ESSAYS ON TRADE IN GOODS AND FACTOR MOVEMENTS UNDER INCREASING RETURNS TO SCALE

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Contents

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Chapter 1

Introduction

The central issues that have engaged trade theorists from its inception can broadly be classified under three leads. First, to identify, what countries trade with each other, or what has come to be known as the question of *pattern of trade*. Second, the consequent *gains* that trade allows for. And the third, which is an immediate appendage to the second is to identify the *redistribution* of income due to trade.

The first and the third, as is immediately evident, are issues in positive trade theory. The second is a normative issue, which evidently brings in questions of welfare change of the country as a whole or its constituent groups. These traditional questions of trade theory have remained central till date. Though contingent issues have steered the path of investigation in varied directions, these threefold question can be identified as remaining the core point around which mainstream neo-classical trade theory has developed.

1.1 Pattern of Trade

Positive trade theory seeks an answer to what decides the pattern of trade. Ricardo identified that to be differences in technology in his famous doctrine of Comparative Advantage, where a country which is relatively (comparatively) technologically better off in producing a commodity would produce and export the commodity. Comparative advantage, in Ricardian model is determined exclusively by technological conditions. The difference in technology generates non-identical autarkic relative prices and hence the reason for trade.

Heckscher-Ohlin (H-O) formulation advances on similar lines to ground the possibility of trade not on technological differences but on differences in endowments. Even with identical technology, difference in endowments generates non-identical autarkic relative prices and hence the opportunity for trade. Be that as it may, reasons for trade has traditionally been identified to be embedded in differences (technological and/or endowment) amongst trading partners. Both the Ricardian and the H-O model assume constant returns to scale (CRS) technology and a perfectly competitive market structure.

As it happens with all theoretical structures, validation ultimately rests on how well a theory stands up to facts, and on the extent to which it can accommodate the empirical findings. Though it is perfectly legitimate to claim that the competitive model rendered the basic framework in which a wide spectrum of issues did fit in fairly well, even then there were facts which were increasingly giving discomfort to the competitive paradigm.

Krugman (1981) points out two such issues, that can be identified as crucial in triggering research to find out alternative models to account for the empirical findings. The first being the fact that a large volume of trade was found to be between countries which were similar (technology or endowment-wise) (Grubel & Llyod (1975)). Thus a comparative advantage theory could not account for such findings. Second, such trade was more of intra-industry nature, where similar goods were being cross-hauled in trade. Thus countries were both exporters and importers of similar products. These two findings could not be accommodated into the competitive models with CRS technology.

There were some initial attempts to offer informal and tentative explanations to these seeming paradoxes. [Balassa (1967), Grubel (1970), Kravis (1971)]. But a full blown formal model was still missing. Krugman (1979) and Ethier (1979, 1982) mark a break in clearly coming out with an alternative explanation for the new empirical findings.

Krugman's (1979) strategy of explanation rests on two crucial features of his model: increasing returns and product differentiation. Increasing returns dictates that it is technically efficient to produce a commodity in one location, to reap the benefits of scale economies. Product differentiation implies that all goods are desired by consumers. Thus the model has different varieties of the same commodity. Production of each variety is located in one single location. There being *love for variety*, trade facilitates cross hauling of goods across countries. Thus we have an alternative structure that breaks out of the comparative advantage paradigm, where the possibility of trade is not grounded on differences (technology or endowment or otherwise), but on increasing returns to scale (IRS). Identical countries in Krugman (1979) has perfectly valid reasons to trade between them. Moreover, trade is of intra-industry nature where the same commodity (albeit different varieties) is both exported and imported by a country.

Ethier (1982) deploys a similar model but supplements it with a different insight, where product differentiation and *love for variety* is substituted by the idea of *gains from specialisation.* Ethier (1982) draws on the Smithian notion of division of Labour. As production is segmented over more and more narrowly defined activities (interchangeably defined as differentiated intermediate goods), there are output gains due to enhanced productivity. Furthermore, intermediate goods in his model are produced under internal IRS. These two features taken together creates room for gainful trade in intermediate goods, even when countries are perfectly similar. Krugman (1981) and Ethier (1982) further show that trade is of intra-industry nature when countries are identical. As they become more dissimilar (in the endowment sense), trade based on comparative advantage takes over. Furthermore, it is shown in Either (1982) that in a diversified equilibrium factor price equalisation theorem holds good when intermediate goods trade is allowed for along with trade in final goods. Under the condition that the strength of scale economy is not too strong the Heckscher-Ohlin theorem, the Stolper-Samuelson theorem and the Rybczynski theorem carry over to such models with IRS. It should be noted that validation of factor price equalisation theorem in this model is crucially contingent on there being free trade in intermediate inputs. This ensures that external economies, generated through intermediate goods trade, affect the final output production symmetrically in both the trading countries. Ethier (1982) calls this *international economies of scale.*

As already noted, the *new trade theory* literature identifies product differentiation, scale economies and imperfect competition as crucial in determining the extent of intra-industry trade with respect to identical countries. Intra-industry trade can also occur due to market segmentation [Brander (1981), Brander and Krugman (1983)], which is dubbed as reciprocal dumping.

Differences in country size has also been identified as crucial in determining the pattern of trade. Markusen (1981) and Markusen and Melvin (1981) show that the larger country is a net exporter of the goods produced under IRS. The size element has also proved decisive in new models of *Economic Geography.* Krugman (1991) and Krugman and Venables (1990) are representative papers along this line.

Krugman (1991), Kurgman and Venables (1990) build on the idea that firms choose to locate near the larger market (assuming there are significant transport costs). Furthermore, there are fixed costs to be incurred which implies firms would locate at one point, and that this will be closer to the larger market (market access effect). To maintain labour market equilibrium the smaller country has to offer a differential wage to offset the locational disadvantage. Thus the larger country ends up with higher wages. Furthermore, each country will end up being the net exporter of the good for which it has a relatively larger domestic market (home market effect).

Krugman (1980) considers a model with two identical countries of equal size with two imperfectly competitive industries. But consumers in each country differ in their taste patterns. So each industry will concentrate in the country which has higher demand for its product and the country becomes a net exporter of that good. Thus trade within manufacturing sector is driven by difference in consumer tastes.

Amiti (1998) constructs a similar model where the two imperfectly competitive industries differ in capital intensities. It is assumed that capital is perfectly mobile. Trade pattern is shown to be such, that the countries which are identical in capital-labour ratios, but differ in sizes develop distinct trade patterns. The larger country is shown to be a net exporter of the capital-intensive good. Although two countries are identical except for sizes, when trade is allowed for, capital has an incentive to flow into the larger country. So comparative advantage arises endogenously and the result follows.

Alongside the theory of trade in intermediate goods as proposed by Ethier (1982) and Markusen (1989) which crucially depends on IRS (both internal and external), there is yet another lineage of theory of trade in intermediate goods which is even older and built around the assumptions of CRS and perfect competition. Sanyal and Jones (1982) makes an interesting combination of the specific factors model and Heckscher-Ohlin-Samuelson (H-O-S) model, to arrive at a theory of trade in intermediate goods or *middle products* as they call it. Sarkar (1985) considers an Austrian model of a time phased economy with flow input point output to show that trade pattern replicates the usual H-O prediction where the labour rich country exports the upstream intermediate goods and the final goods are exported by the capital rich, low rental country. This is perfectly in tune with the comparative advantage prediction.

The trade pattern suggested in these models does not seem to be very obvious in the changed global scenario. Over the years intermediate goods have become increasingly capital intensive and final output production has been relegated to the labour rich countries where these intermediate goods are assembled and re-exported [see (Chang and Kim (1989)].

In chapter 2 of this thesis, I attempt to blend both the insights of comparative advantage and IRS to arrive at a theory of pattern of trade across stages of production. It is shown that the labour rich country is an exporter of the final good which are made out of assembling specialised intermediate inputs and the capital rich country is a net *exporter of the* intermediate inputs. This reasonably mimics a real life situation. Interestingly enough it is seen that countries are asymmetrically exposed to the distributional conflict following the opening up to trade. It is shown that the wage rate, irrespective of labour being scarce or abundant (in the sense of physical definition, that is, in terms of labour-capital ratio), increases in both the countries. In this sense wage rate is immune to comparative advantage effect (where comparative advantage is endogenously determined through differences in labour-capital ratio). And this rise in wage rate is attributed to the economies of scale that trade in intermediate goods generates (the variety effect). On the other hand, rental rate is affected both by the expanding variety of intermediate goods and also the comparative advantage effect. And this, as is shown, brings in the possibility that the labour-rich country might land up with a lower rental rate. The interesting part is that the capital rich country faces no distributional conflict potential or actual. Thus one of the partners in trade does not face any conflict in distribution of income. This is in stark conflict with the result arrived at by Krugman (1981), where it is shown that countries are symmetrically exposed to the Stolper-Samuelson kind of a distributional conflict. Nevertheless, Krugman shows that this distributional conflict might be avoided (at least at a potential level), if the gain from specialisation is high enough. And both the scarce and the abundant factor might gain.

What is important to note in all this is that it is of consequence how factors of production are located in the general scheme of things. In our model, wages are only affected by the variety effect but remain immune to the comparative advantage effect. Furthermore trade leads to unambiguous gain for one of the countries and can potentially lead to a loss for another. This is closely related to the *sufficient-condition* for gains from trade arrived at by Markusen (1989) and Helpman and Krugman (1985), where it is shown that the expansion of the under-produced goods sector (where price exceeds the marginal cost) is sufficient to ensure gains from trade. In our model, forces of comparative advantage perforce leads to a contraction of the underproduced goods sector for one country and expansion for another.

1.2 Normative Issues

We have discussed how imperfect competition, scale economies and product differentiation taken together can be a basis for trade. It is now natural to ask how such trade confers gain to the parties concerned. In what follows we discuss these issues.

Trade, when markets are competitive (as in the Ricardian or the H-O-S models) is necessarily gainful or at the least can never hurt any partner in trade. Furthermore, trade in such a set up, increases the global welfare. Sources of such gains are attributed to consumption and production gains. This result is robust only to the extent that there are no distortions in the market : technology generated or otherwise.

Under imperfect competition, yet other sources of gain can be identified. Trade, when markets are non-competitive, naturally leads to more competition. This is simply because trade opens up the market to larger number of producers. This has been identified as the pro-competitive gains from trade. The procompetitive gain has been defined and measured in two distinct ways. One way is to define it as a lowering of the mark-up. The other is to define it as the expansion of the firms' output (the product expansion effect), as a result of which the surplus of price over marginal cost increases. The product expansion effect can be decomposed into two separate effects. The first is the profit effect. If price exceeds average cost, then an increase in output generates a surplus of price over the average cost on the additional output. The second is the decreasing average cost effect. With increasing returns, average cost falls with the output. This confers an additional gain.

Yet another important source of gain from trade under imperfect competition and scale economies has been identified as the firm exit effect. On the one hand it is desirable to have smaller number of firms on grounds of technical efficiency, as this leads to larger output per firm and lower average cost. Yet this confers larger monopoly power to the firms. Thus there is an inherent trade-off on welfare count. Trade can serve to resolve the dilemma. With trade, we can increase the total number of firms competing globally, yet have smaller number of firms (than under autarky) operating in each country. Thus exit of firms in each country frees up resources that have been devoted to fixed cost and can have a favourable impact on the welfare. Over and above all these sources of gain, we have the gains from product differentiation, that we have already discussed.

Markusen (1989) develops a model along the lines proposed by Ethier (1982) and Romer (1987). In the model, each of the two countries has a competitive sector and a sector producing a final good from an array of intermediate inputs or services. The later are produced under IRS and are complementary in the production of final output. It is shown that trade in intermediate inputs is superior to trade in final goods alone. Free intermediate goods trade guarantees that both countries will be better off relative to autarky. This is because, free trade in intermediate inputs ensures that both countries experience an expansion of production in the distorted (under-produced goods) sector and this has been identified as a sufficient condition for gains from trade. On the other hand, free trade in final goods alone might potentially lead to a contraction of the already under-produced goods sector for the disadvantaged country. This brings about a possibility of welfare immiserization for one of the countries.

Moreover free input trade is superior to trade in final goods alone from the point of view of both the countries. This follows from the complementarity of domestic and foreign intermediate inputs in final goods production. With trade in intermediate inputs the advantage of economies of scale spills over across boundaries of a country. Thus each country confers a positive externality on its trading counterpart.

1.2.1 Trade Policies

An immediate corollary to the question of gains from trade is to ask how such gains are shared and how trade policy might be used to corner such gains by partners in trade.

Venables (1987) investigates trade policy (tariff, subsidy) in a model with differentiated products where consumers value varieties. His model allows for the possibility that firms have different market shares in various markets they operate. It is shown that equilibrium location of firms, are determinate. An interesting result arrived at in this paper is that an import tariff might reduce the domestic price (appropriately defined) of the importable. This is reminiscent of Metzler's (1949) paradox; though the causality in Venables (1987) is altogether different. The intuition is that tariff changes both the price of imported products and the number of products produced domestically and imported. Tariff reduces the profits of foreign firms causing exit in the foreign industry and therefore raising the export earnings of domestic firms. These profits in the domestic economy must be bid away by new entry. This entry in domestic economy of new firms reduces the aggregate price index of the importable (by a combination of transport cost savings or by a better matching of commodity types to preferences and a possible increase in the product types available).

Trade models with differentiated final goods and/or specialised intermediate inputs have been investigated for optimal trade policies. Gros (1987) shows that optimal tariff in such models would never go down to zero, however small the country might be. This follows from the fact that in a monopolistically competitive market structure there are no price-takers in the strict sense. No matter how small the country is, it is still specialised in a range of products that nobody else produces and is therefore a price-setter that can influence its terms of trade (TOT).

Flam and Helpman (1987) point out yet another count on which tariff would increase the welfare even when it cannot change the TOT. This is called the *production efficiency effect.* Tariff can be used to shift the demand from foreign to domestic varieties. This allows an expansion of the domestic underproduced sector leading to a welfare gain. Note that even then tariff here is a second best device. It would be more appropriate to straight away subsidize the consumption of these goods directly than to enable them expand production behind a tariff wall.

Markusen (1990) develops yet another important point making a case against tariff. In spite of a TOT improvement and the production efficiency effect, tariff can potentially have an adverse effect on yet another count which is typical to the differentiated intermediate inputs models.

Markusen (1990) shows that if the domestic differentiated inputs are general equilibrium complements, then an import tariff may reduce welfare. Tariff leads to a favourable terms of trade, but the increased prices of the imported inputs may generate a fall in the demand for and production of domestic inputs produced under IRS. This can potentially entail a negative *product expansion effect* and might outweigh the favourable TOT effect.

Francois (1992) considers a model with traded intermediate goods. It is shown that there is under-provision of intermediate inputs. A subsidy to intermediate goods production can rectify that. But with traded intermediate inputs, the external economies generated out of proliferation of intermediate goods, spill over to the trading partner.

Thus the country concerned is not able to capture fully the gains from its subsidy policy. Therefore an unilateral optimal subsidy falls short of achieving maximal global gain. Hence, the reason for coordinating subsidy policy by trading partners. That is to say unilateral optimal subsidy falls short of the optimal co-operative subsidy.

Lovely (1997) develops a two sector model with one of the sector being subject to IRS. The model allows for capital mobility. Lovely claims that on the face of restriction on sector specific subsidy, a blanket capital subsidy might be used. Capital being mobile, capital subsidy raises the inflow of capital. To the extent, the IRS sector is capital-intensive, capital inflow, through the usual Rybczynski effect, expands the IRS sector leading to welfare gain. Furthermore, in a diversified equilibrium such expansion of the IRS sector also raises the rental rate and hence adversely affects the factor terms of trade. But if foreign ownership of capital is insignificant, the gain due to an expansion of the IRS sector might outweigh the loss on account of the adverse shift in factor terms of trade, and hence increase welfare.

1.2.2 Trade Policy with Factor Mobility

The issue of capital mobility and its normative consequences, when there are other distortions (tariff, quota etc.) in the economy is a long standing debated issue in both trade and development theory. Johnson (1967) investigated the issue of growth in a small open economy, to arrive at the result that growth might be immiserizing if it is so very biased towards the distorted (tariff protected) sector that increased distortionary loss erases the favourable impact of increased production at given domestic prices. Brecher and Diaz-Alejandro (1977) model the case of capital inflow in a small tariff protected economy, where profits are fully repatriated. Under the usual Heckscher-Ohlin-Samuelson (H-O-S) framework, it is shown that captial-inflow is necessarily immiserizing when the tariff protected sector is capital intensive. The mechanism is easily understandable. Given the H-O-S framework and the small country assumption, factor rewards are pinned down. This makes the total factor earnings invariant to changes in endowment. On the other hand capital inflow leads to the expansion in domestic production of import competing good (which is capital-intensive). This crowds out cheaper imports, leading to a welfare loss. Yet other interesting papers in this tradition are Bertrand and Flatters (1971), Tan (1969), Martin (1977). Bhagwati (1973) hypothesized that the conventional result whereby imposition of tariff would reduce a small country's real income, might carry over ɔ the case where in addition to usual consumption and production loss, increased rate ⁝ protection would attract foreign capital by raising the domestic return, under the a umption that the import competing sector is relatively capital intensive.

A these above mentioned papers are in the competitive framework with CRS technology. Models with labour market imperfection of the Harris Todaro type has also been used to address similar question. Khan (1982) considers a model with urban unemployment of the Harris-Todaro (H-T) type. Capital inflow in such a model is shown to be necessarily immiserizing when the tariff protected urban sector is capital-intensive. Brecher and Findlay (1983) shows that in an H-T model with sector specific capital, capital inflow is conditionally immiserizing under stable factor markets.

There is yet another genre of models with IRS within which similar welfare questions are posed. Sen *et al.* (1997) build up a model incorporating the features of IRS and product differentiation along the lines proposed by Dixit and Stiglitz (1977). They show that in such a set up capital-inflow leads to higher varieties of domestic consumption goods leading to a welfare gain. On the other hand as is usual it leads to crowding out of cheaper imports. Hence there is a distortionary loss. So the exact direction of welfare change is left to definite parametrization.

Chapter 4 of this thesis investigates the issue of welfare consequence of capital inflow for a small tariff protected economy. The model is built along the lines proposed by Ethier (1982). It is shown that the variety effect attendant to capital inflow leads to higher factor income. As already discussed this is commonplace in the literature. What is not obvious and is interesting enough, is that capital inflow, even when it expands the tariff protected sector, might crowd-in imports. Thus imports and hence tariff revenue might go up. Thus there is a second channel through which welfare might go up. This is in stark contrast to the results arrived at by most of the models in this tradition. In all these models, capital inflow leads to an expansion of the tariff protected sector crowding out cheaper imports. Our model departs in showing that increased variety of domestically produced intermediate inputs might enhance the productivity in final output production and increase the derived demand for foreign inputs, leading to higher imports. The crucial point here is the complementarity of foreign and domestic intermediate goods.

Welfare effects of capital inflow under alternative protectionist regimes have also been addressed in the literature. Dei (1985) constructs a large country H-O-S model where import competing sector is protected by a voluntary export restraint (VER), implemented by the trading counterpart. An exogenous capital inflow leads to higher production of importables. With the imports fixed at a constant level (by VER), this leads to an excess supply of importables at initial prices. This excess supply can only be erased by a fall in the price of importables. This leads to an improvement in commodity TOT. To the extent that the importables are capital intensive, this also leads to a fall in the rental rate (Stolper-Samuelson effect), leading to a gain in factor terms of trade. Thus welfare moves up unambiguously.

In chapter 5 of this thesis we address the issue of capital inflow under VER in an economy where there is an IRS sector. This brings about the possibility of contraction of the IRS sector as a result of resource re-allocation following capital inflow. It is shown that even when the commodity terms of trade improves unambiguously, the factor terms of trade might deteriorate. Added to this there remains the direct loss as a result of a potential contraction of the IRS sector.

1.3 Trade and Distribution

As already discussed, relative price shifts and consequent changes in factor rewards have been discussed in variants of H-O-S model with IRS. Ethier (1982) has shown that Stolper-Samuelson theorem remains valid even with IRS if the scale effect is not significant enough.

Furthermore, as already mentioned, it is investigated in chapter 2 of the thesis how Stolper-Samuelson kind of a conflict becomes questionable. It is shown that there might be a basic asymmetry in how trading partners are exposed to distributional conflict attendant to trade.

Though consequences of price shifts on factor rewards have been fairly well addressed in two sector models with mobile factors, both with CRS and IRS, the issue of factor specificity and how it might interact with IRS remains relatively unattended.

Chapter 6 of this thesis investigates the consequence of having an IRS sector when there are specific factors. We propose a model along the lines of Gruen and Corden (1970), where there are three final goods sector. Two of the three sectors constitute a Heckscher-Ohlin (H-O) sub-sector, called the H-O Nugget (see Jones and Marjit (1990), Marjit and Beladi (1996)). The sector outside uses a specific factor (say land). There is a mobile factor (say labour), which is mobile across the H-O nugget and the sector outside the nugget. One of the sectors in the nugget is subject to IRS.

Under such a set up it is shown that protecting the sector outside the nugget increases the real reward of the factor specific to that sector. This is usual. Furthermore, it is shown that the specific factor of the nugget might also gain in terms of all the three final goods, and the mobile factor is severely hurt (loses in terms of all the three final goods). The last two results are in stark conflict with the conventional wisdom associated with specific factors model. Moreover under an alternative regime where the H-O nugget is given uniform protection, it is shown that under some condition it might fail to protect the factor specific to the nugget, and in such a situation the mobile factor gains unambiguously.

All this casts serious doubt over the blanket conclusions arrived at, in the specific factors model, that there is an inherent discord between the interests of the specific factors. This thesis tries to unveil how gains from protection might spill over from one specific factor to another.

1.4 Plan of the Thesis

This theses consists of six chapters. In chapter 2, a model of trade in intermediate goods and final good is developed incorporating the features of increasing returns and monopolistic competition. It is shown that the endowment basis (comparative advantage) for trade becomes crucial in determining trade across stages of production. The capital rich country is shown to be a net exporter of specialised intermediate inputs and an importer of the final good. Along with the forces of comparative advantage, the usual increasing returns and the product variety effect gets locked in in determining the functional distribution of income. Capital rich country is shown to be immune to distributional conflicts, whereas for the labour rich country the distributional conflict crucially hinges upon the elasticity of substitution between intermediate inputs. Thus free trade has inherently asymmetric effects on functional distribution of income for countries differing in labour-capital ratios.

Chapter 3, develops a model with a traded sector subject to CRS and a non-traded final goods sector with increasing returns to scale. The production of the nontraded sector is formalised in the spirit of Ethier (1982), but we depart in allowing for trade in skilled labour, which virtually constitutes the upstream of the IRS sector. Allowing for such trade in skilled labour essentially truncates the vertically integrated production structure of the IRS sector (as in Ethier) into a traded upstream and a nontraded downstream. Under such a structure we propose to raise the issue of brain-drain.

It tries to bring into focus the crucial role of repatriated earnings of the emigrants that can potentially help a higher absorption of skill and a higher level of skill differentiation in the domestic economy. Situation might also arise where insufficient demand for the skill-using sector gives way to an outcome where the economy produces and exports a higher level of skilled work force but is unable to absorb the same domestically, and this might be potentially welfare immiserizing.

In chapter 4 the issue of capital mobility is addressed when there are tariff distortions in the economy. Capital inflow is generally immiserizing when the capital intensive import competing sector is tariff protected and profits are repatriated in full.In this chapter we construct a model with increasing returns, embedded in a monopolistically competitive market to show that capital inflow might lead to higher factor income and interestingly enough, growth of import competing sector might lead to still higher imports. Thus two distinct possible channels are identified through which welfare might improve.

Chapter 5 investigates the welfare consequence of exogenous capital inflow for the host country when the source country implements a voluntary export restraint. In an imperfectly competitive market structure with an increasing returns to scale sector, we show that there arises a possibility of welfare immiserization. Two distinct channels are identified through which immiserization can occur. First, and this is direct, resource reallocation following capital inflow can potentially squeeze the under-produced goods sector and thereby reduce welfare. Second, contraction of IRS sector can potentially raise the return to capital, even when the price of the capital intensive importables falls unambiguously. Thus even with an improvement in commodity terms of trade, factor terms of trade can worsen and reduce welfare.

Chapter 6 develops a simple model with an increasing returns to scale sector and complementarity in production. We explore the consequence of tariff protection in such a model. Interestingly enough, it is shown that under a particular protectionist regime the factor specific to the sector(s) suffering an adverse shift in relative price (the unprotected sector) might gain along with the factor specific to the protected sector.

Thus there can be a concord in the interests of the specific factors. Furthermore, under such a regime the mobile factor (identified as labour in our model) is most severely hurt.

Under yet another protectionist regime it is shown that both the specific factors (even the factor specific to the protected sector(s)) might lose and the mobile factor gains unambiguously.

Both these cases are in stark conflict with the conventional wisdom associated with the specific factors model.

Chapter 2

Trade in Intermediate Goods in a Model With Monopolistic Competition

2.1 Introduction

Trade in intermediate goods comprise a large bulk in the volume of world trade (nearly 50%, Markusen (1989)). A large body of empirical research has validated the claim that much of the world trade follows a pattern where the capital rich countries export specialised intermediate inputs to the labour rich countries and import back final goods. A prominent case of this mid-product processing occurs in the United States' trade with Mexico, where several American firms ship components to the Maquiladora plants in Mexico along the border for assembly into automobile parts, televisions and the like. Similar pattern is observed in trade between the high income countries of the European Community and the Mediterranean Nations and between Japan and the developing nations in Asia. The newly industrialising countries (NICs) in East Asia rely heavily on imports of sophisticated intermediate inputs from the developed countries (DCs) in order to produce its final goods for export (Chang and Kim 1989).

Many of the intermediate manufactures that enter into international trade are probably characterized by significant degrees of scale economies and product differentiation. Factor intensity data suggests that intermediate manufactures are on average significantly more capital intensive than final goods (Markusen and Melvin (1984)). Capital intensity in turn suggests strong scale economies in that capital is required at an initial stage in developing the product and in setting up the plant to begin production. Subsequently the product can be provided at a low marginal cost.

There is a growing literature aimed at formalising the specificities of such trade in intermediate products. Beginning with the early contributions of Sanyal and Jones (1982), Findlay (1978), Dixit & Grossman (1982), Sanyal (1983), Sarkar, (1985), Marjit (1987) stepped in the traditional models of perfect competition and constant returns to scale, the new trade theory opened up a wider avenue of research. Models incorporating the features of scale economies, set up in monopolistically competitive market structure, has been used extensively to formalise the idea of largely evident intra-industry trade between similar countries. Krugman (1981) uses such a model to explore the consequences of international trade on income distribution. His model accommodates both intra-industry and inter industry type of trade where it is shown that intra-industry trade dominates as countries become similar. It is further shown that the effects of trade on income distribution crucially hinge upon the specific pattern of trade. With comparative advantage as the dominant basis for trade, income distribution pattern reveals the usual Stolper Samuelson type of distributional conflict. Whereas for similar countries where the basis for trade is grounded on increasing returns, this conflict vanishes; both the scarce and the abundant factors gain. Though later models of trade informed by the features of scale economies and product differentiation have been used extensively to study the effects of trade policy, the question of income distribution has taken a relatively back seat since then.

Here we build up a model along the lines proposed by Ethier (1982) and Krugman (1981) incorporating the features of scale economies and monopolistic competition. The economy is broadly divided into a final output sector Y, and an intermediate goods sector x. The intermediate goods are produced under increasing returns to scale and are used as inputs in the production of final good along with labour. The way the intermediate goods enter into the final output production, incorporates the feature of gains from specialisation. Intermediate goods on the other hand are produced by incurring an initial fixed cost, which comprises purely of capital, and production of each additional unit of output requires a constant amount of labour.

The results demonstrate that allowing for trade in both final good and intermediate goods, leads to a trade pattern which reveals both the features of comparative advantage and increasing returns to scale. The model sharply brings into focus the forces of comparative advantage as determinant of trade across stages of production. It is shown, that the capital rich country is the net exporter of specialised intermediate inputs and importer of the final good; a pattern of trade which mimics an empirically valid situation. We also explore the consequences of such trade on income distribution. It is shown that there is a basic asymmetry between countries with regard to the effect of trade on factor rewards. The capital rich country is shown to be immune to any distributional conflict, with both capital and labour gaining unambiguously through trade. On the other hand the distributional consequences for the labour rich country crucially hinge upon the returns to specialisation. Though labour stands to gain, the returns to capital might fall. This result has serious political-economic implication. Labour in both the countries would prefer a liberalised trade regime, whereas capital owners in the labour rich countries might favour a protectionist policy. This is in accord with recent experiences of the LDCs where initiatives have been taken to re-orient the economy towards a more liberalised trade regime. Capitalists in these countries have been raising a furore over trade liberalisation and seeking more protection on the ploy that they be offered a level playing ground before the economy opens up to foreign competition. It is further shown, that the forces of comparative advantage, of necessity, must have opposite effects on the expansion of the already under-produced intermediate goods. Intermediate goods are under-produced in the sense that price exceeds marginal cost for these goods. As has been shown by Markusen and Melvin (1981), trade under imperfect competition is surely gainful if it leads to the expansion of the distorted (price exceeding marginal cost) sector. In our model the labour rich country suffers a contraction of the distorted sector, thereby leading to a welfare loss. This can on the balance be nullified only if the returns from specialisation due to intermediate goods trade are sufficiently high.

In what follows we develop the basic model and explore the autarky situation in section 2.2. Section 2.3 delineates the trade equilibrium, section 2.4 discusses the distributional consequences and gains from trade. Section 2.5 concludes. An Appendix contains derivations of few results given in the main text.

2.2 The Model

Consider an economy producing a final good Y, according to the production function

$$Y = X^{\alpha} L_y^{1-\alpha} \tag{2.1}$$

$$\text{where} \qquad X = \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{1/\rho} \qquad \text{and} \qquad 0 < \alpha, \rho < 1$$

$x_i, i = 1, \ldots, n$, are the intermediate inputs and L_y is the direct labour employed in the production of Y. Two features of X are important. The first is the imperfect substitutability of differentiated intermediate inputs. The elasticity of substitution (σ) between any pair of x_i is given by $1/(1-\rho)$ (see equation (A.5) of the Appendix for the derivation), leading to a downward sloping demand curve for single intermediate good producer. Higher values of ρ indicate less differentiation, easier substitution, more elastic demand and less market power for any single producer of intermediate input. The second feature to note is that X is increasing in n, the number of distinct intermediate inputs, keeping the total devoted resources constant. Thus there are output gains to be made as resources are spread out more thinly over larger number of components. This incorporates the Smithian notion of increased division of labour, discussed by Ethier (1982) and Romer (1987). If all intermediate goods have identical cost functions leading to identical output (x), X collapses to[1]

$$X = n^{1/\rho}\, x$$

Thus in equation (2.1) output of Y is characterized by constant returns to scale in the quantity of inputs, holding constant the number of varieties of intermediate inputs. However the output of Y is increasing in the number of varieties holding constant the aggregate quantity of inputs. As number of inputs proliferate there is a gain to be made out of specialisation over narrowly defined activities. One of Ethier's (1982) insight is that these activities need not be geographically concentrated. Trade in intermediate goods generate a form of international increasing returns.

The intermediate goods (x_i) are produced under increasing returns to scale. Because of fixed costs no two firm will produce exactly the same variety in equilibrium. With large number of potential varieties, strategic behaviour on the part of the firm is ruled out. Finally the absence of entry barrier drives down profit to zero. Production of representative x_i requires a_k units of overhead capital, constituting the fixed cost

$$a_k\, r = F \tag{2.2}$$

where r is the rental rate and F is the fixed cost. The marginal cost component

$$m = a_L\, w \tag{2.3}$$

[1]This reduced form is not unique to X in (2.1). The form

$$X = n^{\gamma} \left[\sum \frac{x_i^{\rho}}{n} \right]^{1/\rho}$$

also leads to the same reduced form in which $\gamma = 1/\rho$. Thus in our specification, returns to specialisation are derived directly from input substitutability. But this is merely a simplifying assumption. For many questions of policy analysis, these two aspects of returns to specialisation and market power has to be addressed separately [on this issues, see Holtz-Eakin and Lovely (1996)].

where, a_L is the marginal labour requirement to produce each additional unit of x and w is the wage rate.

A few comments are in order with regard to the structure of the model. Firstly, we have assumed that fixed cost in production of intermediate goods comprises exclusively of capital cost. On the other hand, the variable input is exclusively labour. This requires some justification. To the extent one considers the intermediate goods as specialised inputs, development of such inputs would require high capital investment. Like development of blue print of some Hi-tech input (might be a Pentium processor) requires high capital outlay. Once this blue print has been developed, successive units of output can be delivered as a routine task where capital investment would probably become insignificant and this would be a more labour intensive activity. Thus our model reasonably formalises a situation which casual empiricism would suggest. A very similar formalisation can be found in Helpman and Krugman (1989, pp. 141-142).

An essential aspect of the structure of intermediate goods production in our model is that all adjustments in this sector would be in terms of per-variety output and not in terms of number of varieties which is held fixed by the given capital endowment.

Assuming large number of varieties such that strategic behaviour is ruled out on the part of the firms producing intermediate goods, it can be shown that market elasticity of demand faced by producers of intermediate goods is equal to the elasticity of substitution (σ) between any pair of intermediate inputs, and is equal to $1/(1-\rho)$ (see equations (A.5) and (A.7) of the Appendix). Thus each producer of intermediate inputs equate marginal revenue to marginal cost.

$$\begin{aligned} p_i(1-\tfrac{1}{\sigma}) &= a_L\, w \\ \Rightarrow p_i &= \tfrac{a_L\, w}{\rho} \end{aligned} \tag{2.4}$$

The prices of intermediate goods are a constant mark-up over the marginal cost. With identical technology all firms charge the same price ($p_i = p$) for intermediate goods.

Free entry drives down profits to zero. Thus the operating surplus must be just enough to cover the fixed cost.

$$\frac{p_i}{\sigma}\, x_i = a_k\, r \tag{2.5}$$

This also implies that output x_i is the same for all producers ($x_i = x$).

The full employment condition for labour and capital is given by

$$L_x + L_y = a_L\, n\, x + L_y = L \tag{2.6}$$

$$a_k\, n = K \tag{2.7}$$

where L_x and L_y are the employment levels in the intermediate and final goods sector and L and K are the total labour and capital endowment of the country. Thus the number of input varieties are directly given from the full employment condition of capital.

The price index of the composite intermediate input bundle $X = [\sum_{i=1}^{n} x_i^{\rho}]^{1/\rho}$ is given by

$$P^{1-\sigma} = \sum_{i=1}^{n} p_i^{1-\sigma} \tag{2.8}$$

The composite price index P may be interpreted as the unit cost function of X (see equation (A.8) in the Appendix). Thus the effective price P is positively related to the prices (p_i) of each intermediate input and negatively related to the number (n) of available varieties of intermediate inputs. The later relation captures the gains from specialisation.

Producers of final good Y (numeraire) maximize profits by choosing the optimal input mix of labour and specialised intermediate inputs, taking the number of intermediate goods producing firm (n), the wage rate w and the prices of intermediate inputs p_i as given, subject to the production function (2.1). The first order conditions for profit maximization are given by

$$\frac{\partial Y}{\partial L_y} = (1-\alpha)(X/L_y)^{\alpha} = w \tag{2.9}$$

$$\frac{\partial Y}{\partial X} = \alpha(X/L_y)^{\alpha-1} = P \tag{2.10}$$

Dividing equation (2.9) by equation (2.10), we get

$$\frac{(1-\alpha)}{\alpha}\frac{X}{L_y} = \frac{w}{P} \tag{2.11}$$

Under the condition that intermediate goods production is subject to identical cost condition across board, price and output of representative intermediate input are $p_i = p$ and $x_i = x$ respectively. Thus in this symmetric equilibrium, equation (2.8) collapses to

$$P = n^{1/(1-\sigma)}\, p \tag{2.12a}$$

$$\text{and} \qquad X = n^{1/\rho}\, x \tag{2.12b}$$

Using equations (2.12a and 2.12b) in equation (2.11),

$$\frac{(1-\alpha)}{\alpha}\frac{nx}{L_y} = \frac{w}{p} \tag{2.13}$$

Taking note of equation (2.4), equation (2.13) can be rewritten as

$$\frac{nx}{L_y} = \frac{\alpha}{(1-\alpha)}\frac{\rho}{a_L} \tag{2.14}$$

Using the full employment condition for labour, equation (2.6), we rewrite (2.14) as

$$\frac{L_x}{L_y} = \frac{\alpha\,\rho}{(1-\alpha)} \tag{2.15}$$

The following proposition is immediate from equation (2.15).

Proposition 1 : Under autarky the sectoral allocation of labour is determined by the parameters of the final output production function alone.

Using equation (2.14) in equation (2.9), the unit cost function for final output Y can be calculated at given factor prices. For good Y to be produced, unit cost must equal price $p_Y = 1$. Thus

$$(1-\alpha)^{-1}\left(\frac{\alpha}{1-\alpha}\,\frac{\rho}{a_L}\right)^{-\alpha} \quad n^{-\alpha/(\sigma-1)}\, w \geq 1 \tag{2.16}$$

In order that $Y > 0$, strict equality must hold in (2.16).

Equation (2.16) reveals that higher number of intermediate goods *Ceteris-Paribus* will translate into higher wage rates. This reflects the standard productivity gain due to specialisation.

Thus with Y sector operative, wage rate is given by

$$w = M n^{\alpha/(\sigma-1)} \tag{2.16a}$$

$$\text{where} \qquad M = (1-\alpha)\left(\frac{\alpha}{(1-\alpha)}\,\frac{\rho}{a_L}\right)^{\alpha}$$

Using equation (2.4), price of a representative brand of intermediate input is given by

$$p = \frac{a_L\, M\, n^{\alpha/(\sigma-1)}}{\rho} \tag{2.17}$$

Equation (2.15), along with the full employment condition (2.6), gives the x-sector employment

$$L_x = L - L_y = \frac{\alpha\,\rho}{(1-\alpha+\alpha\,\rho)}L \tag{2.18}$$

Using equation (2.18) and equation (2.6), output per variety of intermediate inputs

$$x = \frac{\alpha\,\rho}{(1-\alpha+\alpha\,\rho)}\frac{L}{a_L\,n} \tag{2.19}$$

A point to be noted here is that the number of varieties (n) of intermediate goods produced in the country remain fixed, given the capital endowment. The only adjusting factor is the per-variety output (x). As we will show later, with trade opening up, per variety output will change in accordance with the endowment ratios of the countries. Thus any expansion or contraction of intermediate goods sector would be in terms of x.

Using (2.19) and (2.17) in equation (2.5), and taking note of equation (2.7),

$$r = \left(\frac{M\,n^{\alpha/(\sigma-1)}}{\rho\,\sigma}\right)\left(\frac{\alpha\,\rho}{1-\alpha+\alpha\,\rho}\right)\frac{L}{K} \tag{2.20}$$

Thus the autarkic equilibrium is solved for all the eight endogenous variables, $Y, x, p, w, r, L_x, L_y, n$.

2.3 Trade

There are two countries : home and foreign. In what follows, we assume that both intermediate and final goods are tradable. We further assume that home and foreign countries are identical in all respect except possibly the labour-capital endowment ratio. Where necessary, we denote the foreign values of variables by a superscript f and home values by h.

As import of foreign varieties of intermediate inputs becomes possible, the composite price index of intermediate goods bundle X^h is given by

$$(P^h)^{1-\sigma} = \left[\sum_{i=1}^{n^h}(p_i^h)^{1-\sigma} + \sum_{j=1}^{n^f}(p_j^f)^{1-\sigma}\right] \tag{2.21}$$

where $X^h = \left[n^h(x_h^h)^\rho + n^f(x_h^f)^\rho\right]^{1/\rho}$ with x_j^i denoting the amount of intermediate input produced in the ith country and used by the jth country producers of Y.

This is also the relevant price-index for the foreign country under the condition that trade is unimpeded by tariff, taxes, or transport cost.

Final output producers of Y maximize profits by choosing the optimal input mix taking the number of available varieties of intermediate inputs (foreign and home), the prices p_i^h and p_j^f and the wage rate w^h as given, subject to the production function (2.1). The usual first order conditions are

$$\frac{\partial Y^h}{\partial L_y^h} = (1-\alpha)(X^h/L_y^h)^\alpha = w^h \tag{2.22}$$

$$\frac{\partial Y^h}{\partial X^h} = \alpha\,(X^h/L_y^h)^{\alpha-1} = P^h \tag{2.23}$$

Dividing (2.22) by equation (2.23),

$$\frac{X^h}{L_y^h} = \frac{\alpha}{(1-\alpha)}\frac{w^h}{P^h} \tag{2.24}$$

Substituting equation (2.24) in equation (2.22), we get the unit cost function for Y. With Y sector in operation, unit cost function is equal to the price of Y. Thus

$$\frac{(P^h)^\alpha\,(w^h)^{1-\alpha}}{(1-\alpha)^{1-\alpha}\,\alpha^\alpha} = p_Y = 1 \tag{2.25}$$

With free trade equalising the price of final goods, and noting that with free trade in intermediate inputs $P^h = P^f$, equation (2.25) implies that wage rates are equalised across countries, under the condition that technologies are identical.

The demand supply equilibrium of intermediate goods market is given by

$$x^h = x_h^h + x_f^h \tag{2.26a}$$

$$x^f = x_h^f + x_f^f \tag{2.26b}$$

where, x^h and x^f are the supplies of a representative brand of intermediate inputs of home and foreign country respectively and the R.H.S. denotes the aggregate demands.

The demand function for intermediate inputs are given by (this demand function is quite usual. For sake of completeness we give its derivation in the Appendix; see equation (A.7))

$$x_j^i = \frac{(p^i)^{-\sigma}\, P^j\, X^j}{(P^j)^{1-\sigma}} \tag{2.27}$$

Using (2.27) in equation (2.26a and 2.26b),

$$x^h = \frac{(p^h)^{-\sigma}\, P^h\, X^h}{(P^h)^{1-\sigma}} + \frac{(p^h)^{-\sigma}\, P^f\, X^f}{(P^f)^{1-\sigma}} \tag{2.28a}$$

$$x^f = \frac{(p^f)^{-\sigma}\, P^h\, X^h}{(P^h)^{1-\sigma}} + \frac{(p^f)^{-\sigma}\, P^f\, X^f}{(P^f)^{1-\sigma}} \tag{2.28b}$$

Dividing equation (2.28a) by (2.28b),

$$\frac{x^h}{x^f} = \left(\frac{p^h}{p^f}\right)^{-\sigma} \tag{2.29}$$

But, as we have already shown, wage rates are equalised through free trade and prices of intermediate goods being a constant mark-up over the marginal wage cost, equation (2.4) implies that prices of intermediate goods in both the countries are equalised, that is, $p^h = p^f$. Therefore equation (2.29) implies that the output per brand of intermediate inputs in both the countries are equal. Thus with prices and output per brand equalised across countries, operating surplus for each intermediate goods producer are equal. Hence, the rental rates are equalised by equation (2.5). The following proposition is immediate.

Proposition 2 : Free trade in final good and intermediate goods equalises factor returns in both the countries under the condition that technologies are identical.

With the wage rates and hence prices of intermediate goods equalised across countries, the home country wage rate can be now written using equation (2.25) as

$$w = M(n^h + n^f)^{\alpha/(\sigma-1)} \tag{2.30}$$

Comparing equation (2.30) with equation (2.16a), it is evident that free trade increases the wage rate in both the countries and this increase is directly related to the larger number of available varieties of intermediate inputs. The productivity gains due to specialisation are translated into higher wage rates. Interestingly enough, wage rates in both the countries increase irrespective of labour being the scarce or the abundant factor.

Proposition 3 : Free trade raises the wage rate in both the countries irrespective of labour being the scarce or the abundant factor.

Though we have shown that trade equalises factor returns, as yet we have not determined the rental rates. This will be determined, once we have determined the labour allocation across sectors. Note, under autarky, sectoral allocation of labour (L_x and L_y) was given directly by exogenous technological parameters of the model and this could be used to find out the per-variety output (x) of intermediate goods. This is no more the case now.

Demand-supply equilibrium in final output market is given by

$$Y_S^w = Y_D^w \tag{2.31}$$

where, Y_S^w and Y_D^w are world supply and demand for good Y.

Noting that wages and hence prices of intermediate goods between countries have been equalised through trade we can rewrite equation (2.24) as

$$\frac{X^h}{L_y^h} = \frac{\alpha}{1-\alpha} \frac{\rho}{a_L(n^h + n_f)^{1/(1-\sigma)}} \tag{2.32}$$

Substituting equation (2.32) in the production function (2.1), the home country supply function for good Y becomes

$$Y_S^h = \left(\frac{\alpha}{(1-\alpha)} \frac{\rho}{a_L}\right)^\alpha (n^h + n^f)^{\alpha/(\sigma-1)} L_y^h \tag{2.33}$$

Similarly

$$Y_S^f = \left(\frac{\alpha}{(1-\alpha)} \frac{\rho}{a_L}\right)^\alpha (n^h + n^f)^{\alpha/(\sigma-1)} L_y^f \tag{2.34}$$

There being only one final good Y, the home demand for Y is given by the total factor earnings. Using equations (2.4) - (2.7),

$$Y_D^h = wL^h + rK^h = wL^h + \frac{a_L w}{\rho\sigma a_k} \frac{(L^h - L_y^h)}{a_L\, n^h} K^h = w\left[L^h + \frac{1}{\rho\sigma} \frac{(L^h - L_y^h)}{K^h} K^h\right] \tag{2.35}$$

The foreign counterpart can be written as

$$Y_D^f = w\left[L^f + \frac{1}{\rho\sigma}\frac{(L^f - L_y^f)}{K^f}K^f\right] \tag{2.36}$$

Now, using the Y - market equilibrium condition (2.31) and invoking the respective supply demand functions (2.33) - (2.36), we get

$$\left(\frac{\alpha}{(1-\alpha)}\frac{\rho}{a_L}\right)^{\alpha}(n^h + n^f)^{\alpha/(\sigma-1)}\left[L_y^h + L_y^f\right] = w\left[L^h + L^f + \frac{(L^f - L_y^f)}{\rho\sigma K^f}(K^h + K^f)\right] \tag{2.37}$$

where use has been made of the fact that factor rewards are equalised across countries. With n^h and n^f determined directly from the full employment condition for capital, equation (2.37) contains two variables L_y^h and L_y^f to be solved for. We have already shown that the per-variety output of intermediate goods in both the countries are equal (note equation (2.29)). This implies

$$\frac{L_x^h}{a_L n^h} = \frac{L_x^f}{a_L n^f} \tag{2.38}$$

$$\Rightarrow \frac{(L^h - L_y^h)}{a_L n^h} = \frac{(L^f - L_y^f)}{a_L n^f}$$

Thus, using the relation of L_y^h and L_y^f given in equation (2.38), equation (2.37) can be transformed into an equation in one variable L_y^f,

$$L_y^f = \frac{L^f\left((1-\alpha)\,\rho\sigma n^f + \rho\sigma n^h + (1-\alpha)(n^h + n^f)\right) - \rho\sigma\alpha n^f L^h}{(1-\alpha+\rho\sigma)(n^h + n^f)} \tag{2.39}$$

Having, determined L_y^f, we can determine L_y^h. With the sectoral allocation of labour at hand the scale of intermediate goods production $x^h = x^f = x$ is determined and hence r.

$$x^h = x^f = x = \frac{\alpha\rho}{(1-\alpha+\alpha\rho)}\frac{(L^h + L^f)}{(n^h + n^f)\,a_L} \tag{2.40}$$

$$r = \frac{px}{\sigma a_k} = \frac{M(n^h + n^f)^{\alpha/(\sigma-1)}}{\rho\sigma}\frac{(\alpha\rho)}{(1-\alpha+\alpha\rho)}\frac{(L^h + L^f)}{(K^h + K^f)} \tag{2.41}$$

Equation (2.40) suggests that output per variety, under trade, for both the countries, is determined exclusively by the world wide labour-capital ratio. Whereas under autarky this was determined solely by the national labour-capital ratios.

With all the endogenous variables relevant to trade equilibrium determined, the trade pattern can now be resolved. To explore formally the trade pattern, let us note that at the equilibrium L_y^f, the foreign country is an exporter of the final good Y if

$$Y_S^f > Y_D^f \tag{2.42}$$

Substituting equation (2.34) and (2.36), equation (2.42) implies

$$L_y^f > (1-\alpha)\left[L^f + \frac{(L^f - L_y^f)}{\rho\sigma}\right] \tag{2.43}$$

Substituting the equilibrium value of L_y^f from equation (2.39), inequality (2.43) is reduced to

$$\frac{L^f}{K^f} > \frac{L^h}{K^h} \tag{2.44}$$

The following proposition is immediate.

Proposition 4 : The country with higher labour-capital ratio is the exporter of final good and thereby a net importer of the intermediate goods.

Thus endowment difference between countries determine the extent of the trade across stages of production. Put differently, it is the force of comparative advantage which is crucial in determining this trade between stages.

2.4 Gains from Trade and Distributional Conflict

We have already seen that the wage rates are higher in both the countries under trade, whether or not labour is scarce or abundant. Thus irrespective of the forces of comparative advantage, the gains from specialisation due to trade, raises the wage rate in both the countries. On comparing equation (2.40) and equation (2.19) it is evident that for the capital rich country output of representative brand of intermediate goods x increases with the opening up of trade. This follows from the fact that $\frac{(L^h+L^f)}{(K^h+K^f)} > \frac{L^h}{K^h}$ (we assume that home country is capital rich). This increase in output (x) *ceteris-paribus* leads to a larger operating surplus and hence higher rental rates. This is further augmented over by a rise in the price of intermediate inputs, coming through the productivity gains due to specialisation, as the available array of intermediate goods increases. Thus the rental rate is unambiguously higher in the capital rich country.

This is not true for the labour-rich country. There trade leads to a contraction of intermediate goods output (x) in accordance with the forces ofcomparative advantage, thus leading to a lower operating surplus and hence lower rental rates. This loss can only be offset, if the prices of intermediate goods move up sufficiently. This will be true only if the returns from specialisation are sufficiently high and the available array of intermediate goods is sufficiently larger than under autarky.

Rewriting equations (2.20) and (2.41) as

$$r_a^f = M(n^f)^{\frac{(1+\alpha-\sigma)}{(\sigma-1)}} \frac{\alpha}{(1-\alpha+\alpha\rho)\,\sigma a_k} L^f \tag{2.45}$$

$$r_t^f = M(n^h+n^f)^{\frac{(1+\alpha-\sigma)}{(\sigma-1)}} \frac{\alpha}{(1-\alpha+\alpha\rho)\,\sigma a_k} (L^h+L^f) \tag{2.46}$$

where r_a^f and r_t^f are the rental rates in the foreign country (assumed to be labour rich) under autarky and trade respectively.

Comparing (2.45) and (2.46), one sufficient condition for the rental rate in the labour rich country to be higher under trade than under autarky is given by

$$\sigma < (1+\alpha) \tag{2.47}$$

Proposition 5 : The capital rich country is immune to distributional conflict following trade, in the sense that both wage and rental rates are higher than under autarky. On the other hand, for the labour rich country the wage rate is unambiguously higher than under autarky but the rental rate might be lower. One sufficient condition under which such distributional conflict is ruled out is given by $\sigma < (1+\alpha)$. Furthermore, if the countries are perfectly symmetric with same labour-capital ratio, trade across stages of production freezes and distributional conflicts are ruled out.

This is in sharp contrast to the results derived in Krugman (1981), where both the countries are symmetrically exposed (at least potentially) to the distributional conflict due to trade. The structure of our model is inherently such as to make the labour rich country susceptible to distributional conflict. For the labour rich country trade perforce shifts labour out of the intermediate goods sector into the final goods sector, thus leading to a contraction of the output per variety of intermediate goods. The loss of operating surplus on this count can only be compensated if the prices of intermediate goods shoot up sufficiently. This will be the case only if the new array of intermediate inputs is sufficiently large and/or the returns to specialisation are adequately high reflected in low $\sigma, (\sigma < (1+\alpha))$. For the capital rich country, on the other hand, the rental rate increases on both counts, scale of intermediate output goes up as labour shifts out of the Y sector into the intermediate goods sector and the prices of intermediate goods are also higher.

There being only one final good Y, the economy wide consumption of the final good can reasonably be taken as an index of welfare. Thus our earlier discussion carries over to the context of the gains from trade. The capital rich country unambiguously gains as both wage and rental rates are higher, but this might not be the case for the labour rich country. Assuming the foreign country to be labour rich,

$$Y^f_{Da} = w^f_a L^f + r^f_a K^f = M(n^f)^{\alpha/(\sigma-1)}\left[L^f + \frac{\alpha\rho}{(1-\alpha+\alpha\rho)\,\rho\sigma}\frac{L^f}{K^f}K^f\right] \tag{2.48}$$

$$Y^f_{Dt} = w^f_t L^f + r^f_t K^f = M(n^f+n^h)^{\alpha/(\sigma-1)}\left[L^f + \frac{\alpha\rho}{(1-\alpha+\alpha\rho)\,\rho\sigma}\frac{L^f+L^h}{K^f+K^h}K^f\right] \tag{2.49}$$

where subscripts a and t refer to autarky and trade regimes. Trade will lead to gains for the foreign (labour rich) country if

$$Y^f_{Dt} > Y^f_{Da}$$

$$\Rightarrow \left(\frac{n^h+n^f}{n^f}\right)^{\alpha/(\sigma-1)} > \frac{1+c}{1+c\frac{(L^h+L^f)}{(K^h+K^f)}\frac{K^f}{L^f}} \tag{2.50}$$

where $c = \frac{\alpha\rho}{(1-\alpha+\alpha\rho)\,\rho\sigma}$

Proposition 6 : The capital rich country unambiguously gains from trade. The labour rich country gains only if (2.50) is valid and it loses otherwise.

This result is closely akin to Markusen and Melvin (1981). They show that under imperfect competition one sufficient condition for trade to be gainful is that the distorted sector where price exceeds marginal cost, experiences an expansion. This is what is referred to as the *product expansion condition* in the literature. In our model the capital rich country experiences an expansion of the distorted sector (x-sector) where prices are a constant mark-up over the marginal cost and gains unambiguously. On the other hand, for the labour rich country, per-variety output of intermediate good contracts violating the *product expansion condition.* In our model the forces of comparative advantage necessarily leads to a contraction of the already under-produced goods (under-produced in the sense that prices are higher than the marginal cost) leading to a welfare loss which can only be outweighed if the international increasing returns captured through trade in intermediate inputs are sufficiently high.

2.5 Conclusion

In this chapter we proposed a model of trade incorporating the features of increasing returns, cast in a monopolistically competitive framework, with one final good and an intermediate goods sector. We showed how the force of comparative advantage serves as the crucial determinant of trade between stages of production. Secondly, we showed that the forces of comparative advantage are such as to lead to the expansion of the distorted sector (price exceeding marginal cost) in the capital rich country and a contraction of the same in the labour rich country. Thus the usual pro- competitive effects of trade are stalled in the labour rich country. Thirdly we show that countries differing in labour-capital ratios are asymmetrically exposed to the distributional conflict attendant to trade. The capital rich country is shown to be immune to any distributional conflict, whereas the labour such country stands a chance of the same.

Appendix

One can derive the optimal solution in final output production through a two stage maximization. In the first stage, given any allocation of the budget, say Z, for use of intermediate inputs, the final output producers optimally chooses x_i's and in the second stage producers optimally choose the allocation Z that goes to intermediate inputs.

The second stage maximization has been shown in the text equations (2.9) and (2.10) which implies $Z = \alpha Y$ and $wL_y = (1-\alpha)Y$. For the first stage maximization define the Lagrangean

$$\mathcal{L} = \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{\frac{1}{\rho}} + \lambda\left[Z - \sum_{i=1}^{n} p_i x_i\right]$$

First order condition is given by

$$\frac{\partial \mathcal{L}}{\partial x_i} = 0$$

$$\Rightarrow \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{\frac{1}{\rho}-1} x_i^{\rho-1} = \lambda p_i \quad \forall\, i \tag{A.1}$$

Multiplying both sides of equation (A.1), by x_i and summing over all n yields

$$\left[\sum_{i=1}^{n} x_i^{\rho}\right]^{\frac{1}{\rho}} = \lambda \sum_{i=1}^{n} p_i x_i$$

$$\Rightarrow \lambda = \frac{X}{Z} \tag{A.2}$$

The unit cost function P, for producing X is given by

$$P = \frac{\sum p_i x_i}{X} = \frac{Z}{X} \tag{A.3}$$

Noting equation (A.2),

$$P = \frac{1}{\lambda} \tag{A.4}$$

Using equation (A.1),

$$\left(\frac{x_j}{x_i}\right) = \left(\frac{p_i}{p_j}\right)^{\frac{1}{(1-\rho)}} \qquad (A.5)$$

Equation (A.5) implies that elasticity of substitution between any pair of intermediate input $\sigma = \frac{1}{(1-\rho)}$.

Rearranging equation (A.1),

$$x_i = \left[\frac{\lambda p_i}{[\sum x_i^{\rho}]^{\frac{1-\rho}{\rho}}}\right]^{-\frac{1}{(1-\rho)}} \qquad (A.6)$$

Noting $\sigma = \frac{1}{(1-\rho)}$, and substituting from equation (A.4), equation (A.6) boils down to

$$x_i = \frac{p_i^{-\sigma}\, PX}{P^{1-\sigma}} \qquad (A.7)$$

This yields the demand function given in equation (2.27) of the text. This is the demand function faced by the intermediate goods producers. If a firm produces good i and that firm is small enough relative to the market as a whole that it regards itself as unable to affect X or P, then it will view itself as facing a demand curve of elasticity σ.

Substituting x_i from equation (A.7) into equation (A.3),

$$P^{1-\sigma} = \sum p_i^{1-\sigma} \qquad (A.8)$$

This yields equation (2.8) of the text.

Chapter 3

Brain-Drain : An Alternative Theorisation

3.1 Introduction

In this chapter we extend on the theme of increasing returns to scale (IRS). A two sector model is proposed in which one of the sectors is subject to IRS. The final good produced in this sector is assumed to be nontraded. Under such a set up, we address the issue of what has come to be known as Brain-drain. Specifically we look into the consequence of emigration of skilled workforce (in response to better prospects outside the country) on the IRS sector. The issue of emigration has for some time now, become a central issue in trade theoretic literature. Berry and Soligo (1969) is one of the earliest contributions made to this literature. The main purpose of their paper is to look into the effects of permanent emigration on the welfare of the residents left behind. They show that emigration in a perfectly competitive set up, is necessarily harmful for those left behind in the source country. The argument is simple. Considering a two factor (say, capital and labour), one sector model, we have the usual diminishing marginal productivity of labour. Emigration causes a fall in output of the economy. But to the extent that the marginal productivity of labour schedule is downward sloping, the fall in output outweighs the initial earnings of emigrants (what they earned before emigrating). This constitutes a net loss for those left behind. This loss is identified as the famous *Harberger triangle.* Extensions on the same theme is provided in the works of Wong (1986), Quibria (1988) and Tu (1991). It is readily understandable, how the preceding result can be extended to a multi-factor, multi-commodity set up. Say, W^0 represents the vector of factor prices before emigration and V^0 be the initial (before emigration) factor endowment. Similarly W^t and V^t represent the post emigration vectors of factor prices and endowments respectively, prevailing in the economy. Now consider the case where, $W^0 \neq W^t$. Cost minimization condition under perfect competition implies, $W^tV^t < W^0V^t$. Note, the left hand side of the inequality represents the current factor earnings of those left behind and the right hand side represents the initial (as it were before emigration took place) earnings of those left behind. To the extent that, all goods are tradable at constant prices (before and after emigration), this surely implies that welfare of those left behind in the process of emigration, falls. This result has been extended to a set up where some final goods are non-tradable. Rivera-Batiz (1982) proved the result in a set up with one tradable and one non-tradable sector.

As seen from the preceding analysis, this result is quite general. It covers the case of emigration of any factor; meaning that even emigration of unskilled labour can hurt those left behind. As is readily understandable, the results are generated by the changes in factor rewards consequent to emigration. Therefore, it follows by implication, that if factor prices are invariant to changes in endowment, emigration would have no effect on the residents left behind (of course under the assumption that prices of commodities do not change). Thus in the standard Heckscher-Ohlin-Samuelson (H-O-S) model under the small economy assumption, emigration will have no effect on the welfare of those left behind. This is because under H-O-S technology, the factor prices get determined once commodity prices are known, and are invariant to changes in the amount of factors operating in the economy.

The case of emigration has also been extended to models of non-constant returns to scale. Wong (1995) models a situation of emigration where there are external effects generated out of the aggregate labour used in the economy. The externalities are purely Marshallian in nature and producers act competitively. Naturally the social marginal product exceeds the private marginal product of labour. In this case, emigration has more severe impact on the economy. Added to the already mentioned *Harberger triangle* loss, there is a loss on externality count. This is due to the fall in the labour force operating in the economy, which has a higher social marginal product than the private marginal product reckoned by the producers. Miyagiwa (1991) also models a situation of brain-drain where there are scale effects in education.

In this chapter, we develop a two sector model along the lines proposed by Ethier (1982). One of the sectors is an increasing returns to scale (IRS) sector and is non-tradable. This non-tradable final good is produced by specialized services (the interpretation is motivated by Markusen (1989)). These specialized services in turn require skilled labour (or, human capital) m. Skilled labour production requires unskilled labour and capital. There is yet another traded good which is competitively produced by unskilled labour and capital. We consider a situation where skilled labour can emigrate in response to changes in rewards in the international market.

In our model emigrants repatriate their income fully back to the source country. Furthermore, we include the welfare of the emigrants in the welfare calculations of the source country. Though this is not customary in models where effects of emigration is studied, there is strong empirical evidence pointing to the fact that emigrants remit a large share of their income back to the source country. In fact Galor and Stark (1990) build up a model of emigration where emigrants save (i.e., they do not consume in the country they emigrate to) a large part of their income because they face a positive probability of returning back to the low wage source country. Djajic and Milbourne (1988) is yet another case in point where the model is built up explicitly on the theme that emigrants have strong preference towards consuming in the source country.

In such a set up we show how deskilling of the economy arises as a possibility when domestic demand is not adequately responsive to accommodate the non-traded increasing returns sector in the face of a rise in cost, as skilled labour emigrate in response to higher international rewards. To the extent that incomes are fully repatriated by emigrants, a rise in international rewards to skilled labour does enrich the economy. However if this higher income does not translate into higher demand for the increasing returns sector, then it might lead to lesser domestic absorption of skilled labour. Interestingly, such a contraction of increasing returns sector goes hand in hand with higher production of skilled labour in the economy which is exporting skilled labour. This resembles the classic case of Brain-drain.

The plan of the chapter is as follows. Section 3.2 describes the model economy and discusses the determination of the model and stability issues. Section 3.3 studies the effect of a rise in the international reward of skilled workers. Section 3.4 concludes the chapter.

3.2 The Model

The model we construct closely follows that of Ethier (1982). There are two final commodities 1 and 2. Commodity 2 is produced under competitive conditions with usual constant returns to scale (CRS) technology, using unskilled labour and capital. The production technology of good 1 is given by

$$X_1 = \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{1/\rho}, \quad \text{where } 0 < \rho < 1 \tag{3.1}$$

where x_i is the input of intermediate good i. These intermediate goods are to be interpreted as specialized forms of services, which are nontradable. Thus the economies of scale generated by the production technology are purely localised in nature (localised within national boundaries)[1]. Intermediate goods are imperfect substitutes, where ρ measures the degree of differentiation of inputs. The production technology exhibits constant returns to scale (CRS) for a given number of varieties of inputs and increasing returns with higher degree of specialization as measured by the number of intermediate goods n. These economies are external to the firms but internal to the industry. Thus each atomistic producer of good 1 take n as given.

The intermediate goods, or specific service forms, as we will interpret it, are produced from a composite factor bundle m. This composite factor bundle in turn is produced by unskilled labour and capital under CRS. Our interpretation of this factor bundle m is that it represents a homogeneous form of skilled labour which can emigrate out in response to changes in international returns. The point to note is the departure in this structure from that of Ethier (1982). In our model trade (or unbridled possibility to emigrate in response to changes in international rewards of skilled labour (m)) truncates the vertically integrated production structure of X_1 at the level of skilled labour (m) production, that is to say, before the scale economies are realised and absorbed domestically. Thus we have a tradable upstream production of m and a nontradable downstream where specialized services (x_i) are produced and used in the production of X_1. To the extent that services (x_i) are nontradable and furthermore X_1 is nontradable, the production range of the specialized services will depend upon the domestic demand for X_1. Thus realization of the scale economies within the national boundary will crucially depend upon the demand conditions.

As already suggested the model closely mimics a situation of brain-drain. Opening up to trade at the level of m production has two distinct effects on national income of the economy. Exports of skill to the outside world market and the consequent repatriation of the earnings made abroad, enriches the economy. On the other hand, demand condition dictates to what extent the derived demand for differentiated skilled services would be supported and absorbed by the national economy. We show that the factors governing the supply demand shifts would crucially determine the extent of skill differentiation (division of labour) that is realised within the national economy.

[1]See a similar formalisation in Markusen (1991) where the spill over is confined within the sector, due to nontradedness of intermediate goods. Furthermore, added to this we have the requirement of X_1 itself being nontraded.

As in Ethier (1982) we assume all intermediate goods to have identical cost functions. The cost of producing the quantity x_i of a given variety of intermediate input is $C_x = (ax_i + b)p_m$, where a and b are the marginal and fixed requirements of m respectively and p_m is the price of factor bundle m.

An individual X_1 producer maximizes profits subject to the production function and considering n to be parametrically given. This gives rise to the input demand function for each intermediate input (see the Appendix of chapter 2)

$$x_i = \frac{q_i^{-\sigma} \sum q_i x_i}{\sum q_i^{1-\sigma}} \tag{3.2}$$

where q_i is the price of the ith intermediate input and $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between any pair of intermediate inputs. Assuming large number of intermediate good producers, such that strategic behaviour is ruled out on their part, it can easily be shown that σ is the elasticity of demand faced by the intermediate good producers. Thus each producer of intermediate inputs equate marginal revenue to marginal cost,

$$q_i\left(1 - \frac{1}{\sigma}\right) = ap_m$$

Taking note of the fact that $\sigma = \frac{1}{1-\rho}$,

$$q_i = \frac{ap_m}{\rho} \tag{3.3}$$

It follows that prices of intermediate goods are a constant mark-up over the marginal cost. With identical technology all firms charge the same price ($q_i = q$). Free entry drives down profits to zero (the Chamberlinian large group case). Thus the operating surplus must be just enough to cover the fixed cost.

$$\frac{q}{\sigma} x_i = bp_m \tag{3.4}$$

Under the assumption of identical technology (i.e., a and b being the same for all intermediate good producers), this also implies that output x_i is the same for all producers ($x_i = x$).
Dividing equation (3.3) by (3.4), we get

$$x = \frac{b\rho}{1-\rho} \tag{3.5}$$

If in equilibrium n is the effective number of produced varieties then the total amount of skilled labour absorbed domestically in the economy (m^a) is given by

$$m^a = n(ax + b) \tag{3.6}$$

Note that (3.5) implies that output per firm is a constant. Thus any expansion of X_1 would be in terms of increased n. And this, as has already been noted, implies increasing returns to scale at the industry level in X_1 production.

Given the symmetry in intermediate goods production, (3.1) collapses to

$$X_1 = n^\alpha x \tag{3.7}$$

where $\alpha \equiv \frac{1}{\rho} > 1$.

Further we assume that the zero profit condition holds in X_1 production, due to free entry. Thus

$$p_1 X_1 = nqx \tag{3.8}$$

where p_1 is the price of commodity 1.
Using (3.7) in equation (3.8), we have

$$p_1 = n^{1-\alpha} q \tag{3.9}$$

Equation (3.9) implies that a rise in the price of intermediate goods raises the final good price, and a rise in n depresses the same.

Next, we consider the determination of the model. We assume that skilled labour (m) faces a constant price p_m in the international market. In other words we assume that the country supplies only a small fraction of the total world volume of skilled workforce. Better prospects for emigration would be modelled as a rise in p_m (this is done in the next section).

Note that m and X_2 constitutes a subsumed CRS system in our model where both m and X_2 are produced by unskilled labour and capital under perfect competition and CRS technology. This implies, the production possibility frontier in m and X_2 plane would be concave to the origin[2]. This naturally gives rise to a positively sloped supply

[2]Substitutability of unskilled labour and capital in the production of skilled labour requires some justification. In fact, we are assuming here that unskilled labour is already measured in basic efficiency unit so that a less efficient unskilled labour produces the same amount of skilled labour with more capital, where the outlays on training unskilled labour constitutes the capital cost.

curve for m,

$$\hat{m} = A\hat{p_m} \tag{3.10}$$

where $p_2 = 1$ by choice of numeraire.

Here $\hat{}$ represents a percentage change, e.g. $dz/z \equiv \hat{z}$. Note that, lesser the difference in capital intensities between sector 2 and sector m, higher will be the value of A and larger would be the resource shift to m-sector for a given rise in p_m (see Jones (1965)).

Thus, given the world demand price p_m, the production of both m and X_2 are determined. Given p_m, the price of intermediate goods (q) is determined from equation (3.3). With q known, for any given final good price p_1, the derived demand for intermediate varieties (n) is determined from equation (3.9). Noting the production function (3.7), n determines the supply of X_1 (as x is constant). Thus for any given p_1, corresponding supply of X_1 is known and hence the supply curve for X_1 is determined. Next the demand for X_1 is used to close the model. With the equilibrium price p_1 and X_1 determined, we can retrace the argument backward to find the volume of exports of skilled labour. Total production of X_1 determines the extent of division of labour supported domestically (i.e., n). n determines the amount of skilled labour that has been absorbed domestically (see equation 3.6). Now, as has been noted, given the world demand price p_m, total skill production m in the economy, is already known. Thus $(m - m^a)$, the total export of skill to the outside world is determined.

Next we discuss the determination formally, along with the stability issues. Denoting the supply price of X_1 as p_1^s, we take log derivatives of equation (3.9), to obtain

$$\widehat{p_1^s} = (1 - \alpha)\,\hat{n} + \hat{q} \tag{3.11}$$

Thus, given the price (q) of specialized services, higher differentiation of specialised services (n) depresses the supply price p_1^s. Log differentiating equation (3.4), we obtain

$$\hat{q} = \widehat{p_m} \tag{3.12}$$

Given the world price of $m, \widehat{p_m} = 0$, which implies $\hat{q} = 0$.

Equation (3.11) reduces to

$$\widehat{p_1^s} = (1 - \alpha)\hat{n} \tag{3.13}$$

Taking derivative of the production function (3.7), equation (3.6) and noting, that x is a constant,

$$\hat{X}_1 = \alpha\hat{n} = \alpha\hat{m}^a \tag{3.14}$$

Substituting equation (3.14) in (3.13),

$$\widehat{p_1^s} = \frac{(1-\alpha)}{\alpha}\,\hat{X}_1 \tag{3.15}$$

Equation (3.15) gives an inverse supply relation for X_1, shown as SS in Figure 1.

To close the model we need the demand side for commodity 1. Equilibrium in commodity 1 market is given by

$$D_1(p_1, y) = X_1 \tag{3.16}$$

Denoting the demand price for commodity 1 by p_1^d and differentiating equation (3.16), we obtain

$$-\eta_1\,\hat{p}_1^d + \frac{\epsilon_1}{p_1 D_1}dy = \hat{X}_1 \tag{3.17}$$

where $\eta_1 \equiv -\frac{p_1}{D_1}\frac{\partial D_1}{\partial p_1}$, is the compensated price elasticity of demand for good 1, and $0 < \epsilon_1 \equiv p_1\frac{\partial D_1}{\partial y} < 1$ is the marginal propensity to consume good 1.

To determine the demand relation, we need to know the relation between real income (y) and price p_1, in a general equilibrium context. To calculate the real income change (following Jones (1967)), we assume the index of social welfare u, to depend only on the bundle of final goods consumed.

$$u = u(D_1, D_2) \tag{3.18}$$

where D_i is the consumption of good i.

We assume non-satiation or non-specialization in consumption.

Then total differentiation of (3.18) yields

$$\frac{du}{u_2} = \frac{u_1}{u_2}\,dD_1 + dD_2 \tag{3.19}$$

where u_i is marginal utility of the *ith* commodity.

Following Jones (1967) $\frac{du}{u_2} = dy$ is the change in home real income measured in units of commodity 2. With the home price ratio equal to the marginal rate of substitution, we obtain

$$dy = p_1\,dD_1 + dD_2 \tag{3.20}$$

where, commodity 2 is assumed to be the numeraire commodity.

The trade balance condition entails domestic consumption evaluated at home prices to be equal to domestic production evaluated at home prices plus the export earning.

$$p_1 X_1 + X_2 + p_m E = p_1 D_1 + D_2 \tag{3.21}$$

where $E = m - m^a$ denotes the volume of exports of skilled labour. Alternatively $p_m E$ can be interpreted as repatriated income of the skilled labour, earning abroad.

Differentiating the trade balance condition equation (3.21) and noting equation (3.20),

$$dy = p_1\, dX_1 + dX_2 + p_m dE + E dp_m \tag{3.22}$$

where, use has been made of the market clearing condition for the nontraded commodity 1, that is, $D_1 = X_1$.

Noting $dE = dm - dm^a$ equation (3.22) reduces to

$$dy = p_1\, dX_1 + dX_2 + p_m dm - p_m dm^a + E dp_m \tag{3.23}$$

Cost minimization requires that the price weighted sum of changes in production along the transformation curve (in m, X_2 plane) must be zero. Thus at constant endowment of unskilled labour and capital

$$dX_2 + p_m dm = 0 \tag{3.24}$$

Using equation (3.24) in (3.23),

$$dy = p_1\, X_1\, \hat{X}_1 - p_m\, m^a\, \hat{m}^a + E p_m\, \hat{p}_m. \tag{3.25}$$

Zero profit condition in X_1 production implies

$$p_1\, X_1 = nqx = p_m m^a \tag{3.26}$$

Therefore, equation (3.25) boils down to

$$dy = p_1 X_1 (\hat{X}_1 - \hat{m}^a) + E p_m \hat{p}_m \tag{3.27}$$

Substituting equation (3.14) into (3.27), we obtain

$$dy = p_1\, X_1 (\alpha - 1)\, \hat{m}^a + E p_m\, \hat{p}_m. \tag{3.28}$$

The welfare change equation (3.28) is readily understandable. The last term on the right is the usual terms of trade effect; a rise in p_m, the price of exportable skilled labour, generates a favourable effect. The first term on the other hand gives the effect of changes in the production of the sector experiencing increasing returns to scale. Any contraction (expansion) of the sector producing X_1 has an unfavourable (favourable) effect. The extent of which is contingent upon the extent of the scale economy prevailing in the X_1 sector, as measured by α. Higher α would magnify the welfare effect of such changes.

At a given price for skilled labour p_m, real income change would solely depend on the change in the output of IRS sector ($\hat{X}_1$ or equivalently $\hat{m}^a$).

Next, substituting for dy from equation (3.28) (with $\hat{p}_m = 0$) into equation (3.17) we have

$$p_1^d = -\left(\frac{\alpha - \epsilon_1(\alpha - 1)}{\alpha\eta_1}\right) \hat{X}_1 \tag{3.29}$$

Equation (3.29) gives the demand curve for good 1. Nothing that, $0 < \epsilon_1 < 1$, the term in parenthesis on the right hand side of the equation (3.29) is positive. This implies that the demand curve for good 1 is negatively sloped. To get an insight into the slope of the demand curve, note that a rise in p_1, necessarily reduces the demand for X_1, on own price effect count. Furthermore a rise in p_1 has income effects on the demand for X_1, working through changes in real income (dy). Noting equation (3.28) real income can only change through a change in production of good 1 ($\hat{X}_1$) and/or through changes in p_m. At $\widehat{p_m} = 0$, only the first channel is operative. Moreover with $\widehat{p_m} = 0, \hat{q} = 0$ (equation 3.12). Therefore, a rise in p_1 of necessity implies a fall in n (see equation 3.13) and hence contraction of X_1. This reduces the real income unambiguously and to the extent good 1 is non-inferior this fall in real income reduces the demand for good 1. Thus at constant p_m, a rise in p_1 reduces the demand for good 1 both on own-price effect and income effect counts. This naturally gives rise to a negatively sloped demand curve.

Thus equations (3.15) and (3.29) gives the supply and demand curves respectively, both of which are negatively sloped. This obviously raises problems of stability. The equilibrium which is stable in the Marshallian sense will not be so in the Walrasian sense. To derive the stability condition, we propose a Marshallian quantity adjustment in the market for good 1. This is in keeping with tradition of the models with IRS (see Ethier (1982)). Ide and Takayama (1991) show how in models with variable returns to

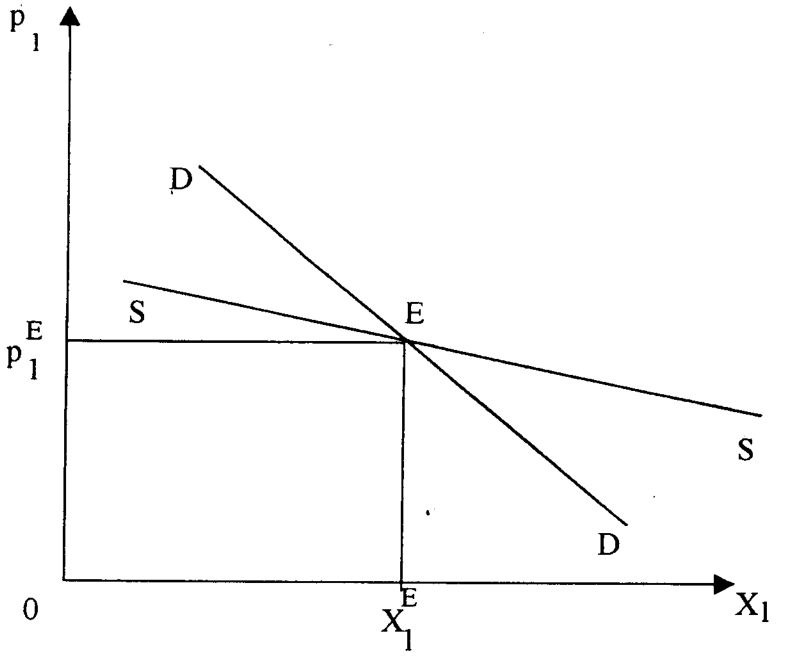

Figure I

scale, Marshallian stable equilibria rules out perverse comparative statics responses. Furthermore they argue that in models which explicitly has production, quantity adjustment should be the more appropriate rule than price adjustment (in the sense of Walrasian auction), to formalise the off equilibrium dynamics. On the other hand, they argue that price adjustment rule (hence Walrasian stability condition) is more suited for pure exchange models where there is no production.

In figure I, DD and SS represent the demand (equation 3.29) and the supply (equation 3.15) curves respectively, with E being the equilibrium. Note that the way we have drawn the curve presumes the equilibrium to be Marshallian stable with the DD curve cutting the SS curve from above. The equilibrium prices and quantities are given by p_1^E and X_1^E respectively. This formally closes the model. Having determined equilibrium X_1, we have essentially determined the extent of skill differentiation (n) that the domestic demand condition allows for, and also the extent to which the economy absorbs (m^a) the existing stock of skilled labour (m) [see equation (3.14)]. Note that m is already determined once p_m is given, as is true in our model. Thus the residual ($m - m^a$), the export of skill, gets determined.

To determine the stability condition, we propose a Marshallian quantity adjustment rule in the X_1 market.

$$\dot{X}_1 = \beta \left[\frac{p_1^d(X_1)}{p_1^s(X_1)} - 1 \right] \tag{3.30}$$

Here $\dot{}$ represents the time derivative and $\beta > 0$ in the speed of adjustment. Here we assume all other markets adjust instantaneously except for the X_1 market.

Linearizing equation (3.30) around the equilibrium, we obtain

$$\dot{X}_1 = \frac{\beta}{X'} \left[\frac{\hat{p}_1^d}{\hat{X}_1} - \frac{\hat{p}_1^s}{\hat{X}_1} \right] (X_1 - X_1^E) \tag{3.31}$$

where X_1^E is the equilibrium value of X_1.

Stability then requires

$$\left[\frac{\hat{p}_1^d}{\hat{X}_1} - \frac{\hat{p}_1^s}{\hat{X}_1} \right] < 0 \tag{3.32}$$

Substituting for $\hat{p}_1^d/\hat{X}_1$ from equation (3.29) and $\hat{p}_1^s/\hat{X}_1$ from equation (3.15), into equation (3.32), we get

$$\frac{((\eta_1 + \epsilon_1)(\alpha - 1) - \alpha)}{\alpha \eta_1} < 0 \tag{3.33}$$

Stability in effect requires the numerator of (3.33) to be negative, as the denominator in (3.33) is positive, i.e.

$$((\eta_1 + \epsilon_1)(\alpha - 1) - \alpha) \equiv \Delta < 0 \tag{3.34}$$

Proposition 1 : The market for commodity 1 is stable in the Marshallian sense (assuming all other markets adjust instantaneously) if inequality (3.34) is satisfied.

Inequality (3.34) gives the condition for stability in X_1 market, which we will require in determining the comparative statics signs.

3.3 Consequence of Emigration

In this section, we investigate the consequence of changes in world demand for skilled workforce. This is modelled here as a one time change in p_m. Thus better prospects for skilled labour abroad, is formalised in our model as $\widehat{p_m} > 0$.

Generally in models where effects of emigration are studied, it is customary to investigate the welfare of the residents who are left behind. This is of course one way to look at the question of emigration. But on yet another count it misses a crucial point and that is not of no consequence. A large part of emigrants' earnings are in fact repatriated back to the home country. As already noted, there is a strong empirical evidence in favour of this, even casual empiricism suggests in that direction. The role of repatriated earning has also been investigated by Djajic (1986) in an interesting rejoinder to the result arrived at by Rivera-Batiz (1982). Djajic considers a model with a traded and a non-traded good as in Rivera-Batiz (1982). It is shown that the welfare of the non-migrants might increase, contrary to Rivera-Batiz's claim, if the earnings repatriated back to the source country by the emigrants exceed a critical value. Gupta (1994) also considers a model where the foreign workers repatriate back their earnings fully. In our model the role of repatriated earning in supporting the domestic IRS sector is investigated. Furthermore as already noted we depart from the usual tradition of excluding emigrants' welfare from aggregate domestic welfare calculations and incorporate emigrants' welfare with same weightage in the domestic welfare calculation as that of the residents. More specifically we propose a utility function representative of a monolithic consumer (representing both the migrants and non-migrants). Alternatively, we could assume that the repatriated income is enjoyed by those who stay back.

Now, note with $\hat{p}_m > 0$, the real income change dy is given by equation (3.28). The second term on the RHS of equation (3.28), $Ep_m\widehat{p_m}$, is in fact the change in repatriated earnings, due to change in p_m. Thus $Ep_m\hat{p}_m$ is positive and resembles a terms of trade improvement. But the fate of the IRS sector would be crucial in determining the ultimate welfare change.

Equation (3.11) gives us (henceforth the superscripts denoting supply and demand are suppressed)

$$\hat{p}_1 = (1-\alpha)\hat{n} + \hat{q} \tag{3.35}$$

Noting $\hat{q} = \hat{p}_m$, and $\hat{X}_1 = \alpha\hat{n} = \alpha\hat{m}^a$, equation (3.35) reduces to

$$\hat{p}_1 = \frac{(1-\alpha)}{\alpha}\hat{X}_1 + \hat{p}_m\ . \tag{3.36}$$

This is the generalised supply schedule for X_1 with $\hat{p}_m$ acting as a shift parameter. At any given level of X_1 production a rise in p_m raises the cost of intermediate inputs (q), raising the average cost of production of commodity 1. This shifts the supply schedule upwards.

Equation (3.36) suggests that, if the country was trading with the rest of the world at a constant p_1 (i.e., $\hat{p}_1 = 0$), a rise in p_m would necessarily imply, $\hat{X}_1 > 0$. Thus in that case the IRS sector would surely expand. In our model we would explore the fate of the IRS sector when it is non-traded, and that will crucially depend upon the demand and supply shifts, consequent to changes in p_m.

Using equation (3.36) in (3.17) and noting $\hat{X}_1 = \alpha\widehat{m^a}$, we obtain

$$dy = [\alpha - \eta_1(\alpha - 1)]\frac{p_1D_1}{\epsilon_1}\widehat{m^a} + \frac{\eta_1p_1D_1\widehat{p_m}}{\epsilon_1} \tag{3.37}$$

Equations (3.37) and (3.28) can be used to solve for $\hat{m}^a$.

$$\widehat{m^a} = \frac{\left[\frac{p_1D_1\eta_1}{\epsilon_1} - Ep_m\right]\frac{\epsilon_1}{p_1D_1}\widehat{p_m}}{\Delta} \tag{3.38}$$

Note that $\Delta < 0$ from the stability condition already derived in inequality (3.34).

Hence the following proposition.

Proposition 2 : Following a rise in the price of skilled labour, p_m, the sector producing commodity 1 (or equivalently domestic absorption of skilled workforce) expands or contracts depending upon Ep_m greater than or less than $\frac{p_1D_1\eta_1}{\epsilon_1}$.

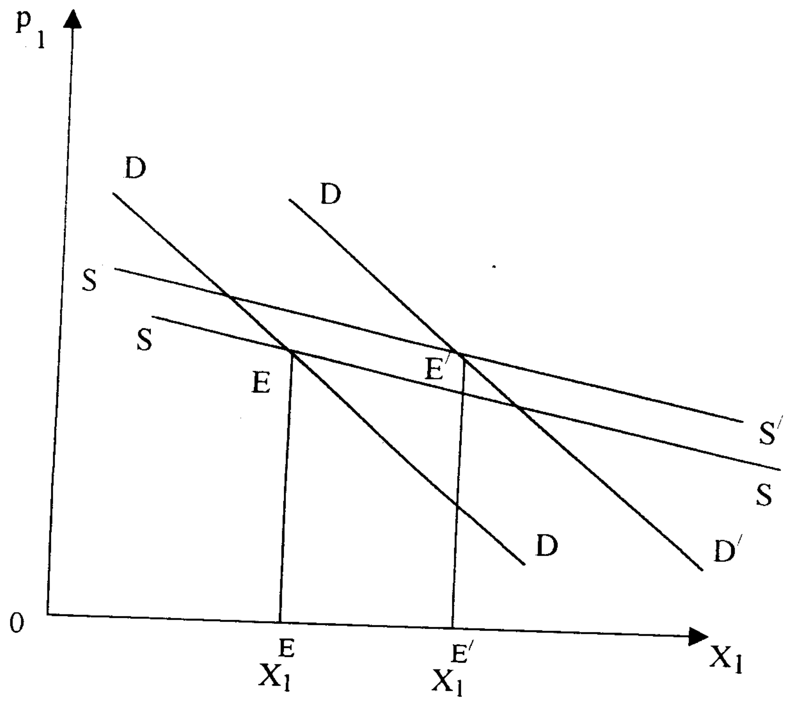

Figure II a

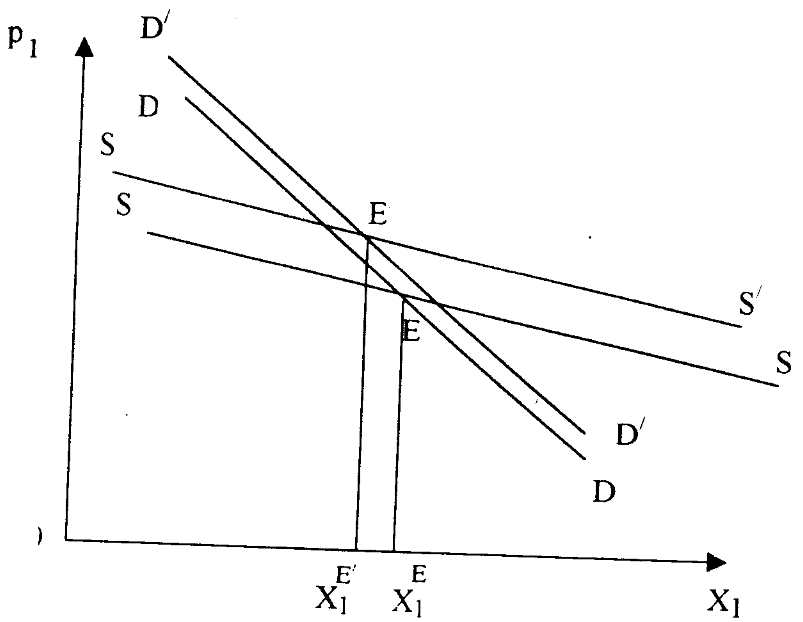

Figure II b

To see the mechanism at work more clearly, we should be able to deleniate the demand and supply repercussion of a change in p_m. Note we have already got the generalised supply schedule in equation (3.36). A rise in p_m shifts the supply curve from SS to S′S′ in figure IIa and IIb. To derive the demand shift, we substitute for dy from equation (3.28) in equation (3.17) and noting that $\widehat{m^a} = \frac{\widehat{X_1}}{\alpha}$, obtain

$$\widehat{p^d}_1 = \frac{-(\alpha - \epsilon_1(\alpha - 1))}{\alpha\eta_1}\widehat{X}_1 + \frac{\epsilon_1 E p_m}{\eta_1 p_1 D_1}\widehat{p_m} \tag{3.39}$$

This gives us the generalised demand schedule for X_1 with $\frac{\epsilon_1 E p_m}{\eta_1 p_1 D_1}\widehat{p_m}$ acting as the shift parameter. A rise in p_m necessarily shifts the demand curve upwards from DD to D′D′ in figure IIa and IIb.

Thus with the supply and demand schedule both shifting to the right, the new equilibrium can end up either with higher or lower level of X_1 production depending on the extent of the shifts.

It is obvious from the figure that if the demand curve shifts upward by a larger (lesser) extent than the supply curve from the initial equilibrium point E, X_1 will increase (decrease).

Figure IIa shows the situation where X_1 increases in the new equilibrium. Figure IIb depicts the situation where sector X_1 contracts.

Note that the shift parameter of the supply curve is $\widehat{p_m}$ and that of the demand curve is given by $\frac{\epsilon_1 E p_m}{\eta_1 p_1 D_1}\widehat{p_m}$. Thus a larger production of X_1 and therefore a higher domestic absorption of skilled labour (m^a) in new equilibrium E′ would require

$$\frac{\epsilon_1 E p_m}{\eta_1 p_1 D_1}\widehat{p_m} > \widehat{p_m} \tag{3.40}$$

Now noting equation (3.38), $\widehat{m^a} > 0$ iff $E p_m > \frac{p_1 D_1 \eta_1}{\epsilon_1}$, and this is the same as inequality (3.40).

A higher value of $E p_m$ implies that the repatriated income is large and the increase in p_m leads to a large increase in repatriated earning. Furthermore, if the propensity to consume good 1 (ϵ_1) is high this will translate into a large increase ($\epsilon_1 E p_m \widehat{p_m}$) in demand for good 1. This can effectively act as a buffer in the face of increased supply price for X_1 and can potentially help sustain a higher level of demand and hence in equilibrium, production of the IRS sector and thereby make possible a larger absorption of the skilled labour domestically.

As already noted a rise in p_m, necessarily implies a higher production of m, (see equation 3.10) but to what extent such an increased production can be accommodated by the domestic demand becomes the issue at stake. As has been starkly brought out here, the role of repatriated income working through the demand side becomes decisive in determining the extent to which higher production of m can be gainfully translated into higher division of skilled labour (as measured by higher n and m^a see equation (3.14)).

Thus a lower value of export basket and/or lower marginal propensity to consume commodity 1, ϵ_1 and/or higher η_1 makes room for the case where the economy gets deskilled (brain-drain) as measured by a fall in X_1 and hence a fall in m^a and n.

Solving for dy, from equations (3.37) and (3.28) yields

$$dy = \frac{[\eta_1 p_1 X_1(\alpha - 1) - E p_m(\alpha - \eta_1(\alpha - 1))]\,\widehat{p_m}}{\Delta} \tag{3.41}$$

Following proposition is immediate from equation (3.41).

Proposition 3 : Following a rise in the price of skilled labour, p_m, welfare increases or decreases according as $\frac{(\alpha-1)}{\alpha} \lessgtr \frac{E}{\eta_1 m}$.

As already noted in equation (3.28), a necessary condition for welfare immiserization is $\widehat{m^a} < 0$. But to what extent such contraction would manifest as a welfare loss would depend on the extent of the scale economy α. Larger α would exacerbate the welfare loss due to contraction of X_1 and might even (for some parameterization) outweigh the primary gains made through a larger value of earnings repatriated by the emigrants.

3.4 Conclusion

With no restriction on emigration of skilled work force, an economy is faced with the crucial question of what happens to the level of skill absorption and differentiation inside the economy. Confronting favourable bargain for skilled work force in the world economy, the possibility arises where skill formation within the economy is enhanced but absorption of the same is not.

Our model suggests that the level of skill differentiation and absorption of the same within the economy is crucially contingent upon the demand side of the economy. The income effect of the terms of trade gain which can potentially translate itself into higher demand for goods produced under IRS can accommodate a higher level of production of the same. To the extent, the market size effect is not strong enough, possibility of a de-skilling of the economy cannot be ruled out. Interestingly, this situation of deskilling of the economy goes hand in hand with higher production and export of skilled work force.

Chapter 4

Welfare Consequence of Capital Inflow for a Small Tariff Protected Economy*

4.1 Introduction

The welfare consequence of changes in factor endowment has been one of the most severely contested issues in the field of international trade. Johnson (1967) demonstrated the possibility of immiserizing growth caused by capital accumulation (or technical progress) in a small country subject to tariff. His analysis was followed by Tan (1969) Bertrand & Flatters (1971) and Martin (1977). Subsequently, a series of papers have demonstrated that growth induced by foreign capital was necessarily immiserizing for the host country if the sector experiencing growth was tariff protected and foreign capital income was repatriated in full. Hamada (1974) and Brecher and Diaz-Alejandro (1977) are two representative papers along this line. Bhagawati (1973) shows that the conventional result whereby the imposition of tariff would reduce a small country's real income might carry over to the case where in addition to the usual consumption and production effects, the increased rate of protection would attract foreign capital by raising the domestic return under the assumption that the import competing sector is relatively capital intensive.

These results were derived in the context of the familiar two factor, two good Heckscher-Ohlin-Samuelson (H-O-S) model of the small open economy with the possibility of capital inflow. Thus the assumption of constant returns to scale (CRS) and perfect competition has remained central to all these exercises. One obvious question to ask for is then what happens if the assumptions of CRS and perfect competition are relaxed. Research has also extended into these areas, exploring the conditions under which welfare is immiserized with foreign capital induced growth in the tariff protected sector when there are still other imperfections in other markets.

* This Chapter is based on Chakraborty (1999)

One of the most tractable models of labour market imperfection is the Harris-Todaro (H-T) model. Given the fact that its structure is a close kin of the H-O-S model, it is not unusual that H-T model became a natural candidate to investigate the repercussion of capital inflow on welfare. For generalised H-T economies with urban unemployment, capital inflow with full repatriation of profit has been shown to be necessarily welfare immiserizing with stable factor markets (Khan, 1982), and conditionally immiserizing in the presence of sector specific capital (see, Brecher and Findlay 1983). Grinols (1991) introduces an urban informal sector within the H-T set up, arguing that immiserization effects are extreme parametrization of a generally welfare improving outcome. In all these, the important point to note is that if there are more than one distortions (one of which being tariff protection), foreign capital inflow might alleviate some distortion at the expense of aggravating others. Thus the welfare results are no more unambiguous and can only be pinned down by definite parametrization.

Sen *et al.* (1997) builds up a model incorporating the features of product differentiation *a la* Dixit-Stiglitz, embedded in a monopolistically competitive market. They show that in such a set up capital inflow is conditionally welfare improving. The mechanism that drives their result is simple. Capital inflow leads to higher varieties and thus welfare improvement. On the other hand it also leads to the expansion of the distorted sector (tariff protected sector), crowding out cheaper imports. Thus for some parametrization it can be shown that welfare improves.

In what follows, Sen *et al.* (1997) will be our point of departure. We build up a model of an economy producing a final good with labour and an array of intermediate goods both domestically produced and imported. The imports of intermediate goods are paid back by exports of the final good alone. Thus the intermediate goods are purely importables and the final good is an exportable, balancing the trade. We show that capital inflow raises factor income in terms of the final good. This result is driven by the returns to specialization which an extra dose of capital allows for. We further show, and this is interesting, that foreign capital induced growth of the import competing sector might not crowd out imports. On the contrary, imports might go up, thus reducing an already existing distortion and increase welfare on yet another count. Note that Sen *et al.* (1997) is essentially a two sector model with one sector producing differentiated final goods and another sector producing a homogenous good. On the other hand, our model is fundamentally a one sector model to the extent that the final goods are considered to be the identifying mark of a sector. At yet another level it is a two sector model if one considers the intermediate and final goods being two distinct sectors.

One common feature that most of the models in this tradition share is that a foreign capital induced growth in the import competing sector necessarily crowds out cheaper imports and thus leads to a welfare loss. [see Johnson (1967), Brecher, Diaz-Alejandro (1977)]. This result has been contested in recent times by Marjit and Beladi (1996) in a competitive general equilibrium model where the resource re-allocation effect attendant to capital inflow increases the final output production and thus derived demand for intermediate inputs (importables) might shoot up leading to higher imports. We show in our model that a similar outcome might arise due to an altogether different reason. Capital inflow in our model leads to higher varieties of intermediate inputs leading to productivity gain. If the productivity impact is sufficiently high, the derived demand for imported intermediate might go up hand in hand with the expansion of the domestic intermediate goods sector.

The plan of the chapter is as follows. Section 4.2 develops the model. Section 4.3 draws the comparative statics results of capital inflow. Section 4.4 concludes.

4.2 The Model

The model we propose in this section closely follows the structure developed in chapter 2. But here the home country is assumed to be a small open economy, with one final output sector which is traded (exportable by assumption) and an import competing intermediate goods sector. The economy produces a final good Y according to the production function

$$Y = X^{\alpha} L_y^{1-\alpha} \tag{4.1}$$

where

$$X = \left[\sum_{i=1}^{n^h} x_i^{h^\rho} + \sum_{j=1}^{n^f} x_j^{f^\rho}\right]^{1/\rho} \quad \text{and} \quad 0 < \rho < 1$$

$x_i^h, i = 1, \ldots, n^h$ are the domestically produced intermediate inputs and are non-traded. The intermediate inputs $x_j^f, j = 1, \ldots, n^f$ are foreign produced and available at given international prices p^f. The domestic prices of these foreign brands are marked over by the prevailing tariff rate t. Thus the domestic prices of these foreign brands are given by $p^f(1+t)$. Following Venables (1982) we assume that both p^f and n^f are given exogenously. This constitutes a variant of the usual small country assumption. L_y is the direct labour used in the production of final output Y.

The price index of the composite intermediate input bundle X is given by (the derivation is shown Appendix of chapter 2)

$$P^{1-\sigma} = \left[\sum_{i=1}^{n^h} p_i^{h^{1-\sigma}} + \sum_{j=1}^{n} (p_j^f(1+t))^{1-\sigma} \right] \tag{4.2}$$

The composite price index P may be interpreted as the unit cost function of X. Thus the effective price P is positively related to the prices of each intermediate input p_i^h and p_j^f and negatively related to the number of available inputs $n = n^h + n^f$. The later captures the gains from specialisation.

Producers of final good Y maximize profits by choosing the optimal input mix of labour and specialised intermediate inputs, taking the number of intermediate goods n, the wage rate w and the intermediate goods prices p_i^h, p_j^f given, subject to the production function (4.1). The first order conditions for profit maximization are given by

$$\frac{\partial Y}{\partial L_y} = (1-\alpha)(\frac{X}{L_y})^{\alpha} = w \tag{4.3}$$

$$\frac{\partial Y}{\partial X} = \alpha(\frac{X}{L_y})^{\alpha-1} = P \tag{4.4}$$

Using equations (4.3) and (4.4), we derive the unit cost function for Y,

$$\frac{P^{\alpha}w^{1-\alpha}}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}} \geq p_y \tag{4.5}$$

with equality if $Y > 0$. Here p_y is the price of final good y and is constant under the assumption of a small country.

The inverse demand functions for intermediate inputs are given by (derivation shown in Appendix of chapter 2)

$$x_i^h = \frac{(p_i^h)^{-\sigma} PX}{P^{1-\sigma}} \tag{4.6}$$

$$x_j^f = \frac{(p_j^f(1+t))^{-\sigma}}{P^{1-\sigma}} PX \tag{4.7}$$

The important implication of the demand function (4.6) is the following : If a single home firm produces a good i, and if the firm is small enough relative to the economy as a whole so that it regards itself unable to affect X or P, then it will perceive itself as facing a demand curve of elasticity $\sigma (= \frac{1}{(1-\rho)})$. We assume that n^h is a large number, so that each firm has a small market share facing a perceived demand curve with elasticity σ.

The domestic brands $x_i^h, i = 1, \dots, n^h$ are produced under increasing returns to scale. Because of fixed cost no two firm will produce exactly the same variety in equilibrium. With large number of potential varieties, strategic behavior on the part of the firm is ruled out. Finally the absence of entry barrier drives down profits to zero.

Production of representative x_i^h requires a constant amount a_k units of overhead capital, constituting the fixed cost.

$$a_k r = F \tag{4.8}$$

where F is the fixed cost and r is the rental rate. The marginal cost component

$$m = a_L w \tag{4.9}$$

where a_L is the constant marginal labour requirement to produce each additional unit of x and w is the wage rate.

As has been just noted, the elasticity of the perceived demand curve faced by the intermediate goods producers is given by σ.

Thus each producer of intermediate inputs equate marginal revenue to marginal cost

$$p_i^h(1 - \frac{1}{\sigma}) = a_L w \tag{4.10}$$

$$\Rightarrow p_i^h = \frac{a_L w}{\rho}$$

The prices of intermediate goods are a constant mark up over the marginal cost. With identical technology all firms charge the same price for intermediate goods ($p_i^h = p$). Free entry in intermediate goods production drives down profits to zero. Thus the operating surplus much be just enough to cover the fixed cost, i.e.,

$$\frac{p^h}{\sigma} x_i^h = a_k r \tag{4.11}$$

This also implies that output x_i^h is the same for all producers; ($x_i^h = x^h$).

The full employment condition for labour and capital is given by

$$L_x + L_y = a_L n^h x^h + L_y = \overline{L} \tag{4.12}$$

$$a_k n^h = k^h + k^f = k \tag{4.13}$$

where L_x and L_y are the employment levels in the intermediate and final goods sector and $\overline{L}$ and k are the total available labour and capital.

With symmetry, $x_i^h = x^h$, $x_j^f = x^f, p_i^h = p^h$ and $p_j^f = p^f$, equation (4.2) collapses to

$$P^{1-\sigma} = n^h p^{h^{1-\sigma}} + n^f (p^f(1+t))^{1-\sigma} \tag{4.14}$$

where $PX = n^h p^h x^h + n^f p^f (1+t) x^f$.

Furthermore, under symmetry input demand functions (4.6) and (4.7) are reduced to

$$x^h = \frac{(p^h)^{-\sigma} PX}{P^{1-\sigma}} \tag{4.15}$$

$$x^f = \frac{(p^f(1+t))^{-\sigma} PX}{P^{1-\sigma}} \tag{4.16}$$

A few comments are in order with regard to the structure of the model. We have assumed that the domestically produced intermediate varieties are not exported and the foreign intermediate goods are imported. This is not without purpose. We want to keep the domestically produced intermediate goods sector as a purely import competing sector and the final goods sector as pure exportables. Were we to allow for exports of intermediate goods, it would no more be possible to identify the intermediate goods sector as purely importable. The way our model identifies the two sectors, one as purely exportable (final goods sector) and another as purely importable is in keeping with the Brecher, Diaz-Alejandro (1977) structure. We require this structure, because we have some issues to raise in this context. Specifically we intend to show that, quite contrary to the Brecher, Diaz-Alejandro result, an expansion of the domestic production of importables might go hand in hand with a larger level of imports of foreign intermediate goods.

Yet another point that needs clarification is that one could have possibly considered a different structure with a differentiated final goods *a la* Dixit-Stiglitz (1977). As we will show later that a crucial result (just mentioned above) in this chapter, hinges upon the extent of complementarity of differentiated intermediate goods. We show below that the validation of that result requires that the differentiated goods be sufficiently complementary. With differentiated final goods this is not very likely. On the other hand, there are reasons to presume that differentiated intermediate goods are sufficiently complementary in production. As Markusen (1990) (see pp. 376), in yet another context, notes "..... *A feature of the differentiated-final-goods models, which now appears crucial to the tariff results, is that the differentiated goods are better substitutes for one another than for the numeraire competitive good. ..... While such an assumption seems empirically plausible, its role in generating results has not been identified. Furthermore, I would argue that it is not empirically compelling in the case of specialized intermediate inputs, which are often highly complementary in modern technologies*".

Markusen (1990) is possibly the lone paper with emphasis on distinguishing the class of models with differentiated final goods from those with specialized intermediate inputs. Markusens' context is of course very different from the issue we address here. Markusen (1990) raises the point that a small tariff might be welfare reducing even when it improves the terms of trade. A tariff that reduces the number of foreign varieties of intermediate inputs might also reduce the domestic varieties of intermediate inputs, in so far as they are complementary in the production process. This contraction of the domestic intermediate goods sector which is subject to increasing returns to scale leads to a welfare loss. Hence the result. In this chapter we show that capital inflow which raises the number of domestic intermediate inputs might simultaneously raise the level of imports of foreign inputs, if these inputs are sufficiently complementary.

To understand the determination of this model, note that capital stock k determines the number of domestic varieties of intermediate inputs n^h, according to equation (4.13). Now with n^f and p^f given exogenously and n^h known, equation (4.14) gives a relation between price p^h of domestic brands and the composite price index P.

The unit cost function or the pricing equation (4.5) gives a relation between w and P. But w in turn is related to the pricing equation of intermediate goods through equation (4.10). Thus equation (4.5) effectively gives another relation between p^h and P.

Thus we have two equations in p^h and P, one from equation (4.14) another from equation (4.5), to solve for p^h and P. With p^h known, wage rate w can directly be solved from equation (4.10). With w and P known, labour allocation L_y to sector Y is determined from equations (4.3) and (4.4). With L_y known, L_x is solved from full employment condition of labour given by equation (4.12). With n^h and L_x already at hand, per variety output of intermediate good $x = \frac{L_x}{a_L n^h}$, is solved. Further, p^h and x, solves for the rental rate r in equation (4.11). Thus all the endogenous variables are determined.

4.3 Capital Inflow

Capital inflow is modelled here as one time jump in the capital stock which one for one increases the number of domestically produced varieties.

There being only one final good Y (numeraire), welfare can reasonably be measured by the level of consumption of the final good. With the earnings made by foreign capital being fully repatriated, the value of domestic consumption of the final good and hence welfare (Ω) is equal to the total domestic factor earnings plus the proceeds of the tariff revenue.

$$\Omega = w\overline{L} + rk^h + tn^f p^f x^f \tag{4.17}$$

As such, we are not interested in the consequences of capital ownership attendant to profit repatriation, therefore we set, $k^h = 0$.

Denoting proportional changes by a circumflex ($\wedge$) and noting that n^f, p^f and t are constants,

$$\hat{\Omega} = \beta\hat{w} + (1-\beta)\hat{x}^f \tag{4.18}$$

where β is the share of wages in national income. Equation (4.18) implies that, any increase in the wage rate and/or in the volume of intermediate goods import will increase the level of welfare.

Log differentiation of the full employment conditions (4.12), (4.13), gives

$$\lambda_{L_x}(\hat{n^h} + \hat{x^h}) + \lambda_{Ly}\hat{L_y} = 0 \tag{4.19}$$

$$\hat{n^h} = \hat{k} = \hat{k^f} \tag{4.20}$$

where $\lambda_{L_i} = \frac{L_i}{L}$.

Differentiating the unit cost function (4.5), we obtain

$$(1-\alpha)\hat{w} + \alpha\hat{P} = 0 \tag{4.21}$$

As prices of intermediate inputs are a constant markup over the marginal wage cost; equation (4.10) on differentiation yields

$$\hat{w} = \hat{p^h} \tag{4.22}$$

Differentiating the composite price index equation (4.14) and noting that p^f, n^f and t are constants and using the demand equations (4.15), (4.16), we get

$$(1-\sigma)\hat{P} = s^h(\hat{n^h} + (1-\sigma)\hat{p^h}) \tag{4.23}$$

where $s^h = \frac{n^h p^h x^h}{PX}$, is the share of domestically produced inputs in the total value of intermediate inputs used.

Combining equations (4.21) and (4.22),

$$\hat{w} = \hat{p^h} = -\frac{\alpha}{1-\alpha}\hat{P} \tag{4.24}$$

using equations (4.24) and (4.20), in equation (4.23) we obtain

$$\frac{\hat{P}}{\hat{k}} = -\frac{s^h(1-\alpha)}{(1-\alpha s^f)(\sigma-1)} < 0 \tag{4.25}$$

where s^f is the share of foreign intermediate inputs and $s^h + s^f = 1$.

Thus capital inflow unambiguously reduces the composite price index of the intermediate goods. With capital inflow translating one for one into higher input varieties, attendant productivity gain lowers the composite price index.

Substituting equation (4.25) into (4.24), and taking note of equation (4.22),

$$\frac{\hat{w}}{\hat{k}} = \frac{\hat{p^h}}{\hat{k}} = \frac{\alpha s^h}{(1-\alpha s^f)(\sigma-1)} > 0 \tag{4.26}$$

Thus wage rate goes up with capital inflow and hence prices of intermediate inputs. This is in contrast with the usual result in competitive general equilibrium models, where commodity prices fix the factor rewards and wage and rental are immune to endowment changes.

Proposition 1 : Capital inflow leads to higher wage rate. This in turn leads to higher prices of domestic intermediate inputs (p^h). Nonetheless the composite price index for intermediate inputs (P) falls due to the favourable effect of increased availability of domestic varieties (n^h) dominating the rise in p^h.

Next we look for the consequence of capital inflow on the level of imports x^f. Log differentiating the production function (4.1), we get

$$\hat{Y} = \alpha(\hat{X} - \hat{L}_y) + \hat{L}_y \tag{4.27}$$

From equations (4.3) and (4.4),

$$(\hat{X} - \hat{L}_y) = (\hat{w} - \hat{P}) \tag{4.28}$$

Substituting (4.28) into (4.27) and using (4.21) and (4.19),

$$\hat{Y} = \hat{p^h} - \frac{\lambda_{Lx}}{\lambda_{Ly}}(\hat{n^h} + \hat{x^h}) \tag{4.29}$$

Differentiating equation (4.15) and noting that $PX = \alpha Y$,

$$\hat{x^h} = -\sigma\hat{p^h} + (\sigma - 1)\hat{P} + \hat{Y} \tag{4.30}$$

Substituting (4.29) into (4.30) and using (4.25), (4.26) and (4.20),

$$\frac{\hat{x^h}}{\hat{k}} = -\lambda_{Ly}[\frac{s^h}{(1 - \alpha s^f)} + \frac{\lambda_{Lx}}{\lambda_{Ly}}] < 0 \tag{4.31}$$

Now,

$$\frac{\hat{n^h} + \hat{x^h}}{\hat{k}} = \frac{\hat{k} + \hat{x^h}}{\hat{k}} = \frac{\lambda_{Ly}(1 - \alpha)s^f}{(1 - \alpha s^f)} > 0 \tag{4.32}$$

$\frac{\hat{n^h}+\hat{x^h}}{\hat{k}} > 0$ implies that the intermediate goods sector expands in terms of labour usage, L_x where $L_x = a_L\, n^h\, x^h$. This happens through a release of labour from the final goods sector. Note that, we have already shown that wage rate w increases and the composite price index P falls with inflow of capital (Proposition 1). Given the Cobb-Douglas structure of final output production (see equation 4.1), this readily implies that final output producers economize on the use of direct labour. Thus labour is released from final output production to the production of intermediate goods.

Equation (4.32) implies that capital inflow unambiguously expands the tariff protected import competing sector. In usual Brecher and Diaz-Alejandro kind of a set up this necessarily crowds out cheaper imports leading to a welfare loss. This might not be valid in our context.

Differentiating equation (4.16) and noting that $PX = \alpha Y$ and n^f, p^f and t are constants,

$$\hat{x^f} = (\sigma - 1)\hat{P} + \hat{Y} \tag{4.33}$$

using equations (4.24) and (4.29),

$$\hat{x^f} = (\sigma - 1)(\frac{(\alpha - 1)}{\alpha}\hat{p^h}) + \hat{p^h} - \frac{\lambda_{Lx}}{\lambda_{Ly}}(\hat{k} + \hat{x^h}) \tag{4.34}$$

substituting (4.26) and (4.32) into (4.34) we get

$$\frac{\hat{x^f}}{\hat{k}} = \frac{\frac{\alpha s^h}{(\sigma-1)} - (1-\alpha)(s^h + \lambda_{Lx}s^f)}{(1-\alpha s^f)} \tag{4.35}$$

Hence the possibility that imports might go up ($\frac{\hat{x^f}}{\hat{k}} > 0$), and this is true if

$$\sigma < 1 + \frac{\alpha s^h}{(1-\alpha)[s^h + \lambda_{Lx}s^f]}. \tag{4.36}$$

Proposition 2 : Expansion of import competing domestic intermediate goods sector consequent to capital inflow might go hand in hand with increased import demand for foreign intermediate inputs if inequality (4.36) is satisfied.

Condition (4.36) makes ready sense. Lower σ implies higher differentiation and as has already been discussed, this also corresponds to higher gains from specialisation. Thus with low σ capital inflow leads to higher varieties and higher productivity gains and this might lead to higher derived demand for imported inputs. Alternatively, low σ implies higher differentiation and therefore higher complementarity between intermediate inputs (both domestic and foreign). Capital inflow raises the number of domestic varieties in our model. To the extent these inputs are complementary to the foreign intermediate inputs, it can potentially raise the level of imports of foreign inputs. As has already been noted a low σ is not very *empirically plausible* in case of differentiated final goods; whereas intermediate inputs are more complementary in their use and this high degree of complementarity can potentially crowd-in imports.

Substituting for $\hat{w}$ and $\hat{x}^f$ from equations (4.26) and (4.35) respectively, into (4.18) we get

$$\frac{\hat{\Omega}}{\hat{k}} = \beta\left[\frac{\alpha s^h}{(1-\alpha s^f)(\sigma-1)}\right] + (1-\beta)\left[\frac{\frac{\alpha s^h}{(\sigma-1)} - (1-\alpha)(s^h + \lambda_{Lx}s^f)}{(1-\alpha s^f)}\right]. \tag{4.37}$$

It follows that, $\frac{\hat{\Omega}}{k} > 0$, if and only if,

$$\sigma < 1 + \frac{\alpha s^h}{(1-\beta)(1-\alpha)(s^h + \lambda_{Lx} s^f)} \tag{4.38}$$

Proposition 3 : Following capital inflow, inequality (4.38) is a necessary and sufficient condition for welfare improvement.

Following capital inflow, wage unconditionally increases (see (4.26)). On the other hand imports and hence tariff revenue might either rise or fall (according as (4.36) is satisfied or violated). Therefore a higher share of wages (β) makes it all the more probable that welfare will improve following capital inflow. This is manifested in inequality (4.38). For a given value of σ (and other parameters remaining the same), higher β makes it more probable that inequality (4.38) will be satisfied.

4.4 Conclusion

Under the assumption of a small country, it has usually been shown that capital inflow leads to welfare immiserization, when the import competing sector is capital intensive and profits are fully repatriated. Heuristically put, capital inflow leads to an expansion of the capital intensive import competing sector through the usual Rybczynski effect and this crowds out cheaper imports, the effect manifesting itself in lesser tariff revenue. On the other hand, factor rewards remain invariant to capital inflow. Thus welfare is reduced. In this chapter we attempted to show that once out of the perfectly competitive world with constant returns to scale production function, the welfare consequence of capital inflow can no more be unambiguously settled.

In our model with increasing returns driven by the forces of gains from specialisation *a la* Ethier, capital inflow leads to higher wages. This is quite a commonplace result in the recent literature, but what is not obvious is that the productivity gain leads to higher derived demand for imports resulting in higher tariff revenue. Marjit and Beladi (1996) derives a similar result in the context of competitive general equilibrium model where the result stems from the resource reallocation effect driving up the derived demand for imports consequent to capital inflow. In our model the driving force is the productivity impact of capital inflow which leads to higher imports. For some parametrization we show that capital inflow rather than crowding out imports might increase the same.

Chapter 5

Capital Inflow under Voluntary Export Restraint

5.1 Introduction

In Chapter 4, we investigated the interaction of capital movement and tariff protection. We extend on that theme in this chapter. Specifically, we look into the effects of capital movement under an alternative protectionist regime; the voluntary export restraint (VER).

VER is one of the most often used restrictive trade practices. Given the fact that tariff restrictions and quantitative restrictions like quota have been increasingly proscribed by multilateral trade negotiations, VER has more proponents than ever before. Put simply a voluntary export restraint (VER) is an undertaking by exporting firms to restrict the quantity of their exports to a particular market, and is equivalent to an import quota where the quota rent accrues to the foreign exporter.

At the theoretical level there does not seem to be any general consensus with regard to the welfare implications of VER vis-a-vis other restrictive trade practices. There are as many on this side as on that side of the fence. One reason which vitiates the possibility of arriving at any general conclusion is the heavy reliance on partial equilibrium models to formalise the issue of VER. The earliest formalisations in partial equilibrium models were rendered by Bergsten (1975) Tackacs (1978), Hindley (1980), Murray, Schmidt and Walter (1983). A general equilibrium attempt was made by Lizondo (1984). At a simplistic level it might seem that VER is inferior to an import tariff on welfare grounds, since it is equivalent to the importing country imposing an import tariff and giving the tariff revenue to the foreign exporter. Collie and Su (1998) in a *love for variety* model shows that this might not be the case. The otherwise counter intuitive result stems from the fact that VER has less effect on the profitability of foreign firms than the tariff and hence the reduction in product variety is less under VER than under tariff regime. This variety gain might mitigate the quota rent loss and hence the result. Bhagwati (1965) has shown that import quotas are inferior to tariffs, because the quota allows domestic monopoly to exploit its market power. Krishna (1989) extends this argument to oligopoly to show that VER allows the domestic and foreign firm to raise its prices. However, Rotemberg and Saloner (1989) in a model of implicit collusion shows that quota may have procompetitive effect and therefore be superior to equivalent tariff. Be that as it may these models do not address the issue of capital movement which may coexist with VER. Falvey (1976) treats capital movements under quantitative restrictions. The paper discusses the transition from free trade to import quotas with perfect capital mobility. Dei (1985) constructs a two sector competitive general equilibrium model to show that capital inflow is welfare improving for the host country when the VER protected import competing sector is capital intensive. This is quite interesting when seen against the standard results of immiserization arrived at by Brecher, Diaz-Alejandro (1977) where capital inflow is allowed for in a model with tariff protected capital intensive sector. To see what brings about this difference in welfare effects of capital inflow under the two alternative protectionist regimes, one might recall that in Brecher, Diaz-Alejandro (1977), capital inflow leads to an expansion of the domestically produced capital intensive goods sector via the usual Rybczynski effect thus leading to a crowding out of cheaper imports which constitutes the loss and manifests as a shrinkage in tariff revenue. The mechanism in Dei (1985) is quite different. The model is once again a competitive two sector general equilibrium model with usual Heckscher-Ohlin-Samuelson (H-O-S) technologies. But the country is large in the sense that the terms of trade is endogenously determined. The import competing sector is protected by a VER and is capital intensive and profits on foreign capital are fully repatriated back. An exogenous capital inflow leads to an expansion of the import competing sector, thus leading to an excess supply at the initial price. This leads to a fall in the price of the importables leading to the usual terms of trade gain. Furthermore to the extent that importables are capital intensive, this leads to a fall in the rental rate via the Stolper-Samuelson effect leading to a favourable factor terms of trade thus bringing down the repatriation load. Dei (1985) serves as our point of departure. Once out of the competitive set up, robustness of this result becomes questionable. Capital inflow under a protectionist regime has been investigated in recent times by Sen *et. al.* (1997), where protection is rendered through tariff and markets are imperfectly competitive. In this chapter we identify two distinct channels through which welfare might be immiserized. We show that, as in Dei (1985), commodity terms of trade unambiguously improves following capital inflow, but this does not necessarily imply that factor terms of trade improves. In fact, it is shown that with the labour intensive sector being the one subject to increasing returns to scale (IRS), a contraction of that sector can raise the rental rate (potentially) even when the price of capital intensive good falls. This enhances the repatriation load on the existing stock of foreign capital operating in the domestic economy. Furthermore, to the extent that the IRS sector can potentially contract, this directly has an immiserizing effect because these goods are under-produced in the sense that the price exceeds the marginal cost in this sector.

The plan of the chapter is as follows. Section 5.2 builds the model. Section 5.3 analyse the effects of exogenous capital inflow. Section 5.4 concludes. Essential results are contained in the Appendix.

5.2 The Model

There are two countries, home and foreign, and two commodities, 1 and 2. The home country exports commodity 1 and the foreign country exports commodity 2. The VER on commodity 2 is implemented by the foreign country. On the assumption that commodity 2 is capital intensive, VER creates a return differential for capital, which we assume drives capital to flow into the home country. Capital inflow is modelled here as purely exogenous. The world economy is described as follows :

$$D_1 + p_2 D_2 = X_1 + p_2 X_2 - r(K - \bar{K}) \tag{5.1}$$

$$D_2 = X_2 + \bar{Q}_2 \tag{5.2}$$

$$D_1^* + p_2^* D_2^* = X_1^* + p_2^* X_2^* + r(K - \bar{K}) + (p_2 - p_2^*)\bar{Q}_2 \tag{5.3}$$

$$D_2^* = X_2^* - \bar{Q}_2 \tag{5.4}$$

$$K + K^* = \bar{K} + \bar{K}^* \tag{5.5}$$

where, $D_i(p_2, y)$ denotes the demand for the ith commodity in the home market. Commodity 1 is chosen as the numeraire. X_i denotes the home output of the ith commodity. p_2 denotes the relative price for commodity 2. y denotes real income. $\bar{K}$ is the capital stock owned by the residents of the home country, and K is the capital stock utilized at home, $\bar{Q}_2$ is the foreign export quota on commodity 2. An asterisk denotes variables pertaining to the foreign country.

Equations (5.1) and (5.3) express the budget constraint for each country. Foreign capital invested in the home country earns the income $r(K - \bar{K})$ and is repatriated in full. The foreign government is assumed to auction off licenses to export. The proceeds $(p_2 - p_2^*)\ \bar{Q}_2$ are redistributed to foreign nationals in a lump sum manner. Equations (5.2) and (5.4) gives the market clearing condition for commodity (2). Walras' law takes care of the clearance of market for commodity 1. Equation (5.5) gives the full employment condition for the world capital stock.

5.2.1 The Producers

Production of good 1 is subject to IRS. With regard to the formalisation of IRS, we follow the structure used in chapter 3. X_2 is supplied by perfect competitors using capital and labour in a constant returns to scale technology (CRS). Capital and labour may also be used to produce factor bundles (m) under CRS, which serve as inputs into the production of intermediate goods. These intermediate goods are costlessly assembled to produce X_1.

$$X_2 = F(L, K) \tag{5.6}$$

$$m = G(L, K) \tag{5.7}$$

where, F and G are usual CRS production functions.

The production technology for assembling X_1 is given by

$$X_1 = \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{\frac{1}{\rho}}, \qquad \text{where, } 0 < \rho < 1 \tag{5.8}$$

where x_i is the input of intermediate good i. Intermediate goods are imperfect substitutes. ρ measures the degree of differentiation of intermediate inputs. Given the number of intermediate inputs the production function (5.8) exhibits constant returns to scale but there is increasing returns to higher degree of specialization as measured by the number of intermediate varieties n. These economies are external to the firm but internal to the industry i.e., X_1 producers take n as given. We further assume that intermediate goods are nontraded. Thus economies of scale are purely localised within the national boundaries.

As in chapter 3, we assume that all intermediate goods have identical cost functions. The cost of producing the quantity x of a given variety of intermediate input is $C_x = (ax + b)\ p_m$ where a and b are marginal and fixed requirements of m respectively and p_m is the price of factor bundle (m). The presence of fixed cost gives rise to internal economies of scale at the firm level.

An individual producer of X_1 maximizes profits subject to the production function and considers n to be parametrically given. This gives rise to the inverse input demand function for each intermediate input,

$$x_i = \frac{(q_i)^{-\sigma} \sum_{i=1}^{n} q_i x_i}{\sum_{i=1}^{n} q_i^{1-\sigma}} \tag{5.9}$$

where q_i is the price of the ith intermediate input and $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between any pair of intermediate inputs. Assuming large number of intermediate goods producers, σ is the elasticity of demand faced by the intermediate producers.

Each producer of intermediate inputs equate marginal revenue to marginal cost,

$$q_i(1 - \frac{1}{\sigma}) = ap_m$$

$$\Rightarrow q_i = \frac{ap_m}{\rho} \tag{5.10}$$

Thus prices of intermediate goods are a constant mark up over the marginal cost. With identical technology all firms charge the same price for intermediate goods ($q_i = q$). Free entry in production of intermediate inputs drives down profits to zero. This implies that the operating surplus must be just enough to cover the fixed cost.

$$\frac{q}{\sigma} x_i = bp_m \tag{5.11}$$

This also implies that output x_i is the same for all producers ($x_i = x$).

Dividing equation (5.10) by (5.11) we get

$$x = \frac{b\rho}{a(1-\rho)} \tag{5.12}$$

with this symmetry ($x_i = x$), (5.8) collapses to

$$X_1 = n^{\alpha} x \tag{5.13}$$

where $\alpha \equiv \frac{1}{\rho} > 1$.

Further, note that (5.12) implies output per firm (x) is a constant. Thus any expansion of X_1 would be in terms of increased n. And this, as has already been noted, implies increasing returns to scale at the industry level in X_1 production.

If in equilibrium, n is the effective number of produced varieties, then the total amount of factor bundle produced and used in the production of x is given by

$$m = n(ax + b) \tag{5.14}$$

where m is nontraded and hence supply of m must match the demand for m made by the domestic intermediate goods producers.

The factor market equilibrium conditions in the home market are given by

$$a_{L2}\, X_2 + a_{Lm} m = \bar{L} \tag{5.15}$$

$$a_{K2}\, X_2 + a_{Km} m = K \tag{5.16}$$

where a_{ij} are the usual input-output coefficients (ith input required to produce one unit of the jth output), $\bar{L}$ is the fixed labour endowment and K is the amount of capital operating in the home country.

Noting that X_2 and m are produced under usual assumptions of CRS and perfectly competitive market, pricing equations are given by

$$a_{L2} w + a_{K2} r = p_2 \tag{5.17}$$

$$a_{Lm} w + a_{Km} r = p_m \tag{5.18}$$

where, w and r are the wage and the rental rate respectively. We assume X_2 to be capital-intensive.

Now taking note of the symmetry in intermediate goods production ($x_i = x$ and $q_i = q$) and the fact that zero profit prevails in the X_1 industry

$$X_1 = nqx \tag{5.19}$$

Using the production function (5.13) in (5.19), obtain

$$1 = n^{(1-\alpha)} q \tag{5.20}$$

Thus, given the price of commodity 1 (numeraire) any rise in n must be accompanied by a rise in prices of intermediate inputs q to maintain the price cost equality (5.20). This follows from the fact that at any given q, higher n implies higher division of labour, leading to lower average cost in production of X_1. Thus there are output gains to be made as resources are spread out more thinly over larger number of intermediate inputs. Now to bring about the equality of price and average cost q must rise.

5.3 Capital Inflow

Capital inflow is modelled here as purely exogenous, though, as already noted, it is driven by the rental rate differential that is created due to the imposition of VER. In what follows, we only look at the impact of capital inflow on home welfare. We assume the index of home social welfare, u to depend only upon the bundle of goods consumed.

$$u = u(D_1, D_2) \tag{5.21}$$

Further assume no satiation or specialization in consumption takes place. Then total differentiation of (5.21) yields

$$\frac{du}{u_1} = dD_1 + \frac{u_2 dD_2}{u_1} \tag{5.22}$$

Following Jones (1967), $\frac{du}{u_1} \equiv dy$ is the change in home real income measured in units of commodity 1. With home price ratio equal to the marginal rate of substitution, we obtain

$$dy = dD_1 + p_2 dD_2 \tag{5.23}$$

The change in real income is the price weighted change in the quantities consumed.

Totally differentiating (5.1) and (5.2) and using (5.23), some rearrangement yields

$$dy = -\bar{Q}_2 dp_2 + dX_1 + p_2 dX_2 - (rdK + (K - \bar{K})dr) \tag{5.24}$$

The first term on the right of equation (5.24) gives the usual terms of trade effect, $(dX_1 + p_2 dX_2)$ gives the price weighted change in the value of home production and the last term gives the change in the degree of indebtedness.

Log differentiating (5.13) and noting that x is a constant, we obtain

$$\hat{X}_1 = \alpha \hat{n} \tag{5.25}$$

where ˆ represents a proportionate change (e.g. $\hat{x}$ is $\frac{dx}{x}$).

Taking note of the full employment condition of factor bundles (equation (5.14)) and noting that x is a constant, equation (5.25) can be rewritten as

$$\hat{X}_1 = \alpha \hat{m} \tag{5.26}$$

Using (5.26) we can rewrite (5.24) by adding and subtracting $p_m\ dm$ on the right.

$$dy = -\bar{Q}_2 dp_2 + \left(\frac{\alpha X_1}{m} - p_m\right) dm - (K - \bar{K})dr \tag{5.27}$$

where use has been made of the following two relationships.

(i) The price weighted sum of changes in production along the transformation curve in (m, X_2) plane is zero and, this implies

$$\left[p_2 \frac{\partial X_2}{\partial p_2} + p_m \frac{\partial m}{\partial p_2}\right] dp_2 + \left[p_2 \frac{\partial X_2}{\partial p_m} + p_m \frac{\partial m}{\partial p_m}\right] dp_m = 0$$

(ii) the price weighted sum of changes in production at constant prices resulting from an inflow of capital $\left\{p_2\ \frac{\partial X_2}{\partial K} + p_m\ \frac{\partial m}{\partial K}\right\}$ is equal to home rate of return to capital r.

Taking note of the zero profit condition in X_1 production, $X_1 = p_m\ m$, equation (5.27) reduces to

$$dy = -\bar{Q}_2 dp_2 + (\alpha - 1)\ X_1 \hat{m} - (K - \bar{K})\ dr \tag{5.28}$$

The first and the last term on the right gives the usual commodity and factor terms of trade effect on welfare. A fall in p_2 and a drop in r which implies an improvement in commodity and factor terms of trade respectively, are beneficial to the home country. To put it differently, the home country being a net buyer of commodity 2 and capital (K), a fall in p_2 and a fall in r, have positive income effects. The second term gives the impact of production changes of the sector experiencing increasing returns. With $\alpha > 1$ any contraction of m, and thereby of X_1, leads to an adverse welfare effect.

Differentiating the market clearing condition for commodity X_2, equation (5.2), we obtain

$$-\eta_2 D_2 \hat{p}_2 + \frac{m_2}{p_2} dy = dX_2 \tag{5.29}$$

$$\Rightarrow \hat{p}_2 = \frac{\frac{m_2}{p_2} dy - dX_2}{\eta_2 D_2}$$

where $\{\eta_2 = -\frac{p_2}{D_2}\frac{\partial D_2}{\partial p_2}\}$ is the substitution effect on the demand for commodity 2, and $\{m_2 = p_2 \frac{\partial D_2}{\partial y}\}$ is the marginal propensity to consume commodity 2.

Now, the changes in m and X_2 following capital inflow can be obtained by totally differentiating (5.15) - (5.18) [see Jones (1965)].

$$\hat{m} = \left(\frac{\lambda_{K2}\delta_L + \lambda_{L2}\delta_K}{\mid \lambda \mid\mid \theta \mid}\right)(\hat{p}_m - \hat{p}_2) - \frac{\lambda_{L2}}{\mid \lambda \mid}\hat{K} \equiv A(\hat{p}_m - \hat{p}_2) - \frac{\lambda_{L2}}{\mid \lambda \mid}\hat{K} \tag{5.30}$$

$$\hat{X}_2 = -\left(\frac{\lambda_{Km}\delta_L + \lambda_{Lm}\delta_K}{\mid \lambda \mid\mid \theta \mid}\right)(\hat{p}_m - \hat{p}_2) + \frac{\lambda_{Lm}}{\mid \lambda \mid}\hat{K} \equiv -B(\hat{p}_m - \hat{p}_2) + \frac{\lambda_{Lm}}{\mid \lambda \mid}\hat{K} \tag{5.31}$$

where

$$\delta_L \equiv (\lambda_{Lm}\,\sigma_m\,\theta_{Km} + \lambda_{L2}\,\sigma_2\,\theta_{K2}) > 0$$

$$\delta_K \equiv (\lambda_{Km}\,\sigma_m\,\theta_{Lm} + \lambda_{K2}\,\sigma_2\,\theta_{L2}) > 0$$

$$\mid \lambda \mid \equiv (\lambda_{Lm} - \lambda_{Km}) > 0 \text{ and } \mid \theta \mid = (\theta_{Lm} - \theta_{L2}) = (\theta_{K2} - \theta_{Km}) > 0$$

where, $A, B > 0$ and $A+B = (\delta_L + \delta_K)/\mid \lambda \mid\mid \theta \mid$ and λ_{ij} is the share of ith factor going to the jth sector and θ_{ij} is the ith factor's share of value contribution in the price of the jth good and σ_i is the elasticity of substitution in the production of ith good. Note $\mid \lambda \mid, \mid \theta \mid > 0$ follows from our assumption that X_2 is capital intensive.

Similarly, totally differentiating the price equations (5.17), (5.18) and taking note of the cost minimizing conditions, $\theta_{Li}\,\hat{a}_{Li} + \theta_{Ki}\,\hat{a}_{Ki} = 0$; $i = m, 2$, we obtain

$$\hat{w} = \frac{\theta_{K2}\,\widehat{p_m} - \theta_{Km}\,\widehat{p_2}}{\mid \theta \mid} \tag{5.32}$$

$$\hat{r} = \frac{-\theta_{L2}\,\widehat{p_m} + \theta_{Lm}\,\widehat{p_2}}{\mid \theta \mid} \tag{5.33}$$

Note that, at any given p_m a rise in p_2 depresses the wage rate and increases the rental rate. This is in consonance with the usual Stolper-Samuelson effect. On the other hand a rise in p_m lowers the rental rate and raises the wage rate. As we will shortly see, changes in p_m is positively related to changes in m. Thus any expansion (contraction) of the IRS sector (m or equivalently X_1) will lower (increase) the rental rate. This is a point, which we show, in our model plays a key role in worsening the factor terms of trade.

Differentiating equations (5.20) and (5.10) we obtain

$$(\alpha - 1)\,\hat{n} = \hat{q} \tag{5.34}$$

$$\widehat{p_m} = \hat{q} \tag{5.35}$$

Differentiating the full employment condition for factor bundle (m) equation (5.14) and noting that x is a constant,

$$\hat{m} = \hat{n} \tag{5.36}$$

Equations (5.34 - 5.36) yields

$$(\alpha - 1)\,\hat{m} = \widehat{p_m} \tag{5.37}$$

Substituting (5.37) in equation (5.30) we obtain

$$\hat{m} = \frac{-A\widehat{p_2}}{(1-(\alpha-1)A)} - \frac{\lambda_{L2}}{\mid \lambda \mid (1-(\alpha-1)A)}\,\hat{K} \tag{5.38}$$

We assume

$$(1-(\alpha-1)A) > 0 \tag{5.39}$$

Inequality (5.39) ensures positive price-output response in our model. Furthermore, we can show that, $(1-(\alpha-1)A) > 0$, is a sufficient condition to ensure stability of commodity markets under the Marshallian adjustment principle[1]. (Shown in the Appendix).

Inequality (5.39) puts a restriction on the strength of the scale economy. As has been shown in Ethier (1982), it is the force of the scale economy that lies at the root of perverse comparative static results. Higher α can give rise to a downward sloping relative supply curve resulting in perverse results. Proposing a Marshallian adjustment, rules out such a situation under stable equilibrium. [See Ide and Takayama (1991) and Wong (1995). Also see Jones (1968) in this context].

Using equations (5.31), (5.37), (5.38) in equation (5.29), obtain

$$\widehat{p_2} = M dy - N\hat{K} \tag{5.40}$$

[1]In fact $(1-(\alpha-1)A) > 0$ in our model is sufficient to ensure stability both in the Marshallian and Walrasian sense. Though we will be specifically using the Marshallian quantity adjustment to formalise the off-equilibrium dynamics.

where $$M = \frac{m_2}{p_2\, D_2\, \eta_2} / \left[1 + \frac{X_2 B}{[D_2\, \eta_2(1-(\alpha-1)A)]}\right] > 0,$$

$$N = \frac{X_2}{D_2\, \eta_2}\left[\frac{B(\alpha-1)\,\lambda_{L2}}{|\,\lambda\,|\,(1-(\alpha-1)A)} + \frac{\lambda_{Lm}}{|\,\lambda\,|}\right] / \left[1 + \frac{X_2 B}{D_2\eta_2(1-(\alpha-1)A)}\right] > 0$$

Rewrite equation (5.28) by substituting for $\hat{m}$ from equation (5.38) and for $\hat{r}$ from equation (5.33), to obtain

$$dy = -\bar{Q}_2 p_2 \hat{p}_2 + (\alpha-1)\, X_1 \left[\frac{-A\,\hat{p}_2}{(1-(\alpha-1)A)} - \frac{\lambda_{L2}\,\hat{K}}{|\,\lambda\,|\,(1-(\alpha-1)A)}\right]$$

$$-r(K-\bar{K})\left[\frac{-\theta_{L2}\,\widehat{p_m} + \theta_{Lm}\,\widehat{p_2}}{|\,\theta\,|}\right] \tag{5.41}$$

Now, take note of the fact that $\hat{p}_m = (\alpha-1)\hat{m}$ (see equation (5.37)) and substitute for $\hat{m}$ from equation (5.38), to rewrite (5.41) as

$$dy = -D\hat{p}_2 - P\hat{K} \tag{5.42}$$

where

$$D \equiv \left[\bar{Q}_2 p_2 + \frac{r(K-\bar{K})\,\theta_{Lm}}{|\,\theta\,|} + (\alpha-1)\left\{X_1 + \frac{r(K-\bar{K})\theta_{L2}}{|\,\theta\,|}\right\}\frac{A}{(1-(\alpha-1)A)}\right] > 0$$

$$P \equiv \frac{(\alpha-1)\,\lambda_{L2}}{|\,\lambda\,|\,(1-(\alpha-1)A)}\left[X_1 + \frac{r(K-\bar{K})\,\theta_{L2}}{|\,\theta\,|}\right] > 0$$

$D, P > 0$ follows from inequality (5.39).

Solving for $\hat{p}_2$ from (5.42) and (5.40),

$$\hat{p}_2 = \frac{-(MP+N)}{(1+DM)}\,\hat{K} \tag{5.43}$$

Thus the following proposition is immediate.

Proposition 1 : Following inflow of capital the price (p_2) of the import competing good falls unambiguously.

Equation (5.43) implies that the commodity terms of trade unambiguously improves following capital inflow. To understand the mechanism at work that leads to a fall in p_2, let us begin with the supply side of the model. At initial p_2, capital inflow leads to an expansion of X_2 and a contraction of m. This is the usual Rybczynski effect (see equation (5.38) and equation (A.1)), which remains valid in our model under the assumption that $(1-(\alpha-1)A) > 0$. Note, this is the condition which ensures both positive price-output response and stability in our model. At unchanged p_2, this increases the supply in X_2 market. On the demand side, at constant p_2, capital inflow can have an effect on the demand for X_2, only through changes in real income. It can be readily seen that at constant p_2, real income falls $(dy < 0)$, following an increase in the stock of capital. This is evident from equation (5.42). Fall in real income, reduces the demand for X_2, at constant prices. Both the supply and demand shifts unambiguously create an excess supply of X_2 at initial prices, which can only be erased through a fall in p_2.

A simple diagram suffices to clearly bring out the supply-demand interaction leading to a fall in p_2. Let us concentrate on the market for good 2 and characterize its initial equilibrium (i.e., prior to capital inflow). At initial $K(\hat{K}=0)$, we need to identify the demand and supply sides of the X_2 market.

On the demand side, a change in p_2 can affect the demand $D_2(p_2, y)$ directly on own-price effect count and/or through a change in real income (y). A rise in p_2 of necessity lowers the demand (D_2) on own-price effect count. Furthermore at $\hat{K}=0$, a rise in p_2 can affect the real income (y) on three counts. One, a rise in p_2 worsens the commodity terms of trade and thereby reduces real income (see, the first term on right hand side (RHS) of equation 5.28). Two, a rise in p_2 (at $\hat{K}=0$) leads to a contraction of m (see equation 5.38), and thereby reduces real income (see, the second term on the RHS of equation 5.28). Three, a contraction of m due to a rise in p_2 must be accompanied by a fall in p_m (equation 5.37). Thus at constant K a rise in p_2 necessarily requires a fall in p_m. But a rise in p_2 and fall in p_m, unambiguously increases the rental rate (r) (see equation (5.33)) and thus once again reduces real income (see the last term in equation (5.28)).

The above argument suggests that a rise in p_2 at constant K, unambiguously reduces real income. This is summed up in equation (5.42). To the extent that commodity 2 is non-inferior this implies that a rise in p_2 reduces D_2 also on account of the income effect. Thus we have a negative relation between D_2 and p_2 depicted as DD in figure I.

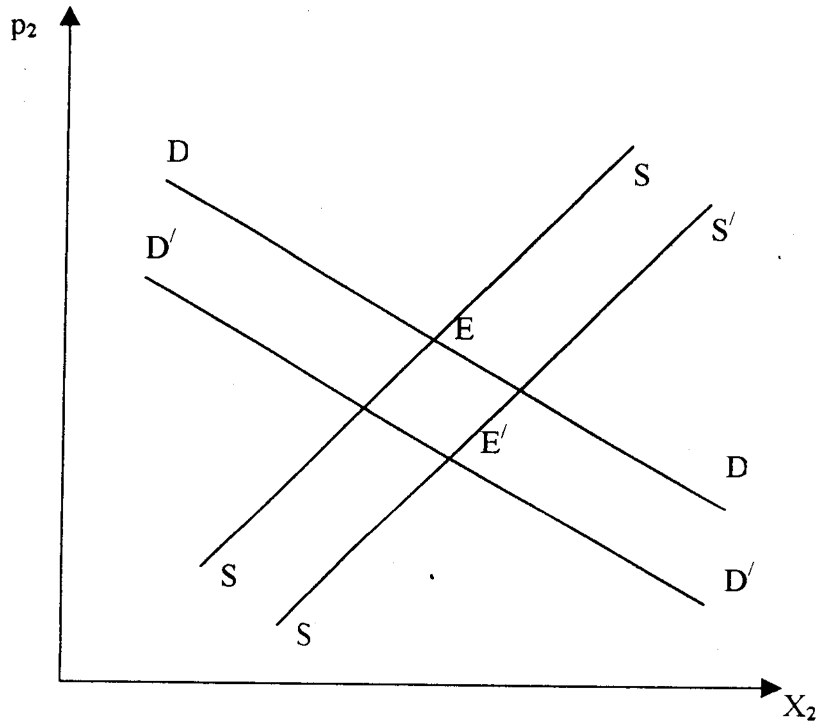

Figure I

On the supply side, a rise in p_2 at $\hat{K} = 0$, raises X_2 production under the assumption $(1 - (\alpha - 1)A) > 0$. This is evident in equation (A.1). This positive supply relation is depicted as SS in figure I, with the equilibrium being at E.

Next, let us work through the repercussion of capital inflow that disturbs the initial equilibrium. At any given $p_2(\widehat{p_2} = 0)$, capital inflow ($\hat{K} > 0$) leads to a rise in the supply of X_2. This is evident from equation (A.1). This implies that the supply curve SS in figure I shifts to the right to S′ S′.

On the other hand, at any given p_2, demand D_2 can only change through a change in real income y, that is brought about by capital inflow. So let us look for the change in real income y, attendant to capital inflow, at any arbitrarily given p_2.

Noting equation (5.28), at constant p_2, real income can only change through a change in m and/or r, that is brought about by the inflow of capital. With $\widehat{p_2} = 0$, capital inflow reduces m, under the assumed condition $(1-(\alpha-1)A) > 0$ (see equation (5.38)), and thereby reduces real income. Furthermore a contraction of m, requires p_m to fall (equation 5.37). Thus at $\widehat{p_2} = 0$, capital inflow must lead to a fall in p_m. With p_2 held fixed and p_m falling, rental rate (r) necessarily rises, and on this count again reduces real income. This implies that at any given p_2, capital inflow reduces real income unambiguously and to the extent commodity 2 is non-inferior, reduces D_2, shifting the demand curve DD to the left, to D′ D′ in figure I. With demand curve shifting to the left and supply curve shifting to the right, it follows that an excess supply is created at the initial equilibrium price, and equilibrium can only be restored through a fall in p_2. The new equilibrium corresponds to E′ in figure I.

Note in all this, it is obvious from the diagram that our assumption $(1-(\alpha-1)A) > 0$ ensures the equilibrium to be both Marshallian and Walrasian stable.

In fact this result, that capital inflow leads to a fall in the price of importables (p_2), is a central result in Dei (1985). To see that our result carries over to the case of CRS (as in Dei (1985)), set $\alpha = 1$ on the RHS of equation (5.43), which then still yields $\widehat{p_2}/\hat{K} < 0$.

But in case of CRS ($\alpha = 1$) the supply-demand shifts are a little bit different. To see this, a very similar diagramatic exercise can be done.

To construct the initial equilibrium (prior to capital inflow, that is with $\hat{K} = 0$), we trace the repurcussion of an arbitrary rise in p_2 on the supply of and demand for X_2. A rise in p_2 reduces D_2 on own-price effect count. Next note that a change in real income

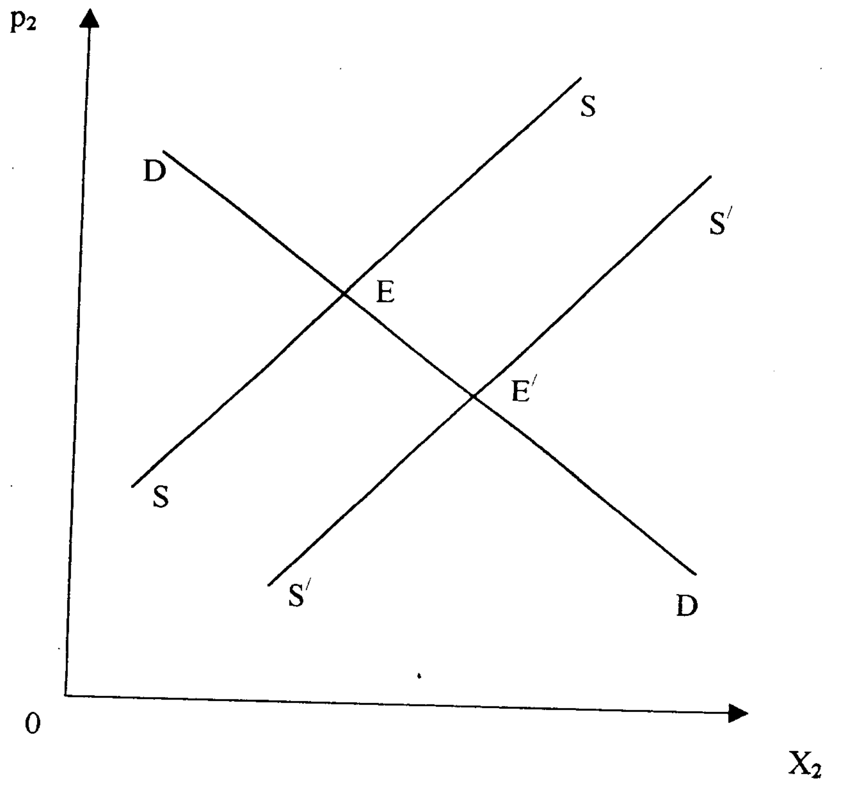

Figure II

(dy) is now only contingent upon the first and last terms on the RHS of equation (5.28) (as the term $(\alpha - 1)X_1\hat{m}$ drops out with $\alpha = 1$). A rise in p_2 necessarily reduces real income on account of the first term on the R.H.S. of (5.28). Furthermore, with a rise in p_2, rental rate (r) increases (the usual Stolper-Samuelson effect)[2] reducing real income on account of the third term on the RHS of equation (5.28). Thus real income unambiguously falls with a rise in p_2 and thereby reduces demand D_2 on account of the income effect. Naturally the demand curve is again negatively sloped, shown in figure II as DD.

On the supply side, with $\alpha = 1$, the condition $(1 - (\alpha - 1)A) > 0$, is automatically satisfied and we have a positive supply response (see equation A.1), shown as SS in figure II, with the equilibrium being at E.

Next, we trace the repurcussion of capital inflow. At any given level of p_2, (i.e., $\widehat{p_2} = 0$) capital inflow increases X_2 (equation A.1) and this shifts the supply curve SS to S′ S′ in figure II. But now capital inflow will have no effect on the demand curve. To see this, note at any given p_2 (i.e., $\widehat{p_2} = 0$), capital inflow will not have any effect on real income (y). This is evident from equation (5.28). At $\widehat{p_2} = 0$ and with $\alpha = 1$ the rental rate gets fixed, that is, $\hat{r} = 0$ (this is the usual result that under CRS, the commodity prices alone determine factor prices in a diversified equilibrium) and hence $dy = 0$[3]. Thus capital inflow at any given price (p_2) will have no effect on real income (y) and hence on demand D_2. This implies that DD curve remains invariant to changes in capital inflow. The new equilibrium E′ has a lower p_2 as in the case of IRS. The difference to note is that under IRS both the demand and supply curves are dislocated, but under CRS it is only the supply curve that shifts out and the demand curve remains immune to capital inflow. However, under both the cases p_2 falls.

Substituting for $\hat{p}_2$ from equation (5.43) into equation (5.38), we obtain

$$\frac{\hat{m}}{\hat{K}} = \left[\frac{A(N+MP)}{(1-(\alpha-1)A)(1+DM)} - \frac{\lambda_{L2}}{\mid \lambda \mid (1-(\alpha-1)A)}\right] \tag{5.44}$$

Reckoning equation (5.44) the following proposition is immediate.

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[2]To see this note $(\alpha - 1)\hat{m} = \widehat{p_m}$ and with $\alpha = 1$ this implies $\widehat{p_m} = 0$. Thus the term $\widehat{p_m}$ in equation (5.33) drops out and we have $\hat{r}/\widehat{p_2} = \theta_{Lm}/ \mid \theta \mid > 0$.

[3]This is also evident from equation (5.42). At constant p_2, equation (5.42) yields $dy = -P\hat{K}$. With $\alpha = 1$, we have $P = 0$, hence $dy = 0$.

Proposition 2 : Following capital inflow the spillover generating sector (m-sector or equivalently sector 1) might either expand or contract according as the RHS of equation (5.44) is positive or negative.

As is obvious from (5.44), $\frac{\hat{m}}{\hat{K}}$ can have either signs. In case it is negative, this will have an unfavourable impact on welfare (see equation (5.28)).

In a competitive set up (i.e. $\alpha = 1$) it is of no consequence in welfare terms whether m or equivalently sector 1 contracts or expands (the second terms on the RHS of equation 5.28 drops out), but under IRS it is significant.

At constant p_2 capital inflow surely contracts the m-sector. This is brought out by the second term on the RHS of equation (5.44), but the fall in p_2 on the other hand has an expansionary effect on m-sector. If the substitution possibilities in the production of m and X_2 are low, leading to a low value of A, this effect will be feeble and will be outweighed by the second term and the m-sector will contract.

Substituting for $\hat{p}_2$ from equation (5.43) into equation (5.33), and using equations (5.37), (5.38), we obtain

$$\frac{\hat{r}}{\hat{K}} = \left\{ - \left[\frac{\theta_{L2}(\alpha-1)A}{\mid \theta \mid (1-(\alpha-1)A)} + \frac{\theta_{Lm}}{\mid \theta \mid} \right] \frac{(N+MP)}{(1+DM)} + \frac{\theta_{L2}(\alpha-1)\,\lambda_{L2}}{\mid \theta \mid (1-(\alpha-1)A) \mid \lambda \mid} \right\} \tag{5.45}$$

This leads to the following proposition.

Proposition 3 : Following capital inflow the rental to capital may either increase or decrease according as the RHS of equation (5.45) is positive or negative.

Equation (5.45) suggests that $\hat{r}$ can have either signs. Fall in p_2 depresses the rental rate (this corresponds to the first term in equation (5.45)). This is the usual Stolper-Samuelson effect. But on yet another count the fate of the IRS sector can potentially have a counter drag on the rental rate. To the extent that the m-sector can potentially contract this will bring down p_m and will increase the rental rate. And if the later effect dominates, the economy might end up with a higher rental rate and hence a worse factor terms of trade and a larger indebtedness in terms of increased profits on foreign capital that is repatriated back to the foreign country. In usual H-O-S model with incomplete specialisation commodity prices alone determine factor prices, but once one allows for IRS, factor prices become contingent on both the commodity prices and also on the factor endowments. Changes in endowment leads to a change in the scale of operations of different sectors and this has an effect, over and above the usual Stolper-Samuelson effect.

As already discussed, with $\alpha = 1$, equation (5.43) implies $\frac{\hat{p}_2}{\hat{K}} < 0$. Thus under CRS commodity terms of trade improves and this corresponds to Dei (1985). Furthermore under CRS a drop in p_2 implies a fall in r. Thus under the benchmark case ($\alpha = 1$), factor terms of trade also improves, and welfare moves up unambiguously (See equation (5.28)).

Increasing returns to scale ($\alpha > 1$) adds complexity to the story. To the extent that commodity terms of trade improves ($\hat{p}_2/\hat{K} < 0$), there is a favourable impact on welfare. Nevetheless resource reallocation attendant to capital inflow might lead to a contraction of the already under-produced sector (increasing returns sector) leading to a direct welfare loss. And if the level of production of the increasing returns sector is already high enough even a small percentage fall in production might lead to a high absolute contraction, thus enhancing the loss.

Furthermore, as we have shown, the possibility that the labour intensive IRS sector might contract raises the possibility that the rental to capital might move up leading to a deterioration of factor terms of trade and hence reduce welfare.

Solving for dy (the change in welfare) from equations (5.40) and (5.42), we obtain

$$dy = \frac{(DN - P)}{(1 + DM)} \hat{K} \tag{5.46}$$

Noting equation (5.46) the following proposition is immediate.

Proposition 4 : Capital inflow might either improve or immiserize welfare according as the RHS of equation (5.46) is positive or negative.

With the denominator of equation (5.46) being positive, $dy \gtrless 0$ according as $(DN - P) \gtrless 0$. To understand the implication of this, let us revert back to the expression D and P defined in equation (5.43). First term in the parentheses (see the expression for D) $\bar{Q}_2 p_2$ gives the value of imports at initial equilibrium. To the extent that p_2 falls, terms of trade improves and this can translate into significant gains if $\bar{Q}_2 p_2$ is high. Next note the second term $\frac{r(K-\bar{K})\theta_{Lm}}{|\theta|}$. With a fall in p_2 the usual Stolper-Samuelson effect tends to reduce the rental rate and this effect is stronger, higher the value of θ_{Lm}, which is evident from equation (5.33). To the extent that the rental rate gets depressed, factor terms of trade can potentially improve and the extent of gain on that count will be higher, higher the level of indebtedness ($r(K - \bar{K})$) at the initial equilibrium. The last term in parentheses has two distinct components. The term $\frac{(\alpha-1)X_1 A}{(1-(\alpha-1)A)}$ is quite obvious. High value of A implies that, with a fall in p_2, there is a strong tendency towards an expansion of m or equivalently X_1 (see equation (5.38)). With X_1 (IRS sector) being the spillover generating sector, any expansion of this sector leads to a direct gain. If the production of X_1 is already high even small percentage expansion will translate into a large absolute expansion of X_1 and hence higher the gain. Furthermore, stronger the forces of scale economy, (higher the value of α) higher will be the extent of such gain.

The other component of the last term, $\frac{(\alpha-1)\, r(K-\bar{K})\, \theta_{L2} A}{|\theta|(1-(\alpha-1)A)}$ is also comprehensible. With a high value of A, any fall in p_2 has a strong expansionary effect on m. An expansion of m can only be accomodated if p_m rises (and rise in p_m for any given increase in m will be larger, higher the value of α). This is evident in equation (5.37). This has a dampening effect on rental rate and hence favourable welfarewise. Furthermore, this dampening effect on rental rate (r) will be stronger, higher the value of θ_{L2} (see equation (5.33)).

It is evident from the above discussion that D captures the gain aspects, both direct and indirect, that a fall in p_2 delivers. Direct gain corresponds to an improvement in commodity terms of trade. Indirect gain comprises of the improvement (potential) of factor terms of trade and the gain due an expansion (potential) of the IRS sector that a fall in p_2 entails.

Next, note the expression for P. Higher the value of λ_{L2} and/or lower the value of $|\lambda|$, higher is the possibility that m and therefore X_1 contracts following capital inflow (see the second term on the R.H.S. of equation (5.44)). Contraction of X_1 will have two distinct effects. One, and this is captured in the first term of P, $\frac{(\alpha-1)\, \lambda_{L2}\, X_1}{|\lambda|(1-(\alpha-1)A)}$ is a direct loss which contraction of the IRS sector entails, for it is already under-produced and this contraction of X_1 will be high in absolute terms higher the value of existing production of X_1 and the welfare loss on this count will be higher, stronger the scale economy (higher α).

To understand the second effect of contraction of X_1 and hence the second component in P, $\frac{(\alpha-1)\, r(K-\bar{K})\, \theta_{L2}\, \lambda_{L2}}{|\lambda||\theta|(1-(\alpha-1)A)}$, note that a contraction of X_1 has to go hand in hand with a fall in p_m and such fall would be higher, higher the value of α. On the other hand, any fall in p_m has a tendency to raise the rental rate (r) and hence reduce welfare. Furthermore, the effect of a fall in p_m on r will be more severe, higher the value of

θ_{L2} (see equation (5.33)). The expression P therefore captures the loss aspect that a contraction (potential) of IRS sector entails.

5.4 Conclusion

In this chapter we propose a model where the labour intensive sector generates a positive spillover and the capital intensive sector is import competing and protected by a VER. We show how increasing returns to scale brings about a possibility of welfare immiserization for the host (home in our model) country attendant to capital inflow even when commodity terms of trade improves. It is shown that capital inflow leads to an excess supply of importables at the initial price, which can only be mitigated by a fall in the price of importables, leading to a welfare gain.

Though the price of the capital intensive good falls, rental rate can either fall or rise depending upon the fate of the IRS sector. Any contraction of the IRS sector, it is shown, can potentially raise the rental rate and hence increase the level of profits accruing to foreign capital which are fully repatriated. This might adversely affect welfare. Lastly, the fact that the IRS sector can contract, directly affects welfare in so far as the IRS good is already under-produced. Furthermore, it is shown how this model replicates the results in Dei (1985) as a special case, where capital inflow necessarily results in improvement of commodity and factor terms of trade leading to higher welfare. However, under a general situation the fate of the spillover generating sector becomes crucial in determining the welfare consequence of capital inflow.

Appendix

Price Output Response

From equation (5.31)

$$\hat{X}_2 = -B(\hat{p}_m - \hat{p}_2) + \frac{\lambda_{Lm}}{|\lambda|}\,\hat{K}$$

Noting $\hat{p}_m = (\alpha - 1)\,\hat{m}$ and using equation (5.30) to substitute for $\hat{m}$, (5.31) can be written as

$$\hat{X}_2 = -B\left[\frac{-\hat{p}_2}{(1-(\alpha-1)A)} - \frac{(\alpha-1)\,\lambda_{L2}\,\hat{K}}{|\lambda|\,(1-(\alpha-1)A)}\right] + \frac{\lambda_{Lm}}{|\lambda|}\,\hat{K} \qquad (A.1)$$

At constant K i.e. $\hat{K} = 0, (1-(\alpha-1)A) > 0$ is sufficient to ensure that $\frac{\hat{X}_2}{\hat{p}_2} > 0$ (i.e. positive price-output response).

Stability :

Noting that the home country imports are fixed at the level $\bar{Q}_2$, supplies of commodity 2 in the home market (at constant $K; \hat{K} = 0$) is a function of p_2 alone. Furthermore, as has been shown in the text, real income y (at $\hat{K} = 0$) (see equation (5.42)) is a function of p_2 alone. Thus at $\hat{K} = 0$, demand for X_2 is a function of p_2 alone. This makes the problem easier in the sense that stability analysis can proceed purely in terms of the domestic price p_2, since the home market for commodity 2 is immune to the repurcussions of changes in p_2^*.

We propose a Marshallian adjustment rule of the form

$$\dot{X}_2 = \beta\,\left[\frac{p_2^d(X_2)}{p_2^s(X_2)} - 1\right] \qquad (A.2)$$

where $\dot{}$ denotes the time derivative and p_2^d and p_2^s are demand and supply prices respectively and $\beta > 0$ is the speed of adjustment. Linearising (A.2) around the equilibrium $X_2 = X_2^0$, we obtain

$$\dot{X}_2 = \frac{\beta}{X_2^0}\,\left[\frac{\widehat{p_2^d}}{\hat{X}_2} - \frac{\widehat{p_2^s}}{\hat{X}_2}\right]\,(X_2 - X_2^0) \qquad (A.3)$$

Thus the system is locally stable if and only if

$$\left(\frac{\widehat{p_2^d}}{\hat{X}_2} - \frac{\widehat{p_2^s}}{\hat{X}_2}\right) < 0$$

Note that at $\hat{K} = 0$, (A.1) gives the supply schedule for X_2,

$$\frac{\widehat{p_2^s}}{\hat{X}_2} = \frac{(1-(\alpha-1)A)}{B} \tag{A.4}$$

Equation 5.29 in the text gives the demand side of the market for X_2,

$$\widehat{p_2^d} = \frac{m_2\, dy}{p_2\, D_2\, \eta_2} - \frac{X_2}{D_2\, \eta_2}\, \hat{X}_2$$

Substituting for dy from (5.42), and using (A.1), (at $\hat{K} = 0$),

$$\frac{\widehat{p_2^d}}{\hat{X}_2} = -\left[\frac{m_2(1-(\alpha-1)A)}{p_2\, D_2\, \eta_2\, B}\left\{\bar{Q}_2 p_2 + \frac{r(K-\bar{K})\,\theta_{Lm}}{|\,\theta\,|} + \right.\right.$$

$$\left.\left.(\alpha-1)\left\{X_1 + \frac{r(K-\bar{K})\theta_{L2}}{|\,\theta\,|}\right\}\frac{A}{(1-(\alpha-1)A)}\right\} + \frac{X_2}{D_2\,\eta_2}\right] \tag{A.5}$$

Noting (A.4) and (A.5) it follows that $(1-(\alpha-1)A) > 0$ is sufficient to ensure $\left(\frac{\widehat{p_2^d}}{\hat{X}_2} - \frac{\widehat{p_2^s}}{\hat{X}_2}\right) < 0$. Hence, commodity markets are stable under the assumption $(1-(\alpha-1)A) > 0$.

Chapter 6

Protection and Real Rewards

6.1 Introduction

The last two chapters dealt with capital movement and its interactions with protectionist commercial policies. The theme of this chapter departs from the earlier chapters. It is primarily focussed on the issue of intersectoral price shifts and distribution. The central concern of this chapter is to investigate the distributional effects of intersectoral price changes in a model with specific factors and increasing returns to scale.

The specific factors model developed by Jones (1971) remains one of the outstanding contributions to neo-classical trade theory. Not merely was it a fore-runner to break out of the straitjacket of the Heckscher-Ohlin (H-O) structure, it was also a serious attempt to address a range of issues pertaining to political economy and economic history. A key result of the specific factors model is that a relative price increase of a good benefits the factor specific to that industry, reduces the real income of the other specific factor, and the mobile factor is relatively unaffected (moderately hurt). An immediate corollary to the result is that there is an inherent discord between the interests of the specifc factors. Factors employed solely in sector that will enjoy a price increase would strongly support such protectionist measures while factor employed in other sector would oppose the same and the mobile factor may avoid expressing opinions through voting or lobbying.

Since then several papers have been written extending and generalising the result. Key contributions were made by Mayer (1974) and Mussa (1974). Mussa considers a short run, where limited adjustment possibilities locks the capital in a sector giving rise to the specific factors structure and a long run where mobility across sectors equalises the rate of return to capital so that in the limit the model replicates the Heckscher-Ohlin structure. Magee (1978) shows that the model helps explain the observed phenomenon that lobbying for and against protective barriers against imports tends to be done by coalitions of specific factors in particular sectors.

In this chapter we consider a variant of the specific factors model in the spirit of Gruen and Corden (1970). The essential departure of the model is to add yet another commodity in a specific factors structure. There are three traded goods the first of which is produced by labour and land (specific to that sector), the rest of the two commodities are produced by labour and capital and labour is intersectorally mobile. Note that the subsectors using labour and capital resemble the Heckscher-Ohlin structure and therefore has been referred to, in the literature as the Heckscher-Ohlin (H-O) nugget (see Jones and Marjit (1990)). This type of a framework gives rise to complementarity in the sense that changes in output of a commodity is positively related to changes in output of yet another commodity (see, Jones and Scheinkman (1977), Jones and Marjit (1990), Marjit and Beladi (1996)). Added to this complementarity, we introduce increasing returns to scale to investigate the consequences of relative price changes on real rewards. Quite contrary to the results of the specific factors model, we show that there can be a concord in interests of the specific factors when increasing returns to scale get locked-in with complementarity of production structure. Moreover, and this is of interest, a relative price rise of a commodity produced outside the Heckscher-Ohlin nugget hurts the mobile factor (labour in our model) most and both the specific factors (of course, under some parameterization) might gain. Thus differential/discriminatory protection at a manifest level might deliver gains to both the specific factors at the ulterior level, at the cost of the mobile factor (labour). Furthermore, we show that, with uniform tariff protection being given to the H-O nugget and the sector outside it left unprotected, the mobile factor gains unambiguously (i.e., in terms of all the three final commodities). Land (the specific factor outside the nugget) is hurt unambiguously. However contrary to what one would generally expect, capital (the factor which is specific to the H-O nugget) loses in terms of the final commodities in the nugget and under some parameterization, might even lose in terms of the commodity outside the nugget. The bottomline once again is that the presumptions of the specific factors model seem to be violated. Protection at a manifest level fails to protect the factor specific to that sector, and mobile factor makes the most out of the protectionist regime.

The plan of the chapter is as follows. Section 6.2 builds the model. Section 6.3 analyses the effects of price change. Section 6.4 concludes. An Appendix contains a discussion on stability.

6.2 The Model

We have a small open economy producing three goods X_1, X_2, X_3. Production of X_1 requires labour and land. Labour and capital is used to produce X_3 and a composite factor bundle m. X_1, X_3, m are produced by usual constant returns to scale (CRS) technology.

$$X_1 = F(L, T) \tag{6.1}$$

$$m = G(L, K) \tag{6.2}$$

$$X_3 = H(L, K) \tag{6.3}$$

where, F, G and H are usual CRS production functions.

Equations (6.2) and (6.3) resembles the H-O structure with both labour (L) and capital (K) mobile across sector m and sector 3. This has been referred to in the literature as the Heckscher-Ohlin nugget. Note, capital (K) here is specific to the nugget and land (T) is specific to sector 1, and labour has perfect intersectoral mobility. In this sense the model renders an asymmetry with regard to the mobility of two types of specific factors, with capital being allowed partial mobility and land (T) being perfectly immobile. This production structure in fact is not arbitrary as it might seem to be. Jones and Marjit (1990) show that a multisector small economy with each sector having plenty of subsectors using the same specific factor and labour can converge through trade to only two possible production structures. Ethier it would be a pure specific factors structure or it would be the one we propose in this chapter.

Factor bundle m in turn is used to produce an array of intermediate inputs by monopolistically competitive producers. These intermediate inputs are costlessly assembled to produce commodity X_2 by final output producers. We further assume m to be more capital intensive than X_3.

The production technology for assembling X_2 is given by

$$X_2 = \left[\sum_{i=1}^{n} x_i^{\rho}\right]^{\frac{1}{\rho}}, \qquad \text{where, } 0 < \rho < 1 \tag{6.4}$$

where x_i is the input of intermediate i. Intermediate goods are imperfect substitutes. ρ measures the degree of differentiation of intermediate inputs[1].

As in chapters 3 and 5, we assume that all intermediate goods have identical cost functions.

The cost of producing the quantity x of a given variety of intermediate input is, $C_x = (ax + b)\, p_m$, where, a and b are marginal and fixed requirements of m respectively and p_m is the price of factor bundle (m).

An individual producer of X_2 maximizes profits subject to the production function (6.4) considering n to be parametrically given. The demand function for each intermediate input

$$x_i = \frac{(q_i)^{-\sigma} \sum_{i=1}^{n} q_i x_i}{\sum_{i=1}^{n} q_i^{1-\sigma}} \tag{6.5}$$

where q_i is the price of the *ith* intermediate input and $\sigma = \frac{1}{1-\rho}$ is the elasticity of substitution between any pair of intermediate inputs.

Prices of intermediate inputs are given by

$$q_i = \frac{ap_m}{\rho} \tag{6.6}$$

Thus prices of intermediate goods are a constant mark-up over the marginal cost. With identical technology, all firms charge the same price for intermediate goods $(q_i = q)$. Free entry entails zero profits in intermediate goods production. Thus the operating surplus must be just enough to cover the fixed cost,

$$\frac{q}{\sigma} x_i = bp_m \tag{6.7}$$

This also implies that output x_i is the same for all producer $(x_i = x)$.

Dividing equation (6.6) by (6.7) we get

$$x = \frac{b\rho}{a(1-\rho)} \tag{6.8}$$

[1]The features of the function in equation (6.4) has already been discussed in earlier chapters. We skip the discussion here and write down the relevant equations of intermediate goods production, as would be required for our purpose, without any elaboration.

Under symmetry ($x_i = x$), equation (6.4) collapses to

$$X_2 = n^{\alpha} x \tag{6.9}$$

where, $\alpha \equiv \frac{1}{\rho}$.

Note that (6.8) implies output per firm is constant. Thus equation (6.9) implies, any expansion of X_2 would be in terms of increased n. And this, as has already been noted implies increasing returns to scale at the industry level in X_2 production.

Full employment condition for factor bundle m, is given by

$$m = n(ax + b) \tag{6.10}$$

The factor market equilibrium conditions are given by

$$a_{L1}X_1 + a_{Lm}m + a_{L3}X_3 = \bar{L} \tag{6.11}$$

$$a_{T1}X_1 = \bar{T} \tag{6.12}$$

$$a_{Km}m + a_{K3}X_3 = \bar{K} \tag{6.13}$$

where $\bar{L}, \bar{T}, \bar{K}$ are the fixed levels of endowments of labour, land and capital and a_{ij}'s are the usual input-output coefficients.

Noting that zero profit condition prevails in all the final output markets and also at the level of production of m, the pricing equations are as follows :

$$a_{L1}w + a_{T1}R = \bar{p}_1 \tag{6.14}$$

$$a_{Lm}w + a_{Km}r = p_m \tag{6.15}$$

$$a_{L3}w + a_{K3}r = \bar{p}_3 \tag{6.16}$$

$$\bar{p}_2 X_2 = nqx = p_m m \tag{6.17}$$

where $\bar{p}_1, \bar{p}_2, \bar{p}_3$ are the given world prices of traded final goods and corresponding domestic prices will be denoted by p_i, $i = 1, 2, 3$. w, R, r are wage, rental to land and rental to capital respectively. Note that second part of the equality (6.17) follows from the symmetry in intermediate goods production (i.e., $x_i = x, q_i = q$) and zero profit condition prevailing in intermediate goods production, and the first part from zero profit at the level of production of X_2.

Note the pricing equations (6.14) - (6.16) implies that with the world prices ($\bar{p}_i$) for final goods given, p_m is the only variable price changes in which would change the factor prices.

Using the production function (6.9) in equation (6.17), it follows

$$\bar{p}_2 = n^{(1-\alpha)} q. \tag{6.18}$$

Thus given the price of commodity 2, $\bar{p}_2$, any rise in n must be accompanied by a rise in price of intermediate inputs q to maintain the price cost equality (6.18).

6.3 Consequences of Protection

6.3.1 Regime I

In this section we explore the effects of protection being rendered to X_1 producers by means of a tariff. This is modelled here as a one time jump in tariff from the initial free trade level. We assume X_2 and X_3 to be exportables, and traded freely.

In what follow "^" represents a proportionate change (e.g., $\hat{x} = \frac{dx}{x}$). Differentiating (6.14 - 6.16) and using the cost minimizing condition in input use (see Jones (1965)),

$$\theta_{L1}\hat{w} + \theta_{T1}\hat{R} = dt \tag{6.19}$$

$$\theta_{Lm}\hat{w} + \theta_{Km}\hat{r} = \hat{p}_m \tag{6.20}$$

$$\theta_{L3}\hat{w} + \theta_{K3}\hat{r} = 0 \tag{6.21}$$

Differentiating (6.18),

$$(\alpha - 1)\hat{n} = \hat{q} \tag{6.22}$$

Noting that, equation (6.10) implies $\hat{m} = \hat{n}$ and equation (6.6) implies $\hat{q} = \hat{p}_m$, equation (6.22) boils down to

$$(\alpha - 1)\hat{m} = \hat{p}_m \tag{6.23}$$

Equation (6.23) implies an upward sloping derived demand curve for factor bundle m. This gives rise to a problem of instability. As we will show later, that under a stable equilibrium α must be bounded above (shown in the Appendix, equation A.7). The stability condition tames the extent of the scale economy and moreover ensures normal comparative statics response.

Differentiating (6.11 - 6.13), after some rearrangement, yields

$$\lambda_{L3}\hat{X}_3 + \lambda_{Lm}\hat{m} = \lambda_{L1}\sigma_1(\hat{w} - \hat{R}) + (\lambda_{Lm}\sigma_M\theta_{Km} + \lambda_{L3}\sigma_3\theta_{K3})(\hat{w} - \hat{r})$$

$$\equiv \lambda_{L1}\sigma_1(\hat{w} - \hat{R}) + \delta_L(\hat{w} - \hat{r}) \tag{6.24}$$

$$\lambda_{K3}\hat{X}_3 + \lambda_{Km}\hat{m} = -(\lambda_{Km}\sigma_m\theta_{Lm} + \lambda_{K3}\sigma_3\theta_{L3})(\hat{w} - \hat{r})$$

$$\equiv -\delta_K(\hat{w} - \hat{r}) \tag{6.25}$$

where λ_{ij} is the physical share of the *ith* factor going to the *jth* sector, θ_{ij} is the value share of the *ith* factor in the *jth* good and σ_i is the elasticity of substitution in the *ith* sector.

Using equation (6.19) - (6.21), and noting (6.23),

$$\hat{w} = \frac{-\theta_{K3}\hat{p}_m}{\mid \theta \mid} = \frac{-\theta_{K3}(\alpha - 1)\hat{m}}{\mid \theta \mid} \tag{6.26}$$

$$\hat{r} = \frac{\theta_{L3}}{\mid \theta \mid}\hat{p}_m = \frac{\theta_{L3}(\alpha - 1)\hat{m}}{\mid \theta \mid} \tag{6.27}$$

$$\hat{R} = \frac{dt}{\theta_{T1}} + \frac{\theta_{L1}}{\theta_{T1}}\frac{\theta_{K3}(\alpha - 1)\hat{m}}{\mid \theta \mid} \tag{6.28}$$

where, $\mid \theta \mid = (\theta_{L3} - \theta_{Lm}) > 0$.

Substituting for $\hat{w}$ and $\hat{r}$ and $\hat{R}$ from (6.26 - 6.28) into (6.24) and (6.25) and solving for $\hat{m}$ yields

$$\hat{m} = \frac{\lambda_{K3}\,\lambda_{L1}\,\sigma_1\,dt}{\theta_{T1}\mid \lambda' \mid} > 0 \tag{6.29}$$

where

$$\mid \lambda' \mid = \begin{vmatrix} \lambda_{L3} & \left(\lambda_{Lm} + \frac{\lambda_{L1}\sigma_1\theta_{K3}(\alpha-1)}{|\theta|\theta_{T1}} + \frac{\delta_L(\alpha-1)}{|\theta|}\right) \\ \lambda_{K3} & \left(\lambda_{Km} - \frac{\delta_K(\alpha-1)}{|\theta|}\right) \end{vmatrix} > 0$$

(Shown in the Appendix, equation A.6).

Noting that $\hat{m} = \hat{n}$ (from equation (6.10)), and $\hat{X}_2 = \alpha\hat{n}$ (from equation (6.9)), we have $\hat{X}_2 = \alpha\hat{m}$. Therefore, $\frac{\hat{m}}{dt} > 0$ in (6.29) implies that sector 2 of the nugget expands when protection is rendered to sector 1, which lies outside the nugget. It can readily be checked that this goes hand in hand with an expansion of sector 1. As we show in what just follows, the real return $\left(\frac{R}{p_1}\right)$ to land increases unambiguously with an unilateral tariff protection being given to sector 1. Noting that land is specific to sector 1, this implies that more labour has been drawn into sector 1 from the nugget. Therefore it necessarily follows that sector 1 has also expanded following tariff protection. In this sense sector 1 and sector 2 are complementary in their supply response.

Proposition 1 : Tariff protection rendered to sector 1 leads to an expansion of both sector 1 and sector 2.

Note that, under constant returns to scale (CRS) (i.e., $\alpha = 1$), $\mid \lambda' \mid = (\lambda_{L3}\lambda_{Km} - \lambda_{Lm}\lambda_{K3}) \equiv \mid \lambda \mid > 0$. The last inequality follows from the assumed intensity condition. Thus under CRS, $\hat{m} > 0$. This essentially replicates the Gruen and Corden (1970) response. We can show (shown in the Appendix, equation A.6) that a stable equilbrium under Marshallian quanitity adjustment rule ensures that $\mid \lambda' \mid$ is positive in a general case, where $\alpha > 1$[2].

Noting equations (6.26) - (6.28) and using (6.29),

$$\hat{w} = -\left(\frac{\theta_{K3}(\alpha-1)}{\mid \theta \mid}\,\frac{\lambda_{K3}\lambda_{L1}\sigma_1}{\theta_{T1}\mid \lambda' \mid}\right) dt < 0 \tag{6.30}$$

$$\hat{r} = \left(\frac{\theta_{L3}(\alpha-1)}{\mid \theta \mid}\cdot\frac{\lambda_{K3}\lambda_{L1}\sigma_1}{\theta_{T1}\mid \lambda' \mid}\right) dt > 0 \tag{6.31}$$

$$\hat{R} = \left(\frac{1}{\theta_{T1}} + \frac{\theta_{L1}\theta_{K3}(\alpha-1)\lambda_{K3}\lambda_{L1}\sigma_1}{\mid \theta \mid \theta_{T1}^2 \mid \lambda' \mid}\right) dt > 0 \tag{6.32}$$

[2]Note that the condition $\mid \lambda' \mid > 0$ does not follow from the intensity condition. As we show in the Appendix, it is dependent upon the specific stability criterion that is proposed. In fact it is shown that Marshallian stability requires, $\mid \lambda' \mid > 0$. Furthermore with an upward sloping demand curve and an upward sloping supply curve for factor bundle m (as is shown later is the case in our model) Walrasian stability would require a reversal of the inequality (i.e., $\mid \lambda' \mid < 0$). But note, proposing the Marshallian adjustment requires that the stable equilibrium (i.e., $\mid \lambda' \mid > 0$) be such as to replicate the usual CRS response.

The crux of the matter is then, in models where there can be perverse supply or demand responses, the signs of comparative statics become crucially linked to the proposed stability criterion. Furthermore, in principle it can hardly be decided in static models, what exactly would be the off equilibrium dynamics except by using some kind of prudent judgement or at worse by some adhocism. Be that as it may, we use Marshallian criteria here and we have already rendered some defence for that in chapter 3.

Now, note that following tariff protection rendered to X_1, we have, $\hat{p}_1 = dt, \hat{p}_2 = \hat{p}_3 = 0$; where p_i's are domestic prices. Therefore, equations (6.30 - 6.32) implies $(\widehat{w/p_i}) < 0,\ i = 1,2,3$; $(\widehat{R/p_i}) > 0,\ i = 1,2,3$ and $(\widehat{r/p_i}) > 0,\ i = 2,3$ but with respect to the first commodity, r might either increase or decrease.

Evidently,

$$\left(\widehat{r/p_1}\right) \gtrless 0 \text{ according as } \theta_{L3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\ \sigma_1 \gtrless \mid \theta \mid \theta_{T1} \mid \lambda' \mid \tag{6.33}$$

Thus the following proposition is immediate.

Proposition 2 : With protection being given to the sector outside the nugget (at the rate $dt > 0$), **a)** the reward to the factor, specific to that sector (i.e., Land) increases in terms of all the final commodities, **b)** the reward to the mobile factor (Labour) falls in terms of all the final commodities and **c)** if $\mid \theta \mid\mid \lambda' \mid \theta_{T1} < \theta_{L3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\ \sigma_1$, the reward to the specific factor of the nugget (Capital) increases in terms of all the final commodities.

This makes room for the possibility that the benefits of protection not only goes to the factor specific to the protected sector but might spill over to the factor specific to the unprotected sector(s). Furthermore this comes at the expense of the mobile factor (Labour in our model). In this sense there might be a concord in interests of specific factors. This might have serious political-economic implications. The mobile factor (labour) might severely object to such a protectionist regime. Whereas quite contrary to the conclusions arrived at in the usual specific factors model, the factor specific to the unprotected sector might not only concede to but actively lobby for such a regime.

A simple diagram suffices to reveal the mechanism at work behind the results. As has been pointed out, $\hat{p}_m = (\alpha - 1)\ \hat{m}$ (see equation 6.23), gives the derived demand curve for the composite factor bundle m, which is denoted by DD in Figure I. Now note, under free trade (i.e., $dt = 0$), we can derive the supply curve SS for factor bundle m, by means of tracing the repercussion of an arbitrary increase in p_m, on the supply of m. Given an initial allocation of labour in the nugget, an increase in p_m increases the supply of m. Furthermore, an increase in p_m increases r and decreases w (the usual Stolper-Samuelson effect, note equations 6.20, 6.21). A lower w implies higher R (note equation 6.19, with $dt = 0$). Higher R necessarily implies, that more labour has been drawn into the production of X_1. That is to say the Heckscher-Ohlin Nugget (m and X_3) is left with lesser amount of labour. This triggers the usual Rybczynski effect with

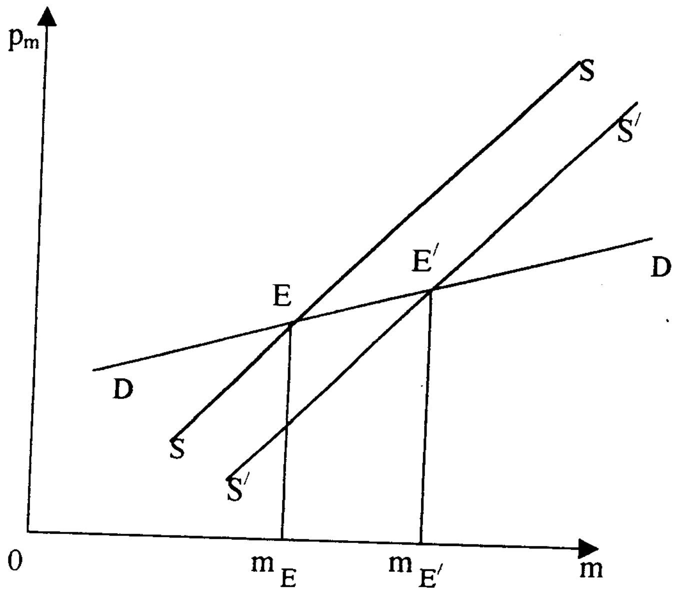

Figure I

X_3 contracting and m expanding even further (note we have assumed m to be capital intensive). Thus we have a positively sloped supply curve drawn as SS in Figure I, and the equilibrium is at E. The way we have drawn the DD & SS curves in Figure I, presumes the equilibrium to be Marshallian stable. Note the DD & SS curves in Figure I corresponds to equations (A.3) and (A.4) respectively derived in the Appendix.

Next, we turn to the effects of imposition of a tariff. At constant p_m ($\hat{p}_m = 0$), equations (6.20 and 6.21) suggests w and r are constant. With tariff protection being rendered to X_1 production, R invariably increases as w is fixed. This happens by drawing labour out of the H-O Nugget. With the nugget being left with lesser amount of labour, m expands. Thus at constant p_m, tariff protection to X leads to a rightward shift of SS in Figure I. Next, note that tariff here has no effect on the demand curve for m. Thus the new equilibrium is at E$'$ with both higher m and p_m.

Higher p_m in the new equilibrium necessarily implies higher r, lower w and higher R (See equations 6.19 - 6.21). Hence the result in proposition 2.

Note that the result in proposition 2 crucially hinges on both the complementarity of supply response and the increasing returns to scale. To see this, consider the case under CRS, that is with $\alpha = 1$. It is evident from equations (6.30) - (6.32), that under such a set-up $\hat{w} = \hat{r} = 0$ and $\hat{R} = \frac{dt}{\theta_{T1}} > 0$. That means, tariff protection rendered to sector 1, will have no effect on the wage (w) and rental rate (r), and will increase the real return (R) to land. Furthermore, this implies that the real wage ($\frac{w}{p_1}$) and real rental ($\frac{r}{p_1}$) in terms of commodity 1 falls, though real return to land increases in terms of all the commodities (i.e., $(\widehat{\frac{R}{p_i}}) > 0, i = 1, 2, 3$). This suggests that the result in proposition 2 does not go through under CRS.

To have an intuition behind the result, note that with $\alpha = 1$, equation (6.23) implies $\widehat{p_m} = 0$. Therefore w and r get determined from equations (6.15) and (6.16) and remain invariant to protection being rendered to sector 1. Protection to sector 1 simply increases R.

The role of complementarity of supply response is also crucial in generating the result. From proposition 1 we know that, protection given to sector 1 expands both sector 1 and sector m. Next note that expansion of m is crucial in generating the result in proposition 2. Because it is the expansion of m which triggers a change in p_m, and this change in p_m is pivotal in changing w and r.

It is worth mentioning that proposition 2 remains valid even if the intensity assumption on the H-O nugget is reversed. We have assumed m or equivalently X_2 to be more capital intensive than X_3. Proposition 2 goes through even if X_3 is more capital intensive than m. To see this note equations (6.30 - 6.32). In all these three equations we have $\mid \theta \mid$ and $\mid \lambda' \mid$ in the denominator. This implies that even if the intensity condition is reversed, the signs in (6.30 - 6.32) remain unaltered (as both $\mid \theta \mid$ and $\mid \lambda' \mid$ will then be negative)[3]. Now, with changed intensity assumption the mechanism through which proposition 2 is arrived at, is bit different. Tariff protection to X_1 draws labour out of the H-O-nugget. This makes the labour intensive sector (now m) contract in the new equilibrium. This contraction of m can only be accomodated through a fall in p_m (See equation 6.23). With fall in p_m, w falls and r rises (as m is now the labour intensive sector). With w falling, R must rise. Thus the same result as in proposition 2 is arrived at.

6.3.2 Regime II

Given the fact that we have three final commodities, one can investigate several other configurations of differential tariff protection. That would only make the whole exercise taxonomic. Rather it would be of interest, to investigate, akin to the specific factors model the consequence of protection being given to the sector(s) employing capital. In the following part we work through the effect of uniform protection (at rate $dt > 0$) given to both the sectors X_2 and X_3 with X_1 left unprotected (to put it otherwise, the sector(s) to which capital is specific, is favoured with a relative price increase with respect to the sector where land is the specific factor). We now assume X_1 to be exportables and X_2, X_3 to be importables.

Note, if X_2 and X_3 are given a uniform tariff protection (where protection is once again modelled as a one time jump in tariff from free trade level), equation (6.18) would be

$$\bar{p}_2(1+t) = n^{1-\alpha} q \tag{6.34}$$

Log differentiating (6.34), and noting that initial $t = 0$,

$$dt = (1-\alpha)\hat{n} + \hat{q} \tag{6.35}$$

[3]See equation A.8 in the Appendix.

Noting, that $\hat{m} = \hat{n}$ and $\hat{q} = \widehat{p_m}$, equation (6.35) reduces to

$$\widehat{p_m} = dt + (\alpha - 1)\hat{m} \tag{6.36}$$

Log differentiation of the pricing equations are now given by

$$\theta_{L1}\hat{w} + \theta_{T1}\hat{R} = 0 \tag{6.37}$$

$$\theta_{Lm}\hat{w} + \theta_{Km}\hat{r} = \hat{p}_m = dt + (\alpha - 1)\hat{m} \tag{6.38}$$

$$\theta_{L3}\hat{w} + \theta_{K3}\hat{r} = dt \tag{6.39}$$

Solving from equations (6.37 - 6.39),

$$\hat{w} = dt - \frac{\theta_{K3}(\alpha - 1)\ \hat{m}}{\mid \theta \mid} \tag{6.40}$$

$$\hat{r} = dt + \frac{\theta_{L3}(\alpha - 1)\hat{m}}{\mid \theta \mid} \tag{6.41}$$

$$\hat{R} = -\frac{\theta_{L1}}{\theta_{T1}} \left[dt - \frac{\theta_{K3}(\alpha - 1)\hat{m}}{\mid \theta \mid} \right] \tag{6.42}$$

Substituting for $\hat{w}, \hat{r}$ and $\hat{R}$ from (6.40 - 6.42) in (6.24) and (6.25) and solving for $\hat{m}$, yields

$$\hat{m} = -\frac{\lambda_{K3}\ \lambda_{L1}\ \sigma_1\ dt}{\theta_{T1} \mid \lambda' \mid} < 0 \tag{6.43}$$

$\frac{\hat{m}}{dt} < 0$ in equation (6.43) implies a contraction of sector 2. Putting it less rigorously, tariff protection rendered to the nugget draws labour out of sector 1. With more labour in the H-O nugget the capital intensive m-sector (sector 2) contracts by virtue of Rybczynski effect. Further note, it can easily be shown that sector 1 now contracts. As we will just show in what follows, that tariff protection to the nugget unambiguously reduces the real return $(\frac{R}{p_1})$ to land, which is specific to sector 1. Which can only happen through a release of labour from this sector. This readily implies a shrinkage of sector 1, once again revealing the complementarity of supply response of sector 1 and sector 2.

Proposition 3 : Uniform tariff protection rendered to the H-O nugget leads to a contraction of the m-sector (or equivalently sector 2) of the nugget and contraction of sector 1, outside the nugget.

Substituting (6.43) in (6.40 - 6.42), we obtain

$$\hat{w} = dt + \frac{\theta_{K3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\ \sigma_1}{|\ \theta\ |\ \ \theta_{T1}\ |\ \lambda'\ |} dt \tag{6.44}$$

$$\hat{r} = dt - \frac{\theta_{L3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\sigma_1}{|\ \theta\ |\ \ \theta_{T1}\ |\ \lambda'\ |} dt \tag{6.45}$$

$$\hat{R} = -\frac{\theta_{L1}}{\theta_{T1}} \left[dt + \frac{\theta_{K3}(\alpha - 1)\lambda_{K3}\ \lambda_{L1}\ \sigma_1\ dt}{|\ \theta\ |\ \theta_{T1}\ |\ \lambda'\ |} \right] \tag{6.46}$$

Noting that, $\widehat{p_1} = 0, \widehat{p_2} = \widehat{p_3} = dt$, equations (6.44 - 6.46) implies $\widehat{(w/p_i)} > 0;\ i = 1,2,3$. $\widehat{(R/p_i)} < 0;\ i = 1,2,3$, $\widehat{(r/p_i)} < 0;\ i = 2,3$. Noting equation (6.45) $\widehat{(r/p_1)} = \hat{r} \gtrless 0$ according as $|\ \theta\ ||\ \lambda'\ |\ \theta_{T1} \gtrless \theta_{L3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\ \sigma_1$.

Thus the following proposition is immediate.

Proposition 4 : With uniform protection being given to the nugget (X_2 & X_3) at the rate $dt > 0$, **a)** the reward to the mobile factor increases in terms of all the final commodities, **b)** the reward to the specific factor of the unprotected sector X_1 (Land) falls in terms of all the final commodities and **c)** if $|\ \theta\ ||\ \lambda'\ |\ \theta_{T1} < \theta_{L3}(\alpha - 1)\ \lambda_{K3}\ \lambda_{L1}\ \sigma_1$ then the reward to the specific factor of the nugget (Capital) falls in terms of all the final commodities.

An interesting aspect of proposition 4 is that, benefit of protection rendered to the sector(s) at a manifest level might fail to reach the factor specific to the sector(s). The gains of protection under regime II is exclusively cornered by the mobile factor (labour). This is once again in stark conflict with the usual presumption associated with the specific factors model.

Once again note that the validity of proposition 4 is not contingent upon our intensity assumption about the nugget.

A diagram will facilitate understanding of the mechanism behind the result.

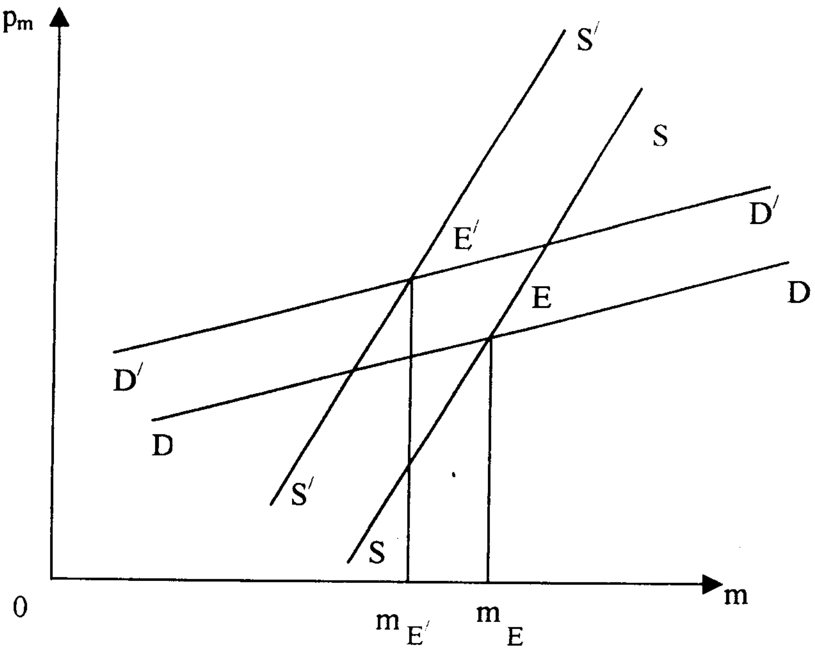

Figure II

At the intial free trade the demand and supply curves for m are DD and SS respectively in Figure II (Note, these curves are the same as in figure I and we do not discuss their slopes here, which have already been explained), and the equilibium is at E. With uniform protection being given to the nugget (X_3 and X_2) we have to trace out the shifts in the DD and SS curves. For that, let us begin with the SS curve. At constant p_m, protection leads to $\hat{p}_3 = dt$. Given the initial allocation of labour and capital in the nugget this leads to an expansion of X_3 and a contraction of m. Furthermore, at constant p_m, a rise in p_3 leads to an increase in wage (w) and a fall in rental rate (r) (Stolper-Samuelson effect). A rise in wage (w) leads to a fall in R (See equation 6.39). Fall in R necessarily implies that labour has been released from sector 1 into the nugget. This triggers the Rybczynski effect, leading to a second round of contraction of m (the capital intensive sector) and expansion of X_3. Thus at constant p_m the supply of m falls unambiguously, with the supply curve shifting to the left. The new supply curve is S′ S′. On the other hand, tariff now affects the demand curve DD. Note equation (6.36), at constant p_m, tariff protection ($dt > 0$) leads to a fall in m. Thus the demand curve shifts to the left, to D′ D′.

Nevertheless, as has been shown (equation 6.43), that the new equilibrium E′ is such that m falls in the new equilibrium. This evidently implies that the upward shift of the demand curve is less than the upward shift of the supply curve at initial m_E, leading to a new equilibrium with lower m ($m_{E'} < m_E$).

To see this, note that at intial m_E, a tariff leads to an upward shift of the supply curve to the extent of dt (in percentage terms). This is evident from equation (6.36); where freezing m at the initial level, $\hat{p}_m = dt$. Next we have to show that the shift in the supply curve outweighs the shift in demand curve at initial m_E.

From equations (6.37 - 6.39), we get

$$(\hat{w} - \hat{r}) = \frac{dt - \hat{p_m}}{|\,\theta\,|} \tag{6.47}$$

and

$$(\hat{w} - \hat{R}) = \frac{\theta_{Km}\, dt - \theta_{K3}\hat{p_m}}{|\,\theta\,|} \tag{6.48}$$

Substituting (6.47) and (6.48) into (6.24) and (6.25) and solving for $\hat{m}$, we get

$$\hat{m} = \frac{\left\{-\lambda_{L3}\delta_K\left(\frac{dt-\hat{p_m}}{|\theta|}\right) - \frac{\lambda_{K3}\,\lambda_{L1}\,\sigma_1}{\theta_{T1}}\left(\frac{\theta_{Km}\,dt-\theta_{K3}\,\hat{p_m}}{|\theta|}\right) - \lambda_{K3}\delta_L\left(\frac{dt-\hat{p_m}}{|\theta|}\right)\right\}}{|\,\lambda\,|} \tag{6.49}$$

Equation (6.49), represents the supply side of the m-market. To find out the shift in the supply curve, at any given level of m, solve for $\hat{p_m}$ in terms of dt setting $\hat{m} = 0$. This, after some rearrangement yields

$$\hat{p_m} = \frac{(M + \theta_{Km})}{(M + \theta_{K3})}\, dt > dt \tag{6.50}$$

where

$$M = \frac{\theta_{T1}(\lambda_{L3}\, \delta_K + \lambda_{K3}\, \delta_L)}{\lambda_{K3}\, \lambda_{L1}\, \sigma_1} > 0$$

Note the last inequality in (6.50) follows from the intensity assumption ($\theta_{Km} > \theta_{K3}$). Thus at the initial equilibrium m_E the vertical shift of the supply curve (SS to S′ S′, which is given by the expression $\frac{(M+\theta_{Km})\, dt}{(M+\theta_{K3})}$, in percentage terms) outweighs the vertical shift of the demand curve (DD to D′ D′, which is given by dt in percentage terms). Hence m falls to $m_{E'}$, in the new equilibrium.

With m falling at the new equilibrium the relative price of m with respect to X_3 falls (See equations 6.38 and 6.39), and accordingly the results in proposition 4 follows.

To sum up : important implications of what we have shown is, first, the interests of specific factors might be in agreement. The second point that we infer is that the interest of the mobile factor might be opposed to the specific factor(s). The first feature evidently hints that there might be a broader general interest of specific factors across board. Furthermore, the second point suggests that this broader general interest of specific factors is opposed to the interest of the mobile factor. In standard H-O set up the distributional conflict suggested by the Stolper-Samuelson theorem tells us that the interest of capital is strongly opposed to that of labour where both the factors are perfectly mobile. Our model in a modified sense comes closer to such a conclusion even in a set up where factor specificity is allowed for.

6.4 Conclusion

Essentially, the Gruen-Corden (1970) model can be seen as a more disaggregated version of the specific factors model developed by Jones (1971). The departure of our model from the specific factors model are two fold. First, we allow for partial specificity of one factor, in the sense that, Capital in our model is allowed to have limited mobility (across sectors X_2 and X_3), whereas Land is completely specific to the production of X_1 (this is the structure of the Gruen-Corden Model). Second, we introduce increasing returns in the Heckscher-Ohlin nugget (X_2, X_3). As is obvious from the preceeding exercise both these features contribute in shaping the results we arrived at. What we attempted then is to add complexity to the specific factors model. As it stands now, many of the general presumptions seem to be questionable.

It is shown that when the sector outside the nugget is protected, the specific factor in that sector and the specific factor in the nugget, (which is left unprotected) both can gain, and the mobile factor is severely hurt.

Furthermore uniform tariff protection given to the nugget leads to an unambiguous loss for the specific factor outside the nugget and under some parameterization, severely hurts the factor specific to the nugget. Under such a situation the mobile factor (Labour) stands to gain most.

Appendix

Let us assume that all markets adjust instantaneously except the market for factor bundle (m). We propose a quantity adjustment rule in the market for factor bundle m.

$$\dot{m} = \beta \left[\frac{p_m^d(m)}{p_m^s(m)} - 1 \right] \tag{A.1}$$

where $\dot{}$ represents time derivative, $\beta > 0$ is the speed of adjustment and $p^d(m)$ and $p_m^s(m)$ are the demand and supply prices of m.

Linearising (A.1) around the equilibrium, we get

$$\dot{m} = \frac{\beta}{m^*} \left[\frac{\widehat{p_m^d}}{\hat{m}} - \frac{\widehat{p_m^s}}{\hat{m}} \right] (m - m^*) \tag{A.2}$$

where m^* is the equilibrium value of m. Stability requires $(\widehat{p_m^d}/\hat{m} - \widehat{p_m^s}/\hat{m}) < 0$.

From equation (6.23) of the text

$$\frac{\widehat{p_m^d}}{\hat{m}} = (\alpha - 1) \tag{A.3}$$

Using equations (6.26) - (6.28) in equations (6.24), (6.25) and solving for $\hat{m}$ (at $dt = 0$) in terms of $\widehat{p_m}$, we obtain

$$\frac{\widehat{p_m^s}}{\hat{m}} = \frac{\lambda_{L3}\lambda_{Km} - \lambda_{Lm}\lambda_{K3}}{\left[\frac{\lambda_{L3}\delta_k}{|\theta|} + \frac{\lambda_{K3}}{|\theta|} \left(\frac{\lambda_{L1}\sigma_1\theta_{K3}}{\theta_{T1}} + \delta_L \right) \right]} \tag{A.4}$$

Using (A.3) and (A.4),

$$\left(\frac{\widehat{p_m^d}}{\hat{m}} - \frac{\widehat{p_m^s}}{\hat{m}} \right) = \frac{\left\{ \left[\frac{\lambda_{L3}\delta_k}{|\theta|} + \frac{\lambda_{K3}}{|\theta|} \left(\frac{\lambda_{L1}\sigma_1\theta_{K3}}{\theta_{T1}} + \delta_L \right) \right] (\alpha - 1) - [\lambda_{L3}\lambda_{Km} - \lambda_{Lm}\lambda_{K3}] \right\}}{\left[\frac{\lambda_{L3}\delta_k}{|\theta|} + \frac{\lambda_{K3}}{|\theta|} \left(\frac{\lambda_{L1}\sigma_1\theta_{K3}}{\theta_{T1}} + \delta_L \right) \right]}. \tag{A.5}$$

As the denominator on the R.H.S. of A.5 is positive $\left(\frac{\widehat{p_m^d}}{\hat{m}} - \frac{\widehat{p_m^s}}{\hat{m}} \right) < 0$ implies

$$\left\{\left[\frac{\lambda_{L3}\delta_k}{|\theta|}+\frac{\lambda_{K3}}{|\theta|}\left(\frac{\lambda_{L1}\,\sigma_1\theta_{K3}}{\theta_{T1}}+\delta_L\right)\right](\alpha-1)-[\lambda_{L3}\lambda_{Km}-\lambda_{Lm}\lambda_{K3}]\right\}<0$$

$$\Rightarrow\mid\lambda'\mid>0. \qquad (A.6)$$

Further note, as has been pointed out in the text $\mid \lambda' \mid > 0$ implies

$$\alpha<1+\frac{\lambda_{L3}\lambda_{Km}-\lambda_{Lm}\lambda_{K3}}{\left[\frac{\lambda_{L3}\delta_k}{|\theta|}+\frac{\lambda_{K3}}{|\theta|}\left(\frac{\lambda_{L1}\,\sigma_1\theta_{K3}}{\theta_{T1}}+\delta_L\right)\right]} \qquad (A.7)$$

Thus the stability condition in effect requires α to be bounded above, as has been pointed out in the text.

We can readily check that with the intensity condition in the nugget reversed (that is with X_3 being more capital intensive than m), $\mid \lambda' \mid < 0$. Note, with intensity condition reversed, $\mid \theta \mid < 0$. Thus the denominator in (A.5) is negative. This implies that stability (i.e., $\left(\frac{\widehat{p^d}}{\hat{m}}-\frac{\widehat{p^s}}{\hat{m}}\right)<0$) requires

$$\left\{\left[\frac{\lambda_{L3}\delta_k}{\mid\theta\mid}+\frac{\lambda_{K3}}{\mid\theta\mid}\left(\frac{\lambda_{L1}\,\sigma_1\theta_{K3}}{\theta_{T1}}+\delta_L\right)\right](\alpha-1)-[\lambda_{L3}\lambda_{Km}-\lambda_{Lm}\lambda_{K3}]\right\}>0$$

$$\Rightarrow\mid\lambda'\mid<0 \qquad (A.8)$$

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