SOME IMPLICATIONS OF THE GROWTH OF THE MINERAL SECTOR*

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The rapid growth of Australian mineral exports, through its effect on the balance of payments, is a significant force for structural change in other sectors. From the viewpoint of the rural sector which exports and the manufacturing sector which competes with imports, this force will be similar to that which would flow from very large tariff changes. Consequently, by observing the adjustments of the rural and manufacturing sectors to the rapid growth of mineral exports, it is possible to calculate indirect estimates of the effect of the Australian tariff on them. It is calculated that the mineral discoveries have had a much greater effect on these sectors than the recent across the board 25 per cent general reduction of tariffs.

Introduction

The impact of the tariff on the structure of the Australian economy has been a subject of discussion for a long time. The Brigden Committee [14], the Vernon Committee [13], and the Jackson Committee [11] believed that the tariff should be maintained at a high level to increase the size of the manufacturing sector.[1] As a corollary of this each believed that if the average tariff level were to be reduced it should be done very slowly. Although the Brigden Committee attempted to measure the cost of the tariff, none of the Committees was able to deal adequately with the quantitative effects of the tariff on the structure of Australian industry or to quantify the likely effects of tariff reductions.

It will be shown in this paper that it is possible to measure indirectly and approximately the influence of the average tariff level, and changes in that tariff level, on different sectors of the Australian economy by ob-

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[1] Australian tariffs are both higher and subject to greater variation across imports than tariffs levied by most other countries with comparable income levels. In 1970 Australian tariffs were approximately twice as high as Canadian tariffs, three to five times higher than Scandinavian tariffs, and two to three times higher than EEC tariffs. See IAC Annual Report 1974-5. The three Committees recommended against very high tariffs. The Jackson Committee recommended that tariffs be lowered to several benchmarks and the Vernon Committee recommended that tariffs be clustered around a uniform benchmark.

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serving the adjustments of each sector to the rapid growth of mineral exports. This measurement may be done by the application of a simple model which emphasises that the development of a new and rapidly growing export sector will affect the import competing sector in much the same way as a tariff reduction and affect the traditional export sector in much the same way as a tariff increase.

It is concluded, on the basis of the simple model, that the rapid and significant growth of mineral exports over the last decade has generated pressures for change in the structure of the Australian economy, at the broad sector level, which are greater in force than the influence of the average tariff. It is estimated, on the best available estimates of demand and supply price elasticities for exports and imports, that the effect of the rapid growth of mineral exports on the rural exporting industries is approximately equal to the effect, in the absence of the mineral exports, of a doubling of the tariff level. For the import competing sector the effect of the mineral discoveries is estimated to be approximately equal to setting the average tariff at zero and introducing an import subsidy.

Consequently, a significant proportion of the difficulties now experienced by export and import competing industries which are arising from changes in the Australian cost level relative to that of our overseas trading partners—both through exchange rate changes and relative inflation rates—might be explained by the rapid growth of mineral exports over the last decade. In this regard it is constructive to compare some relevant figures related to mineral exports and the tariff. Over the 6 years 1964-5 to 1970-1 mineral exports from Australia increased from 9 to 26 per cent of total exports. Between 1973-4 and 1974-5 one mineral export, coal, increased in value by $313 million or 5 per cent of the total value of exports. These export figures might be compared with estimates of the effect on import flows of the 25 per cent general tariff reduction of 19 July, 1973. *The Report on Possible Ways of Increasing Imports* [12] estimated that over a 12 month period imports would increase by $400 million, that is approximately 6½ per cent of total exports,[2] which is a slightly greater increase than the annual increase in the value of coal exports.

Two other related themes may also be illustrated by the simple model. First, the adjustment difficulties of the sectors involved in international trade, which are arising from large changes in the structure and level of Australian exports, cannot be avoided by increases in government assistance to all export and import competing industries simultaneously. Assistance to one export industry or an import competing industry represents a tax on other export or import competing industries and hence increases in assistance 'all round' will be self defeating. Industry assistance must be concerned with relative levels of assistance between industries.

Second, it follows from the nature of industry assistance that one effect of the 25 per cent general reduction of tariffs was to move some of the adjustment, which the mineral exports necessitated, away from the mineral and rural sectors to the import competing sector. It is extremely unlikely, however, that the adjustment required by the mineral

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[2] The estimate provided by Gregory and Martin [5] of the increase in imports arising from the general tariff reduction is approximately 4½ per cent of total exports.

and rural sectors will be avoided by the 25 per cent general tariff reduction. The analysis suggests that as a result of the 25 per cent general tariff reduction less than one quarter of the adjustments that the mineral and rural sectors may otherwise have incurred will be shifted on to the import competing sector.

The paper is structured as follows. The simple model is developed in Part I and applied to the Australian economy in Part II. A summary is provided in Part III.

I   The Model

The essence of the simple model, which serves as a framework around which to arrange the paper and to establish rough orders of magnitude of the economic phenomena to be discussed, is that it stresses the effect of relative prices on the supply of exports and the demand for imports. The prices considered are the price of internationally traded goods, exports and imports, relative to the price of non traded goods. We assume that the world prices of traded goods are given and unaffected by the demand for imports in Australia or the supply of Australian exports. This is the small country assumption which is often made when analysing Australian trade problems. The model therefore abstracts from terms of trade effects. In the beginning the model also abstracts from capital flows and concentrates upon the balance of trade.

Figure 1 measures on the vertical axis the price of traded goods divided by the price of non traded goods. The horizontal axis measures the quantity of traded goods. Two assumptions are necessary to permit exports and imports to be represented along the one axis. First, it is assumed that the terms of trade between them are fixed and as a result the world prices of Australian exports and imports are independent of Australian actions.[3] Second, it is assumed that the units of exports and imports are chosen so that the terms of trade between them, at world prices, are unity.

The line marked M_o on Figure 1 represents the demand for imports at each relative price. At any given set of co-ordinates the steeper the curve the less elastic the demand for imports. The line marked X_o represents the export supply curve. The steeper the curve, at any given set of co-ordinates, the less elastic the supply of exports. The price ratio P_o and the quantity q_o are those that prevail at balance of trade equilibrium under conditions of free trade.

A tariff may be introduced into Figure 1. The effect of a tariff, at any given set of pre-tariff relative prices, is to reduce the demand for imports; that is to move the M line to the left. If M_1 is the demand curve for imports after a tariff has been imposed the tariff is measured by the vertical distance between M_o and M_1. The introduction of a tariff reduces the quantity of imports purchased, causes the balance of payments to move into surplus, and hence generates pressures to decrease the price of traded goods relative to non traded goods.[4] This price change may arise

[3] The assumption that the terms of trade are unaffected by Australia's actions is necessary for the diagrammatic presentation of the analysis but not for the analysis itself. To allow for variable terms of trade will increase the complexity of the analysis but will not change the key propositions of the paper.

[4] It is assumed that the introduction of a tariff does not affect the supply curve of exports. For example the increased price of imported inputs, inclusive of the

Price of Traded Goods
Price of Non Traded Goods
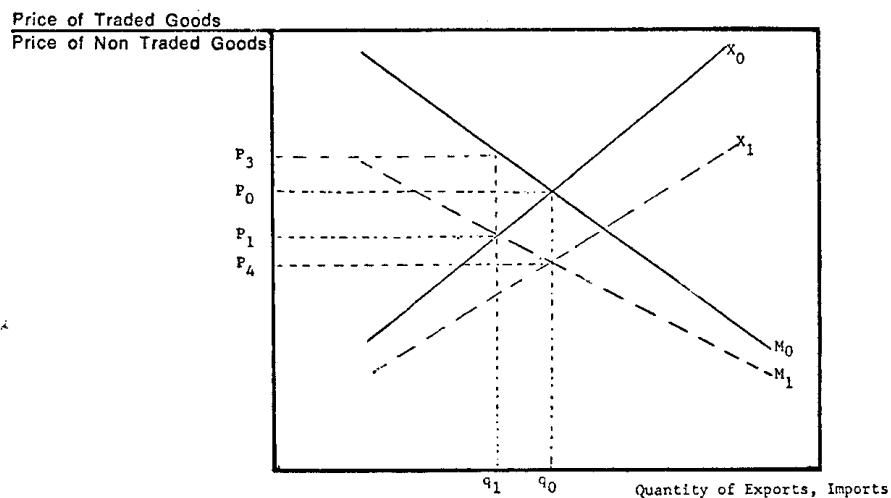
FIGURE 1

Exports, Imports and Relative Prices

Price of Traded Goods
Price of Non Traded Goods
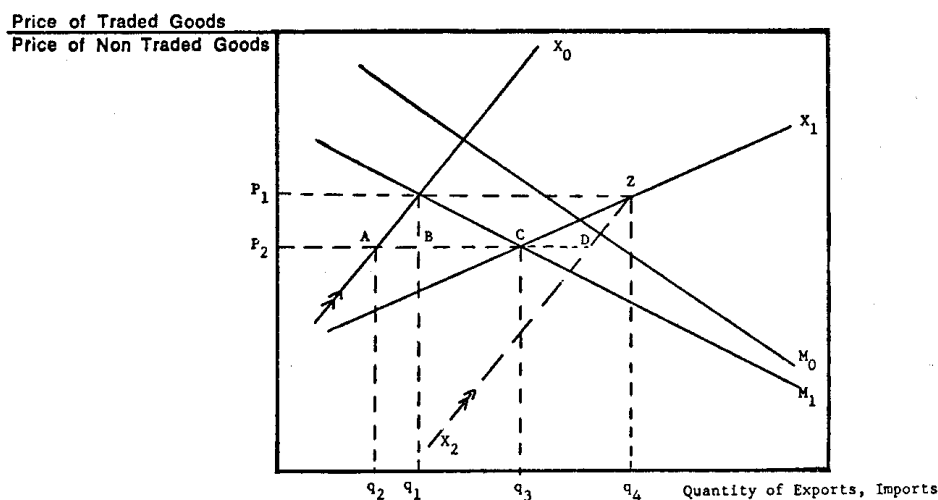
FIGURE 2

Exports, Imports and Relative Prices

from differential rates of inflation between Australia and the rest of the world or through exchange rate changes. We assume for the moment, purely for purposes of exposition, that all price changes between traded and non traded goods are effected by exchange rate changes so that

tariff, and the change which may occur in factor prices are not sufficiently large to warrant attention. (Note that if the average tariff on the imported inputs into the export sector is less than the devaluation equivalent of the tariff then the tariff structure may reduce costs to the export sector.) It is also assumed that domestic consumption of exportables is negligible and hence there are zero cross price effects in consumption between traded goods.

relative price changes can be equated with devaluations or appreciations of the Australian dollar—in other words, the price of non traded goods is fixed. At the new equilibrium represented by the price P_1 and the quantities q_1 there is a lower quantity of exports and imports. The reduction of exports and imports can be measured by the distance $q_o - q_1$.

Another effect arising from the imposition of a tariff is to introduce another relative price into the analysis. In addition to the relative price of traded and non traded goods at border prices, P_1, there is now the price of non traded goods relative to the price of imports, inclusive of the tariff, P_3.

The distance $P_o - P_1$ is the appreciation of the exchange rate induced by the tariff. It is sometimes referred to as the devaluation equivalent of the tariff because it represents the amount, given the assumption that the price of non traded goods is fixed, that the Australian dollar would need to be devalued if the tariff were removed.

To increase our familiarity with Figure 1 we use it to illustrate two recent well known policy issues; tariff compensation and the effect of the tariff on the size of the manufacturing sector as discussed by the Vernon Committee.

The key proposition of the tariff compensation argument, that if imports are subject to a uniform tariff then subsidising exports can bring about a free trade situation (see the Rural Green Paper [10] and the 1973-74 IAC Annual Report [9]), may be illustrated by moving the export line downwards to X_1, where the vertical distance between X_o and X_1 is the export subsidy. If the subsidy, at the new equilibrium prices, is set equal to the tariff, the free trade export and import quantities q_o will be generated. The domestic prices received and paid in Australia, inclusive of tariffs and subsidies, are represented by the free trade price ratio P_o.[5] The border price of traded goods, exclusive of tariffs and subsidies, relative to the price of non traded goods is represented by P_4, the Australian dollar having appreciated by the extent of the tariff and the subsidy.

Figure 1 can also be used to illustrate an important contradiction in the Vernon Report (see Corden [1]). It was argued in that Report that (i) for all practical purposes the price elasticity of the export supply curve could be regarded as approximately zero and (ii) the tariff had increased the size of the manufacturing sector. It becomes fairly obvious, if a vertical export supply curve is drawn on Figure 1, that these state-

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[5] The model developed here is based on the 'elasticity approach' and cannot take into account the effects of differences in the level of national income in the situations that are being compared. It has this defect in common with most empirical work that measures the cost of protection and the gains from trade liberalization, see S. Magee [7]. Rudiger Dornbusch [3] has recently developed more fully the theory underlying models of the type above and their relationship to 'absorption' models.

To fully account for general equilibrium effects would require a much more complex and computerized model such as the IMPACT model being developed by a number of Australian government departments. At the empirical level, however, it is not likely to be particularly important that expenditure effects are ignored. Estimates of the increase in GNP which will arise if the tariff were removed vary between 1 and 3 per cent. If the income elasticity of demand for imports is approximately unity the change in the position of the import demand curve as a result of the differences in the income levels of the situations being compared will be quite small relative to the movement along the curve in response to changes in relative prices.

ments are contradictory. If the export supply curve is vertical the effect of a tariff is to redistribute income away from the export sector towards the government sector which receives the tariff revenue. The import competing sector is unaffected by the introduction of a uniform tariff because the tariff is exactly offset by the exchange rate change that is necessary to maintain external balance. The tariff therefore solely affects income distribution and not the relative size of the export and import competing sectors.

Each of these examples demonstrates that to assess the effects of significant and widespread tariff reform, or other changes in industry assistance, export demand and supply relationships are as important as import demand and supply relationships.

The Emergence of a New Export Sector: The Mineral Discoveries

By using a diagram similar to Figure 1 the effects of an emergence of a new export sector may be easily demonstrated. This is done in Figure 2. The curve X_1 in Figure 2 represents the horizontal addition of the export supply curve of the traditional (rural) export sector, X_o, and the export supply curve of the new (mineral) export sector. The horizontal distance between X_o and X_1 represents the quantity of mineral exports at any given relative price. The emergence of a new export sector causes the price of traded relative to non traded goods to fall from P_1 to the new price equilibrium P_2. This price reduction has a number of effects on the traditional export sector and the import competing sector.

First, with regard to the traditional export sector, the price received, relative to the price of non traded goods, falls from P_1 to P_2 and the quantity of exports supplied falls from q_1 to q_2, or B to A. Hence, *ceteris paribus*, mineral exports reduce the size of the traditional export sector.

Second, with regard to the import competing sector, the price of importables falls and the quantity of imports demanded increases from q_1 to q_3, or the distance B to C. Hence the mineral discoveries increase the quantity of imports and reduce the size of the import competing sector.[6]

Finally, with regard to the new export sector, if its plans before it began exporting were predicated on the old price ratio P_1 then it too will be adversely affected by the new price ratio P_2. The under-realization of expectations based on the old price ratio can be measured in terms of output by drawing X_2 parallel to X_o through the point z and measuring the horizontal distance, C to D, between X_2 and X_1 at the new price ratio, P_2.

It is evident therefore that each of the three sectors must adjust from the situation they would be in if relative prices had remained at P_1. Each sector will bear the same price adjustment downwards from P_1 to P_2,[7]

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[6] Not all of the increase of imports, $q_1 - q_3$, will replace Australian production. The exact proportion depends on the expenditure effects which are ignored. The proportion will be less than 100 per cent because the mineral discoveries will increase national income and the import competing sector will share in the income effects.

[7] There are two prices of importables, one inclusive of the tariff which is the price of domestic production of importables and the other exclusive of the tariff which is the price of imports at border prices. The reduction in the two prices will not generally be equal. The exposition is simplified if it is conducted mainly in terms of the price of imports excluding the tariff.

but in general, will be subject to different quantity adjustments, B to A, B to C and C to D. It is the contraction of traditional exports, B to A, and the increase in the quantity of imports, B to C, which 'makes room', for the quantity of new exports, which is equal to A to C.

The adjustments that need to be made depend on the extent of the mineral discoveries, the price elasticity of supply of mineral exports and the price elasticity of demand and supply of imports and traditional exports. If the elasticity of supply of mineral exports is zero all the adjustment must be borne by both or either of the import competing and traditional export sector. The more elastic the import demand curve relative to the traditional export supply curve the greater the output adjustment by the import competing sector and the less the output adjustment of the traditional export sector. If the price elasticity of supply of the traditional export sector is also zero, as it was assumed to be by the Vernon Committee, then there will be an income transfer away from both export sectors, because the price of their output has fallen, but *all* the output adjustment must be borne by the import competing sector.

Government Intervention and the Incidence of Adjustment to the Emergence of a New Export Sector

A major short run effect of an unanticipated emergence of a new export sector, and the movement towards the new price ratio of traded to non traded goods, is that expectations as to future profitability of each sector will be disrupted. Each sector will become less profitable as mineral exports grow. It is this disruption in profit expectations, arising from the change in price relativities, that leads to the adjustments that are necessary in the economy to accommodate the new export sector and to convert the mineral exports into goods and services which will increase the wealth of the Australian community. If relative prices do not change mineral exports will result in the accumulation of foreign reserves in London and New York banks and the wealth of the community, in terms of the goods and services it consumes, will not increase.

This disruption of expectations is a short run phenomenon which occurs while the adjustment is taking place. Once the adjustment is complete each sector has changed in size and the profitability of each sector has returned to its long run equilibrium rate. In the short run, however, as a result of the disruption of expectations in the traded goods sectors and perhaps as a result of the higher unemployment that may occur during the adjustment period, governments will be subject to an increasing number and intensity of requests for assistance from the traded goods sector. The requests for assistance may take two general forms: requests that the Australian dollar be devalued to restore the profitability of the traded goods sector and requests for assistance specific to each sector.

Devaluations of the Australian dollar

It is clear from Figure 2 that to reach a new balance of payments equilibrium the price of traded goods must fall relative to non traded goods either through an appreciation of the Australian dollar which causes the price of traded goods to fall, or through inflation of the domestic price level which causes the price of non traded goods to rise. Whatever the mechanism that changes the price of traded goods relative

to non traded goods, it is possible that significant sections of the traded goods sectors will see the solution to their difficulties in the devaluation of the Australian dollar which will move the price ratio back to P_1. It is clear, however, that the old price ratio generates balance of payments surpluses, measured in terms of export quantities q_1 to q_4. Hence, if the Australian dollar is to be devalued and relative prices set at an inappropriate level by this action the price of non traded goods must change to restore balance of payments equilibrium and the rate of inflation in Australia must be higher than it would otherwise be. Devaluation of the Australian dollar to restore the old price ratio, P_1, and to place the traded goods sectors back in their previous relative positions is self-defeating. Exchange rate changes cannot relieve the traded sectors of the adjustments that are necessary and therefore cannot provide a mechanism of assistance. In this model the relative price of traded and non traded goods is determined by the real factors underlying the import demand and export supply curves and government assistance measures such as the tariff.[8] The exchange rate is a veil behind which the relative size of sectors is determined.

Assistance Specific to Each Sector

The analysis of increases in assistance which are specific to each sector is simplified if it is divided into two parts. First, the effect of increases in assistance all round, that is more government assistance to all of the trading sectors, and second the effect of differential rates of assistance.

Assistance all round to restore each sector to its previous position at the price ratio P_1 is self-defeating for the same reason that devaluation of the exchange rate is self-defeating. Assistance all round to the traded goods sectors, which in the first instance manages to restore the old price ratio, will generate balance of payments surpluses which, in turn, will result in off-setting changes in the exchange rate or the rate of inflation in Australia relative to her trading partners to move the price ratio back to the new equilibrium P_2.

Rates of assistance which differ between sectors, however, affect both the new equilibrium price ratio P_2 and the adjustments to be made by each sector. Consider first an increase in the tariff to protect the import competing sector. In Figure 3 this is represented as a downward movement in the import demand curve to M_2. The effect of an increase in the tariff is to cause the equilibrium price ratio of traded to non traded goods to fall further to P_3 and for the equilibrium quantity of exports to fall to q_2, that is to be reduced by the distance C to E. Hence the adjustment to be borne by the traditional export sector and the new export sector is increased. The additional output adjustment by the traditional export

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[8] In the analysis above it is relative prices which are important and not absolute prices. Hence there are infinite combinations of exchange rate changes and relative rates of inflation between Australia and her trading partners that can generate the equilibrium price ratio. For this reason it is by no means necessary, in order to maintain balance of payments equilibrium, that the mineral discoveries be accompanied by appreciations of the Australian dollar. All that is necessary is a change in the price of traded goods relative to non traded goods. The emergence of a new export sector could easily be accompanied by devaluations of the Australian dollar which are more than offset by the rate of inflation in Australia relative to her trading partners.

Price of Traded Goods
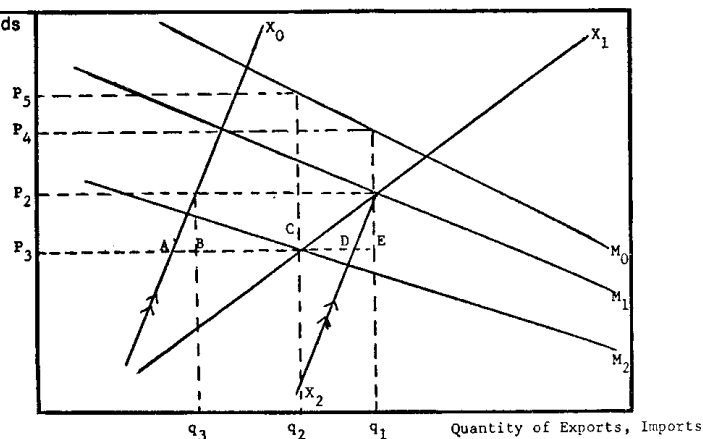Price of Non Traded Goods

FIGURE 3

Exports, Imports and Relative Prices

Price of Traded Goods
Price of Non Traded Goods
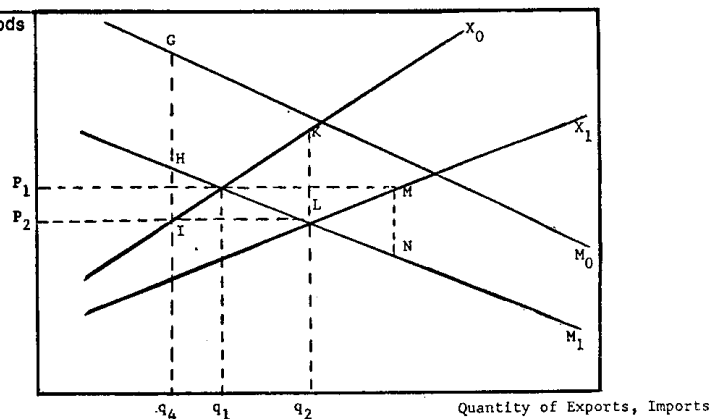
FIGURE 4

Exports, Imports and Relative Prices

sector is the distance A to B, and the additional output adjustment of the mining sector is the distance C to D. The distance C to D is calculated in a manner akin to that used previously by drawing X_2 parallel to X_o and to pass through the point represented by the co-ordinates of the previous equilibrium P_2q_1 and then measuring the horizontal distance between X_1 and X_2 at the new equilibrium price ratio, P_3. The distance A to B is also calculated in the same manner as previously. As X_2 is parallel to X_o the distance A to B is equal to the distance D to E. The reduction in the adjustment to be borne by the import competing sector is the addition of A to B and C to D, which is equal to the distance C to E. *Hence, measured in terms of output, the increased assistance to*

the import competing sector is equal to the increased adjustment that must be borne by the other two sectors.[9]

Similar analysis may be undertaken for increases in assistance to the other sectors. For example, the rural sector may be granted more subsidies. This could be represented on Figure 3 by moving X_o and X_1 to the right. The equilibrium price of traded to non traded goods will fall and the adjustment to be borne by the other sectors will increase. Alternatively, the mining sector may be offered taxation concessions in which case X_1 is moved to the right and more adjustment is borne by the other sectors.

The three sectors are inextricably linked by the balance of payments constraint and hence assistance to one must be at the cost of the others. Each of the traded goods sectors therefore has a vital interest in the increases of assistance granted to the others.

It also follows, as a result of the symmetrical properties of the analysis above, that the adjustment to one of the traded goods sectors, as a result of the emergence of a new export sector, can be relieved by reducing the level of assistance to another. For example, assume that M_2 (Figure 3) represents the demand for imports at the tariff level prevailing before 19 July 1973 and a general tariff reduction of 25 per cent moves the import demand curve upwards to M_1. In these circumstances the two export sectors are relieved of the adjustment measured by C to E, which is now borne by the import competing sector.

II   An Indirect Method for Assessing some of the Effects of Across The Board Increases and Decreases in the Tariff

From the viewpoint of individual sectors producing traded goods the emergence of a new export sector will simulate the more important effects of significant across the board tariff increases or decreases. Consequently, because of the rapid growth of mineral exports, it is possible from recent history to derive some indication of the effects on the traditional export and the import competing sectors of across the board tariff changes without the necessary pre-condition that these tariff changes have actually occurred. The way this may be done is demonstrated in Figure 4.

From the viewpoint of the traditional export sector there is little to choose between the emergence of a new export sector and an increase in the general level of tariffs. Both lead to less traditional exports and lower prices for traditional export products. It is possible therefore to define a tariff increase which, in the absence of the new export sector, would have had approximately the same effect on traditional export output and prices as the emergence of the new export sector. In Figure 4 the tariff increase which is equivalent[10] to the emergence of the new export sector is

[9] The change in the relative position of the sectors may also be measured in terms of price changes. The price of import competing products is increased from P_4 to P_5 (the increase in the tariff less the fall in the price ratio of traded to non-traded goods at border prices) and the price received by the other two sectors has fallen from P_2 to P_3.

[10] It is important to appreciate the limited nature of this equivalence. An equivalence as defined here does not imply that all the effects of a tariff increase and the emergence of a new export sector are identical. For example, a tariff increase will reduce, but the emergence of a new export sector will increase, the equilibrium volume of exports and imports. Likewise a tariff increase will increase,

measured by the distance H to I. A tariff increase of this amount would move the import demand curve downwards to pass through the point with co-ordinates P_2 q_4 and hence give rise to the same price ratio and quantity of traditional exports that are generated by the emergence of the new export sector. The equivalent tariff increase may be compared with the existing tariff which is measured by the distance G to H.

From the viewpoint of the import competing sector, the emergence of a new export sector is equivalent to a tariff reduction. Both lead to a lower price of importables, more imports and a smaller import competing sector. The tariff reduction which is equivalent to the emergence of a new export sector may be measured on Figure 4 by the distance L to K. A tariff reduction of this magnitude, in the absence of a new export sector, would have placed the import competing sector in approximately the same position that it is placed in by the mineral discoveries.[11]

Finally, from the viewpoint of the new export sector the gap between the economic conditions that would have prevailed at the old price ratio P_1 and the economic conditions that prevail at the new price ratio can also be measured in tariff equivalent terms. The deterioration in economic conditions experienced by the mineral sector, which is brought about by its own growth, can be offset by a tariff reduction. This tariff reduction, which is measured as M to N, would enable the old price ratio and the corresponding level of mineral exports to be consistent with balance of payments equilibrium.

In principle therefore the emergence of a new export sector can enable an indirect assessment of the effects of an across the board change in the general level of tariffs on the rural and import competing sectors. Broadly speaking, by measuring the distances H to I and L to K on Figure 4 and the distance between M_1 and M_o, we can say that the changes that have been observed in the traditional export and the import competing sectors since the emergence of the new export sector are, *ceteris paribus*, the changes that would have occurred without the mineral discoveries but with a tariff increase of H to I, from the viewpoint of the rural sector, or a tariff reduction of L to K from the viewpoint of the import competing sector.

The Numerical Analysis

To estimate the 'tariff equivalents' of the emergence of a new export sector and thereby derive indirect estimates of the effect of across the board tariff changes it is necessary to measure the tariff and the slopes of the various export supply and import demand curves.

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but the emergence of a new export sector will decrease, the size of the import competing sector. However, from the viewpoint of the traditional export sector the difference in the effects of a tariff increase and the emergence of a new export sector are not great.

[11] There are a number of reasons why this tariff equivalent may be less precise than that defined for the traditional export sector. One reason is that the equilibrium expenditure level which accompanies the tariff change, in the absence of the mineral discoveries, is different from that which accompanies the mineral discoveries. This complication, however, is probably not quantitatively significant. Another reason arises from the dispersion of the Australian tariff structure. This is discussed later.

The Tariff

Before tariff data can be applied to Figure 4 there are two questions which need to be resolved. First, since the previous analysis includes only one tariff, what are the implications of the large dispersion of Australian tariff rates and second, what is the tariff that is measured on Figure 4?

The Australian tariff ranges from zero, for approximately 55 per cent of imports, to over 55 per cent, for approximately 4 per cent of imports (Gregory and Martin [5]). From the viewpoint of the rural and the mining export sectors this dispersion of tariff rates is of little significance if the tariff exerts most of its influence on the price of their outputs, through the change in the price ratio of traded to non traded goods, rather than on the prices of different inputs, through the direct effect of tariffs.[12] As this appears to be the case, the dispersion of tariff rates can probably be ignored without serious repercussions.

For the import competing sector, however, the substitution of an average tariff for the existing tariff structure does have some important implications. One implication is that the tariff change which is equivalent to the mineral discoveries is not a clear cut concept which parallels exactly the type of tariff reduction which could conceivably be implemented. The difficulty is that across the board tariff reductions and most other systematic reductions in the average tariff will narrow the dispersion of prices within the import competing sector. However, the effect of an emergence of a new export sector, which operates through the exchange rate or the rate of inflation in Australia relative to its overseas trading partners, is to leave that price dispersion unaffected. Consequently, within the import competing sector the effect of the mineral exports on industries which are protected by a tariff below (above) the average will be more (less) than is implied by the calculated tariff change equivalent.[13] The tariff change equivalent therefore must be interpreted as an average and should not be applied to individual industries.

What is the appropriate tariff to be measured on Figure 4? For our purposes Australian imports may be divided into dutiable imports in one category and by-law and non dutiable imports in another. Dutiable imports, which are often identified as imports which compete directly with Australian production (Corden [2]), have in recent years been approximately 45 per cent of total imports (A.B.S. [15]). In principle, therefore, two import demand curves could be included in the earlier figures, one for dutiable and the other for non dutiable and by-law imports and the question arises as to whether the vertical distance between M_o and M_1 represents the average tariff over all imports or the average tariff over

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[12] It has been implicitly assumed earlier that the effects of the tariff on input prices in the export sector is not sufficiently great to change export supply curves in response to tariff changes.

[13] Perhaps the problem may be best understood by an example. Suppose the emergence of the new export sector leads to an appreciation of 10 per cent of the Australian dollar and thus reduces the domestic price of imports by 10 per cent. The tariff change equivalent of this appreciation, on the price of imports, will vary from industry to industry according to the level of the tariff which is applied to the competitive imports of each industry. An appreciation of 10 per cent is equivalent to a 25 per cent tariff reduction for an industry protected by a 40 per cent tariff; a 60 per cent tariff reduction for an industry protected by a 20 per cent tariff and a 100 per cent tariff reduction plus an import subsidy for industries protected by tariffs of less than 11 per cent.

dutiable imports. The correct tariff is the average tariff which applies to dutiable imports. This tariff will be approximated by dividing the total tariff revenue collected by the value of dutiable imports.[14] For all but one year between 1961-62 and 1973-74 the average duty paid on dutiable imports varied between 23 and 26 per cent. For 1972-73 the average duty paid was 29 per cent and the following year, the year of the 25 per cent general tariff reduction, it was 26 per cent (A.B.S. [15]).

The Slopes of Import Demand and Export Supply Curves

Import Demand Curves

Most attempts to estimate price elasticities of demand for Australian imports have either estimated statistically insignificant price elasticities or price elasticities which are very low. The early versions of the Treasury-ABS *National Income Forecasting Model* did not include a significant price elasticity of demand for imports. The current version estimates the long term price elasticity to be 0·88. The early versions of the Reserve Bank econometric model also did not include separate statistically significant price elasticities of import demand. The current version estimates the long term price elasticity of import demand to be 0·78. Similar results have been found for other countries. A recent but by no means exhaustive bibliography, by R. M. Stern *et al* [8] lists 134 published articles covering 18 major trading countries. Table 1, which is taken from that survey, lists the range and median of the 'best estimates'[15] of long run elasticities of demand for a number of countries. The most noticeable features of these price elasticities are their consistency and low values. All estimates are within the interval —0·13 and —3·00. The 'best' estimates lie between —0·65 and —1·66. We will assume the elasticity of demand for imports to be unity, two or three.

Export Supply Curves

Rural Sector

There is not a great deal of information as to the price elasticity of rural export supply curves. The Vernon Committee believed that for practical purposes they may be assumed to be zero. In a study for the U.S. Department of Agriculture F. H. Gruen *et al.* [6] estimated for 5 major rural exports—wool, lamb, wheat, coarse grains, and dairy—that the price elasticities of supply after a 5-year period were all less than unity. After a 10-year period most elasticities were still less than two. A list of the estimates[16] of Gruen *et al.* [6] is given in Table 2. We assume that the price elasticities of rural export supply vary between 0·7 and 3.

[14] The available estimates of the uniform tariff equivalent of the tariff structure before the 25 per cent general tariff reduction (see Evans [4]) indicate that this is a reasonable assumption. Evans estimated the uniform tariff to be between 18 and 22 per cent. The average tariff on dutiable imports in that year was approximately 23 per cent.

[15] The best estimates are the approximate median estimates from each study.

[16] These are estimates of the price elasticity of total rural supply for each product and not estimates of export price elasticities. It is not possible, *a priori*, to know whether these elasticities are larger or smaller than the export elasticities. To the extent that there is substitution between the domestic and export market the total supply elasticities will understate the export supply elasticities. However, a bias in the other direction will also arise because the supply elasticities are calculated by varying the price of one product, keeping the prices of other agricultural products fixed.

TABLE 1

Estimated Elasticities of Import Demand for Selected Countries

Country	Range	Best	Country	Range	Best
			United King-		
United States	—0·41 to —3·00	—1·66	dom	—0·22 to —1·38	—0·65
Canada	—0·62 to —1·59	—1·30	New Zealand	—0·38 to —1·12	—1·12
Japan	—0·77 to —1·47	—0·78	W. Germany	—0·24 to —1·48	—0·88
France	—0·39 to —1·53	—1·08	Italy	—0·13 to —1·42	—1·03

Source: R. M. Stern *et al.* [8] pp. 19-21.

TABLE 2

Estimated Own Price Elasticities of Supply for Some Rural Products

Product	Own Price Elasticity		
	Period 1 year	Period 5 years	Adjusted Infinite Period
Wool	0·05	0·24	3·6
Lamb	0·20	0·93	3·2
Wheat	0·18	0·82	3·8
Coarse Grains	0·21	0·80	1·5
Dairy	0·19	0·43	0·45

Source: F. H. Gruen *et al* [6] p. 178.

New Mineral Sector

I have yet to find published estimates of the price elasticity of export supply curves for the mineral sector. It is assumed that they lie between 0·5 and 6·0.

The Calculations

The estimates of tariff equivalents which follow are not and cannot be precise. One reason is the simple nature of the model and another is the lack of reliable estimates of the various price elasticities of demand and supply.[17] The estimated tariff equivalents are provided to establish rough orders of magnitude and to demonstrate that the phenomena that are being discussed are not quantitatively trivial.

The Rural Export Sector

The calculations are based on Figure 4. Over the last few years rural exports have been approximately 50 per cent of total exports and mineral exports approximately 25 yer cent. Some of the remaining 25 per cent of exports are also attributable to these sectors in that they involve fairly basic processing of mineral and rural products. We assume therefore that mineral exports are one-third and rural exports two-thirds of total exports.[18]

[17] Earlier, the model of Part I was described as an exercise in the 'elasticity approach' to exchange rate and tariff changes. An alternative view is to assume that the demand and supply curves embody both price and income responses.

[18] A more sophisticated analysis, which groups together mineral and manufactured exports, which have also grown relative to rural exports, and takes into account the level of these exports before the rapid growth of non-rural exports began also leads to similar proportions. The calculations presented in Table 3 can be easily adjusted by dividing by 0·3 and multiplying by a proportion which the reader may prefer.

If the equilibrium prices, P_2, and quantities, q_2, of Figure 4 are set at unity the distance q_4 to q_2 may be written as $0 \cdot 3$. If the slope of the M_1 curve[19] is unity the vertical distance H to I is also $0 \cdot 3$. The vertical distance, G to H, which is the uniform tariff, is measured as 25 per cent of the sum of P_2 and H to I, that is 25 per cent of $1 \cdot 3$, which is $0 \cdot 32$. Hence, assuming that the elasticity of demand for imports is unity implies that from the viewpoint of the traditional rural sector the emergence of the new export sector is equivalent to approximately doubling the average tariff.[20] A matrix of results for different slopes and elasticities of the import demand curve is given in Table 3.

It is fairly clear from Table 3 that the more elastic the import demand curve the less the adjustment that needs to be made by the rural sector and hence from its point of view the lower is the tariff equivalent of the emergence of the new export sector. If the slope of the import demand curve is $0 \cdot 3$, for example, the vertical distance H to I is $0 \cdot 1$ and the tariff equivalent of the mineral discoveries is approximately equal to an increase in the tariff of 37 per cent. If the elasticity of import demand were closer to the Treasury and Reserve Bank estimates, say unity, then the tariff equivalent of the mineral discoveries is approximately equal to

TABLE 3

Tariff Equivalents of the Rapid Growth of Mineral Exports

RURAL EXPORT SECTOR		IMPORT COMPETING SECTOR*	
Slope of Demand Curve for Imports†	Tariff equivalent (tariff increase per cent)	Slope of the Supply Curve of Rural Exports†	Tariff equivalent (tariff increase per cent)
0·3 (3·0)	37	0·5 (2·85)	60
0·5 (2·0)	53	1·0 (1·40)	120
1·0 (1·0)	93	3·0 (0·47)	360

* The price elasticity of non dutiable imports is assumed to be zero.

† Figures 1-4 and the results listed above are based upon linear demand and supply curves, that is curves along which the price elasticities are not constant. Price elasticities at the equilibrium price P_2 (Fig. 4) are written in brackets.

an increase in the tariff of 93 per cent. The estimated tariff equivalents are therefore very sensitive to the assumed price elasticities of import demand. Of course, the more elastic the import demand curve the greater the adjustment occurring in the import competing sector.

The Import Competing Sector

The calculation of the tariff reduction which, from the viewpoint of the import competing sector is equivalent to the emergence of the mineral exports, is complicated by the existence of a significant quantity of non dutiable imports which are imports into the sector. The existence of non dutiable imports means that the import competing sector is advantaged twice by the tariff. First, and more importantly, there is the

[19] The slope of only one curve is necessary because the share of exports attributable to the mineral discoveries is taken as datum.

[20] As the equilibrium price, P_2, and quantity, q_2, are set at unity it follows that the slope of the M_1 curve, at the point of equilibrium, is equal to the price elasticity.

effect of the tariff on the price of its output. Second, the appreciation of the Australian dollar induced by the tariff results in prices lower than the free trade price for non dutiable imports which are inputs into the sector. If the demand curve for non dutiable imports can be assumed to be price inelastic no special difficulties arise[21] and the calculation which is described in Figure 4 can be used.

The calculations of the tariff equivalent of the mineral discoveries, given in Table 3, assume that the demand for non dutiable imports is price inelastic.[22] If the elasticity of rural export supply is $1 \cdot 4$ (the slope of the rural export supply curve is unity) the tariff equivalent of the mineral exports is $0 \cdot 3$, the distance L to K on Figure 4. As the tariff, the distance G to H, is assumed to be $0 \cdot 25$, the tariff equivalent is equal to setting the average tariff at zero and introducing an import subsidy. The more price elastic the supply curve of the rural export sector the less the tariff equivalent.

In each of the estimates in Table 3 the tariff equivalent of the rapid growth of mineral exports exceeds the 25 per cent general tariff reduction. For the 25 per cent general tariff reduction to have had an effect on the import competing sector comparable with the rapid growth of mineral exports the price elasticity of rural exports would need to be approximately eight—a number which far exceeds the prior notions of most people.

The Mineral Sector

In Figure 2 it was demonstrated that at P_1, the equilibrium relative price which prevailed before the rapid growth of mineral exports, the quantity of mineral exports to be supplied would exceed the final equilibrium quantity at the lower equilibrium price, P_2. Consequently, if the expectations of the mineral sector were based on the original equilibrium price ratio those expectations must be unfulfilled. This disappointment of expectations could be avoided by reductions in assistance to one or both of the other two sectors. For example, in terms of Figure 4 the tariff could be reduced by the distance N to M so that the old equilibrium price ratio P_1 is restored. A tariff reduction of this magnitude would not only avoid the adjustment to be made by the mineral sector but also avoid the adjustment to be made by the rural export sector. All the adjustment would therefore be transferred to the import competing sector. A matrix

[21] If the demand for non dutiable imports is price inelastic then a tariff change which is equivalent to the mineral discoveries can be defined to bring about the same import quantity of dutiable and non dutiable imports as the mineral discoveries and the same price of dutiable imports inclusive of the tariff, but these will be accompanied by a different price of non dutiable imports. The reason why a tariff change cannot bring about the same relative prices and quantities of dutiable and non dutiable imports as the mineral discoveries is that the tariff change which brings about the same price of dutiable imports, inclusive of the tariff, is accompanied by a different exchange rate than that which results from the mineral discoveries.

If demand for non dutiable imports is price elastic, however, then not only is it not possible to set a tariff on dutiable imports which will bring about the same relative prices between dutiable and non dutiable imports as the mineral discoveries but also it is not possible to bring about the same relative quantities of imports.

[22] This assumption is employed at an industry level in the Evans [4] general equilibrium model of protection in Australia. It has not been possible from that work to measure the implied aggregate price elasticity of non dutiable imports which will arise from differential industry output responses to tariff changes.

TABLE 4

*Tariff Equivalents of the Rapid Growth of Mineral Exports: The Tariff Reductions which place all Adjustments onto the Import Competing Sector.**

Supply Curve Slopes	0·5 (2·8)			1·0 (1·4)			2·0 (0·7)		
Rural Exports	4·40 (0·75)	2·20 (1·66)	0·75 (4·40)	4·00 (0·80)	1·00 (3·00)	0·50 (6·00)	6·00 (0·55)	1·55 (2·50)	0·66 (5·04)
Mineral Exports	*(0·5 (2·8))*			*(1·0 (1·4))*			*(2·0 (0·7))*		
Aggregate Exports	0·45 (2·20)	0·40 (2·50)	0·30 (3·30)	0·80 (1·25)	0·50 (2·00)	0·33 (3·00)	1·50 (0·66)	0·80 (1·25)	0·50 (2·00)
	Per cent			**Per cent**			**Per cent**		
Slope of Demand Curve for Imports									
0·3 (3·0)	37	41	45	40	45	56	36	44	52
0·5 (2·0)	69	74	100	70	90	119	64	86	109
1·0 (1·0)	168	184	253	157	264	428	150	237	400

* The figures in brackets are the respective elasticities of each of the curves measured at the price ratio P_2 on Figure 4.

B

of estimates of this tariff reduction is given in Table 4 and the method of calculation is described in Appendix 1.

Consider the element in the first row and column in Table 4: 37 per cent is the reduction in the tariff which is needed to avoid any adjustment in the export sectors if the slope of the aggregate export supply curve is 0·45, which represents a price elasticity of 2·2, and the slope of the import demand curve is 0·3, which represents a price elasticity of import demand of 3. Moving down each column the slope of the import demand curve increases (the elasticity of demand becomes smaller) and the extent of the tariff reduction needed increases. Likewise moving across each row, for each of the three assumed rural export supply curves, the slope of the mineral and aggregate export supply curves decreases (the price elasticities of export supply curves increase) and the extent of the tariff reduction needed to transfer all adjustment away from the export sectors to the import competing sector increases.

Small changes in the price elasticities of import demand and rural export supply bring about large changes in tariff equivalents. A reduction in the price elasticity of import demand from 2 to 1, for example, can increase the tariff equivalent by a factor as large as 4 (see the element in the last row and column). It is evident from Table 4 that the general tariff reduction of 25 per cent would have been insufficient to confine adjustment to the import competing sector, unless the price elasticity of import demand exceeded three and the aggregate price elasticity of export supply was very low.

Concluding Comments

There are a number of comments which should be made to keep the analysis in perspective. First, the tariff equivalents are approximate. In my view the approximate nature of the equivalents is not particularly important. A more complex model would probably not change the key propositions of the paper and the empirical estimates of the effects of the mineral exports are sufficiently large and striking to suggest that the qualitative conclusions would also not change. The model also abstracts from dynamic considerations and it is therefore important to think of the analysis as concerned with the long run. The effects of tariff changes and the emergence of a new export sector are likely not only to be distributed differently through time but that time profile is also likely to differ by sectors. From the viewpoint of the import competing sector, a tariff change is likely to have a much quicker effect than the emergence of a new export sector. The latter operates only after a sufficient period has elapsed to require either an exchange rate change or to provide for a change in the relative rates of inflation between Australia and her major trading partners. From the viewpoint of the rural sector, however, the major effects of a tariff change and mineral exports operate through the same mechanisms, the exchange rate or inflation rate, and the time profiles of the effects of each may not be very different.

Second, long term international capital flows which have been ignored may be easily included in the figures used in the previous section either by adding an additional curve to the import demand or the export supply curve depending on whether there is a net capital inflow or outflow. If international capital flows are directly linked to either the mineral discoveries or to tariff changes the equivalents presented above become

less precise and to improve the estimates the links between the different sectors and international capital flows would need to be specified. For example, if the mineral sector is completely financed by capital inflows, the tariff equivalent of the rapid growth of mineral exports is greater in the short run, in that adjustment would be needed to the additional mineral exports and to the capital inflows. If capital inflows are used to finance imports for the development of the mining discoveries the tariff equivalent is less. The analysis is increased in precision if the model is designed to take into account the net exports of the rural and mining sectors, that is the net contribution to foreign earnings of each sector.

Finally, the limited nature of the technique of defining equivalents should be stressed. The rapid growth of mineral exports and changes in the average tariff have many effects on the economy. The equivalents utilized in this paper are defined only with respect to some of these effects. In this sense much of the analysis is partial, but very useful for particular purposes. In addition the analysis is not prescriptive as to where the adjustment necessitated by the rapid growth of mineral exports should fall. That is a separate question.

III   Summary

This paper has presented a simple model which stresses some of the policy trade-offs that Australian Governments will be increasingly forced to face and which enables rough orders of magnitude of the effect of the Australian tariff and the rapid growth of mineral exports on the broad sectoral structure of the Australian economy to be calculated.

The simple model of Part I has been used to emphasize that the balance of payments—through its effect on exchange rates and relative rates of inflation in Australia and overseas—links together export and import competing industries so that the import competing sector is vitally affected by export developments and vice versa.

It follows therefore that assistance to the import competing sector is paid for, in part, by the export sector and that increases in assistance to export industries will reduce the quantity of resources being used in import competing industries. Consequently, as the rapid growth of a new export sector will lead to adjustments both to the traditional export sector and the import competing sector any reduction in the adjustment of one sector, brought about by government intervention, will increase the adjustment which must occur in the other.

The empirical analysis of Part II suggests that the effects on the structure of the Australian economy of the rapid growth of mineral exports have been comparable, from the viewpoint of individual sectors, to very large tariff changes. It has been estimated, very approximately, that the rapid growth of mineral exports has been equivalent, from the viewpoint of the traditional rural export sector, to a doubling of the tariff. From the viewpoint of the import competing sector the rapid growth of mineral exports appears to have been equivalent to the removal of the tariff and the introduction of an import subsidy. The effects of the mineral discoveries therefore have been far more important, from the viewpoint of both sectors, than the 25 per cent general reduction of tariffs.

APPENDIX 1

The Measurement of the Tariff Reduction which ensures that the adjustment arising from mineral exports is borne by the import competing sector.

Price of Traded Goods / Price of Non Traded Goods
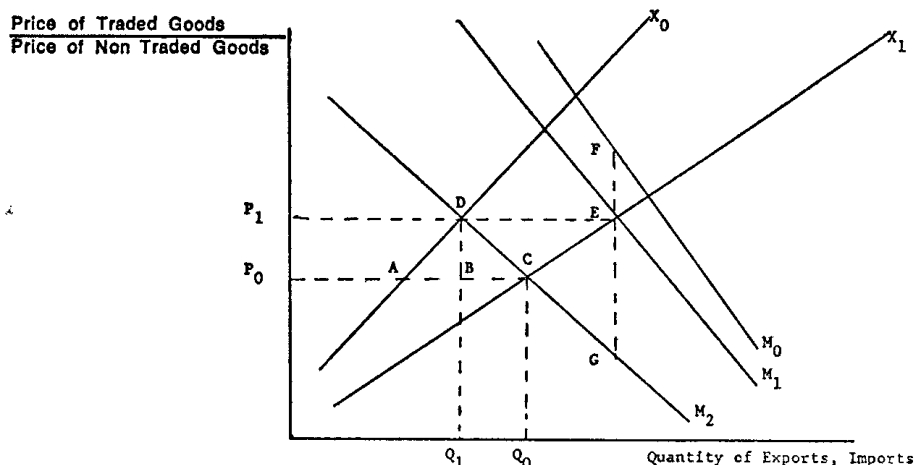
$P_1 Q_1$ = equilibrium price and quantity of traded goods before new export sector.
$P_0 Q_0$ = equilibrium price and quantity of traded goods after growth of new export sector.
X_0 = the traditional export supply curve, slope a.
X_1 = aggregate export supply curve, slope b.
M_0 = import demand curve in the absence of a tariff.
M_1 = import demand curve given the tariff.
M_2 = import demand curve, given the tariff, slope c.
Redefine the distances
  A to C as x
  D to B as z
  D to E as w
  E to G as y^*
  F to G as y

To calculate the tariff reduction y^* as a fraction of the tariff y, which will ensure that all adjustment associated with the new export sector is borne by the import competing sector.

(1) $x = z \left(\dfrac{1}{a} - \dfrac{1}{c} \right)$

$\therefore z = \dfrac{xca}{c - a}$

(2) $w = z \left(- \dfrac{1}{c} + \dfrac{1}{b} \right)$

$\therefore w = \dfrac{xa \ (c - b)}{b \ (c - a)}$

(3) $y^* = wc$

The average tariff is assumed to be 0·25. Hence

(4) $y = 0 \cdot 25 \ (1 + z - y^*)$

(5) $\dfrac{y^*}{y} = \dfrac{wc}{0 \cdot 25 \ [1 + z - wc]}$

w and z can be evaluated from the assumed slopes a, b, c, and the proportion of total exports which originate from the mineral sector, x.

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