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Trade Liberalisation and Growth: Market Access Advantage

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Abstract

This paper analyses the effect of integration on growth when countries have different preferences. It describes a two-country two-sector model, with the first sector producing the homogeneous good and the second sector producing a differentiated good, which is divided in a first-class goods group and a second-class group. The only innovative sector is the one producing first-class goods. In autarchy, both countries produce first and second-class goods. Opening up to trade, with non-zero transport costs, induces countries' specialisation according to their home-market comparative advantage. In these circumstances, transportation costs affect the growth rate.

There are three main findings. First, integration has a positive effect on growth, but there is a discontinuity at free trade. Second, integration with a country with a smaller market for the innovative good may increase growth more than integration with a country with symmetric preferences. Finally, the effect of integration on growth is higher the larger the size of the home market advantage and the smaller is the extent of spillovers between countries.

Keywords: home market comparative advantage; integration; intra-industry trade; endogenous growth.

JEL classification: F12; F15; F43; O41.

1 Introduction

The literature on trade and growth emphasised four different mechanisms through which economic integration might affect growth: scale, knowledge spillovers, compe-

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tition and specialisation effects.[1] On the basis of these effects, economic literature generally predicts that integration between *similar* countries is growth-enhancing; while integration between *different* countries may be detrimental for growth. This is because in the former case the scale, knowledge spillovers and competition effects of integration dominate, and these effects are likely to have a positive impact on growth. First, integration enlarges the size of the market in which each firm operates. This scale effect increases the expected reward for investment in R&D. As a result, firms invest more in innovation, and the growth rate increases. Second, international trade facilitates knowledge spillovers. Higher knowledge spillovers increase productivity in the research sector and this increases growth (Grossman and Helpman, 1991). Third, competition encourages investment toward new products rather than imitation, it eliminates R&D redundancy, thus increasing growth (Rivera-Batiz and Romer, 1991a).

In contrast, when integration occurs between different countries, specialisation according to a country's comparative advantage may reduce growth. In fact, if specialisation shifts resources from research into production, technological innovation may slow down.

So far, economic literature on trade and growth has analysed the effects of integration when countries are symmetric and when they have different factor endowments.[2] Moreover, it has generally studied the effects of integration on growth by comparing autarchy with the free trade equilibrium.[3]

This paper discusses how integration affects a country's growth rate when countries have *different preferences*. In particular, it analyses the effect of a progressive

[1] For a review see Grossman and Helpman, 1991; Grossman and Rogoff, 1995; Obsfeld and Rogoff, 1996; and Aghion and Howitt, 1998.

[2] In order to focus on the specialisation effect of integration, Grossman and Helpman (1991) assume a Heckscher-Ohlin model of trade where spillovers are national in scope.

[3] The only exception is the paper by Rivera-Batiz and Romer (1991b), where integration is modelled as the progressive reduction of the tariff rate.

reduction in transport costs on growth in an intra-industry trade model, where the pattern of trade is pinned down by the market access advantage. The contribution of this paper to the development of economic theory of trade and growth is twofold. First, this paper introduces in the literature on trade liberalisation and growth a new channel through which integration might affect the growth rate: the home market effect. Second, it provides an example of how misleading the simple comparison of free trade and autarchy can be in the analysis of the effect of trade.

The home market effect has been analysed by the literature on intra-industry trade. In his pioneer paper, Krugman (1980) shows that when countries differ in size and trade is costly, trade patterns are pinned down by the home market advantage. In fact, when there are trade costs, production of the differentiated good concentrates in the country, where the demand is larger. This is because firms will try to avoid transport costs on the larger part of their sales. Therefore, this country will become a net exporter of the differentiated good.[4]

Using a partial equilibrium model of intra-industry trade, Krugman and Venables (1990) analyse what are the static effects of trade liberalisation. They show that, as trade barriers fall, the pattern of localisation of production between the two trading countries is non-linear. In autarchy each country produces a volume of each class of goods proportional to its expenditure; as transport costs fall production concentrates in the country with the home market advantage. As the two countries approach a free trade regime, the home market advantage disappears and production randomises between the two countries. So, under free trade, each country produces each class of goods in proportion to its expenditure.

This paper argues that there are also dynamic implications of the home market ad-

[4]Note that in a more recent paper, Weder (1995) has refined Krugman' s result. Weder shows that, when there are two types of differentiated good, the pattern of trade is no longer determined by the home market advantage but by the *comparative* home market advantage; i.e. each country will export the type of differentiated good for which it has the *relatively* larger domestic demand.

vantage effect. The rationale is as follows. Growth theory has shown that, when there are spillovers between countries, there is a steady state at which different countries grow at a common growth rate. When, knowledge spillovers tend to zero, this growth rate is determined by the country with the larger labour force (Feenstra, 1996). We argue that in a world characterised by a multiplicity of sectors, some of which are non-progressive (i.e. there is no learning-by-doing implied by the production of these goods), the common growth rate at which countries grow will be determined by the labour force employed in the progressive sector (i.e. knowledge is a by-product of manufacturing in this sector) in the country where this sector is larger. Therefore, it is rational to expect that the non-linear pattern of the effect of lower transport costs on localisation of production reflects onto the growth rate.

In order to focus on the home market effect of integration, this paper assumes that countries only differ in their preferences over the differentiated good. It describes a two-country two-sector model, with one sector producing a homogeneous good and the other one producing a differentiated good. There are two types of differentiated good; a first-class goods group and a second-class group. First-class goods are the only innovative goods. An economy's growth rate is determined by the size of this progressive sector. In autarchy, the size of the progressive sector is determined by the size of the home market for it. If trade is possible, with non-zero transport costs, production of first-class goods will concentrate in the country with the larger demand for it. The size of the progressive sector in this country will be more than proportional to the size of the home market. This will trigger higher growth.

There are three main findings. First, this paper shows that integration is growth-enhancing also when countries have different preferences. Yet, in these circumstances, there is a discontinuity at free trade. When transport costs fall to zero, the growth rate falls too. Free trade removes firms' advantage to locate in the country with the larger domestic market. Firms randomise between countries, so the positive effect of specialisation on growth disappears.

This result is new in the literature on trade and growth. Rivera-Batiz and Romer (1991b) also find a non-linear effect of integration on growth. In their model, however, integration has a U-shaped effect on growth. This is the result of the action of two opposing forces. On the one hand, higher tariffs reduce returns to human capital in the research sector, thus decreasing firms' incentive to innovate. On the other hand, they also reduce the marginal productivity of human capital in the manufacturing sector,[5] thus pushing labour from the manufacturing to the research sector. The net effect of higher tariffs on the growth rate depends on which of these two forces dominates. If the fall in marginal productivity of human capital in the manufacturing sector offsets the fall in the return to innovation, trade restrictions increase the growth rate.

Second, this paper shows that trade between countries with different preferences might be more beneficial in terms of growth than trade between similar countries. This is because asymmetric preferences induce specialisation and this in turn trigger growth.

Finally, this paper shows that the extent to which integration will affect a country's growth rate will depend *ceteris paribus* on the size of the home market advantage and the extent of spillovers across countries. In particular, the more preferences differ across countries and the lower is the degree of spillovers across countries (as long as it is positive) the larger is the positive impact of a reduction in transportation costs on growth.

[5] This latter effect is due to the fact that trade restrictions reduce the quantity of imported intermediate inputs used in manufacturing.

2 The Model

Consider a two-country two-sector model with only one scarce factor of production: labour. One sector (agriculture) produces a homogeneous good (good Y), the other sector (manufacturing) a differentiated good (good C). The good Y is freely traded;[6] while trade of the differentiated good is subject to an *iceberg* type transport cost. Trade liberalisation occurs via the progressive reduction of such cost.

Moreover, there are two types of differentiated goods: first-class and second-class goods. First-class goods are the innovative goods, whose design is the outcome of research activity. Second-class goods are imitation goods. First-class goods are denoted with a hat, second-class goods with a double hat. So, $\widehat{c}_1, \widehat{c}_2, ...\widehat{c}_n$ denote consumption levels in the domestic country of varieties from 1 to n of first-class goods produced at home, while $\widehat{\widehat{c}}_1, \widehat{\widehat{c}}_2, ...\widehat{\widehat{c}}_n$ denote consumption levels of different varieties of second-class goods. A star will denote domestic consumption of goods produced abroad.

We assume Bertrand competition in the product market. On the capital market, firms are 100% financed by households. Firms invest in R&D and use the returns of their investments to pay dividends to consumers.

2.1 Households

On the demand side we formalise consumers consumption decisions as a four stage budgeting problem. In the first stage, consumers decide their aggregate consumption path; then, they allocate consumption between the differentiated and the homogeneous good; third, they decide consumption of each of the two classes of goods; finally, they allocate consumption between the different varieties of each class. In order to avoid aggregation problems, we also assume homogeneous agents.

[6] This is the usual simplifying assumption in the literature of trade with differentiated production. For a criticism of this assumption refer to Davis (1997).

In the first stage, consumers maximise an intertemporal utility function of the form:[7]

$$U(\widetilde{C}(.)) = \int_0^\infty e^{-\rho t} \log(\widetilde{C}(t))dt \tag{1.1}$$

subject to the instantaneous budget constraint that investment in new assets is equal to labour and dividend income minus expenditure:[8]

$$\dot{D}\,(t) = w(t)L + rD(t) - \widetilde{P}(t)\widetilde{C}(t) \tag{1.2}$$

where $\widetilde{P}(t)\widetilde{C}(t)$ is total expenditure, D denotes consumers' assets, w is the wage rate, r is the interest rate (that we assume to be constant over time), $\rho > 0$ is the constant pure rate of time preference (the individual discount factor). $\widetilde{C}(t)$ is the instantaneous utility function, describing individuals preferences over the differentiated and the homogeneous goods.

The solution for this maximisation problem is the well known Ramsey formula. The optimal time path of consumption is:

$$\frac{\dot{\widetilde{C}}}{\widetilde{C}} + \frac{\dot{P}}{\widetilde{P}} = r - \rho \tag{1.3}$$

This condition implies that the instantaneous growth rate of nominal expenditure equals the difference between the interest rate and the subjective discount rate. There is no monetary instrument in the economy. Therefore, any nominal variable can be chosen as *numeraire*. Following Grossman and Helpman (1991a) and Feenstra

[7] For simplicity, we specify a logarithmic utility function. A more general function is $U(\widetilde{C}(.)) = \int_0^\infty e^{-\rho t} \frac{(\widetilde{C}(t))^{1-\beta}}{1-\beta} dt$, which allows for different values of the intertemporal elasticity of substitution $1/\beta$. Specifically, if $\beta = 0$ consumers are risk neutral, if $\beta > 0$ consumers are risk adverse. The logarithmic utility function is a special case of this set of utility functions with $\beta = 1$.

[8] This is equivalent to the intertemporal budget constraint that the present discounted value of expenditure must be equal to the present discounted value of labour and dividend income plus initial wealth.

(1996), we normalise prices at any point in time so that nominal expenditure remains constant.

In the second stage, at each instant in time t, consumers, taking as given this time path of expenditure, allocate their total expenditure, $\widetilde{P}(t)\widetilde{C}(t)$, between the differentiated and the homogeneous good. The optimal consumption bundle is obtained by maximising the instantaneous utility function:

$$\widetilde{C} = C(.)^{\alpha} Y^{1-\alpha} \tag{1.4}$$

subject to:

$$\widetilde{P}\widetilde{C} = CP + YP_Y \tag{1.5}$$

where C is the utility derived from the consumption of the differentiated good and Y is the demand for the homogeneous good.

The maximisation of the instantaneous utility function, $\widetilde{C}$, yields the following expressions for the shares of total spending allocated to the two goods:

$$PC = \alpha \widetilde{P}\widetilde{C} \tag{1.6}$$

$$P_Y Y = (1-\alpha)\widetilde{P}\widetilde{C} \tag{1.7}$$

$\widetilde{P}$ is a price index for the composite good, $\widetilde{C}$, and it is defined as the minimum expenditure needed to consume a unit of such good:

$$\widetilde{P} \equiv \left(\frac{P}{\alpha}\right)^{\alpha} \left(\frac{P_Y}{1-\alpha}\right)^{1-\alpha} \tag{1.8}$$

Note that the Cobb-Douglas structure of preferences abstracts from cross-price effects and results in constant sectorial expenditure over time. In addition, P_Y is the price of the homogeneous good. Since the homogeneous good is traded costlessly its price is the same in both countries.

In the third stage, the demand for each variety of the composite good is found by maximising the sub-utility function, $C(.)$. This represents a Cobb-Douglas utility function over two types of differentiated goods: first and second-class goods. It is defined as:

$$C = \left(\widehat{C}\right)^{\gamma}\left(\widehat{\widehat{C}}\right)^{1-\gamma} \tag{1.9}$$

where $\widehat{C}$ and $\widehat{\widehat{C}}$ denote the utility derived from the consumption of first- and second-class goods respectively. Consumers maximise the utility derived by the consumption of the differentiated good, subject to the budget constraint

$$\widehat{P}\widehat{C} + \widehat{\widehat{P}}\widehat{\widehat{C}} = PC \tag{1.10}$$

where $\widehat{P}$ and $\widehat{\widehat{P}}$ are price indexes of first-class and second-class goods. The solution of the third stage maximisation problems yields:

$$\widehat{P}\widehat{C} = \gamma PC \quad \text{and} \quad \widehat{\widehat{P}}\widehat{\widehat{C}} = (1-\gamma)PC \tag{1.11}$$

where, as in equation (1.6) $PC = \alpha\widetilde{P}\widetilde{C}$ is the expenditure on differentiated goods and $0 < \gamma < 1$ is the percentage of expenditure on differentiated goods relative to the first-class goods. Similarly, for the foreign country. The domestic country has a home market advantage over first-class goods when $\gamma > \gamma^*$. Finally, P is defined as:

$$P \equiv \left(\frac{\widehat{P}}{\gamma}\right)^{\gamma}\left(\frac{\widehat{\widehat{P}}}{1-\gamma}\right)^{1-\gamma} \tag{1.12}$$

There is now a fourth stage in which consumers decide consumption over each specific variety of each of the two classes of the differentiated good. The instantaneous utilities deriving from consumption of first- and second-class goods are, respectively:

$$\widehat{C}(.) = \left(\sum_{i=1}^{\widehat{N}} \widehat{c}_i^{\theta} + \sum_{j=1}^{\widehat{N}^*} \widehat{c}_j^{*\theta} \right)^{\dfrac{1}{\theta}} \tag{1.13}$$

and

$$\widehat{\widehat{C}}(.) = \left(\sum_{i=1}^{\widehat{\widehat{N}}} \widehat{\widehat{c}}_i^{\theta} + \sum_{j=1}^{\widehat{\widehat{N}}^*} \widehat{\widehat{c}}_j^{*\theta} \right)^{\dfrac{1}{\theta}} \tag{1.14}$$

where $\widehat{c}_j$ is the demand by a consumer in the domestic country for the variety j of the first-class differentiated good produced in the foreign country, $0 < \theta < 1$, so that $\varepsilon = \dfrac{1}{1-\theta} > 1$ is the constant elasticity of substitution between pairs of variety of the same product[9] and $\widehat{N}$ denotes the potential number of varieties of first-class good produced in the domestic country (we will denote the actual number of produced goods with n). Moreover, τ is the level of transport cost. Transport costs will be assumed to be of a iceberg type, that is only a fraction $1/\tau$ of the product shipped in the domestic country arrives at its destination in the foreign country. Henceforth, $\tau = 1$ under free trade and tends to infinity under autarchy.

At each moment of time, consumers maximise their instantaneous utilities as expressed in equations (1.13) and (1.14) subject respectively to the following budget constraints:

$$\sum_i \widehat{p}_i \widehat{c}_i + \sum_j (\tau \widehat{p}_j^*) \widehat{c}_j^* \ \square \ \widehat{P}\widehat{C} \tag{1.15}$$

$$\sum_i \widehat{\widehat{p}}_i \widehat{\widehat{c}}_i + \sum_j (\tau \widehat{\widehat{p}}_j^*) \widehat{\widehat{c}}_j^* \ \square \ \widehat{\widehat{P}}\widehat{\widehat{C}} \tag{1.16}$$

[9] ε must be grater that 1 in order to make sense of monopolistic competition. If $\varepsilon < 1$ the marginal revenue is less than zero. In order for the product varieties to be imperfect substitute θ is required to be < 1.

where $\widehat{p}_j^*$ is the price for the variety j of the first-class good, produced abroad, charged by the producer (f.o.b.) in the domestic country. Note that arbitrage guarantees that f.o.b. prices are the same for the domestic and the foreign country.

Utility maximisation yields the following demand functions' in the home country for the variety i and j of first-class and second-class goods, respectively, domestically produced:

$$\widehat{c}_i = \left(\frac{\widehat{p}_i}{\widehat{P}}\right)^{-\varepsilon} \widehat{C} \tag{1.17}$$

$$\widehat{\widehat{c}}_j = \left(\frac{\widehat{\widehat{p}}_j}{\widehat{\widehat{P}}}\right)^{-\varepsilon} \widehat{\widehat{C}}$$

and for goods produced in the foreign country:

$$\widehat{c}_j^* = \left(\frac{\tau\widehat{p}_i^*}{\widehat{P}}\right)^{-\varepsilon} \widehat{C} \tag{1.18}$$

$$\widehat{\widehat{c}}_j^* = \left(\frac{\tau\widehat{\widehat{p}}_i^*}{\widehat{\widehat{P}}}\right)^{-\varepsilon} \widehat{\widehat{C}}$$

Similar demand functions can be derived for the foreign country.

The price index , $\widehat{P}$, is defined as the minimum expenditure needed to buy a unit of the composite good $\widehat{C}$, so that:

$$\widehat{P} \equiv \left(\sum_i \widehat{p}_i^{1-\varepsilon} + \sum_j (\tau\widehat{p}_j^*)^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}} \tag{1.19}$$

Similarly, $\widehat{\widehat{P}}$ is the minimum expenditure needed to buy a unit of the composite good $\widehat{\widehat{C}}$.

2.2 Firms

Firms behaviour is formalised as a non-cooperative Nash equilibrium in prices and technologies. Firms choose their R&D expenditure and simultaneously set prices in order to maximise the present discounted flow of future profits, taking as given the technology constraints and consumers' demand.

2.2.1 Technology

The homogeneous good is produced subject to a CRS technology using labour L_Y only. Assuming a constant marginal productivity of labour equal for each firm in the sector, normalisation of this to 1 yields the following form of the production function for the homogeneous good:

$$L_Y = Y \tag{2.1}$$

As far as the differentiated products are concerned, first, we assume that firms compete monopolistically on the product market. Second, we assume that productivity in the manufacturing sector is given (so there is no process innovation). Third, innovation only occurs through the introduction of new differentiated first-class goods.

The invention of a new first-class goods requires that firms invest in R&D. The innovation technology in the domestic country is given by:

$$\dot{\widehat{n}} = \xi K L_Z \tag{2.2}$$

where $\dot{\widehat{n}}$ is the variation in the number of varieties of first-class products, ξK is the productivity of research, and K, which denotes public knowledge, is defined as follows:

$$K = \widehat{n} + \phi \widehat{n}^* \tag{2.3}$$

As the number of varieties increases, the cost associated with the introduction of a new variety, $\frac{w}{\xi K}$, decreases. This maintains the incentive to innovate and is what determines a constant growth rate.

Production of first-class goods in the home country, $\widehat{x}_i$, occurs according to the following technology function:

$$\widehat{x}_i = \widehat{h}\widehat{L}_{Xi} \tag{2.4}$$

The production function of second-class differentiated goods, $\widehat{\widehat{x}}_i$, is:

$$\widehat{\widehat{x}}_i = \widehat{\widehat{h}}_i \widehat{\widehat{L}}_{Xi} \tag{2.5}$$

Moreover, firms producing second-class goods sustain a fixed cost $\widehat{\widehat{L}}_F$ in order to start production. In other words, average costs decline as output increases. This fixed cost will determine the number of firms producing second-class goods in the market. Moreover, the number of firms in the market will equal the number of goods produced. This is because, given the fixed cost, $\widehat{\widehat{L}}_F$, it will be more convenient for each new firm entering the market to produce a new good rather than competing with an existing firm in the production of an existing good.

2.3 Producers' Behaviour

Price Decisions

We assume that producers engage in monopolistic competition and that there is a large number of firms in the market. Therefore, prices will be a constant mark-up over marginal costs. The price of a variety i of the first-class good can be written as:

$$\widehat{p}_i = \frac{\varepsilon}{\varepsilon - 1}\frac{w}{\widehat{h}} \tag{3.1}$$

where ε is the firms' perceived elasticity of substitution. Similarly for the foreign country. We assume that firms are symmetric within each country, therefore $\widehat{p}_i = \widehat{p}_j$, $\forall\ i, j$. Moreover, free trade in the homogeneous sector guarantees that wages are the same in the two countries, i.e. $w = w^*$. Assuming that technology is symmetric across countries, i.e. $\widehat{h} = \widehat{h}^*$, wage equality implies that $\widehat{p}_i = \widehat{p}_i^*$, and alike for second-class goods. Finally, in order to simplify the model, we assume that marginal productivity of labour is the same in the production of first- and second-class goods and across countries, i.e. $\widehat{h} = \widehat{\widehat{h}} = h$. This implies that prices of the two classes of goods are the same: $\widehat{p} = \widehat{\widehat{p}} = p$.

R&D Decisions

Let's now turn to firms' decisions to invest in research and development. At each moment in time, the development of a new first-class good will occur until the present discounted value of profits generated by the production of the new good equals the expenditure in R&D needed to introduce a new product,[10] that is:

$$\int_0^\infty e^{-rt}\left(\frac{1}{\varepsilon - 1}\frac{w}{h}\frac{\widehat{X}}{\widehat{n}}\right)dt = \frac{w}{\xi K} \tag{3.2}$$

where $\widehat{X} = \widehat{n}\widehat{x}_i$. It will be convenient to measure labour in terms of efficiency units in R&D, so that $\xi = 1$.

Differentiating the long-run zero-profit condition (3.2), we obtain the no-arbitrage condition:[11]

[10] Using equation (3.1), profits at each point in time can be expressed as: $(p - \frac{w}{h})\widehat{x}_i = \frac{1}{\varepsilon - 1}\frac{w}{h}\widehat{x}_i$. From R&D technology (2.1), $\dot{\widehat{n}} = 1$, imply $\widehat{L}_Z = \frac{1}{\xi K}$, therefore the expenditure in R&D that generates one unit of output is $\frac{w}{\xi K}$.

[11] Note that this is the general no arbitrage condition: $\pi + \dot{v} = rv$ where $v = \int_0^\infty e^{-rt}\pi(t)dt$. In our model $v = \frac{w}{\widehat{n} + \phi\widehat{n}^*}$ and $\pi = \frac{1}{\varepsilon - 1}\frac{w}{h}\frac{\widehat{X}}{\widehat{n}}$.

$$\frac{1}{\varepsilon-1}\frac{w}{h}\frac{\widehat{X}}{\widehat{n}} + \left[\frac{\dot{w}}{w} - \frac{\dot{\widehat{n}} + \phi\, \dot{\widehat{n}}^{*}}{\widehat{n}+\phi\widehat{n}^{*}}\right]\frac{w}{\widehat{n}+\phi\widehat{n}^{*}} = r\frac{w}{\widehat{n}+\phi\widehat{n}^{*}} \tag{3.3}$$

Equation (3.3) says that the sum of profits obtained by investing a unit worth output of R&D (the first term on the LHS) plus the capital gains from this investment (the second term on the LHS) must equal the return from investing the same amount in a riskless asset.

Production Decisions

Free entry in the production of second-class goods ensures that in this sector, at each moment in time, profits are equal to zero. If profits are positive, new firms will enter and profits will fall. Setting profits equal to zero and using the price setting rule (3.1), we get the following expression for the output of a representative firm i producing second-class products:

$$\widehat{\widehat{x}}_i = h(\varepsilon-1)\widehat{\widehat{L}}_F \tag{3.4}$$

2.4 Equilibrium

So far we have described consumers and producers' behaviour. The model is closed by adding the following equilibrium conditions: the labour market clearing condition, the product market clearing condition and the overall budget constraint. Using the labour market clearing condition, we derive an expression of the steady state growth rate as a function of labour allocated to the first-class good sector. Then, the product market clearing condition and the overall budget constraint are used to express the growth rate of the economy as a function of the parameters of the model only.

2.4.1 Steady-state: the role of labour allocated to the first-class good sector

The labour market clearing condition requires that the sum of labour employed in the development of new varieties and in the production of first-class goods plus labour employed in the production of second-class goods plus labour employed in the production of the traditional good Y equals the country's labour endowment. Analytically, this implies:

$$\frac{\dot{\widehat{n}}}{K} + \frac{\widehat{X}}{h} + \widehat{\widehat{n}}(\frac{\widehat{\widehat{x}}}{h} + \widehat{\widehat{L}}_F) + L_Y = \widehat{L} + \widehat{\widehat{L}} + L_Y = L \tag{4.1.1}$$

where $\widehat{L} = L_Z + \widehat{L}_X$ is the labour employed in the first-class good sector (research labour plus manufacturing labour) and $\widehat{\widehat{L}}$ is the labour employed in the second-class goods sector.

Let $g = \frac{\dot{\widehat{n}}}{\widehat{n}}$, then total labour employed in first-class good sector can be expressed as:

$$g\frac{1}{1+\phi\frac{\widehat{n}^*}{\widehat{n}}} + \frac{\widehat{X}}{h} = \widehat{L} \tag{4.1.2}$$

Following Feenstra (1996) and using the labour market clearing condition (4.1.1), we can rewrite the no-arbitrage condition for the domestic country (3.3) as:[12]

$$g = \frac{1}{\varepsilon}\{\widehat{L}(1+\phi\frac{\widehat{n}^*}{\widehat{n}}) - (\varepsilon-1)[r - \frac{\dot{w}}{w} - (g-g^*)(1-\frac{\widehat{n}}{\widehat{n}+\phi\widehat{n}^*})]\} \tag{4.1.3}$$

where the term $\widehat{L}(1+\phi\frac{\widehat{n}^*}{\widehat{n}})$ reflects the "effective" labour force for determining R&D activity. Note that a higher $\frac{\widehat{n}^*}{\widehat{n}}$ increases effective labour force in the domestic country, similarly, *mutatis mutandis*, for the foreign country . Equation (4.1.3) and its companion equation for the foreign country imply that as $t \to \infty$ the rate of

[12] Equation (4.1.3) is obtained substituting (4.1.1) and (4.1.2) into (3.3) and rearranging.

innovation in both countries converge to a constant rate of innovation $g = g^* = \overline{g}$. This result is explained by Feenstra (1996) as follows. Suppose that the steady state rates of innovation differ for the two countries. Assume that the foreign country, say, grows at a faster long-run growth rate, i.e. $g^* > g$. Then, as $t \to \infty$, $\frac{\widehat{n}^*}{\widehat{n}} \to \infty$. With $\phi > 0$ the effective labour force in the domestic country would tend to infinity. This would be consistent with a finite steady-state growth rate in the domestic country only if the real interest rate, $r - \frac{\dot{w}}{w}$, also tends to infinity, namely if wages at home fall rapidly. However, this situation has to be ruled out. This is because the equilibrium in the homogenous sector guarantees that wages are the same in the two countries. Therefore, their real interest rate is also the same. A real interest rate that tends to infinity is not consistent with a finite growth rate in the foreign country.

Therefore, in equilibrium $g = g^* = \overline{g}$. This condition requires that in equilibrium:

$$\widehat{L}(1 + \phi\frac{\widehat{n}^*}{\widehat{n}}) = \widehat{L}^*(1 + \phi\frac{\widehat{n}}{\widehat{n}^*}) \tag{4.1.4}$$

i.e. the effective labour force in the two countries is the same, that the relative proportion of first-class goods produced in the two countries is:

$$\frac{\widehat{n}}{\widehat{n}^*} = \frac{1}{2\phi\widehat{L}^*}\left[(\widehat{L} - \widehat{L}^*) + \sqrt{(\widehat{L}^* - \widehat{L})^2 + 4\widehat{L}\widehat{L}^*\phi^2}\right] \tag{4.1.5}$$

and that the worldwide growth rate $\overline{g}$ is:[13]

$$\overline{g} = \frac{1}{2\varepsilon}\left[(\widehat{L} + \widehat{L}^*) + \sqrt{(\widehat{L}^* - \widehat{L})^2 + 4\widehat{L}\widehat{L}^*\phi^2} - 2(\varepsilon - 1)\rho\right] \tag{4.1.6}$$

Note that, unlike Feenstra (1996), the steady-state growth rate is now a function of employment in the first-class good sector rather than of the population in the

[13]Equation (4.1.6) has been obtained using the optimal consumption path equation (1.3) and substituting (4.1.5) into equation (4.1.3), after we have substitute $r = \rho$ and $\frac{\dot{w}}{w} = 0$ into (4.1.3). Appendix A provides the proofs for these equalities. Moreover, note that there is a typo in Feenstra (1996). The term ϕ^2 appears as ϕ in Feenstra's paper.

two countries. Therefore, the growth rate will depend on the allocation of labour between the sectors producing first- and second-class goods. Since the allocation of labour between the two sectors depends on the level of transport costs, it is rational to expect that the steady state growth rate is a function of transport costs too.

In particular, note that as $\phi \to 0$, $\overline{g} \to [\max\{\widehat{L}, \widehat{L}^*\} - (\varepsilon - 1)\rho]/\varepsilon$. Feenstra (1996) finds that when there are knowledge spillovers, countries of different size grow at the same growth rate. When $\phi \to 0$, this growth rate is determined by the population of the bigger country. In our context, this growth rate is determined by the level of employment in the first-class good sector in the country where this sector is larger. When $\phi = 1$, $\overline{g} = \dfrac{(\widehat{L} + \widehat{L}^*) - (\varepsilon - 1)\rho}{\varepsilon}$.

Furthermore, note that in a world characterised by different preferences over the differentiated good for the two countries, although the rate at which new products are introduced in the market is the same for both countries, the rate of growth of consumption differs. In particular, for the domestic country:

$$\frac{\dot{\widetilde{C}}}{\widetilde{C}} = \frac{\alpha\gamma}{\varepsilon - 1}\overline{g} \tag{4.1.7}$$

Since $\gamma \neq \gamma^*$, consumption growth path will differ in the two countries.

2.4.2 Labour Allocation

The overall budget constraint for the economy is:

$$\widetilde{P}\widetilde{C} = PC + P_Y Y = wL + \widehat{n}\widehat{\Pi} \tag{4.2.1}$$

Total expenditure in the domestic country is equal to the sum of labour income and profits generated in the first-class sector, $\widehat{\Pi}$.

In equilibrium, labour market condition (4.1.2) holds and profits of a firm producing first-class goods in the domestic country can be written in the form[14]:

$$\widehat{\Pi} = \frac{1}{\varepsilon - 1} w \frac{\widehat{L} - a\overline{g}}{\widehat{n}} \tag{4.2.2}$$

where $a = \dfrac{1}{1 + \phi \dfrac{\widehat{n}^*}{\widehat{n}}}$.

Using the equation of the overall budget constraint (4.2.1) and the expression (4.2.2) for profits, we can derive the following expressions for labour employed in the production of the homogeneous good in the domestic country:[15]

$$L_Y = (1 - \alpha)(L + \frac{\widehat{L} - a\overline{g}}{\varepsilon - 1}) \tag{4.2.3}$$

for labour employed in the production of first-class goods in the domestic country:

$$\widehat{L} = \frac{\varepsilon - 1}{\varepsilon - \alpha}(\alpha L + \frac{1 - \alpha}{\varepsilon - 1} a\overline{g} - \varepsilon \widehat{\widehat{L}}_F \widehat{\widehat{n}}) \tag{4.2.4}$$

for labour employed in the second-class good sector in the domestic country:

$$\widehat{\widehat{L}} = (\widehat{\widehat{L}}_F + \frac{\widehat{\widehat{x}}}{h})\widehat{\widehat{n}} = \varepsilon \widehat{\widehat{L}}_F \widehat{\widehat{n}} \tag{4.2.5}$$

and, similarly, for labour employed in the first-class good sector in the foreign country:

$$\widehat{L}^* = \frac{\varepsilon - 1}{\varepsilon - \alpha}(\alpha L^* + \frac{1 - \alpha}{\varepsilon - 1} b\overline{g} - \varepsilon \widehat{\widehat{L}}_F \widehat{\widehat{n}}^*) \tag{4.2.6}$$

where $b = \dfrac{1}{1 + \phi \dfrac{\widehat{n}}{\widehat{n}^*}}$.

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[14] Instantaneous profits of a firm i, after initial R&D expenditure has been sustained are $\pi_i = \widehat{p}_i \widehat{x}_i - w\widehat{L}_{Xi}$. Using (2.4) and (3.1), profits can be rewritten as: $\pi_i = \frac{w}{h}\frac{1}{\varepsilon - 1}\widehat{x}_i$. Expression (4.2.2) is obtained substituting (4.1.2) in this last expression for profits.

[15] This expressions is obtained using the result (4.2.2), the conditions $P_Y = w$, $Y = L_Y$ and $P_Y Y = (1 - \alpha)\widetilde{P}\widetilde{C}$ in the economy budget constraint equation (4.2.1).

In order to close the model, we need to find the expressions for $\widehat{\widehat{n}}$, $\widehat{\widehat{n}}^*$ and $\dfrac{\widehat{n}}{\widehat{n}^*}$. In the next section we derive these expressions from the product market clearing conditions for the first- and second-class good sectors.

2.4.3 Steady state number of goods produced in the two countries

The ratio $\widehat{\widehat{n}}/\widehat{\widehat{n}}^*$ is determined by the product market clearing condition for the second-class goods sector. This implies that the value of production equals the sum of domestic and foreign expenditure. Analytically,

$$\widehat{\widehat{n}}\widehat{\widehat{p}}\widehat{\widehat{x}} = \alpha\left[\frac{\widehat{\widehat{n}}\widehat{\widehat{p}}^{1-\varepsilon}}{\widehat{\widehat{n}}\widehat{\widehat{p}}^{1-\varepsilon}+\widehat{\widehat{n}}^*(\tau\widehat{\widehat{p}}^*)^{1-\varepsilon}}(1-\gamma)\widetilde{P}\widetilde{C}+\frac{\widehat{\widehat{n}}(\tau\widehat{\widehat{p}})^{1-\varepsilon}}{\widehat{\widehat{n}}^*\widehat{\widehat{p}}^{*1-\varepsilon}+\widehat{\widehat{n}}(\tau\widehat{\widehat{p}})^{1-\varepsilon}}(1-\gamma^*)\widetilde{P}^*\widetilde{C}^*\right]$$

$$\widehat{\widehat{n}}^*\widehat{\widehat{p}}^*\widehat{\widehat{x}}^* = \alpha\left[\frac{\widehat{\widehat{n}}^*\widehat{\widehat{p}}^{*1-\varepsilon}}{\widehat{\widehat{n}}^*\widehat{\widehat{p}}^{*1-\varepsilon}+\widehat{\widehat{n}}(\tau\widehat{\widehat{p}})^{1-\varepsilon}}(1-\gamma^*)\widetilde{P}^*\widetilde{C}^*+\frac{\widehat{\widehat{n}}^*(\tau\widehat{\widehat{p}}^*)^{1-\varepsilon}}{\widehat{\widehat{n}}\widehat{\widehat{p}}^{1-\varepsilon}+\widehat{\widehat{n}}^*(\tau\widehat{\widehat{p}}^*)^{1-\varepsilon}}(1-\gamma)\widetilde{P}\widetilde{C}\right] \tag{4.2.7}$$

Note that the demand for foreign variety (the second term in the RHS of equation (4.2.7)) is multiplied by τ. This is because the demand facing the exporter must be inclusive of the resources lost in transaction.[16]

In order to simplify the model, we consider a special case: consumption of the second-class goods in the home country is a percentage, δ (where δ is a constant) of labour income only. People who receive firms' dividends only consume first-class goods and the homogeneous good. Therefore:

$\alpha\gamma\widetilde{P}\widetilde{C} = \alpha(\delta wL + \widehat{n}\widehat{\Pi})$

$\alpha(1-\gamma)\widetilde{P}\widetilde{C} = \alpha(1-\delta)wL$

[16] (4.2.7) is obtained by substituting (1.6), (1.11),(1.14), (1.16), (1.19) into the market clearing condition $\widehat{\widehat{n}}_A\widehat{\widehat{p}}_A\widehat{\widehat{x}}_A = \widehat{\widehat{n}}_A\widehat{\widehat{p}}_A\widehat{\widehat{c}}_{AA} + \widehat{\widehat{n}}_A\widehat{\widehat{p}}_A\widehat{\widehat{c}}_{AB}\tau$.

Similarly for the foreign country. Note that this assumption is required to allow a close form solution for the relative number of second-class goods produced in the two countries.

We can therefore solve the above system of equations (4.2.7) to obtain:

$$\frac{\widehat{\widehat{n}}}{\widehat{\widehat{n}}^*} = \frac{\dfrac{1-\delta}{1-\delta^*} - \tau^{1-\varepsilon}}{1 - \tau^{1-\varepsilon}\dfrac{1-\delta}{1-\delta^*}} \tag{4.2.8}$$

Equation (4.2.8) is defined for $\dfrac{1-\delta}{1-\delta^*}$ within the range $[\tau^{1-\varepsilon}, 1/\tau^{1-\varepsilon}]$. If the ratio $\dfrac{1-\delta}{1-\delta^*}$ is less than or equal to $\tau^{1-\varepsilon}$, $\widehat{\widehat{n}}$ equals zero. If the ratio is greater than or equal to $1/\tau^{1-\varepsilon}$, $\widehat{\widehat{n}}^* = 0$. The relative number of second-class goods produced in the domestic country rises with an increase in the country relative demand $\dfrac{1-\delta}{1-\delta^*}$. Note that as transport costs increase the range of non specialisation increases.

It follows that when $\tau > 1$, if $\delta > \delta^*$, then $\widehat{\widehat{n}} < \widehat{\widehat{n}}^*$ and $\widehat{L} > \widehat{L}^*$. In other words, even when countries are of the same size, if they have different preferences over the two types of differentiated goods, the production of one type of goods will concentrate in the country where there is a comparatively higher domestic demand for that good. This is because transport costs induce a market access advantage.

The equilibrium condition in the product market of first-class goods close the model. It will be:

$$\widehat{n}\widehat{p}\widehat{x} = \alpha\left[\frac{\widehat{n}\widehat{p}^{1-\varepsilon}}{\widehat{n}\widehat{p}^{1-\varepsilon} + \widehat{n}^*(\tau\widehat{p}^*)^{1-\varepsilon}}\gamma\widetilde{P}\widetilde{C} + \frac{\widehat{n}(\tau\widehat{p})^{1-\varepsilon}}{\widehat{n}^*\widehat{p}^{*1-\varepsilon} + \widehat{n}(\tau\widehat{p})^{1-\varepsilon}}\gamma^*\widetilde{P}^*\widetilde{C}^*\right] \tag{4.2.9}$$

and similarly for the foreign country.

Using the price setting rule, (3.1), the equation for total labour employed in the production first-class good production, (4.1.2), the profit equation, (4.2.2), and the assumption $\alpha\gamma\widetilde{P}\widetilde{C} = \alpha(\delta wL + \widehat{n}\widehat{\Pi})$, the product market equilibrium condition (4.2.9) can be rewritten in the form:

$$\widehat{L}\Phi() = \frac{\alpha}{\varepsilon}\frac{(\tau^{1-\varepsilon}+\widehat{m})[\delta(\varepsilon-1)L+\widehat{L}\Phi()]+\tau^{1-\varepsilon}(1+\tau^{1-\varepsilon}\widehat{m})[\delta^{*}(\varepsilon-1)L+\widehat{L}^{*}\Phi()]}{(\tau^{1-\varepsilon}+\widehat{m})(1+\tau^{1-\varepsilon}\widehat{m})} \tag{4.2.10}$$

where $\widehat{m} = \dfrac{\widehat{n}_B}{\widehat{n}_A}$, and $\Phi(\overline{g},\widehat{m},\widehat{L},\widehat{L}^{*}) = \left(1-\dfrac{\overline{g}}{(1+\phi\widehat{m})\widehat{L}}\right) = \left(1-\dfrac{\overline{g}}{(1+\phi\dfrac{1}{\widehat{m}})\widehat{L}^{*}}\right)$.

Equations (4.1.5), (4.1.6), (4.2.4), (4.2.6), (4.2.8), (4.2.10) form the system of six equations in six unknowns $\widehat{L}$, $\widehat{L}^{*}$, $\dfrac{\widehat{n}}{\widehat{n}^{*}}$, $\widehat{\widehat{n}}$, $\widehat{\widehat{n}}^{*}$ and $\overline{g}$, which defines our model. This is a system of non-linear equations. So, it requires a numerical solution. However, a close form solution of the model is possible for the case of symmetric countries. The next section will analyse the implications of the model for the effects of integration on growth.

2.5 Transport costs and the steady state growth rate

This section examines the impact of transport costs on the steady-state equilibrium. In order to focus on the home market effect, we carry out the analysis in two steps. We begin by describing the effects of transportation costs when countries are perfectly symmetric, i.e. there is no home market effect. Then, we extend the analysis to the case of countries with different preferences over the two types of differentiated goods. Comparing the results obtained in these two cases will enable us to identify how the home market effect affects growth.

2.5.1 Symmetric case

In order to abstract from home market effects, in this subsection, we assume that countries are symmetric. They share the same preferences over the differentiated goods, thus $\delta = \delta^{*}$ and $\gamma = \gamma^{*}$. Under these assumptions, the model described in the previous sections of this paper can be greatly simplified and the analytical solution for the growth rate can be worked out.

Writing out the equilibrium conditions, (4.1.5), (4.1.6), (4.2.4), (4.2.6), (4.2.8), (4.2.10), of the model again, we have:

$$\hat{\hat{n}} = \hat{\hat{n}}^* = \frac{\alpha(1-\gamma)}{\varepsilon \hat{\hat{L}}_F} \tag{5.1.1}$$

and

$$\frac{\hat{\hat{n}}}{\hat{\hat{n}}^*} = 1 \tag{5.1.2}$$

from the product market clearing conditions for second-class goods, (4.2.7)[17] and (4.2.8), respectively.

Using the labour market clearing conditions, (4.2.4) and (4.2.6)[18], and long run equilibrium condition on the relative number of first-class goods in the two countries, (4.1.5), we obtain the result that under symmetry:

$$\hat{L} = \hat{L}^* \tag{5.1.3}$$

and

$$\frac{\hat{n}}{\hat{n}^*} = 1 \tag{5.1.4}$$

Finally, it is possible to rewrite the equation of the product market clearing condition for first-class goods, (4.2.10), as:

[17] In particular, (5.1.1) is obtained by using the price setting rule (3.1), the expression for output per firm (3.4) and the normalisation hypothesis $\widetilde{P}\widetilde{C} = 1$, in the product market clearing condition for second class goods, (4.2.7).

[18] Note that equation (4.1.4) implies that $\frac{a}{\hat{L}} = \frac{b}{\hat{L}^*}$. Substituting this equality, equations (4.2.4) and (4.2.6) necessarily imply $\hat{L} = \hat{L}^*$

$$\widehat{L} = \frac{\overline{g} + \alpha(\varepsilon - 1)(1+\phi)\delta L}{(1+\phi)(\varepsilon - \alpha)} \tag{5.1.5}$$

and to rewrite the expression for the steady state growth rate, (4.1.6), in the form:

$$\overline{g} = \frac{1}{\varepsilon}\left(\widehat{L}(1+\phi) - (\varepsilon - 1)\rho\right) \tag{5.1.6}$$

The expression for the growth rate as a function of the exogenous parameters of the model is derived by substituting equation (5.1.5) into (5.1.6). The result is:

$$\overline{g} = \frac{\alpha\delta(1+\phi)L - (\varepsilon - \alpha)\rho}{\varepsilon + 1 - \alpha} \tag{5.1.7}$$

The growth rate is positively correlated with the population size, the degree of spillovers and the percentage of expenditure on first-class goods, but negatively correlated with the elasticity of substitution between differentiated goods and the intertemporal discount rate. In particular, for the two cases of no knowledge spillovers and full knowledge spillovers commonly analysed by the literature on growth, we obtain that as $\phi \to 0$, $\overline{g}$ tends to $\dfrac{\alpha\delta L - (\varepsilon - \alpha)\rho}{\varepsilon + 1 - \alpha}$ and as $\phi \to 1$, $g \to \dfrac{2\alpha\delta L - (\varepsilon - \alpha)\rho}{\varepsilon + 1 - \alpha}$. The free flow of ideas increases the growth rate. Note that the growth rate for $\phi \to 0$ is also the growth rate of a closed economy.

However, the important point to notice is that transportation costs have no effect on the growth rate. This is because in our model the elasticity of export demand is the same as the elasticity of domestic demand and it is independent of transport costs. Thus, given that the two countries are perfectly symmetric, transportation costs have no effect on the output per firm or on the number of firms at any point in time in either country or on the labour demanded for the production of second-class goods. Since labour allocation between sectors of the economy does not chance, the growth rate will not change.

This result is consistent with that found by Krugman (1980). In his paper, Krugman shows that, in a two-country one-industry[19] economy, transportation costs have no effect on prices, output per firm or the number of firms in either country. We show that Krugman' s result also holds for a symmetric two-country-two industry economy. Moreover, we extend the analysis to the dynamic effects of transport costs.

2.5.2 The home market effect on the growth rate

In this section, we analyse the effect of a reduction of transport costs on the equilibrium growth rate, in a world where there are two classes of differentiated good (one progressive sector producing first-class goods and one non-progressive sector producing second-class goods), people's preferences over these two classes differ across countries, there are knowledge spillovers and trade is impeded by transport costs.

In this case there is no close form solution to our model. Equations (4.1.5), (4.1.6), (4.2.4), (4.2.6), (4.2.8), (4.2.10) form a system of non linear equations in the six unknowns: $\widehat{L}$, $\widehat{L}^{*}$, $\dfrac{\widehat{n}}{\widehat{n}^{*}}$, $\widehat{\widehat{n}}$, $\widehat{\widehat{n}}^{*}$ and $\overline{g}$, that cannot be solved analytically. Thus, comparative statics results are obtained by numerical simulations.[20]

We look at equilibria where there is incomplete specialisation, and we analyse the impact of integration on growth. Moreover, we examine the role played by the elasticity of substitution between differentiated goods, the extent of spillovers, the intertemporal elasticity of substitution, a greater home market advantage and the level of fixed costs in the second-class good sector in determining the pattern of the effect of integration on growth, specialisation and production in the two countries.

The benchmark case assumes the elasticity of substitution between differentiated goods $\varepsilon = 30$, the percentage of expenditure on differentiated goods $\alpha = 0.9$, the degree of spillovers between countries $\phi = 0.7$, the intertemporal rate of discount

[19] Note that in a one-industry setup, if wages are not allowed to differ between countries, full employment equilibrium condition wipes out any home market effect.

[20] The model is simulated in GAUSS. The program is available from the author upon request.

$\rho = 0.3$, the fixed cost in the production function of second-class goods $\widehat{\widehat{L}}_F = 0.5$ and population equal to 100 in both countries. Finally, it assumes that the percentage of income spent on first-class goods $\delta = 0.6$ and $\delta^* = 0.55$ for the domestic and the foreign country respectively. In presence of transport costs, these parameter values imply that the domestic country has a home market comparative advantage in the production of first-class goods, while the foreign country has a home market comparative advantage for second-class goods. Note that, for these values of the parameters, equation (5.1.7) predicts a growth rate equal 2.76 for the two symmetric countries when $\delta = 0.6$ and equal to 2.51 when $\delta = 0.55$.

Figure I shows the impact of increasing transport costs on the steady -state world-wide growth rate in the benchmark case. There are two important points to make. First, there is a non-linear effect of transport costs on the growth rate. As transportation costs fall the growth rate increases. In Figure I, as transport costs fall from 1.6 to 1.006 the growth rate increases from 2.74 to 2.98. However, when transport costs are equal to 1 (i.e. under free trade) the growth rate equals 2.64. The free trade growth rate is obtained by simulation of the system of equations (4.1.5), (4.1.6), (4.2.4), (4.2.6), (4.2.10) and the market clearing equation:

$$\widehat{\widehat{n}} + \widehat{\widehat{n}}^* = \frac{\alpha}{\varepsilon} \frac{(2 - \delta - \delta^*)L}{L_F} \tag{5.2.1}$$

where equation (5.2.1), obtained by substituting (3.1) and (3.4) into (4.2.7), replaces equation (4.2.8) in the equilibrium system of equations. This is because for $\tau = 1$, equation (4.2.8) is not defined when countries have different preferences over the differentiated good.

The non-linear effect of integration on growth is due to the home market effect. The literature on static models of trade has shown that the home market advantage has a non linear effect on concentration. When transport costs are positive, firms locate in the country with the larger home market. Under the conditions specified in the benchmark model, the foreign country has a home market advantage in second-class goods. Therefore, as countries open up to trade, firms producing second class goods will concentrate abroad. The foreign country will be a net exporter of second-class goods; while the domestic country will be a net importer of these goods. The opposite pattern will occur in the home country. However, when trade is free, firms have no advantage in locating in the larger market. Production will randomise between the two countries.

In this paper, the non linear effect of integration on concentration is reflected in a non linear effect of integration on growth. The rationale is as follows. As transport costs fall, countries specialise according to their home market advantage. In our model, concentration has two opposite effects on the level of knowledge of the home country, say. On the one hand, concentration of production of first-class goods in the home country increases domestic knowledge. On the other hand, it reduces the importance of knowledge spillovers from abroad. Vice-versa, for the foreign country. Since spillovers count only for a percentage ϕ in determining the productivity of research, productivity of research will increase at home but it will fall abroad. Thus, it will be more convenient to produce and to engage in research and development in the domestic country rather than in the foreign country. $\widehat{L}$ is likely to increase, while $\widehat{L}^*$ is likely to decrease. Note that the equilibrium condition (4.1.4) implies that if $\frac{\widehat{\widehat{n}}}{\widehat{\widehat{n}}^*}$ increases $\widehat{L}^*$ falls and $\widehat{L}$ augments.

In terms of the equilibrium growth rate equation (4.1.6), the growth rate depends positively on labour employed in the first-class good sector in the home country and abroad (if $\widehat{L}$ and $\widehat{L}^*$ increase $\widehat{L}+\widehat{L}^*$ and $\widehat{L}\widehat{L}^*$ in equation (4.1.6) increase too) and on the gap between the level of labour employed in this sector between the two countries (i.e. growth increases if $\widehat{L}-\widehat{L}^*$ increases). *Ceteris paribus*[21], specialisation according to the home market comparative advantage implies that labour employed in the manufacturing of first-class goods will increase in the country with the larger domestic demand for that class of goods, but it will decrease in the other country; $\widehat{L}-\widehat{L}^*$ will increase and this has a positive effect on the growth rate. However, we do not know what is the effect of specialisation on $\widehat{L}\widehat{L}^*$.[22]

Simulations suggest that the overall effect of specialisation according to the home market advantage is positive. However, when transport costs fall to zero, the growth rate falls below the growth rate characterising a world where there are positive trans-

[21] i.e. for a given $\widehat{L}+\widehat{L}^*$.

[22] Note that $\widehat{L}\widehat{L}^*$ increases only if the elasticity of $\widehat{L}^*$ to $\widehat{L}$ is less than 1.

port costs. This is due to the fact that, when trade is free, the home market effect disappears.

Second, when transport costs are large enough ($\tau > 1.05$ approximately in the figure) and under free trade countries grow at a rate that falls in between the growth rates they would experience if they traded with a symmetric partner. The reason is as follows. When trade costs are high (like also when countries trade with similar partners and under free trade) each country produces a proportion of varieties of first and second-class goods equal (or close) to its demand. In these circumstances, if a country, say the foreign country, trades with a country that has a comparative advantage in the progressive sector, it will benefit from larger knowledge spillovers than if it traded with a similar partner. Larger spillovers lead to higher growth; thus, its growth rate will be larger than in the case of trade with a similar country. Vice-versa, the country with the comparative advantage will benefit from less spillovers than when it trades with a similar partner; thus, the growth rate will be lower that in the case of the domestic country trading with a similar country.

Similarly, the free trade growth rate, equal to 2.64, falls within the range, $[2.51, 2.76]$, bounded by the growth rates that the domestic country and the foreign country, respectively, would realise if they traded with a similar country.

However, when transport costs are low, the worldwide growth rate for two countries with different preferences for the first-class good sector increases above the growth rate of symmetric countries with a large market for the progressive good. This is because the positive knowledge effect of specialisation offset the lower spillovers from abroad.

Hereafter, we will examine how the extent of spillovers,the size of the market access advantage, the elasticity of substitution between the differentiated goods, the level of the fixed cost, the intertemporal elasticity of substitution and the total market size affect the growth rate. We will show that the non linear effect of integration on growth is a robust result; different values for the parameters of the model only have level effects.

Figure II shows the effect of a low degree of knowledge spillovers between countries. In these simulations the parameter ϕ is set equal to 0.1.[23] The figure shows two important features. First, as predicted by most of endogenous growth literature, lower spillovers reduce the growth rate. The growth rate rises from 1.6 to 2.6 as transport costs fall, remaining below the growth rate obtained with $\phi = 0.7$ at any level of the transport cost. The reason is that lower spillovers decrease the productivity of research, thus reducing firms' incentive to innovate.

Second, integration has a larger positive effect on the growth rate. When $\phi = 0.1$, the growth rate increases more than when $\phi = 0.7$. This is because when the percentage of knowledge that spills over from abroad is very low, the negative effect of specialisation on the growth rate (due to the fact that knowledge developed in the country with the home market advantage in the non-progressive sector decreases) is negligible.

Note that when spillovers tend to zero, our model predicts that the growth rate is given by the level of employment in the sector producing first-class goods in the country where it is higher.[24] Therefore, in this case specialisation has only a positive effect on growth.

[23] Simulations have been run for value of $0.09 < \phi$ □ 1.

[24] Recall that when $\phi \to 0$, $\overline{g} \to [\max\{\widehat{L}, \widehat{L}^*\} - (\varepsilon - 1)\rho]/\varepsilon$.

Figure III shows the impact of a larger home market advantage in the production of first-class goods for the domestic country (in particular, it is now assumed that $\delta = 0.75$ and $\delta^* = 0.45$[25]). It appears that a larger home market advantage increases the growth rate. The values of the growth rate range from 2.88 to 3.08. This is because when the home market comparative advantage is larger the specialisation effect is larger. A higher proportion of the production of second-class goods will concentrate in the foreign country. Consequently, more labour will be available in the domestic country for the production of first-class goods. This positive effect of specialisation on the worldwide rate of innovation outweighs the negative effect due to the lower level of research undertaken in the foreign country.

[25] These values have been chosen, in order to leave the average between δ and δ^* unaltered.

As far as the rest of the parameter of the model are concerned, simulations run over a wide range of values for the elasticity of substitution between differentiated goods show that the higher the elasticity of substitution between differentiated goods, the lower the rate of growth is. This is because a higher elasticity of substitution reduces the returns to innovation by reducing price mark-ups.

Simulation run for different values of the intertemporal elasticity of substitution show that a lower value of ρ increases the growth rate. The reason is that the lower the intertemporal elasticity of substitution, the less heavily future consumption is discounted. Therefore, the more welfare-enhancing is a high growth rate.

In contrast, different values of the fixed cost in the second-class sector do not appear to affect the growth rate to any significant extent. This is because there is a negative relationship between the number of firms producing second-class goods and the level of fixed cost. When the fixed cost is higher less firms will enter in the market. These two effects cancel out.

Finally, larger market size (higher values of the total labour force in both countries) increases the growth rate; a relative larger market for the differentiated good sector with respect to the homogeneous good sector (higher values for α) also has a positive effect on the growth rate.

To sum up, when countries' preferences over the differentiated goods differ and transport costs impede free exchange of commodities, trade leads countries to specialise according to their home market comparative advantage. Countries will become net exporter of the commodity for which they have a larger domestic demand. In these circumstances, transportation costs matter for the determination of the allocation of labour between sectors. Thus, they affect the growth rate.

We found that trade liberalisation has a positive effect on growth. However there is a discontinuity at free trade. When transport costs fall to zero the growth rate falls too. Moreover, countries with a large market for the progressive sector may benefit more from integrating with a country with a smaller market for it than with a country with similar preferences.

In addition, we found that the effect of integration on growth is positively correlated to the size of the home market advantage but negatively correlated to the extent of spillovers.

3 Conclusions

Traditional growth literature about the impact of integration on growth focuses on its scale, competition, spillover and allocation effects. In particular, the allocation effect occurs when one of the two (usually) integrating countries has a comparative advantage (*a la* Ricardo or *a la* Heckhscher-Ohlin) in the production of one of the (usually two) sectors of the economy. So that, each country specialises in the production of the good for which it has a comparative advantage. In these circumstances, if spillovers are national in scope, integration favours (in terms of growth rate) the country which specialises in the progressive sector.

In this paper we highlight a further factor that might affect the impact of integration on growth: the *home market* effect.

We assume a two-country two-sector world, where there are spillovers between countries. There are two types of differentiated good whose production technology exhibits IRS: first and second-class goods. However, innovation takes place only in first-class goods.

We show that, if countries share similar tastes over the differentiated good, transportation costs have no effects on the growth rate. Whilst, when countries' preferences differ over the two types of differentiated goods, integration has a positive effect on growth. Yet, there is a discontinuity at free trade. This pattern is the result of specialisation according to the home market comparative advantage.

When countries open up to trade, production will concentrate in the country with the home market advantage, i.e. there is a specialisation effect. The effect of specialisation on growth is twofold. On the one hand, there is a positive effect of specialisation on growth due to the enlargement of first-class good sector in the domestic country. On the other hand, there is a negative effect of specialisation on growth due to the decline of the first-class goods sector abroad. Since spillovers from abroad only count for a percentage towards the determination of a country's knowledge, the former effect outweighs the latter. Thus, as transport costs fall, countries specialise and the growth rate increases. However, when transport costs fall to zero the growth rate falls too. Free trade removes firms' advantage to locate in the country with the larger domestic market. Firms randomise between countries, so the positive effect of concentration on growth disappears.

Furthermore, we show that when countries with different preferences over innovative and second generation type of goods integrate, there will be a stage of the integration process when their growth rate will increase above the growth rate that each of the two countries could realise, if it integrates with a country with similar preferences. We also show that for a given world demand for first-class goods, the effect of integration on the growth rate is greater, when countries differences in preferences is larger and when the degree of spillovers between countries is smaller.

In conclusion, this paper suggests that the effect of integration on growth depends on the degree of advancement of the integration process and on a country's specific circumstances (such as trading countries' relative market size). In contrast, so far empirical literature on the effects of integration has assumed that openness must have the same effects across countries regardless of circumstances. Further empirical research in this direction is therefore needed.

A Appendix: The steady-state growth rate of wages

In order to show that the steady-state growth rate of wages equals zero ($\frac{\dot{w}}{w} = 0$), it will be sufficient to show that $\frac{\dot{p}}{p} = 0$ in steady state. This is because under monopolistic competition $\frac{\dot{p}}{p} = \frac{\dot{w}}{w}$.

Given the equation for the optimal time path of consumption $\frac{\dot{\tilde{C}}}{\tilde{C}} + \frac{\dot{\tilde{P}}}{\tilde{P}} = r - \rho$, normalisation of prices at any point in time so that expenditure remains constant implies that $r = \rho$ for the domestic country, and similarly for the foreign country. Therefore, $r = r^*$. It also implies that:

$$\frac{\dot{\tilde{C}}}{\tilde{C}} = -\frac{\dot{\tilde{P}}}{\tilde{P}} \tag{A.1}$$

From equation (1.4), (1.9) and (1.13) taking logarithms and differentiating with respect to time yields:

$$\frac{\dot{\widetilde{C}}}{\widetilde{C}} = \alpha\gamma\frac{\dot{\widehat{C}}}{\widehat{C}} \tag{A.2}$$

where

$$\frac{\dot{\widehat{C}}}{\widehat{C}} = \frac{\dot{\widehat{c}}}{\widehat{c}} + \frac{1}{\theta}\frac{g + g^*\frac{n^*}{n}\tau^{-\varepsilon\theta}}{(1 + \tau^{-\varepsilon\theta}\frac{n^*}{n})} \tag{A.3}$$

In steady state $g = g^* = \overline{g}$. Substituting (A.3) into (A.2) and using the equality $\frac{\dot{\widehat{c}}}{\widehat{c}} = -g$, we can rewrite the steady state growth rate of consumption in the domestic country as:

$$\frac{\dot{\widetilde{C}}}{\widetilde{C}} = \alpha\gamma\frac{1}{1-\varepsilon}\overline{g} \tag{A.4}$$

Similarly, it can be shown that

$$\frac{\dot{\widetilde{P}}}{\widetilde{P}} = \frac{\dot{p}}{p} + \alpha\gamma\frac{1-\theta}{\theta}\overline{g} \tag{A.5}$$

Together (A.1), (A.4) and (A.5) imply that $\frac{\dot{p}}{p} = 0$.

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