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PROTECTION, INTERNATIONAL FACTOR MOBILITY AND MONOPOLISTIC COMPETITION*

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This paper utilises a model of a small open economy that produces two traded goods by means of primary factors and a large number of varieties of a non-traded intermediate good. Unlike the traded goods, the production of each variety of the non-traded good is subject to internal economies of scale and monopolistic competition prevails in the intermediate good sector. The presence of internal economies in the intermediate good sector gives rise to external economies in the production of the final good sector. Within the context of the present study, inter-industry and intra-industry trade takes place side by side. The model is used to examine the impact of tariffs and changes in factor endowments on allocation of resources and welfare. (JEL: F12, F20, F21)

1. Introduction

Product differentiation is an important firm specific advantage that can ensure higher economic rents. Firms attempt to differentiate products in many ways, but an important component is creation of positive brand image through the use of marketing promotions including advertising. Krugman (1979) and Lancaster (1979) independently developed models of trade in differentiated goods based on the Chamberlinian concept of monopolistic competition. Krugman used Dixit-Stiglitz specification of household preferences designed to reflect consumer's desire for variety in consumption. On the other hand, Lancaster introduced consumer heterogeneity, with individuals distinguished by their most preferred set of product characteristics. According to this approach, differentiated products exist to serve consumers with different tastes. In fact, in both cases, increasing returns to scale in production limit the extent of diversity that the market can provide. In these models trade takes place between similarly endowed economies, because it expands the size of the market and so enables a greater variety of goods to be produced. See Grossman (1992) for further details.

Ethier (1982) showed that intra-industry trade can arise not only because aggregate consumer demands exhibit a preference for diversity, but also because firms realise productivity gains from increasing specialisation of their production process. A number of recent studies, including a significant branch of the "new economic geography" literature, are based on Eth-

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ier's model. Most of these studies are concerned with the effects of integration on location of industries.[1]

Ethier's model has also been extended by, among others, Markusen (1989) and Francois (1990). These studies have considered the pattern of trade when the economy under consideration produces a large number of traded differentiated producer services. Producer services enter as inputs into the production of a final good. On the other hand, Faini (1984), Rivera-Batiz and Rivera-Batiz (1991) are concerned with the role of non-traded differentiated producer services. In addition, the "new economic geography" literature contains a number of studies where non-traded producer services have been modeled along the lines of Ethier (1982). These studies include Rodrik (1996) and Markusen and Venables (1999).

Faini (1984) has developed a two-sector, two-region North-South model in which the existence of increasing returns to scale in the production of non-traded intermediate inputs gives rise to a cumulative divergence of regional growth rates. The producers of the intermediate good are assumed to act as monopolistic competitors, a hypothesis consistent with the existence of increasing returns to scale. Rivera-Batiz and Rivera-Batiz (1991) have developed a general equilibrium model of an economy that produces one final good by means of labour, capital and a large number of differentiated producer services. Producer services are intermediate goods produced by means of labour and capital. The final good is produced under competitive conditions whereas the producer services are produced under conditions of Chamberlinian monopolistic competition. They have shown that foreign capital inflow increases the number of varieties of the producer services produced. On the other hand labour inflow has no effect on the number of varieties produced. Rodrik (1996) has used a model with two final-goods: low-tech and high-tech. The production of the high-tech good requires a large range of non-traded differentiated intermediate inputs that are produced under increasing returns to scale. The high-tech final good sector is viable only if a sufficiently large number of intermediate inputs are produced. At any given point of time, if none of the intermediate inputs is produced then there is no incentive for any firm to enter production on its own. This implies that the economy will completely specialise in the production of the low-tech final good. Rodrik argues that this problem arises due to coordination failure. He suggests that an investment subsidy or a minimum wage policy can help the economy to move to a superior equilibrium. Markusen and Venables (1999) have developed a model where local firms produce a large number of non-trade intermediate inputs. The production of the intermediate inputs is subject to economies of scale and monopolistic competition prevails in the industry. Direct foreign investment allows the foreign producers to utilise the non-traded intermediate inputs for production in the host country. Markusen and Venables have shown that foreign direct investment can lead to the establishment of local industries. They have also shown that in some cases the local industries can grow to the point where foreign investors are forced out. In other words in some cases multinationals provide the initial impetus for industrialisation but growing competition can force multinational out of business.

The present study attempts to analyse traditional trade issues in the context of models surveyed above. Some existing studies have considered the impact of a tariff and changes in factor endowments when monopolistic competition is present in the final good industry.[2] In the

[1] *These studies include Krugman and Venables (1995), Matsuyama (1991), Rodriguez-Clare (1996) and Venables (1996a, 1996b). See Puga and Ottaviano (1997) for an excellent review of the literature on the so-called "new economic geography".*

[2] *These studies which are concerned with the impact of tariffs when monopolistic competition and increasing returns are present in the final good sector include Venables (1985) and Gros (1987). Gros has shown that trade wars can lead to substantial welfare losses, even if it is assumed that each country retaliates only by imposing its own optimal tariff, taking the other country's tariff as given. See Wong (1995) for an excellent summary of the literature involving the effect of tariffs and changes in factor endowments in the presence of increasing returns and monopolistic competition in the final good sector.*

context of a small open economy, the present study is concerned with an impact of tariff and changes in factor endowments when monopolistic competition prevails in the non-traded intermediate good sector.[3]

The present study utilises model of a small open-economy that produces two traded goods (an importable Agricultural good and an exportable Industrial good) and a large number of varieties of a non-traded intermediate good.[4] The presence of internal economies of scale in the intermediate good industry gives rise to external economies in the Industrial good industry through a positive externally. Because there are constant returns to scale in the production of the Agricultural and the Industrial good (at least at the firm level), both are produced under conditions of perfect competition. On the other hand, due to internal economies of scale, monopolistic competition prevails in the intermediate good industry. The presence of internal economies in the non-traded sector leads to external economies of scale in the Industrial good sector. International trade propagates this production externality worldwide. The model utilised in the present study is quite similar to Rodrik (1996). Rodrik-type models combine elements of the traditional increasing returns to scale models and the more recent "new economic geography" models.[5]

Within the context of the present study, trade based on comparative advantage and trade based on scale economies takes place side by side. This paper attempts to extend the existing literature by considering the impact of (i) a tariff and (ii) restricted international factor mobility on factor prices and production when Chamberlain type monopolistic competition is present in the intermediate good sector. The presence of monopolistic competition also allows one to examine the impact of tariff and restricted factor mobility on product diversity. It is shown that, in a symmetric equilibrium, (1) the Rybczynski theorem may not hold unless the equilibrium is stable, (2) an increase in tariff can reduce product diversity thereby decreasing the positive externally to the final good industry, (3) an increase in labour (capital) supply increases (decreases) product diversity, and (4) an increase in the supply of either primary factor can increase welfare.

The rest of the paper is organised as follows. A simple model of a small open-economy is developed in section two. Equilibrium of a small open economy is discussed in section three. The model is used to examine the impact of a tariff on relative prices, production and product diversity in section four. The impact of restricted factor mobility is considered in the fifth section. The welfare implications are considered in section six and the last section contains concluding remarks.

2. *The production model*

Consider a small open economy that produces an Industrial good *(Y)* by means of labour and the output of industry *(X)*. The *X*-industry is characterised by Chamberlinian monopolistic competition. There are many firms in *X*-industry, each a little monopolist producing a distinct product with a technology that exhibits internal economies of scale. Each variety of the intermediate good is produced by means of labour and capital. The economy also produces an Agricultural good *(Z)* by means of labour and capital.[6] The economy exports *Y* in exchange for *Z* whereas the intermediate good is non-traded. In addition, in the initial equilibrium, the primary factors are internationally im-

[3] *In the context of a two-country world, where both countries are assumed to be large, Francois (1994) has considered the positive and normative implication of international scale economies for factor migration and commercial policy.*

[4] *Examples of non-traded intermediate goods include the so-called professional services (consulting, auditing, engineering, architectural, etc.) available to the producers. These examples are taken from Faini (1984) and Rivera-Batiz and Rivera-Batiz (1991). Faini (1984) has also indicated that (i) there is extensive evidence in support of the existence of increasing returns to scale in the provision of professional services and (ii) professional services are labour intensive, but the average level of skills has improved over time.*

[5] *See Wong (1995) for a survey of the literature involving trade in the presence of traditional increasing returns to scale models.*

[6] *The structure of the model is quite similar to Rodrik (1996).*

mobile. The production functions for *Y* and *Z* are as follows:

$$Y = L_y^{1-\alpha}\left(\sum_j x_j^{\delta}\right)^{\frac{\alpha}{\delta}}$$

$$Z = L_z^{1-\beta} K_z^{\beta}$$

Where $j = 1,2,....,n$; α, β and δ are parameters in the range [0,1]; x_j is the output of *j*-th variety produced by the *X*-industry; *n* is the number of varieties produced; L_y and L_z are labour used in the production of *Y* and *Z* respectively and K_z is capital used in the production of *Z*.

Each variety of the intermediate good is produced by means of both capital and labour. Capital is assumed to enter as a fixed input, with the given capital input requirement of each producer equal to θ. Labour is a variable input, with the labour demand given by $L_{xj} = \lambda x_j$, where λ denotes unit labour requirement. The total production cost of x_j is $r\theta + w(\lambda x_j)$, where *w* is the wage rate and *r* is the price of capital. Clearly, due to the presence of fixed cost, the production of each x_j is subject to economies of scale. Due to identical production functions and an equalisation of factor prices between sectors, all varieties produced are equally priced. Additionally, no two firms produce the same variety. Free entry and exit of firms derives the profit of firms down to zero. Thus, in the symmetric equilibrium, the aggregate production $X = nx$. Hence the production function for the final good can be written as

$$Y = L_y^{1-\alpha} X^{\alpha} n^{\frac{\alpha(1-\delta)}{\delta}}$$

From the point of view of each firm in *Y* industry, the number of varieties supplied is given. Accordingly, there are constant returns at the firm level but for the industry as a whole there are increasing returns because $\alpha(1-\delta)/\delta$ is positive.[7] In other words, the presence of internal economies of scale in *X*-industry leads to external economies of scale in *Y*-industry. There are a large number of firms in *Y*-industry each taking external effects, generated by the number of varieties available, on its production level as given. In other words, firms in *Y*-industry while ignoring external economies of scale, behave like firms in competitive markets, perceiving that their production functions exhibit constant returns to scale. The external economies of scale in *Y*-industry are therefore compatible with perfect competition. Within the intermediate good industry *(X)*, a large number of differentiated goods are produced, the price elasticity of demand for each differentiated good is $1/(1-\delta)$.[8] *Y* and *Z* are produced under conditions of perfect competition whereas differentiated goods are produced under conditions of monopolistic competition. The Industrial good *Y* is the numéraire.

3. *Equilibrium of a small open economy*

In the symmetric equilibrium, conditions pertaining to the production of the Industrial good, the differentiated goods and the Agricultural good are as follows, where *p* is the price of *x*, *q* is the world price of *Z* and *t* is the tariff rate on imported good.

If the Industrial good (*Y*) is produced in equilibrium then the following must hold:

$$(1)\quad 1 = \left\{\left[\frac{\alpha}{1-\alpha}\right]^{-\alpha} + \left[\frac{\alpha}{1-\alpha}\right]^{1-\alpha}\right\} w^{1-\alpha} p^{\alpha} n^{\frac{-\alpha(1-\delta)}{\delta}}$$

The right-hand side of equation (1) is the unit cost of production whereas the left-hand side is the unit price, which has been set equal to unity. The productivity of the Industrial sector is linked to the number of varieties of the intermediate input available. An increase in the

[7] *$\alpha(1-\delta)/\delta$ is assumed to be less than unity to avoid being in the land of Cockaigne. See Wong (1995, p. 203).*

[8] *This and similar assumptions are widely used in the literature on international trade in the presence of imperfect competition. See Dixit (1984), Horn (1984), Helpman and Krugman (1985), Ethier and Horn (1991), Wälde (1994) and Wong (1995) for example.*

number of varieties available decreases the unit cost of production in the Industrial sector.

The presence of economies of scale in the intermediate good sector implies that a single firm under monopolistic competition will produce each variety. If the intermediate good sector is active in equilibrium then the following first order condition must hold:

$$(2) \quad \delta p = \lambda w$$

Equation (2) is the usual profit maximisation condition which shows that marginal revenue *(δp)* is equal to marginal cost *(λw)*. Because of free entry and exit, the price of each variety of the intermediate good in the long-run equilibrium will just cover average cost as follows:

$$p = \left[r\theta + w(\lambda x)\right] \div x$$

By making use of equation (2), the above condition can be written as follows:

$$(3) \quad (1-\delta)px = r\theta$$

If the Agricultural good is produced in equilibrium then its unit cost will equal the exogenous world price (q) inclusive of tariff as follows:

$$(4) \quad q(1+t) = \left\{\left[\frac{\beta}{1-\beta}\right]^{-\beta} + \left[\frac{\beta}{1-\beta}\right]^{1-\beta}\right\} w^{1-\beta} r^{\beta}$$

Equation (4) is the zero profit condition for the Agricultural good industry where the right-hand side is the unit cost and the left-hand side is the unit price inclusive of tariff (t). Since the economy under consideration is small, it takes q as given which is determined in international market.

The market clearing condition for labour, which is assumed to be in fixed supply, is as follows:

$$(5) \quad \left[\frac{\beta}{1-\beta}\right]^{-\beta}\left[\frac{w}{r}\right]^{-\beta} Z + n(\lambda x) + \left[\frac{\alpha}{1-\alpha}\right]^{-\alpha}\left[\frac{w}{p}\right]^{-\alpha} n^{\frac{-\alpha(1-\delta)}{\delta}} Y = L$$

The left had side of equation (5) is the demand for labour where L is the supply of labour. The first, the second and the third term on the left-hand side are, respectively, the demand for labour in industry Z, X and Y.

The market clearing condition for capital, which is assumed to be in fixed supply, is as follows:

$$(6) \quad n\theta + \left[\frac{\beta}{1-\beta}\right]^{1-\beta}\left[\frac{w}{r}\right]^{1-\beta} Z = K$$

The left had side of equation (6) is the demand for capital where K is the supply of capital. The first and the second term on the left-hand side are, respectively, the demand for capital in industry X and Z. The market clearing condition for the intermediate good is as follows:

$$(7) \quad \left[\frac{\alpha}{1-\alpha}\right]^{1-\alpha}\left[\frac{w}{p}\right]^{1-\alpha} n^{\frac{-\alpha(1-\delta)}{\delta}} Y = nx$$

The left-hand side of the above equation is the demand for the intermediate good in X-industry. Equation (7) shows that the varieties of the intermediate good are not available for direct consumption.

Equations (1) to (7) are seven equations in seven endogenous variables: w, r, p, n, x, Z, and Y. On the other hand, t, q, K and L are the exogenous variables.[9] The pattern of specialisation determines how each endogenous variable is determined. There are three possibilities as indicated by Rodrik (1996). In a diversified equilibrium where both Y and Z are produced, equations (1) to (7) above jointly determine the values of the seven endogenous variables. If the

[9] *In the present case, (i) the world price of* Z *is not influenced by the economy under consideration and (ii) the Walras' law holds therefore the relevant demand conditions for Y and* Z *can be ignored.*

economy specialises in the production of the Agricultural good, equations (4), (5) and (6) will determine *Z*, *w* and *r* (with $x = n = Y = 0$). On the other hand, if the economy specialises in the production of the Industrial good, equations (1) to (3) and (5) to (7) will determine *n*, *Y*, *x*, *w*, *r* and *p* (with $Z = 0$). The focus of the present study is on a diversified equilibrium.[10]

For a given *n*, equations (1) and (2) determine *w* and *p*. It is clear that changes in tariff rate, capital supply or labour supply has no direct influence on either *w* or *p*. Once *w* has been determined, equation (4) can be used to determine *r* as a function of *n* and *t*. It is clear that changes in the supply of capital or labour have no direct influence on *r*. On the other hand, changes in the tariff rate have a direct and an indirect impact on *r*. Therefore, it may not be possible to unambiguously determine the impact of a change in the tariff rate on *r*. For given, *w*, *p* and *r*, the equilibrium value of *x* can be determined by equation (3). Whereas equations (5) to (7) determine *Z*, *Y* and *n*.

It is well known that when increasing returns are present then the production possibilities curve cannot be strictly concave to the origin, which can result in stability problem. The results presented in this paper are based on the assumption that equilibrium is stable. The stability of the equilibrium ensures that production takes place in the concave region of the production possibilities set both before and after a change in the tariff rate or factor supplies.[11]

4. *Protection, product diversity, relative prices and production*

The impact of an increase in tariff on various economic variables can be determined by partially differentiating equations (1) to (7) with respect to *t*.[12] The impact of an increase in tariff on the production of the imported good *(Z)* and the exported good *(Y)* is as follows:

$$(8)\quad \left(\frac{\partial Y}{\partial t}\right)\left(\frac{t}{Y}\right) = \left[\frac{\alpha(1-\delta)}{\delta}\right](K_z L + K L_z) \div \Delta < 0$$

$$(9)\quad \left(\frac{\partial Z}{\partial t}\right)\left(\frac{t}{Z}\right) = -\left[(nL_x + L_y)\{nK_x + (1-\beta)K_z\} + \beta L_z(nK_x)\right] \div \Delta > 0$$

Where $\Delta = \left[\frac{\alpha(1-\delta)}{\delta}\right] K_z L + \left[\beta L_z (nL_x + L_y)\right]\left[\left(\frac{nK_x}{nL_x + L_y}\right) - \left(\frac{K_z}{L_z}\right)\right]$

The sign of equations (8) and (9) depends on the sign of Δ. The stability condition derived in the appendix requires that Δ to be negative.[13] Clearly, Δ can be negative only if $\{[nK_x/(L_y + nL_x)] - [K_z/L_z]\}$ is negative which is not possible unless the Agricultural good *Z* is capital intensive as compared to the combined factor intensity of the rest of the economy. The rest of the paper is based on the assumption that $\{[nK_x/(L_y + nL_x)] - [K_z/L_z]\}$ is negative.

Equations (8) and (9) show that, as long as the equilibrium is stable, an increase in tariff increases the production of *Z* at the expense of *Y*. This result is not unexpected, however the presence of internal economies in *X*-industry (i.e., $1 > \delta > 0$) strengthens the negative effect on the production of *Y*. In the context of the present study, if the economies of were not present then there is no relationship between the tariff and the production of *Y*. The impact of tar-

[10] Rodrik (1996) has shown that diversification is more likely when the factor intensities of Y and Z sectors are very dissimilar.

[11] See Panagariya (1986) for a discussion of stability problem.

[12] In order to simplify the algebra, the results presented in this paper are based on the assumption that in the initial equilibrium the tariff rate is zero (i.e., t = 0*).*

[13] The stability condition is based on Mayer-Chang adjustment rules. For further details, please see Wong (1995) and references therein.

iff on the number of varieties produced is as follows:

$$(10)\quad \left(\frac{\partial n}{\partial t}\right)\left(\frac{t}{n}\right) = (K_z L) \div \Delta < 0$$

Equation (10) shows that an increase in tariff decreases the number of varieties produced, which implies a decrease in the degree of specialisation and hence the size of the production externality in the Industrial sector. This result follows from the fact that an increase in tariff decreases the production of the exportable good. Since the non-traded differentiated goods are used in the production of the exportable good, an increase in tariff decreases the number of varieties produced. The impact of the tariff on the production of each variety of the intermediate good is as follows:

$$(11)\quad \left(\frac{\partial x}{\partial t}\right)\left(\frac{t}{x}\right) = L_z(nL_x + L_y)\left[\left(\frac{nK_x}{nL_x + L_y}\right) - \left(\frac{K_z}{L_z}\right)\right] \div \Delta > 0$$

Equation (11) shows that there is a positive relationship between the tariff rate and the production of each variety of the non-traded intermediate good. This result can be explained as follows. A decrease in the production of *Y*, due to higher tariff, creates excess supply of labour. Excess supply of labour reduces variable cost in *X*-industry, which results in higher equilibrium output. In addition there is a decrease in the number of varieties produced, which allows the remaining firms in the intermediate good industry to expand.

An increase in the production of each variety reduces the equilibrium price as indicated by equation (12) below:

$$(12)\quad \left(\frac{\partial p}{\partial t}\right)\left(\frac{t}{p}\right) = \left[\frac{\alpha(1-\delta)}{\delta}\right] K_z L \div \Delta < 0$$

Equation (12) shows that a decrease in the number of varieties produced leads to a decrease in the price of the non-traded intermediate good. The presence of internal economies in the intermediate good industry plays a crucial role in the present case. If there were no internal economies of scale then δ is equal to unity and hence there is no relationship between tariff rate and the price of the intermediate good. Equation (12) also shows that due to its negative impact on *n*, an increase in tariff decreases the price of the intermediate good and hence the equilibrium wage rate.[14]

$$(13)\quad \left(\frac{\partial r}{\partial t}\right)\left(\frac{t}{r}\right) = \left\{\left[\frac{\alpha(1-\delta)}{\delta}\right] K_z L + L_z(nL_x + L_y)\left[\left(\frac{nK_x}{nL_x + L_y}\right) - \left(\frac{K_z}{L_z}\right)\right]\right\} \div \Delta$$

At first glance it appears that the sign of equation (13) cannot be determined because an increase in the tariff rate decreases the equilibrium *p* but its impact on the equilibrium output of each variety is unambiguously positive. In fact the sign of equation (13) depends on the size of the externality to *Y*-industry [i.e., $\alpha(1-\delta)/\delta$]. Because $\alpha(1-\delta)/\delta$ is assumed to be small, the relationship between equilibrium rate of return on capital and the tariff rate is likely to be positive. On the other hand in the absence of economies of scale $(\partial r/\partial t)(t/r)$ is equal to $1/\beta$.

It can be easily shown that if Z is capital intensive then the following inequality is likely to hold:

$$(14)\quad \left(\frac{\partial w}{\partial t}\right)\left(\frac{t}{w}\right) < 0 < \left(\frac{\partial r}{\partial t}\right)\left(\frac{t}{r}\right)$$

Equation (14) shows that, within the context of the present study, the Stolper-Samuelson the-

[14] *Because labour is the only variable factor used in the production of each variety, there is a positive relationship between w and p as indicated by equation (3).*

orem is likely to hold. In other words, an increase in tariff increases the real reward of the factor used intensively in the production of the imported good.

5. *Restricted factor mobility, product diversity, relative prices and production*

The impact of limited international factor mobility on the output of *Z* and *Y* can be examined by means of the following equations:

$$(15)\quad \left(\frac{\partial Z}{\partial L}\right)\left(\frac{L}{Z}\right)=\left\{\left[\frac{\alpha(1-\beta)(1-\delta)}{\delta}\right]K_z + \beta(nK_x)\right\}L \div \Delta < 0$$

$$(16)\quad \left(\frac{\partial Y}{\partial L}\right)\left(\frac{L}{Y}\right) = \left\{\left[\frac{\alpha(1-\beta)(1-\delta)}{\delta}\right]-\beta\right\}K_z L \div \Delta$$

An increase in labour supply decreases the output of *Z*, which is capital intensive. This result is strengthened by the presence of economies of scale in *X*-industry. On the other hand, the relationship between the production of *Y* and labour supply cannot be unambiguously determined. However, since $\alpha[(1-\delta)/\delta]$ is assumed to be small and $(\partial Z/\partial L)(L/Z)$ is negative, $(\partial Y/\partial L)(L/Y)$ is likely to be positive which implies that the Rybczynski theorem may hold when the intermediate good industry operates under monopolistic competition.

The impact of a small capital inflow on the production of *Z* and *Y* can be considered by means of equations (17) and (18) as follows:

$$(17)\quad \left(\frac{\partial Z}{\partial K}\right)\left(\frac{K}{Z}\right)=\left\{(\beta L_z + nL_x + L_y)\left[\frac{\alpha(1-\delta)}{\delta}\right]-\beta(nL_x+L_y)\right\}K \div \Delta$$

$$(18)\quad \left(\frac{\partial Y}{\partial K}\right)\left(\frac{K}{Y}\right) = \left\{\beta-\alpha(1-\beta)\left[\frac{(1-\delta)}{\delta}\right]\right\}KL_z \div \Delta$$

Because $[\alpha(1-\delta)/\delta]$ is assumed to be small, an increase in the supply of capital is likely to increase the production of *Z* which is capital intensive. On the other hand the relationship between the production of *Y* and supply of capital is likely to be negative although capital does not directly enter as input in its production. Once again it can be argued that the Rybczynski theorem is likely to hold in the presence of monopolistic competition.[15]

The relationship between restricted factor mobility and the number of varieties produced can be examined by means of the following equations:

$$(19)\quad \left(\frac{\partial n}{\partial L}\right)\left(\frac{L}{n}\right) = -(\beta K_z L) \div \Delta > 0$$

$$(20)\quad \left(\frac{\partial n}{\partial K}\right)\left(\frac{K}{n}\right) = (\beta K L_z) \div \Delta < 0$$

An increase in the supply of labour increases the production *Y* that leads to an increase in demand for the intermediate good. An increase in demand for the intermediate good increases profitability in the intermediate good industry thereby encouraging entry into the industry. Hence there is an increase in the number varieties produced. On the other hand, an increase in the supply of capital has the opposite effect on profitability in the intermediate good industry and hence the number of varieties produced decreases. These results stand in sharp contrast with Rivera-Batiz and Rivera-Batiz (1991). In the context of an economy that produces only one traded good, Rivera-Batiz and Rivera-Batiz have shown that (1) there is no relationship between labour supply and the number of vari-

[15] *It can easily be shown that in the absence of economies of scale (i.e., δ = 1), the Rybczynski theorem holds.*

eties produced and (2) there is a positive relationship between the supply of capital and the number of varieties produced.[16]

The impact of a small inflow of labour and capital on the production of the intermediate good is as follows:

$$(21)\quad \left(\frac{\partial x}{\partial L}\right)\left(\frac{L}{x}\right) = K_z L\left[\frac{\alpha(1-\delta)}{\delta}\right] \div \Delta < 0$$

$$(22)\quad \left(\frac{\partial x}{\partial K}\right)\left(\frac{K}{x}\right) = -KL_z\left[\frac{\alpha(1-\delta)}{\delta}\right] \div \Delta > 0$$

For a given price of the intermediate good, an increase in the number of varieties produced, due to labour inflow, results in a decrease in the production of each variety as indicated by (21). On the other hand, for a given price of the intermediate good, a decrease in the number of varieties produced, due to a small inflow of capital, leads to increase in the output of each variety produced.

The impact of factor mobility on the price of the intermediate good can be discussed by means of equations (23) and (24) as follows:

$$(23)\quad \left(\frac{\partial p}{\partial L}\right)\left(\frac{L}{p}\right) = \left[\frac{\alpha(1-\delta)}{\delta}\right]\left(\frac{\partial n}{\partial L}\right)\left(\frac{L}{n}\right) > 0$$

$$(24)\quad \left(\frac{\partial p}{\partial K}\right)\left(\frac{K}{p}\right) = \left[\frac{\alpha(1-\delta)}{\delta}\right]\left(\frac{\partial n}{\partial K}\right)\left(\frac{K}{n}\right) < 0$$

An increase in labour supply decreases the production of each variety and hence the equilibrium price of each variety produced increases. On the other hand, a small inflow of capital increases the production of each variety and hence the equilibrium price decreases as indicated by equation (24).

The relationship between the factor endowments and the price of capital is as follows:

$$(25)\quad \left(\frac{\partial r}{\partial L}\right)\left(\frac{L}{r}\right) = -\left[\frac{(1-\beta)}{\beta}\right]\left(\frac{\partial p}{\partial L}\right)\left(\frac{L}{p}\right) < 0$$

$$(26)\quad \left(\frac{\partial r}{\partial K}\right)\left(\frac{K}{r}\right) = -\left[\frac{(1-\beta)}{\beta}\right]\left(\frac{\partial p}{\partial K}\right)\left(\frac{K}{p}\right) > 0$$

Since labour and capital are substitute, there is a negative relationship between the supply of labour and the rate of return on capital as indicated by equation (25). Equation (26) shows that, as long as the equilibrium is stable, the response of the price of capital of an increase in the supply of capital is not normal. The same applies to the response of the wage rate to an increase in labour supply. It can easily be checked that the equilibrium wage rate and labour supply are positively related. These unexpected results can be attributed to the presence of economies of scale in the intermediate good industry.

The presence of monopolistic competition in the present study plays a crucial role. It should be noted that if all goods are produced under perfect competition then there is no relationship between (i) t and p, (ii) x and L, (iii) x and K, (iv) r and L, (v) K and r, (vi) L and p and (vii) K and p.[17]

6. *Welfare analysis*

In the context of the present study all income is only factor income. Additionally, the economy under consideration is small. Hence the welfare can be measured by factor income *(I)* alone as follows:[18]

$$I = wL + rK$$

[16] *It should be noted that unlike Rivera-Batiz and Rivera-Batiz (1991), the analysis conducted in the present study is based on the assumption of dynamic stability.*

[17] *In the present case if δ is equal to unity then there is no fixed cost which eliminates increasing returns from the model and hence x will also be produced under conditions of perfect competition.*

[18] *It should be noted that because of the existence of tariffs and increasing returns to scale that can lead to immiserising growth phenomenon, the welfare analysis cannot be conducted in terms of factor income alone. The present study assumes that the tariff rate in the initial equilibrium is zero and the increasing returns are not strong.*

The impact of factor mobility on welfare can be examined by means of the following equations:

$$(27)\quad \left(\frac{\partial I}{\partial L}\right) = w + K\left(\frac{\partial r}{\partial L}\right) + L\left(\frac{\partial w}{\partial L}\right)$$

$$= w\left[1 + \left(\frac{\partial w}{\partial L}\right)\left(\frac{L}{w}\right) + \left(\frac{rK}{wL}\right)\left(\frac{\partial r}{\partial L}\right)\left(\frac{L}{r}\right)\right]$$

$$= w\left[1 + \left\{1 - \left(\frac{rK}{wL}\right)\left(\frac{1-\beta}{\beta}\right)\right\}\left(\frac{\partial w}{\partial L}\right)\left(\frac{L}{w}\right)\right]$$

$$= w\left\{1 + (1-\beta)\left[\frac{\alpha(1-\delta)}{\delta}\right]\left[\left(\frac{K_z}{L_z}\right) - \left(\frac{K}{L}\right)\right](LL_z)\right\} \div \Delta$$

Where $\beta = [rK_z/(rK_z + wL_z)]$ and $1-\beta = [wL_z/(rK_z + wL_z)]$ are respectively the shares of capital and labour income in *Z*- industry.

The sign of equation (27) depends on the sign of $[(K_z/L_z) - (K/L)]$. By using the labour market clearing condition $(L = nL_x + L_y + L_z)$, the capital market clearing condition $(K = nK_x + K_z)$ can be re-written as $(K/L) = [(nL_x + L_y)/L][(nK_x)/(nL_x + L_y)] + (L_z/L)(K_z/L_z)$. This implies that $[(nK_x)/(nL_x + L_y)] < [K/L] < [K_z/L_z]$ as long as the equilibrium is stable. Clearly, as long as the equilibrium is stable, the relationship between welfare and labour supply is unambiguously positive. In other words, an equation (27) shows that, in the presence of economies of scale, an increase in labour supply (due to labour inflow) increases welfare.

The impact of an increase in the supply of capital can be considered by means of the following equation:

$$(28)\quad \left(\frac{\partial I}{\partial K}\right) = r + K\left(\frac{\partial r}{\partial K}\right) + L\left(\frac{\partial w}{\partial K}\right)$$

$$= r\left[1 + \left(\frac{\partial r}{\partial K}\right)\left(\frac{K}{r}\right) + \left(\frac{wL}{rK}\right)\left(\frac{\partial w}{\partial K}\right)\left(\frac{K}{w}\right)\right]$$

$$= r\left[1 + \left\{\left(\frac{wL}{rK}\right) - \left(\frac{1-\beta}{\beta}\right)\right\}\left(\frac{\partial w}{\partial K}\right)\left(\frac{K}{w}\right)\right]$$

$$= r\left\{1 + (1-\beta)\left[\frac{\alpha(1-\delta)}{\delta}\right]\left[\left(\frac{K_z}{L_z}\right) - \left(\frac{K}{L}\right)\right](LL_z)\right\} \div \Delta$$

Equation (28) shows that, as long as the equilibrium is stable, an increase in the supply of capital (due to capital inflow) unambiguously increases welfare. Equation (28) shows that, in the presence of economies of scale in the intermediate good industry, an increase in capital supply leads to a larger increase in welfare.

The welfare implications of the present study are identical to those derived by Rivera-Batiz and Rivera-Batiz (1991). Rivera-Batiz and Rivera-Batiz, in the context of a one-final good model, have shown that an increase in the supply of either capital or labour increases welfare. However, in the present case where there are two traded goods and equilibrium is assumed to be stable. The welfare implications of the present study stand in sharp contrast with Helpman and Razin (1984). In the context of a small open economy that produces one traded good (under competitive conditions) and one non-traded good (under monopolistic competition), Helpman and Razin (1984) have considered the impact of foreign investment on welfare. Helpman and Razin have modeled monopolistic competition along the lines suggested by Lancaster (1980). They have argued that in economies with sectors which produce differentiated final goods under increasing returns to scale, foreign investment can flow in the wrong direction thereby harming the recipient as well as the investing country.

7. Concluding remarks

This paper utilises model of a small open economy where two traded goods are produced by means of primary factors and a non-traded intermediate good. The intermediate good is

produced by a monopolistically competitive sector, which gives rise to external economies in the production of the final good sector. Within the context of the present model trade based on comparative advantage and trade based on scale economies takes place side by side. The model is used to examine the impact of tariffs and changes in factor endowments on prices, production product diversity and welfare. The results presented in this paper cannot be compared with those derived when monopolistic competition prevails in the final good industry, because a unique model of monopolistic competition does not exist. A meaningful comparison is possible only if a generalised two-good, two-factor model is utilised where monopolistic competition is present in both the final good and the intermediate good industries. However such a model is likely to be very complex. In addition, it is unlikely that such a model will produce clear-cut comparative static results.

It is shown that both Rybczynski and Stolper-Samuelson theorems are likely to hold if the equilibrium is stable. An increase in tariff decreases the product diversity thereby reducing the positive externality to the Industrial good sector. An increase in the supply of labour increases product diversity and welfare. Although, an increase in the supply of capital decreases product diversity but its impact on welfare is unambiguously positive.

The welfare implications of the present study stand in sharp contrast with Helpman and Razin (1984). In the context of a small open economy that produces one traded good (under competitive conditions) and one non-traded good (under monopolistic competition), Helpman and Razin have argued that in economies with sectors which produce differentiated final goods under increasing returns to scale, foreign investment can flow in the wrong direction thereby harming the recipient as well as the investing country. The present study is based on a model where economies of scale do not occur in the traded industrial sector but in the production of a non-traded intermediate good. It is shown that this apparently innocuous modification has far-reaching consequences for the welfare implications of an increase in capital supply.

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Appendix: Stability of equilibrium

As indicated earlier, in the context of the present study, the presence of internal economies of scale in *X*-industry gives rise to external economies of scale in *Y*-industry, which can lead to potential stability problem. In the following, equations (1) to (7) are used to derive the Routh-Hurwitz stability conditions. The postulated dynamic adjustment process is described by means of the following equations, where the left hand side is the time derivative of the relevant variable:

The Mayer-Chang adjustment rules:

$$dY/dt = \phi_y[1 - \{[\alpha/(1-\alpha)]^{-\alpha} + [\alpha/(1-\alpha)]^{1-\alpha}\} w^{1-\alpha} p^{\alpha} n^{-\alpha(1-\delta)/\delta}]$$

$$dn/dt = \phi_n[(1-\delta)px - r\theta]$$

$$dx/dt = \phi_x[p - (\lambda/\delta)w]$$

$$dZ/dt = \phi_z[q(1+t) - \{[\beta/(1-\beta)]^{-\beta} + [\beta/(1-\beta)]^{1-\beta}\}w^{1-\beta}r^{\beta}]$$

$$dw/dt = \phi_w[\{\beta/(1-\beta)\}^{-\beta}(w/r)^{-\beta} Z + n(\lambda x) + \{\alpha/(1-\alpha)\}^{-\alpha}(w/p)^{-\alpha} n^{-\alpha(1-\delta)/\delta} Y - L]$$

$$dr/dt = \phi_r[n\theta + \{\beta/(1-\beta)\}^{1-\beta}(w/r)^{1-\beta} Z - K]$$

$$dp/dt = \phi_p[\{\alpha/(1-\alpha)\}^{1-\alpha}(w/p)^{1-\alpha} n^{-\alpha(1-\delta)/\delta} Y - nx]$$

Where the relevant speeds of adjustment *(ϕ_y, ϕ_n, ϕ_x, ϕ_z, ϕ_w, ϕ_r,* and *ϕ_p)* are assumed to be positive constants.

The economic meaning of the above equations are obvious, therefore the interpretation is not included. The relevant Jacobian matrix, denoted by *J* is the following:

Where $J =$

$$\begin{bmatrix} 0 & \frac{\alpha(1-\delta)}{\delta} & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 & 0 & -1 & 1 \\ 0 & 0 & 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & -\beta & 0 & 0 & 0 & -1 \\ 0 & nL_x + L_y & nL_x + L_y + \beta L_z & L_z & 0 & 0 & 0 \\ 0 & nK_x & -(1-\beta)K_z & K_z & 0 & 0 & 0 \\ 1 & \frac{-[1+\alpha(1-\delta)]}{\delta} & -1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

One of the Routh-Hurwitz stability conditions requires $(-1)^7 |J|$ to be positive, where "$|J|$" stands for the determinant of Jacobian matrix J. Clearly, the stability condition is satisfied if "$|J|$" is negative. In the present case, the determinant of the Jacobian matrix is, except for a positive scalar, identical to Δ.