded goods as follows:

\[ \hat{P}_h = \omega \hat{P}_m + (1 - \omega) \hat{P}_e. \]

The change in the relative price of exports is thus

\[ (5.14) \quad \hat{P}_e - \hat{P}_h = -\omega \hat{P}_m, \]

when the internal nominal price of exports is constant \((\hat{P}_e = 0)\).

The internal price of imports is linked to the external price \((P_m^*)\) via the exchange rate \((S)\) and commercial policy:

\[ P_m = T \cdot S \cdot P_m^*, \]

where \(T\) is one plus the tariff rate. Thus,

\[ (5.15) \quad \hat{P}_m = \hat{T} + S + P_m^* = \hat{T}, \]

when world prices and the exchange rate are constant.

Combining (5.13) - (5.15), we obtain the tariff equivalent of the boom, which satisfies

\[ -\frac{\gamma}{\lambda - \sigma} = -\omega \hat{T}^e, \]

where the superscript \(e\) on \(T\) indicates that this tariff change is from the perspective of the exporters. Thus,
where the second step follows from (5.8). In words, the boom is equivalent to a tariff increase equal to the ratio of the size of the boom (γ) to the absolute value of the price elasticity of demand for imports (|α|). Consequently, if imports are unresponsive to price (|α| low), most of the adjustment to the boom must come about via a reduction in the traditional exports, requiring a large increase in $T^e$.

To interpret $T$, let all forms of import protection be equivalent to a uniform ad valorem tariff of 15 percent. If $T = .05$, this would mean that $T$ rises by 5 percent, from 1.15 to $1.15 + .05 \times 1.15 = 1.15 + .06 = 1.21$. In this case, the tariff rate increases by 6 percentage points, from 15 to 21 percent.

(b) The Import-Competing Sector

From (5.10), the relative price of imports falls by

\[ (5.17) \hspace{1cm} \hat{p}_m - \hat{p}_h = - \frac{\gamma}{\lambda - \alpha} < 0. \]

We wish to derive the tariff change that has exactly the same effect on this relative price. From (5.7), which holds in the
absence of the boom,

\[
\hat{P}_m - \hat{P}_h = (1 - \omega)(\hat{P}_m - \hat{P}_e) \\
= (1 - \omega)\hat{P}_m,
\]

when \( \hat{P}_e = 0 \). Using (5.15) to substitute \( \hat{T} \) for \( \hat{P}_m \) in the above equation, we obtain

\[
\hat{P}_m - \hat{P}_h = (1 - \omega)\hat{T}.
\]

Combining this with (5.17) yields the tariff change equivalent to the boom insofar as the firms in the import-competing sector are concerned:

\[
(1 - \omega)\hat{T}^m = -\frac{\gamma}{\lambda - \alpha},
\]

i.e.

\[
(5.18) \quad \hat{T}^m = -\frac{\gamma}{(\lambda - \alpha)(1 - \omega)} = -\frac{\gamma}{(\lambda - \alpha)\frac{\lambda}{\lambda - \alpha}} = -\frac{\gamma}{\lambda} < 0,
\]

where the superscript \( m \) indicates that this tariff change is from the perspective of the import-competing sector and where the second step in (5.18) is based on \( \omega = -\alpha/\lambda \). Thus, this tariff reduction is the ratio of the size of the boom (\( \gamma \)) to the price elasticity of supply of exports (\( \lambda \)). If traditional exports are unresponsive to price (\( \lambda \) low), then most of the adjustment must come about by an increase in imports, requiring a large reduction in \( T^m \).
The Relationship Between the Tariff Increase and the Tariff Decrease

Multiplying both sides of (5.16) and (5.18) by \( \omega \) and \((1-\omega)\), respectively, and adding the left and right hand sides, we obtain

\[
\omega T^e + (1 - \omega)T^m = \frac{\gamma}{\lambda - a} - \frac{\gamma}{\lambda - a} = 0 .
\]

In words, a weighted average of the two tariff changes equals zero.

To analyze further the relationship between \( T^e \) and \( T^m \), we use (5.19) to obtain

\[
\frac{T^m}{T^e} = \frac{\omega}{1 - \omega} .
\]

The term on the left-hand side can be described as the relative cost of the export boom - the cost for importers relative to that for the traditional exporters. It should be noted that this relative cost depends only on \( \omega \), not the size of the boom.

If \( \omega \) takes a low value of, say, .3, then

\[
\left| \frac{T^m}{T^e} \right| = \frac{.3}{1 - .3} = .4 .
\]

In this case, we could say that about 40 percent of the adjustment is borne by import-competing firms and the remaining 60 percent by the traditional exporters. If, on the other hand, \( \omega \) takes the
relatively large value of, say, .8, then the relative cost is

\[ \left| \frac{\tilde{m}}{\tilde{e}} \right| = \frac{.8}{1 - .8} = 4, \]

so that the importers' burden is four times that of the exporters.

We note finally that it follows from (5.20) and \( \omega = -\alpha/(\lambda - \alpha) \) that

\[ (5.21) \quad \left| \frac{\tilde{m}}{\tilde{e}} \right| = -\frac{\alpha}{\lambda - \alpha} \frac{\lambda - \alpha}{1 + \frac{\lambda - \alpha}{\alpha}} = \frac{\alpha}{\lambda}. \]

Accordingly, this relative cost can also be expressed as the ratio of the absolute value of the price elasticity of demand for imports to the price elasticity of supply of exports. The lower a sector's elasticity (in absolute value), the smaller is the adjustment burden that it bears and the larger is the part of the adjustment borne by the other sector. Result (5.21) is reminiscent of Dalton's Law in public finance, whereby the relative incidence of an excise tax is equal to the ratio of the demand elasticity to the supply elasticity; see Dalton (1952).

(vi) Illustrative Numerical Computations

To estimate the tariff equivalence of the boom, \( \tilde{e} \) and \( \tilde{m} \), we require estimates of the import demand and export supply elasticities, as well as the extent of the boom. Since the precise
estimates of these elasticities are not available, we shall calculate $\hat{r}_e$ and $\hat{r}_m$ under different sets of elasticities for a given size of the boom. If we assume various values of either the price elasticity of export supply ($\lambda$) or the price elasticity of import demand ($\alpha$), we can measure the other price elasticity by using the equation (5.8) $\omega = -\alpha / (\lambda - \alpha)$, under the assumption that $\omega$ has a specified value. Clements and Sjaastad (1984) estimated $\omega$ to be about .7 for Australia. Using this value, we can obtain from

$$\omega = \frac{-\alpha}{\lambda - \alpha} = .7$$

the following expression for the export supply elasticity:

(5.22) $\lambda = \frac{-3}{7} \alpha$.

Accordingly, the export supply elasticity is about one-half of the absolute value of the import demand elasticity. Using equation (5.22), we can obtain the value of the export supply elasticity corresponding to a specified value of $\alpha$. Table 5.1 gives various values of these elasticities.
TABLE 5.1
PRICE ELASTICITIES OF IMPORT DEMAND AND EXPORT SUPPLY WHEN \( \omega = .7 \)

<table>
<thead>
<tr>
<th></th>
<th>Import demand price elasticity, ( a )</th>
<th>Export supply price elasticity, ( \lambda )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Import demand price elasticity, ( a )</td>
<td>-1.2</td>
<td>-3.5</td>
</tr>
<tr>
<td>Export supply price elasticity, ( \lambda )</td>
<td>.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Now, for a specified value of \( \gamma \), the size of the boom, we can estimate the tariff equivalences of the boom under the various elasticity values. For example, if we have the import demand and export supply price elasticities of -1.2 and .5, respectively, and total exports expand by 30 percent (so that \( \gamma = .3 \)), then the tariff equivalence of the boom for the traditional export sector is, from (5.16),

\[
\hat{t}^e = \frac{\gamma}{|a|} = \frac{.3}{|-1.2|} = .25.
\]

Consequently, the boom is equivalent to a tariff increase which raises \( T = 1 + t \), where \( t \) is the average *ad valorem* tariff rate, by 25 percent. Thus, if \( t = .15 \) initially, the boom has the same effect as an increase in the tariff rate to \( t^e \), where \( t^e \) is defined by
\[ \hat{t}_m = \frac{\Delta(1 + \hat{t}_m)}{1.15} = .25, \]

so that

\[ \Delta \hat{t}_e = 1.15 \times .25 = .29. \]

Accordingly, the new tariff rate is

\[ t_e = t + \Delta \hat{t}_e = .15 + .29 = .44. \]

In other words, the average ad valorem tariff equivalent of all forms of protection increases by 44 - 15 = 29 percentage points, from 15 percent to 44 percent. This is the tariff equivalence of the boom insofar as traditional exporters are concerned. This huge increase simply reflects the large size of the boom and the relatively low value of the import demand elasticity.

Similarly, the import-competing sector is hit with an equivalent decrease in protection as a result of the boom. From (5.18),

\[ \hat{T}_m = -\hat{\gamma} = -\frac{3}{.5} = -.6. \]

In other words, the boom is equivalent to a tariff decrease such that \( T = 1 + t \) falls by 60 percent. Thus, if \( t = .15 \), we obtain the new tariff rate \( t_m \), defined by

\[ \hat{T}_m = \frac{\Delta(1 + \hat{t}_m)}{1.15} = -.6. \]
so that
\[ \Delta t^m = -.6 \times 1.15 = -.69. \]
Consequently, the new tariff rate is
\[ t^m = t + \Delta t^m = .15 + (-.69) = -.54. \]
In other words, the average ad valorem tariff rate would decrease by 69 percentage points, from 15 percent to -54 percent. Imports are now subsidized! Put another way, the export boom has the effect of squeezing the import-competing sector by the same amount as would a 54 percent tax on that sector.

Table 5.2 shows the tariff equivalences of the boom for various values of the elasticities and \( \gamma \). As can be seen, the tariff equivalences become greater as the size of the boom increases. Also, the less elastic the export supply and import demand, the higher are the tariff equivalences (for a given value of \( \gamma \)). A notable feature of the results is that in all cases, the boom hits the import-competing sector by so much that the new tariff rates, \( t^m \), are always negative (see column 7). While this result in part reflects the assumption that the initial tariff is 15 percent, it nevertheless shows that this model is somewhat too sensitive to exogenous shocks. We shall return to this issue in Section 4.

Finally, column 8 of Table 5.2 presents the change in the price of home goods (wages) resulting from the boom. As can be seen, the wage increase rises with the size of the boom and falls with the import demand and export supply elasticities.
TABLE 5.2  
TARIFF EQUIVALENCES AND INCREASES IN HOME GOODS PRICE RESULTING FROM AN EXPORT BOOM

<table>
<thead>
<tr>
<th>Size of the Boom</th>
<th>Price Elasticity</th>
<th>Tariff Expressed as the Elasticity Equivalence for the Traditional Import Demand</th>
<th>Export Supply Competing Sector to Column (6)</th>
<th>Percentage Increase in Home Goods Price</th>
<th>New Tariff Price</th>
<th>Tariff Percentage Expressed as the Elasticity Equivalence for Rate Increase Corresponding to Column (3)</th>
<th>New Tariff Rate</th>
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<td>7x100</td>
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<td>.43</td>
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<td>.64</td>
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<td>.86</td>
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<td>-13</td>
<td>7</td>
<td>.86</td>
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<td>.43</td>
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<td>.64</td>
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<td>-39</td>
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<td>.64</td>
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<td>25</td>
<td>.86</td>
<td>-59</td>
<td>-53</td>
<td>17</td>
<td>.86</td>
</tr>
</tbody>
</table>

\[ \hat{\gamma} \times 100 = \frac{\gamma}{\sigma} \times 100 \]
\[ t^e \times 100 = \hat{\gamma} \times 100 \]
\[ t^m \times 100 = \frac{\gamma}{(\lambda-a)} \times 100 \]

It is assumed that \( \omega = -a/(\lambda-a) = .7 \) and that the initial *ad valorem* tariff rate is 15 percent.
(vii) Values of the Price Elasticities Yielding Positive Tariff Rates

As shown in column 7 of Table 5.2, the new tariff rates corresponding to the export boom for the import-competing sector are negative. In other words, the export boom has the same effects on domestic producers of import-competing goods as does a subsidy to foreign producers. In this sub-section, we investigate the range of values of the elasticities which yield non-negative tariff rates.

It follows from the definition \( T^m = \Delta (1 + t^m) / (1 + t) \) that

\[
t^m = t + \Delta t^m = t + T^m (1 + t)
\]

Thus, to obtain a non-negative value of \( t^m \), we require

\[
t + T^m (1 + t) \geq 0.
\]

As \( T^m = -\gamma/\lambda \), and using an initial tariff rate \( t \) of 15 percent, the above becomes

\[
.15 - \frac{\gamma}{\lambda} 1.15 \geq 0,
\]

or

\[
(5.23) \quad \lambda \geq 7.7\gamma.
\]

In other words, to obtain a positive \( t^m \), the export supply elasticity must be greater than 7.7 times the proportionate
increase in exports.

Figure 5.11 illustrates (5.23) by showing the values of the export supply elasticity ($\lambda$) which yield $t^m = 0$ for various values of $\gamma$. The figure also gives the associated values of the import demand elasticity ($|\alpha|$). The values of $|\alpha|$ are specified as

$$|\alpha| = \frac{-\gamma}{3} \lambda,$$

which follows from $\omega = -\alpha/(\lambda - \alpha) = .7$. Points on the line give values of the elasticities yielding $t^m = 0$; points above the line yield $t^m > 0$; and points below yield $t^m < 0$. For example, when there is a 20 percent export boom ($\gamma = .2$), the export supply elasticity must be at least 1.5 (and the import elasticity at least 3.5) to yield a positive tariff.

It can be seen from Figure 5.11 that the elasticities must be on the high side to yield a positive tariff. Again, this reflects the tendency of this model to be too sensitive to the size of the exogenous shocks. For this reason, in the next section, we extend the model in such a way that it becomes somewhat less sensitive.

5.4 ALLOWING FOR INCOME EFFECTS

As observed in the previous section, the results of the model are too sensitive to the export boom. The tariff equivalences of the export boom are negative. To make the model less sensitive, we now include the income effects of the boom as well as the
FIGURE 5.11

VALUES OF THE PRICE ELASTICITIES YIELDING POSITIVE TARIFF RATES

Export Supply Elasticity ($\lambda$) vs. Import Demand Elasticity (Absolute Value) ($|\alpha|$)

$\lambda = 7.7\gamma$

$t^m > 0$

$t^m < 0$

Size of the Boom ($\gamma$)

(0, 1, 2, 3)
substitution effects.

(i) The Model

The previous model consists of three equations, viz., import demand (5.1), export supply (5.2) and trade balance equilibrium (5.3). We now extend this model by making income endogenous; in particular, income increases as a result of the boom:

\[ y = \delta \gamma, \quad \delta, \gamma > 0, \]

where \( \gamma \) is the size of the boom, as before. The coefficient \( \delta \) is interpreted as the percentage increase in income as a result of a 1 percent expansion of exports. For simplicity, equation (5.24) contains no trend rate of growth of income.

The model can be solved in exactly the same way as before. The reduced form for wages is

\[ \hat{P}_h = \left[ \frac{\lambda}{\lambda - \alpha} \right] \hat{P}_e - \left[ \frac{\alpha}{\lambda - \alpha} \right] \hat{P}_m + \frac{\gamma(1 - \beta \delta)}{\lambda - \alpha}. \]

This is to be compared with equation (5.4). The reduced form for imports is

\[ \hat{M} = \frac{\alpha \kappa}{\lambda - \alpha} \left[ \hat{P}_m - \hat{P}_e \right] + \frac{\gamma(\beta \delta \lambda - \alpha)}{\lambda - \alpha}, \]

which is to be compared with (5.5). Finally, the solution for exports is
\begin{equation}
(5.27) \quad \dot{X} = \frac{\lambda}{\lambda - a} \left( \dot{p}_e - \dot{p}_m \right) + \frac{\gamma(\beta \delta \lambda - a)}{\lambda - a},
\end{equation}
which is the extended version of (5.6).

When \( \gamma = 0 \), equation (5.25) can be expressed as

\begin{equation}
(5.28) \quad \dot{P}_h = \omega \dot{P}_m + (1 - \omega) \dot{P}_e,
\end{equation}
where \( \omega = -a/\lambda \). The above equation is identical to (5.7).

(ii) The Effects of the Export Boom

From equation (5.25), \textit{ceteris paribus}, the effect of the autonomous increase in exports of \( \gamma \) on \( P_h \), or wages, is

\begin{equation}
(5.29) \quad \dot{P}_h = \frac{\gamma(1 - \beta \delta)}{\lambda - a}.
\end{equation}

As \( \beta \delta \) is almost certainly less than unity (\( \beta \) being the income elasticity of demand for imports) and as \( \gamma > 0, \lambda > 0 \) and \( a < 0 \), the effect of the boom is to inflate wages, as before, i.e. \( \dot{P}_h > 0 \). If commercial policy and the exchange rate remain unchanged, then this increase in wages causes the relative prices of both the traded goods to fall equiproportionally:

\begin{equation}
(5.30) \quad \dot{P}_m - \dot{P}_h = \dot{P}_e - \dot{P}_h = - \frac{\gamma(1 - \beta \delta)}{\lambda - a} < 0.
\end{equation}
The effect of the decrease in the relative price of imports on the volume of imports is

\[ \frac{-a\gamma(1 - \beta\delta)}{\lambda - \alpha} > 0, \]

which follows from (5.1) and (5.30) when \( \gamma = 0 \). The income effect of the boom on imports is, from (5.1) and (5.24),

\[ \beta\delta\gamma > 0 . \]

Consequently, the total increase in imports is

\[ (5.31) \quad \hat{M} = \frac{-a\gamma(1 - \beta\delta)}{\lambda - \alpha} + \beta\delta\gamma = \frac{\gamma(\beta\delta\lambda - \alpha)}{\lambda - \alpha} > 0 . \]

The effect on traditional exports is, from (5.2) and (5.30) when \( \gamma = 0 \)

\[ \frac{-\lambda\gamma(1 - \beta\delta)}{\lambda - \alpha} < 0 . \]

Adding to this the expansion of the new exports, the total change in exports is

\[ (5.32) \quad \hat{X} = \frac{-\lambda\gamma(1 - \beta\delta)}{\lambda - \alpha} + \gamma = \frac{\gamma(\beta\delta\lambda - \alpha)}{\lambda - \alpha} > 0 , \]

which is the same as \( \hat{M} \).
(iii) The Tariff Equivalences of the Boom

As before, we now use the extended model to derive the tariff equivalences of the boom from the viewpoint of (a) the traditional exporters and (b) the import-competing sector.

(a) Traditional Exports

Following exactly the same steps as in the previous section, we can derive the following expression for the change in 1 plus the ad valorem tariff rate:

\[ T^e = \frac{\tau(1 - \beta \delta)}{|\alpha|} > 0 \]

where the superscript e on T indicates that the tariff change is from the perspective of the exporters. The analogous expression from the initial model is equation (5.16), which we reproduce here:

\[ T^e = \frac{\tau}{|\alpha|} > 0 \]

As can be seen, the above expression for the tariff change is always greater than that given in (5.33). This shows that when income effects are allowed for, the model is less responsive to shocks.
(b) The Import-Competing Sector

We can derive in a similar fashion as before the equivalent tariff change for the import-competing sector:

\[(5.34) \quad \tilde{T}_m = - \frac{\lambda(1 - \beta\delta)}{\lambda} < 0,\]

where the superscript \(m\) indicates that this tariff change is from the perspective of the import-competing sector. The corresponding equation in the previous section is (5.18), which we reproduce here:

\[\tilde{T}_m = - \frac{\gamma}{\lambda} < 0.\]

Obviously, the above expression for the tariff change is greater in absolute value than that given in (5.34). In other words, the allowance for income effects in our model dampens the tariff equivalence of the boom for the import-competing sector.

(iv) The Relationship Between the Tariff Increase and the Tariff Decrease

As before, a weighted average of \(\tilde{T}_e\) and \(\tilde{T}_m\) is zero:

\[\omega \tilde{T}_e + (1 - \omega) \tilde{T}_m = 0.\]
Also, the ratio of \( \hat{T}^m \) to \( \hat{T}^e \) is exactly the same as previously:

\[
\frac{\hat{T}^m}{\hat{T}^e} = \frac{\omega}{1 - \omega} = \frac{\alpha}{\lambda}.
\]

The invariance of these relative relationships reflects the fact that allowing for the income effects of the boom changes \( \hat{T}^m \) and \( \hat{T}^e \) equiproportionally.

(v) Illustrative Numerical Computations

In this sub-section, we present estimates of \( \hat{T}^e \) and \( \hat{T}^m \) defined in equations (5.33) and (5.34). We start by discussing the value of the new parameter \( \delta \), the elasticity of GDP with respect to new exports.

(a) The Value of \( \delta \)

According to The Economist of November 30 1985, "Between 1950 and 1973, each 1 percent rise in world income was accompanied by a 1.6 percent rise in world trade. Between 1973 and 1984, it was accompanied by a 1.1 percent increase" (p. 65). The falling responsiveness of world trade relative to income is attributed to increasing protection levels, especially non-tariff barriers. The implied value of the elasticity \( \delta \) for the latter period is \( 0.01/0.011 = .9 \). We shall use this value for \( \delta \).
(b) The Price Elasticities of Import Demand and Export Supply

We shall use the same values of the price elasticities of import demand \((\alpha)\) and export supply \((\lambda)\) as in Table 5.2.

(c) Computation of the Tariff Equivalence

To estimate the tariff equivalence of the export boom in our extended model, we also need the value of the income elasticity of demand for imports \((\beta)\) as well as the size of the boom \((\gamma)\). As before, we use various values of these parameters. Table 5.3 contains the results. The structure of this table is exactly the same as that of Table 5.2; the only difference is that Table 5.3 contains an additional column for the income elasticity \(\beta\).

A comparison of Tables 5.2 and 5.3 reveals the following. The changes in the tariff rates are now lower (compare columns 4 and 7 of Table 5.3 with columns 3 and 6 of Table 5.2). Many of the new tariff rates \(t^m\) are now positive, as can be seen from column 8 of Table 5.3. In addition, wages now increase by less as a result of the boom. Consequently, the model is now less sensitive to shocks, as required.
## Table 3.3

<table>
<thead>
<tr>
<th>Size of the Increase in Exports</th>
<th>Elasticity of Imports with respect to GDP</th>
<th>Tariff Equivalence for the Traditional Exports</th>
<th>New Tariff Rate</th>
<th>Price Elasticity of Home Goods Competing Sector</th>
<th>Tariff Equivalence for Corresponding</th>
<th>New Tariff Rate</th>
<th>Percentage Increase in Home Goods Price</th>
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<tbody>
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<td>$\beta$</td>
<td>$\sigma$</td>
<td>$\lambda$</td>
<td>$\rho$</td>
<td>$\theta$</td>
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<td>0.86</td>
<td>- 2.0</td>
<td>18</td>
<td>- 2.0</td>
</tr>
</tbody>
</table>

It is assumed that $\omega = - \sigma/(1-\sigma) = 0.7$ and that the initial ad valorem tariff rate is 15 percent. The elasticity of GDP with respect to exports $\beta$ is assumed to be 0.8.
REFERENCES


