Trade, demand spillovers, and industrialization: The emerging global middle class in perspective.

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Abstract (this draft: July 2007)

Will the integration of BRIC (Brazil, Russia, India and China) into the global economy provide the biggest boost to the world economy since the industrial revolution? In this paper, we investigate international demand spillovers brought about by an emerging global middle class and their impact on the international structure of production. We put forth a many-industry and two-country trade model featuring international competition, non-homothetic preferences and country-specific asymmetries in income distribution, productivity and population size. Its key characteristic is the introduction of demand complementarities propagating increasing returns across industries and national boundaries, which eventually translate into a *global profit-multiplier*.

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1 Introduction

Trade theory traditionally concentrates on the supply side. One standard assumption is that preferences are identical across trade partners and homothetic, i.e., as income increases, consumption of each good increases proportionately. As a result, demand-side effects are neutralized as a determinant of the composition of trade. This is in contradiction to the stylized facts (see, among others, Francois and Kaplan 1996 and Dalgin, Mitra, and Trindade 2004). In reality, differences in purchasing power lead different goods to be consumed, depending on the level of real income. It is unlikely, for example, that the middle-class household's consumption basket in China is similar to that of its European counterpart. They may both be located on the same preference map. However, they do not belong to the same quintile of the world distribution of income.

In this paper, we investigate how an emerging global middle class may influence trade flows of goods and services and the pattern of global production. We focus on international demand spillovers which contribute to expand production and achieve scale economies. Much as technical externalities propagate increasing returns across industries and national borders, global demand spillovers via goods and services markets may also generate such effects. With non-homothetic preferences, the extent of international spillovers will depend on asymmetries in domestic income distribution, average productivity and population size, i.e., on the distribution of world income.

There are potential benefits to the world economy from the emergence of a large number of consumers whose tastes will change as their living standards catch up with those in advanced nations. A new age of mass consumption is likely to accompany the next wave of globalization. According to the World Bank, the emergence of a global middle class will cause a major change in the demand for goods, creating huge mass markets. Their last projections are eloquent (see Global Economic Prospects 2007, Chapter 3, p. 69):

> "In 2030, 16.1 percent of the world population will belong to what can be called a 'global middle class' up from 7.6 percent in 2000. That is, in 2030 more than a billion people in developing countries will buy cars, engage in international tourism, demand world-class products... Compare that with only 400 million people in developing countries who had access to these kinds of living

> standards in 2005... This large middle class will create rapidly growing markets for international products and services..."

Conversely, the emergence of BRIC (Brazil, Russia, India and China) on the international economic scene poses a challenge to both advanced nations and other emerging countries. If China's economic performance is in line with the Japanese integration experience, the *size* of the former will have a particularly important impact on the modernization or decline of industrial activities across regions of the globe (see Winters and Yusuf (Eds.), Dancing with giants: China, India, and the global economy, 2007). Competition spans increasingly diversified activities. The sheer size of these newcomers means that these spillover effects may dwarf the comparison with Japan. It is therefore not surprising to observe a renewed political thrust towards protectionism. Will the next wave of globalization necessarily come at the expense of the mature industrialized economies? First, the issue needs to be addressed at both aggregate and sectoral levels in order to provide insights into sectors of likely future strength. Secondly, the challenge also concerns regions such as Latin America and the Caribbean, Africa, and the smaller neighboring countries in Asia.

There is a long tradition in development economics, going back at least to the parable of the shoe factory by Rosentein-Rodan (1943), that emphasizes how a positive sectoral shock may stimulate the development of other sectors. Conversely, increased foreign competition may harm one sector, potentially hurting other sectors as well. Rosentein-Rodan's argument was formalized by Murphy, Shleifer, and Vishny in two companion papers (1989a, 1989b). In the first, they model the so-called 'big push' which produces industrial modernization as the outcome of coordinated investments which propagate increasing returns across industries. In the second paper (henceforth MSV), aggregate demand spillovers work via the buying power of the middle class to eventually determine the extent of horizontal complementarity across all sectors of the economy. In the words of Matsuyama (1995, p. 703):

> "... Suppose the [middle class] increases its demand for monopolistically competitive goods... Because prices exceed marginal costs, such a shift in demand would increase the level of monopoly profits in the economy and thus national income. This increased income would generate additional demand for monopolistically competitive goods, which further raises profits and income and so on..."

Our contribution focuses on such a form of complementarities and allows domestic demand to potentially spill over to any rival foreign industry, giving rise to cumulative processes which are global in their scope. Instead, in MSV, such a multiplier is limited to the home market and determined only by the size of the domestic middle class. We extend their closed-economy general equilibrium model to a two-country framework. Goods produced in both countries are imperfect substitutes and are differentiated by their country of origin. According to the relative size of the domestic markets and the competitiveness of home and foreign rival firms, each product may be produced domestically under increasing returns by a monopolist or by a competitive fringe under constant returns to scale. The magnitude and direction of international demand spillovers determine the extent of economies of scale achieved and as a result, the importance of the *global profit-multiplier* process in each country. The market size for each good depends on the number of agents that can purchase it, which itself depends on the distribution of purchasing power both across and within trade partners[1].

Under free trade, the domestic middle class is a relative notion which has no internationally comparable definition. A household which belongs to the middle class in its own country, may be rich enough to belong to the upper class of the world income distribution. Conversely, a household may be rich by national standards but belong to the global middle class. In the closed economy, all profits and wages distributed to the domestic middle class return as demand addressed to the home industries. By opening to trade, they become a component of demand for either the home good or the imperfect substitute produced abroad, depending on international competitiveness, the world income distribution and the extent of love of variety. This in turn affects real national incomes and welfare[2].

[1] In contrast to the strand of international trade literature dealing with monopolistic competition and the so-called "home market" effect (starting with Krugman 1980), there is no trade-off between scale economies and the number of varieties produced by the national industry. Instead, in our framework, the *range* of firms that are able to exploit economies of scale increases with the size of the market, which in turn increases profits. Thus, a larger market for a particular industry is not synonymous with more firms. Rather it yields higher profits which translate into a larger multiplier.

[2] Yusuf *et al.'s* (2007, p. 38) analysis of data on the ownership of consumer durables and automobiles in China and India illustrates the point developed in our model: "... Low-income families in both rural and urban areas [in China and India] do purchase manufactured products, such as garments and footwear, but they do not [yet] purchase automobiles and the more expensive consumer durables. It is precisely in the area of white

Before we turn to the results, we consider it worth drawing a parallel between the well-known Heckscher-Ohlin results and ours. In the standard 2×2 H-O model, when a country exports (imports) a capital-intensive (labor-intensive) good, it implicitly exports (imports) its relatively abundant (scarce) factor. In our model, we intentionally disregard supply-side effects associated with comparative advantage (see our review of the related literature below). Trade rather carries out the task of exchanging the domestic surplus purchasing power of households between countries. More specifically, the relative abundance or scarcity of a particular domestic income class in the world distribution of income is the key to our analysis of trade flows and production patterns.

Our model brings out interesting implications about the geographical distribution of trade flows and production. First, trade integration tends to equalize the average income of trade partners who differ only in their income distribution. The underlying mechanism (discussed in detail in the text) is the following: Trade allows the global middle class to determine the extent of international spillovers and as a result, the size of scale economies in each country. Export-competing industries in the more unequal country will take advantage of the larger middle class in the more egalitarian trade partner. When there is love of variety (a low elasticity of substitution across similar goods as found by Broda and Weinstein 2006), demand in the more equal trade partner contributes to expand production in the unequal trade partner, strengthening its profit-multiplier. This is at the expense of fully exploiting scale economies in the more equal trade partner.

Secondly, when trade partners differ only in their productivity, free trade exacerbates international disparities in real average income and tightens scale economies in the technically backward country. This dampens the local market-size externalities' argument by MSV and revives the infant industry argument which rests on non-capturable externalities[3]. Beyond providing a

and brown goods where economies of scale are important. Thus, the market for these latter household labor-saving and entertainment products is made up mainly of people in upper income groups [or the "middle class"] who have high income elasticities of demand for such products and who live in urban areas in China and India or abroad."

[3]Incidentally, MSV acknowledge that the multiplier may be international in scope (p. 560): "This question gains particular significance in the open economy, where foreign competition might reduce [the multiplier]... We have only focused on the income distribution as the determinant of market size. One can also consider other important determinants of market size, such as population size and average income, and ask various questions about industrialization in small versus large countries, as well as in poor versus rich countries."

rationale for policy intervention, our model formalizes international demand spillovers. On the one hand, terms of trade must adjust to reflect labor productivity differences, penalizing the ability of firms in the lagging country to compete in the global market. This leads the backward country to lose a large share of its domestic market which is exchanged for a smaller share of its trade partner's market. Eventually, markets clear because real average income is higher where the labor force is more productive. Note that all households in both trade partners can buy goods with lower income elasticities of demand, i.e., higher-priority goods. Therefore, demand from the most crowded part of the global income distribution allows industries which produce goods with lower income elasticities of demand in the more competitive country to produce at a more efficient scale, enhancing its domestic but also the global cumulative process. The intuition behind this result is that the top of the middle class of the developing country becomes the bottom of the middle class in the global context. It is indeed likely that the former is characterized by a spending pattern similar to that of the lower middle class in the advanced economy. Eventually, a large proportion of consumers in the developing country contributes in the early stage of development to boost production of goods with low income elasticities of demand in the advanced economy at the expense of their domestic industries. On the other hand, the quid pro quo is that the higher purchasing power of the advanced economy will benefit sectors in the emerging country which produce goods with relatively higher income elasticities of demand. Examples we have in mind concern the toy industry in China and tourism. In fact, trade integration and international demand spillovers lead the technically backward country to diversify its domestic production activities to meet the demand of the advanced country's middle class.

Next, a labor productivity improvement in the emerging country induces a reversal of specialization and a drop in real output in the advanced country, relative to the previous baseline. On average, the mature industrialized economy still dominates world markets, but its share of some sectors will shrink. Technological catch-up yields a decline in export prices in the emerging country's firms which become relatively more competitive. This allows them to capture a larger share of the world market which in turn raises the global profit-multiplier. More firms have access to increasing returns production technologies because of the increased buying power of the global middle class through lower prices. All sectors expand production and each of them grows faster than its foreign counterpart. Thus, there is a parallel between our re-

sults and the increasing share of world manufactured exports from China in nearly all categories of product since the 1980s. Eventually, demand complementarities propagate increasing returns across national boundaries, so that the rise in average productivity in the emerging country spills over to those sectors in the advanced country which produce goods with higher income elasticities of demand. The advanced country sees an increase in both total exports and its share of higher income elasticity goods.

There is still a large pool of labor that can be expected to move from the agricultural to the tradable secondary and tertiary sectors of industry, thus maintaining in the medium run BRIC's international competitiveness vis à vis the smaller emerging countries. Rural-urban migration will lead to an increase in the labor force employed in secondary and tertiary sectors. Accordingly, we also explore how worldwide demand complementarities influence the patterns of trade and industrialization between countries differing in the size and growth of their labor force.

To our knowledge, the papers most closely related to our study are those by Matsuyama (2000) and Mitra and Trindade (2005). Both papers acknowledge the importance of non-homothetic preferences, and therefore income distribution. Matsuyama incorporates international demand complementarities in a Ricardian model à la Dornbusch *et al.* (1977). The assumed pattern of comparative advantage leads the technological leader to completely specialize in goods with higher income elasticities of demand, whereas the developing country exports more basic goods. Matsuyama then discusses the impact of market size and technology differences on trade flows. However, by adopting a Ricardian framework, he considers neither international competition nor demand complementarities as a source of scale economies. The same limitation applies to Mitra and Trindade's contribution which adopts a 2×2 Heckscher-Ohlin framework where trade partners are identical in every respect except for their income distribution. With homothetic preferences, this means that a move from autarky to free trade has no consequence on either of the trade partners. With non-homothetic preferences though, the more unequal (equal) country has a higher demand for the labor- (capital-) intensive good which, by assumption, is characterized by a lower (higher) income elasticity of demand. This yields 'specialization in consumption, not production'. None of these contributions identifies the increased multiplier and scale effects that may accompany the emergence of a global middle class.

The paper proceeds as follows. Section 2 presents the model. Section 3 describes the world general equilibrium under trade. Our main results are de-

rived in Section 4, which analyses the impact of asymmetries in, successively, (i) income inequality, (ii) labor productivity level, and (iii) population size on the global industrial activity, trade flows, real average incomes and consumer welfare. We also investigate the impact of a change in labor productivity and labor supply. Section 5 concludes.

2 The Model

Our model is a two-country framework, 1 and 2, where subscripts i, j, are used as non specific references to 1 and 2 ($\{i, j\} = \{1, 2\}$).

2.1 Preferences

Households are heterogeneous with respect to the utility they incur from buying domestic or foreign varieties of a given good. First, we attach a relative value m_i to each household, which measures the utility from purchasing a good produced in country i. Secondly, we define a utility function of a type-m household over an infinite continuous range of potential goods $q \in (0, \infty)$, where goods are ordered according to decreasing priority $(1+q)^{-1}$. Following Armington (1969) and as reflected in the empirical results obtained by Broda and Weinstein (2006), each good q is differentiated on the basis of the country of origin:

$$V_m = \int_0^\infty (1+q)^{-\sigma} \left[m_i^\delta X_i^q + m_j^\delta X_j^q \right] dq, \; i \neq j, \tag{1}$$

with σ and δ being parameters that respectively measure the degree of substitutability between goods produced within each economy and for a given good q produced in different trade partners. X_i^q and X_j^q are indicator functions which take the form

$$\begin{aligned} X_i^q &= \begin{cases} 1 \text{ if the household buys country } i\text{'s variety of good } q \\ 0 \text{ if the household buys country } j\text{'s variety of good } q \end{cases}, \\ \text{and } X_j^q &= 1 - X_i^q. \end{aligned}$$

Thus, there is non-homotheticity in preferences and a household's utility increases with diversity and not with the consumption of a single good q. The proportion of income that households spend on lower-indexed goods, or

equivalently, on goods with lower income elasticities of demand, decreases with the household's income. Richer households can consume more than the bundle of goods available to poorer households. Furthermore, a single household is not allowed simultaneous consumption of both rival varieties of the same good q.

For a type-m household, preference for domestic or foreign varieties is described by the marginal utility $m^{\delta}/(1+q)^{\sigma}$, with goods with lower income elasticities of demand being more desirable. Specifically, the country i-product variety of good q will be preferred if

$$\frac{(m_i)^{\delta}}{p_i^q} > \frac{(m_j)^{\delta}}{p_j^q} \Leftrightarrow m_j < \frac{(p_j^q)^{1/\delta}}{(p_i^q)^{1/\delta} + (p_j^q)^{1/\delta}},\ i \neq j, \tag{2}$$

with $m_i = 1 - m_j$ being a random variable from a uniform distribution on the interval $(0, 1]$ which by assumption is independent of q, and where p_i^q is the price of good q produced in country i. In particular, if $p_i^q > p_j^q$, i.e., the price of good q produced in country i is greater than the price of its direct rival produced in j, and $\delta = 0$, all households are better off by acquiring good q produced by the industry located in country j. That is, all households opt for the cheapest variety. On the other hand, suppose that $\delta \to \infty$, then whatever p_i^q and p_j^q, households tend to purchase equal amounts of the different varieties of good q, the world population being divided equally into households which prefer the goods produced in country i and those which prefer goods produced in country j. Thus, the higher δ is, the lower is the degree of substitutability. That is, the more households settle on their most preferred variety of good q independently of the terms of trade.

2.2 Technology

Human capital (h) is the only input in production. The stock of human capital (the total effective labor force) in country i is equal to $\overline{h}_i L_i$, where L_i is the size of the labor force and $\overline{h}_i$ is the average level of human capital. In each country, two technologies are available to produce each variety of good. One technology is assumed to exhibit constant returns to scale (CRS). It requires α/A_i units of human capital, with $\alpha > 1$, to produce one unit of good q. A_i acts as an index of efficiency of the labor force in country i and

differs by a uniform amount across trade partners[4].

The alternative technology is characterized by increasing economies of scale (IRS). Specifically, it requires a fixed setup of F/A_i units of human capital and $1/A_i$ units of human capital to produce one unit of good q. A firm switching from the CRS to the IRS technology is used as a metaphor for industrial modernization and *vice versa*. Note that all firms in each country may serve both their domestic and export market.

2.3 Income Inequality and the Budget Constraint

Households are not only heterogenous with respect to their preferences for domestic and foreign goods. They also differ in terms of their income. Following MSV, we assume that there is an exogenous nondegenerate distribution of assets $G_i(\gamma)$ in each country with $\gamma \in [\underline{\gamma}_i, \infty[$ and $\underline{\gamma}_i \geq 0$, the minimum share of ownership. In our framework, $\underline{\gamma}_i$ acts as a threshold which can be interpreted as the poverty line above which one finds two categories of household, namely, the middle class and the upper class, who can spend on non-essential goods produced in tradable secondary and tertiary sectors.

We define a class γ of households' income in country i (y_i^γ) as follows

$$y_i^\gamma = \gamma(w_i \overline{h}_i L_i + \pi_i) \ \forall i, \tag{3}$$

where π_i denotes aggregate profits, w_i is the wage per unit of human capital and γ denotes the degree of capitalism, or, more specifically, the extent of ownership of all profit-making firms located in country i held by type-γ households. $G_i(\gamma)$ thus describes asset inequality which is further assumed (for analytical convenience) to be perfectly correlated with the distribution of the human capital endowment.

The budget constraint of a household in country i with share ownership γ is given by

$$\int_0^{q^\gamma} (\sum_j p_j^q X_j^q) dq = \gamma(w_i \overline{h}_i L_i + \pi_i), \text{ for } j = 1, 2 \text{ and } \forall i. \tag{4}$$

[4]We follow Trefler (1995): Technological differences across trade partners take a simple multiplicative form and are common across sectors. Because we focus on profit–multiplier effects associated with global demand complementarities, we differ from Matsuyama (2000), by making abstraction of supply-side effects associated with comparative advantage; that is, $A_i(q)/A_j(q)$ is identical for all q.

3 International General Equilibrium

3.1 Effective Demand Size and Minimum Efficient Scale

If good q is produced with the CRS technology in country i and the market structure of industry q is competitive, then the free entry zero-profit condition ensures that the price of good q is equal to average cost, i.e., $p_i^q = \alpha w_i / A_i$. On the other hand, if good q is produced with the IRS technology then this can be adopted by only one firm and only if the demand for country i's variety of good q (denoted by D_i^q) enables it to cover fixed costs. The market structure for that industry q located in country i is then monopolistic and the optimal price strategy is the autarky price. Furthermore, it is assumed that the price of any good q produced in country i, is identical whatever the market structure[5]. A key implication is that trade between countries of different size and/or factor efficiency can be closely related to a standard world price equilibrium along the lines of a Ricardian model.

This framework yields the following break-even condition: A good q in country i is produced with the IRS technology if

$$\frac{(\alpha-1)w_i}{A_i} D_i^q - \frac{F w_i}{A_i} \geq 0 \Leftrightarrow D_i^q \geq \frac{F}{\alpha - 1}, \forall i, \tag{5}$$

with the minimum efficient scale defined by $D_i^* = F/(\alpha - 1)$.

Let q_i^* denote the good produced at that minimum efficient scale in country i. Then, industries which produce lower- (higher-) indexed goods, i.e., goods with lower (higher) income elasticities of demand than q_i^*, use IRS (CRS) technologies. First, q_i^* is thus a measure of the extent of industrialization in country i. Secondly, in each economy, there is a customer base which can potentially contribute to increasing the profits of the inframarginal industries located in country i and which is defined by the mass of households whose share ownership is smaller than γ_{ii}^* and γ_{ij}^* in country i and j, respectively. The global middle class by country i standards combines these two groups of households. (From now on, when two subscripts are attached to a variable, the former identifies the country of origin of the good while the

[5] This requires assuming a range of plausible values for the different parameters so that the price elasticity of demand for any good q produced in country i is smaller than one. Notice that because $p_i^q = \alpha w_i / A_i$, pro-competitive gains from trade are also ruled out (see Appendix for details).

latter denotes the country in which the household is located.) Specifically, from (4), γ_{ii}^* and γ_{ij}^* can be defined by

$$\begin{aligned} q_i^* &= \frac{\gamma_{ii}^*(w_i\overline{h}_iL_i+\pi_i)}{p_i} = \frac{A_i}{\alpha}\gamma_{ii}^*\left(\overline{h}_iL_i+\frac{\pi_i}{w_i}\right), \forall i, \\ &= \frac{\gamma_{ij}^*(w_j\overline{h}_jL_j+\pi_j)}{p_i} = \frac{A_j}{\alpha}\frac{p_j}{p_i}\gamma_{ij}^*\left(\overline{h}_jL_j+\frac{\pi_j}{w_j}\right), i\neq j. \end{aligned} \tag{6}$$

All households in country i or j characterized by γ_{ii}^* or γ_{ij}^*, are able to consume q_i^*; they have similar purchasing power in terms of goods produced in country i. However, for each economy, there is also a mass of households in country i and j denoted respectively N_{ii}^* and N_{ij}^* who could potentially acquire good q_i^* plus some higher-indexed goods produced with the CRS technology in country i. By country i standards, the global upper class which combines N_{ii}^* and N_{ij}^* is defined as follows:

$$\begin{aligned} N_{ii}^* &= L_i(1-G_i(\gamma_{ii}^*)), \forall i, \\ N_{ij}^* &= L_j(1-G_j(\gamma_{ij}^*)), i\neq j. \end{aligned} \tag{7}$$

On the one hand, a country i's population can be divided into two distinct groups of households of different size: (i) those who have enough buying power to purchase all goods produced in country i with increasing returns production technologies ($q\leq q_i^*$) plus some more goods with higher income elasticities of demand than q_i^* which are produced with the CRS production technology ($\gamma>\gamma_{ii}^*$), and (ii) those poorer households which cannot acquire such a range of goods ($\gamma<\gamma_{ii}^*$). On the other hand, a country i's population can also be divided into (iii) these households who are rich enough to buy all goods produced in country j with IRS technologies ($(0,q_j^*)$) plus some more luxury goods which are produced with the CRS technology ($\gamma>\gamma_{ji}^*$) and (iv) poorer households which cannot ($\gamma<\gamma_{ji}^*$). Or, put differently, a household of type γ in country i may be rich enough relative to its own country to belong to the upper class although from a global perspective it belongs to the middle class.

The income elasticity of goods produced in country i with IRS technologies is equal to zero for households whose income is greater than $\gamma_{ii}^*y_i$ in country i, respectively $\gamma_{ij}^*y_j$ when they live in country j. Indeed, an increase

in the richest households' income will be spent on goods with the highest income elasticities of demand which are produced with constant returns production technology. Therefore, households which contribute to increasing industrial profits in country i are those which have income smaller than $\gamma_{ii}^* y_i$ in country i, respectively $\gamma_{ij}^* y_j$ in country j.

Finally, given (2), the proportion of households in the world which consume country i-products is

$$\lambda_i = \frac{p_j^{1/\delta}}{p_i^{1/\delta} + p_j^{1/\delta}} \Leftrightarrow \frac{p_i}{p_j} = \left(\frac{1-\lambda_i}{\lambda_i}\right)^{\delta}, \forall i \neq j. \tag{8}$$

Note that $1 - \lambda_i$ is also the proportion of income in country i spent on imported products. Consequently, the width of the market for the producer of q_i^* depends on both the terms of trade and the size of the global upper class. It is given by

$$D_i^* = \lambda_i \sum_j N_{ij}^* = \frac{F}{\alpha - 1}, \text{ for } j = 1, 2 \text{ and } \forall i. \tag{9}$$

3.2 Profits and the Trade Balance

The profit function in country i is

$$\pi_i = (\alpha - 1)\frac{w_i}{A_i}\int_0^{q_i^*} D_i^q dq - \int_0^{q_i^*} w_i \frac{F}{\alpha} dq,$$

with the demand for good q produced in country i defined by

$$D_i^q = \sum_j D_{ij}^q = \lambda_i \sum_j L_j (1 - G_j(\gamma_{ij}^q)), \tag{10}$$

and $\gamma_{ij}^q = p_i q/(w_j \overline{h}_j L_j + \pi_j)$.

Using (6) and (7), the above expression for profits can be integrated by change of variable and then by parts to yield

$$\frac{\pi_i}{p_i} = \frac{\alpha - 1}{\alpha}\lambda_i \left[\sum_j \frac{T_{ij}(w_j \overline{h}_j L_j + \pi_j)}{p_i}\right], \tag{11}$$

with $T_{ij} = L_j \int_{\underline{\gamma}_j}^{\gamma^*_{jk}} \gamma dG_j(\gamma)$ denoting the share of income held by this middle class living in country j which could potentially contribute to increase profits made by industries in country i. Thus, country i profits depend on (i) middle class real income in both trade partners expressed in terms of the price of country i-products, $T_{ij}(w_j\overline{h}_j L_j + \pi_j)/p_i$, and (ii) the proportion of the global middle class which consumes i-products (λ_i) multiplied by the markup, $(\alpha - 1)/\alpha$. In the open economy, the combination of a large global middle class and price competitiveness sets the conditions for a relatively affluent consumer economy.

Our model is static and ignores international borrowing and lending. Therefore, balanced trade requires

$$p_i \int_0^\infty D^q_{ij} dq = p_j \int_0^\infty D^q_{ji} dq \Leftrightarrow \lambda_i(w_j\overline{h}_j L_j + \pi_j) = (1 - \lambda_i)(w_i\overline{h}_i L_i + \pi_i),\ i \neq j. \tag{12}$$

In other words, expenditure on goods produced in country i by households living in country j (left-hand side) equals expenditure on goods produced in country i by households living in country j (right-hand side). Because of Walras' Law, the clearing condition in (12) also ensures equality of demand and supply of labor within each trade partner.

Substituting the balanced trade condition (12) into the profit expression (11) yields profits per wage unit

$$\frac{\pi_i}{w_i} = \frac{\frac{\alpha-1}{\alpha}\overline{h}_i L_i \left[\sum_j \lambda_j T_{ij}\right]}{1 - \frac{\alpha-1}{\alpha}\left[\sum_j \lambda_j T_{ij}\right]}. \tag{13}$$

In the integrated world equilibrium, total profit per wage unit consists of the numerator times the global profit-multiplier

$$M_i = \frac{1}{1 - \frac{\alpha-1}{\alpha}\left[\sum_j \lambda_j T_{ij}\right]} > 1. \tag{14}$$

In autarky, all profits that are distributed to the domestic middle class return as demand addressed to the home sectors. This implies the multiplier $M_i = 1/(1 - \frac{\alpha-1}{\alpha}T_i)$ in country i with $T_i = L_i \int_{\underline{\gamma}_i}^{\gamma^*_i} \gamma dG_i(\gamma)$ and γ^*_i the marginal household under autarky and by country i standards such that

$F/(\alpha-1) = L_i(1-G_i(\gamma_i^*))$. In an open economy where domestic industries face foreign competition, domestic real income becomes a component of demand for both the home and the foreign producers of imperfect substitutes. As a consequence, a domestic firm may earn either higher or lower profits under free trade.

We represent by L_i^{IRS} the amount of labor employed in country i firms with access to IRS technology and which produce $\int_0^{q_i^*} D_i^q dq$ (from which we omit labor required to start production $FA_i^{-1}q_i^*$). An alternative measure of industrialization (in terms of employment) is thus defined by

$$L_i^{IRS} = \lambda_i \sum_j \left(\gamma_{ij}^* N_{ij}^* + T_{ij}\right) \left(\frac{A_j}{A_i}\frac{p_j}{p_i}\frac{\left(w_j \overline{h}_j L_j + \pi_j\right)}{\alpha w_j}\right). \tag{15}$$

Finally, combining the balanced trade condition in (12) and the definition of q_i^* as provided by (6) yields the following relationship linking the degree of capitalism of marginal consumers in both trade partners for goods produced in country i:

$$\gamma_{ii}^* = \frac{1-\lambda_i}{\lambda_i}\gamma_{ij}^*,\ i \neq j. \tag{16}$$

With trade, equations (7), (8), (9), (13) and the market clearing condition (12) determine the international general equilibrium. This can be derived by simultaneously solving the following

$$\begin{aligned} \frac{F}{\alpha-1} &= \lambda_i \left[L_i\left(1-G_i(\gamma_{ii}^*)\right) + L_j\left(1-G_j(\gamma_{ij}^*)\right)\right] \\ &= \lambda_j \left[L_i\left(1-G_i(\gamma_{ji}^*)\right) + L_j\left(1-G_j(\gamma_{jj}^*)\right)\right], \end{aligned} \tag{17}$$

$$\left(\frac{1-\lambda_i}{\lambda_i}\right)^{1+\delta} \frac{1}{1-\frac{\alpha-1}{\alpha}\left[\sum_j \lambda_j T_{ij}\right]} A_i \overline{h}_i L_i = \frac{1}{1-\frac{\alpha-1}{\alpha}\left[\sum_i \lambda_i T_{ji}\right]} A_j \overline{h}_j L_j. \tag{18}$$

Using (16), these jointly determine the unique (see Appendix) trade equilibrium values of γ_{ii}^*, γ_{ij}^*, γ_{jj}^*, γ_{ji}^*, $i \neq j$, and λ_i. As will become clear in the next section, (17) and (18) are very useful in comparative statics.

3.3 Per Capita Income, Welfare and Gains from Trade

The average productivity in country i is

$$\overline{y}_i = \frac{w_i \overline{h}_i L_i + \pi_i}{p_i L_i} = \frac{1}{1 - \frac{\alpha-1}{\alpha}\left[\sum_j \lambda_j T_{ij}\right]} \frac{A_i \overline{h}_i}{\alpha}, \tag{19}$$

where $A_i \overline{h}_i / \alpha$ measures real GDP per capita in country i without scale economies.

Given (1), (4), and (8), average welfare across each income class γ of households living in country i is

$$\overline{V}_i^{\gamma} = \frac{(1+q_i^{\gamma})^{1-\sigma} - 1}{1-\sigma} \int_{1-\lambda_i}^{1} (m_i)^{\delta} dm_i + \frac{(1+q_j^{\gamma})^{1-\sigma} - 1}{1-\sigma} \int_{0}^{1-\lambda_i} (1-m_i)^{\delta} dm_i. \tag{20}$$

Let us assume two identical countries. From (17) and (18), it is clear that there is a unique solution: $\lambda_i = 1/2$ and $\gamma_{ii}^* = \gamma_{ij}^* = \gamma_{jj}^* = \gamma_{ji}^*$, $\forall\ \delta$. The two economies share equally in total real output. The free trade equilibrium is similar to the no-trade equilibrium in terms of real income of all households of any type γ. The two equilibria only differ by the levels of welfare in autarky and under free trade which are determined by our ideal variety assumption. One can easily check that trade between two symmetric countries implies that gains in country i are positive and increase with δ:

$$\left[\int_0^{1/2} (1-m_i)^{\delta} dm_i + \int_{1/2}^{1} (m_i)^{\delta} dm_i\right] - \int_0^1 (m_i)^{\delta} dm_i > 0.$$

4 Comparative Statics

Letting $G_i(\gamma)$ be the Pareto income distribution in country i, we are now in a position to consider how international differences due to inequality, technology, or population size may produce either gains or losses from trade.

4.1 Differences in Income Distribution

In this section, countries 1 and 2 differ only by their distribution of share ownership and human capital endowments $G_i(\gamma)$, i.e., technology is the same

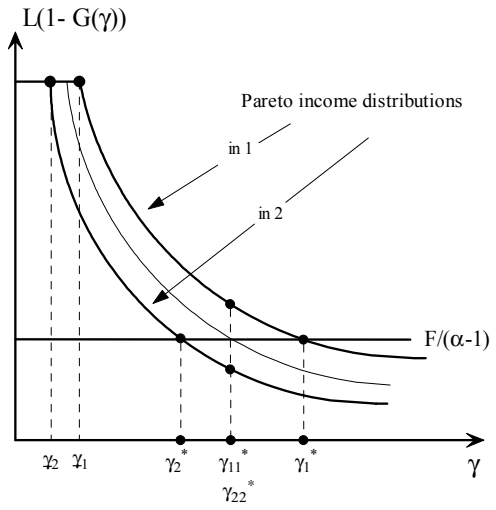

Figure 1: Pareto income distributions and share ownership in equilibrium with similar population size in both trade partners.

($A_1 = A_2$) and population is the same ($L_1 = L_2$). As depicted in Figure 1, country 1 (2) is characterized by a more (less) equal income distribution[6].

In the no-trade equilibrium, the more equal trade partner is characterized by a larger mass of households who are able to contribute to the domestic multiplier. We have $\gamma_1^* > \gamma_2^*$ which implies $T_1 > T_2$. Therefore, the profit-multiplier is higher in country 1 as is average productivity, which both depend positively on the proportion of income held by the domestic middle class. The proportion of production exploiting economies of scale and the proportion of the labor force it employs is also higher in country 1. These differences across countries simply reflect the observation by MSV: A large middle class encourages mass production, i.e., substitution of IRS technologies for CRS technologies, because it boosts the cumulative process.

[6]We specify $G_i(\gamma) = 1 - (\underline{\gamma}_i/\gamma)^{\beta_i}$ with $\beta_i > 1$ and $\gamma \geq \underline{\gamma}_i > 0$, where $\underline{\gamma}_i$ is the minimum share ownership of all domestic profit-making firms in country i. Note that $\int_{\underline{\gamma}_i}^{\infty} \gamma dG_i(\gamma) = 1/L_i$ which implies $\underline{\gamma}_i = (\beta_i - 1)/\beta_i L_i$. We thus have:

$$T_{ii} = L_i \int_{\underline{\gamma}_i}^{\gamma_{ii}^*} \gamma dG_i(\gamma) = 1 - \left(\frac{\beta_i - 1}{\beta_i L_i \gamma_{ii}^*}\right)^{\beta_i - 1}.$$

This allows us to construct Figure 1 where $\beta_1 > \beta_2$.

The shape of domestic income distributions as illustrated in Figure 1 allows us to define three distinct categories of products in each trade partner. Under autarky, we distinguish (i) a range of goods with lowest income elasticities $(0, \underline{q}_i)$ that all households from country i are able to purchase, (ii) an intermediate range of goods $(\underline{q}_i, q_i^*)$ which is acquired by the domestic middle class by country i standards, (iii) and a range of goods with higher income elasticities of demand $(q > q_i^*)$ that only rich households by country i standards $(\gamma > \gamma_i^*)$ can purchase, where

$$\underline{q}_i = \underline{\gamma}_i(w_i\overline{h}_iL_i + \pi_i) \text{ and } q_i^* = \gamma_i^*(w_i\overline{h}_iL_i + \pi_i) \ \forall i.$$

Note also that $\underline{\gamma}_2 < \underline{\gamma}_1$ implies $\underline{q}_2 < \underline{q}_1$. All country 2 households purchase the bundle of goods $(0, \underline{q}_2)$ while all households in country 1 can buy a larger range of goods, $(0, \underline{q}_1)$. Firms which produce goods $(\underline{q}_2, \underline{q}_1)$ may all have access to IRS technologies whether they are located in country 1 or 2. However, country 1 firms will have higher profits than their foreign counterpart because of the more equal income distribution in country 1. These profits which are distributed across households increase their buying power. The cumulative process is put in motion and demand spillovers lead a larger range of industries to be able to implement the IRS technology in country 1, i.e., $q_1^* > q_2^*$. *Ceteris paribus*, this yields

$$\begin{cases} D_1^q = L_1 = D_2^q = L_2 \text{ for } q \leq \underline{q}_2, \\ D_1^q = L_1 > D_2^q = L_2(1 - G_2(\gamma_2^q)) \text{ for } \underline{q}_2 < q \leq \underline{q}_1, \\ D_1^q = L_1(1 - G_1(\gamma_1^q)) > D_2^q = L_2(1 - G_2(\gamma_2^q)) \text{ for } \underline{q}_1 < q \leq q_1^*, \end{cases}$$

with $\gamma_i^q = p_iq/(w_i\overline{h}_iL_i + \pi_i)$, $i = 1, 2$.

The exposure of domestic industries to foreign competition modifies the customer base in each sector. Because labor productivity and the size of the labor force are identical across countries, real wages are equalized under free trade. In the absence of any bias in favor of the national variety, the simultaneous solution to (17) and (18) is $\lambda_1 = \lambda_2 = 1/2$. There are no longer two income distributions, but *one* world income distribution where each type-γ class of household spends its income equally on country 1 and 2 products. Given (16), it is easily verified that the integrated world equilibrium satisfies $\gamma_1^* > \gamma_{11}^* = \gamma_{12}^* = \gamma_{21}^* = \gamma_{22}^* > \gamma_2^*$ (see also Figure 1).

Thus, relative to autarky, country 2 sees its market increase and country 1 sees its market shrink. Free trade increases the multiplier and average

productivity in country 2 and decreases them in country 1 as economies of scale increase in the former and fall in the latter. Country 2 benefits from the relatively larger middle class in country 1. Under autarky, the more equal country benefits more from IRS and as a result has *ceteris paribus* a higher aggregate output. International trade and love of variety lead the cumulative processes to fall in the more equal country because demand spillovers are now international in scope.

Here is a crude example illustrating our point. Suppose that under autarky, there are four German middle-class households who can buy a Volkswagen. Two consumers are required to reach the minimum efficient scale in the industry. Ceteris paribus, if there is love of variety, free trade between Germany and France may lead two of them to buy a Renault. Suppose also that France is more equal, i.e., it has a larger middle class. There are six households in France who could buy a Renault under autarky. After a move from autarky to free trade, three of them may decide to acquire a Volkswagen. Eventually, both Renault and Volkswagen produce five cars each. In contrast, under autarky, the former produces six and the latter only four. As a consequence of trade integration, Renault's profits shrink while Volkswagen's profits rise.

Trade thus shifts domestic demand away from domestic goods and therefore weakens the multiplier in the more equal trading partner. The massive middle class in country 1 boosts industrialization in country 2. Notice that we have $\gamma_{11}^* < \gamma_1^*$ which implies $T_{11} < T_1$. Likewise, the proportion of income in country 2 which could potentially attract imports from firms using the IRS technology in country 1 is even smaller. Indeed, given that $\gamma_{11}^* = \gamma_{12}^*$, we have $T_{11} > T_{12}$, and, therefore, $(T_{11}+T_{12})/2 < T_{11} < T_1$. Thus, the *ceteris paribus* global multiplier for country 1 firms undergoes an erosion, and inframarginal firms close to the minimum efficient scale in autarky will switch to the CRS technology under free trade. Even though the upper class is larger in country 2, it only contributes to the demand for goods with the highest income elasticities of demand in country 1. Since they are produced with the CRS technology, their increased output cannot outweigh the decrease in the average productivity in country 1.

The opposite occurs in country 2. Consider a type-$\widetilde{\gamma}$ household living in country 2 with $\gamma_2^* < \widetilde{\gamma} < \gamma_{22}^*$. In autarky, this household can purchase all the goods produced with the IRS technology domestically plus some goods with higher income elasticities of demand. The latter are produced with the CRS technology in country 2 while they are produced with the IRS technology in

country 1. In the trade equilibrium, the larger middle-class size in country 1 boosts this type-$\widetilde{\gamma}$ household's purchasing power. All its spending is now a source of profit for a larger range of sectors whose firms use IRS technologies in either country 1 or country 2. This eases the constraint associated with the more unequal distribution of income in country 2 in terms of the fixed costs. Even though the type-$\widetilde{\gamma}$ household belongs to the upper class by country 2 standards under autarky, it becomes middle class by global standards under free trade. Furthermore, since $\gamma^*_{22} = \gamma^*_{21}$, we have $T_{22} < T_{21}$ which yields $(T_{22} + T_{21})/2 > T_{22} > T_2$. The benefits from trade for country 2 increase with the degree of equality in the income distribution in country 1.

Equations (19) and (20) are now used to solve the output and welfare levels of the two income classes. Because $A_1 = A_2$ and $L_1 = L_2$, both the world market share of domestic and foreign products and the preference parameter m of the marginal household which is indifferent to the domestic or the foreign variety, are equal to $1/2$. Neither the domestic nor the foreign demand for goods of either country is subject to national bias.

In country 2, all households favor trade independently of their relative standing on the domestic income scale and of their preference for domestic *versus* foreign goods. Indeed, in the trade equilibrium, all households can purchase a larger range of goods. Moreover, each household can pick its ideal variety of any good q. Thus a complementary source of positive gains from trade consists of gains from variety for half the population.

In country 1, $\lambda_1 = \lambda_2 = 1/2$ implies a decline of real consumption income. This hurts all households which now consume a smaller range of goods. Both varieties of each good q are offered at the same price, so for households which rate domestic goods higher than foreign goods, product variety is not a source of gains from trade. Free trade is welfare-reducing for these households. Those which prefer foreign products may not all be compensated by variety gains. In the light of (20), whatever the value of γ, the household which is indifferent to the domestic and foreign variety, i.e., $m_1 = m_2 = 1/2$, differs from the marginal household which prefers trade. Even though the mass of households is equally split between households which buy the domestic good and those which prefer the corresponding foreign substitute, less than half the population in country 1 favors trade. Specifically, across individuals of a given type γ, the proportion of households which are either better or worse off after integration depends positively on δ. The higher δ, i.e., the lower the degree of substitutability across similar goods produced at home and abroad, the more the gains from variety outweigh the losses in the range of goods they

can purchase under free trade.

4.2 Differences in Technology

Next we discuss the relationship between international demand spillovers and industrial activities' growth (or decline) among economies that differ only by their labor efficiency, i.e., $G_1(\gamma) = G_2(\gamma)$ and $L_1 = L_2$. In this section, country 1 has a technological advantage in producing all goods: $A_1 > A_2$.

4.2.1 From Autarky to Free Trade

In autarky, country 1's average productivity is larger, not because of a greater multiplier, but because of greater efficiency. Hence, in terms of the number of sectors where IRS technologies are implemented and of the proportion of the labor force they employ, country 1 does better than country 2. If both countries share the same income distribution and population size, we have $\underline{\gamma}_1 = \underline{\gamma}_2$ and $\gamma_1^* = \gamma_2^*$ which implies $T_1 = T_2$. In contrast to the previous experiment, each country 1's household has a higher purchasing power which does originate from higher productivity and not from a larger domestic profit-multiplier. The type-$\underline{\gamma}_1$ household can therefore purchase a larger range of goods $\underline{q}_1 > \underline{q}_2$. As a consequence, the cumulative process yields $q_1^* > q_2^*$ and, as a result

$$\begin{cases} D_1^q = L_1 = D_2^q = L_2 \text{ for } q \leq \underline{q}_2, \\ D_1^q = L_1 > D_2^q = L_2(1 - G_2(\gamma_2^q)) \text{ for } \underline{q}_2 < q \leq \underline{q}_1, \\ D_1^q = L_1(1 - G_1(\gamma_1^q)) > D_2^q = L_2(1 - G_2(\gamma_2^q)) \text{ for } \underline{q}_1 < q, \end{cases}$$

where $\gamma_i^q = p_i q/(w_i \overline{h}_i L_i + \pi_i)$, $i = 1, 2$. Thus, country 1 produces a higher quantity of all goods characterized by higher income elasticities of demand than $\underline{q}_2$. This implies a smaller proportion of goods with lower income elasticities of demand in country 1's aggregate output.

Note that the more the labor force in country 1 is efficient in producing goods, the more competitive are firms located in country 1. Eventually, the trade equilibrium is obtained when excess demand in the two countries is equal and opposite. Figure 2 illustrates the simultaneous solution to (17) - left-hand quadrant, and (18) - right-hand quadrant. When both trade partners share the same Pareto income distribution, i.e., $\beta_i = \beta_j = \beta$,substituting (17) into (18) yields

$$\frac{M_j}{M_i}\frac{L_j}{L_i}\left(\frac{\lambda_i}{1-\lambda_i}\right)^{1+\delta} - \frac{A_i\overline{h}_i}{A_j\overline{h}_j} = 0,\ i \neq j, \tag{21}$$

with $\sum_j \lambda_j T_{ij} = 1 - (F/(\alpha-1))^{(\beta-1)/\beta}\Phi(\lambda_i)^{1/\beta}$ for $j = 1, 2$, and $\Phi(\lambda_i) = \lambda_i L_i^{1-\beta} + (1-\lambda_i)^{\beta}\lambda_i^{1-\beta}L_j^{1-\beta}$.

First, some algebra shows that the above market clearing condition is monotonically increasing with respect to λ_i, therefore ensuring that the trade equilibrium is unique whatever $\beta > 1$. Secondly, the implicit function theorem yields $\partial\lambda_i/\partial(A_i/A_j) > 0$.

As shown in the right-hand quadrant of Figure 2, balanced trade requires a terms-of-trade adjustment against the more advanced country, meaning that the fraction of world income spent on goods produced in country 1 (λ_1) increases with the widening of the technological gap (A_1/A_2). Under free trade, the more competitive trade partner thus captures a larger share of the whole range of global markets.

The left-hand quadrant of Figure 2 depicts (17) for country 1 and 2, and the free trade equilibrium values of γ_{11}^*, γ_{12}^*, γ_{22}^*, γ_{21}^*, obtained by simultaneously solving (17) and (18). For $i = 1, 2$ and using (16), (17) can be rewritten

$$\gamma_{ii}^* = \frac{\beta-1}{\beta}\left(\frac{\alpha-1}{F}\right)^{1/\beta}\Phi(\lambda_i)^{1/\beta}, \tag{22}$$

with $\Phi(0) = \infty$, $\Phi(1) = L_i^{1-\beta}$, and $\Phi(L_i/(L_i+L_j)) = L_i^{1-\beta}$.

First, if and only if $d\Phi(\lambda_i)/d\lambda_i \lesseqgtr 0$, we have $\partial\gamma_{ii}^*/\partial\lambda_i \lesseqgtr 0$. Given that $d^2\Phi(\lambda_i)/d\lambda_i^2 > 0$, $\Phi(\lambda_i)$ is therefore characterized by one minimum. Secondly, the type of the marginal household in the no-trade equilibrium is given by

$$\gamma_i^* = \frac{\beta-1}{\beta}\left(\frac{\alpha-1}{F}\right)^{1/\beta}L_i^{(1-\beta)/\beta},$$

which allows us to conclude that

$$\lambda_i \lesseqgtr \frac{L_i}{L_i+L_j} \Rightarrow \Phi(\lambda_i) \gtreqless L_i^{1-\beta} \Rightarrow \gamma_{ii}^* \gtreqless \gamma_i^*. \tag{23}$$

It is then easily checked that Equations (6), (14), and (15) yield

$$\frac{\partial q_i^*}{\partial\gamma_{ii}^*} > 0, \qquad \frac{\partial M_i}{\partial\gamma_{ii}^*} < 0, \qquad \frac{\partial L_i^{IRS}}{\partial\gamma_{ii}^*} < 0.$$

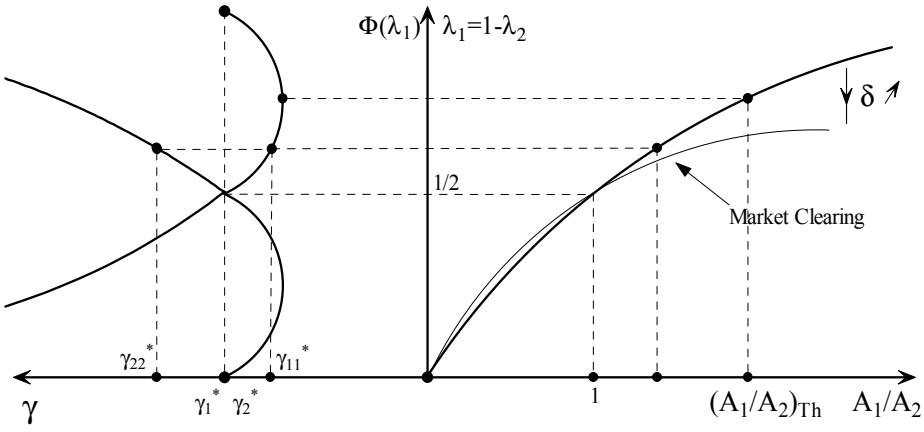

Figure 2: International equilibrium with differences in technology.

We are now in a position to derive the consequences of a move from autarky to free trade in both countries. First, global demand complementarities exacerbate international disparities. We have $\gamma_{11}^* < \gamma_1^*$ ($\gamma_{22}^* > \gamma_2^*$) which implies an increase (decrease) in country 1 (2)'s multiplier. This leads country 2 to fall even further behind country 1. In terms of average productivity (see (19)), trade penalizes the economy with the less efficient labor force and favors the technically more advanced country. In the lagging trade partner, there is a decline in the aggregate output of firms with access to IRS technology brought about by terms of trade adjustments. Overall, the opening to trade raises the proportion of the labor force employed by firms with access to IRS technology in the advanced economy while it shrinks in the backward country. Secondly, because real income is unevenly distributed across households, the deterioration in the latter is not uniform across sectors. Some are affected negatively while others are affected positively. In fact, q_2^* rises because country 2's firms which produce goods with relatively higher income elasticities of demand benefit from country 1's middle-class buying power. Thus, trade integration leads the technically backward country to diversify its domestic production activities using IRS technologies to meet the demand of country 1's middle class. Nevertheless, this is at the expense of fully exploiting its IRS activities at the aggregate level.

Even though the following example does not tell the whole story, it gives

a hint of the mechanisms at work. Suppose all Chinese and European households can buy a TV which is the big home appliance in households' preferences. But only the upper middle class in Europe can buy toys for their children and only rich European households go abroad for tourism. If European firms are more competitive, i.e., produce cheaper varieties, they should have a higher than half share of the world market. European firms which produce TVs then realize larger scale economies in the integrated market. Balanced trade or equivalently, labour markets clearing, means that the toy industry's activity shrinks in Europe while it may switch from CRS to IRS in China. Toys can now be exported to satisfy the European demand. Suppose that tourism uses CRS technologies in both countries. When tourism in China expands, thanks to the European upper class, it neither contributes to increasing the multiplier in China, nor does it penalise the multiplier in Europe.

More specifically, when $A_1 > A_2$, markets clear with $\lambda_1 > 1/2$. Country 1 producers of goods with the lowest income elasticities of demand must now meet demand from more than half the most crowded part of the global income distribution since all households in both countries are able to buy such goods. These producers in country 1 will therefore produce at a more efficient scale. Specifically, free trade leads $D_1^q = \lambda_1(L_1 + L_2) > L_1$ to be greater than $D_2^q = (1-\lambda_1)(L_1+L_2) < L_2$ for all $q \leq \underline{q}_2$. These producers earn higher profits from their sales to a larger customer base, which are eventually distributed across country 1 households, enhancing their purchasing power. This in turn implies a contraction of these industries in country 2. On the other hand, labor market equilibrium requires that increased demand for lowest income elasticity goods produced in country 1 drives labor out of its industries which produce goods with higher income elasticities of demand into industries which produce goods with lower income elasticities of demand. This slows down the switch to IRS technology in those sectors that produce goods with high income elasticities of demand. However, the trade-induced rise in the profit-multiplier produces gains in the winning industries exceeding the losses of the losers. Conversely, labor moves in country 2 from lower- to relatively higher-indexed industries q to meet higher demand from country 1's middle class.

Even more to the point, the terms of trade under free trade ($\lambda_1 > 1/2$) lead in country 1 to $\gamma_{12}^* > \gamma_1^* > \gamma_{11}^*$ which in turn yields $T_{12} > T_{11}$. The proportion of income which may potentially buy goods produced in country 1 using the IRS technology is greater in country 2 than in country 1. Put

differently, given (7), type-γ_{12}^* households in country 2 have a purchasing power similar to that of type-γ_{11}^* households in country 1. Therefore, there is a proportion λ_1 of $L_2G_2(\gamma_{12}^*)$ and $L_1G_1(\gamma_{11}^*)$, where $L_2G_2(\gamma_{12}^*) > L_1G_1(\gamma_{11}^*)$, which contributes to increase profits in country 1 firms with access to IRS technology. If the type-γ_{12}^* household is rich by country 2 standards, its spending pattern is similar to that of the middle class in country 1. In the integrated world equilibrium, a large proportion of the population in country 2 contributes to boosting the production of goods with low income elasticities of demand produced in country 1, at the expense of their less competitive counterparts in country 2. In country 2, we have $\gamma_{21}^* < \gamma_2^* < \gamma_{22}^*$ which yields $T_{21} < T_{22}$. If the type-γ_{21}^* household can be considered lower middle class in country 1, it is at the top of the distribution in country 2, i.e., rich in the global context. However, there is only a proportion $\lambda_2 < 1/2$ of $L_1G_1(\gamma_{21}^*)$, where $\gamma_{21}^* < \gamma_{11}^*$, and $L_2G_2(\gamma_{22}^*)$, where $\gamma_{22}^* < \gamma_{12}^*$, which contributes to profits made by country 2 firms using IRS technologies.

Our model thus identifies a demand-side channel through which trade integration contributes to the gap for countries lagging behind the technological frontier. International trade dampens the local market-size externalities formalized by MSV. Relative to autarky, country 2 sees its markets shrink for goods with lower income elasticities of demand. The *quid pro quo* in our model is that there are demand spillovers from the advanced economy to those sectors in the backward trade partner which produce goods with relatively higher income elasticities of demand, thanks to the relatively high middle-class purchasing power in the advanced economy.

In country 2, free trade introduces more competitive foreign industries generating the famous infant industry argument. This was sometimes used in Brazil in the 1960s and 1970s and in India for most of the second half of the twentieth century to pursue import-substitution policies relying on their enormous domestic market to modernize their industries. On the other hand, South Korea industrialized in the 1960s and 1970s by committing to an export-led growth strategy to compensate for its limited domestic demand. What is common to both strategies is the fixing of prices instead of letting them adjust to the free play of market forces (see, for instance, Chapter 17 of the excellent book on development economics by Debraj Ray, 1998).

We now discuss welfare gains from trade. First, the terms of trade adjustment and the degree of substitutability δ determine the proportion of world demand addressed to each sector and, therefore, the growth or decline of average productivity. Secondly, according to their preferences and relative

price, households may choose their 'ideal' variety produced either at home or abroad. In country 1, average productivity increases. Since more than half the population buys domestic varieties, a majority gains from trade. To this proportion $\lambda_1 > 1/2$, one must add a positive proportion of the remaining population for which gains from variety more than outweigh the loss of purchasing power incurred by the higher relative price of the imported variety. In contrast, average productivity decreases in country 2. This loss is only partially offset by the gains from variety and by access to cheaper goods from abroad. Finally, Figure 2 also illustrates comparative statics with δ. For a given technological gap, the lower the degree of substitutability the closer λ_1 is to $1/2$. That is, the lower the predilection for the cheapest variety the higher the gains from variety in both trade partners.

These are the static welfare gains associated with trade. A factor terms-of-trade improvement in the lagging trade partner enables us to understand trends in the growth or decline of various sectors which produce goods with different income elasticities of demand.

4.2.2 Technological Catch-up, International Competitiveness and Free Trade

We are able to trace out the consequences of the technically backward partner (country 2) narrowing its gap. In this scenario, an increase in country 2's labor productivity yields a higher global profit-multiplier in country 2 which further boosts average productivity. Conversely, if A_1/A_2 is below some threshold, the global multiplier in country 1 and average productivity suffer. Country 1 IRS firms producing goods with lower income elasticities of demand now produce at a less efficient scale because of a smaller world market share. However, the rise in average productivity in country 2 spills over to country 1 sectors producing goods with high income elasticities of demand. If the relative share of IRS firms' production in total output decreases, there is also an increase in the number of country 1 firms that are able to implement the IRS technology when country 2 catches up with the technological frontier. Indeed, technological catch-up in country 2 passes on the associated cost savings to the global middle class, which spurs demand for other products. Thus, Country 2 gains ground compared to country 1. All its sectors expand production and each of them grows faster than its foreign counterpart.

Even though world production remains geographically concentrated in

country 1, technological catch-up induces a reversal in specialization, relative to the above baseline. Country 2 increases both its share of production and its share of exports in goods with lower income elasticities of demand. This result can be explained by noting that an increase in A_2 requires a relative fall in the prices of country 2 goods to keep trade between the two countries in balance. Recall that $\partial\lambda_1/\partial(A_1/A_2) > 0$, a productivity improvement in country 2 reduces λ_1, the fraction of world income spent on goods produced in country 1. Moreover, the extent to which λ_1 decreases, i.e., the proportion of households in both trade partners which switch to country 2 goods, depends negatively on δ (see the right quadrant of Figure 2) and positively on falling costs in country 2. In country 1, the loss of competitiveness mostly harms producers of goods with low income elasticities of demand. Aggregate profits fall (γ_{11}^* increases and $\partial M_i/\partial\gamma_{ii}^* < 0$) but, because labor is perfectly mobile across sectors within the economy, the available labor pool increases for producers of goods with higher income elasticities of demand. This allows them to meet the rising demand from the emerging middle class by global standards in country 2. Inframarginal industries whose production level under autarky is close to the minimum efficient scale now attain larger scale economies. Some supramarginal industries even switch from CRS to IRS technology (γ_{11}^* increases and $\partial q_i^*/\partial\gamma_{ii}^* > 0$). Their profits increase *via* demand complementarities propagating increasing returns across borders, although not enough to counteract losses incurred by these industries which produce goods with low income elasticities of demand. This simply reflects the uneven distribution of income both within and across countries. Overall, a productivity increase in country 2 reduces country 1's total exports and alters its composition, favoring goods with higher income elasticities of demand.

Efficiency gains in country 2 allow its industries to sustain the rising demand for all the goods they produce. The larger customer base has two sources: (i) a larger share of world markets caused by the increase in λ_2, (ii) a larger world market due not only to country 2's labor productivity increase, but also to magnified international demand complementarities which raise international demand. All country 2's industries grow faster than their country 1 direct competitors. This ensures that, *ceteris paribus*, when the technological gap vanishes, both trade partners are absolutely symmetrical. The underlying mechanism relies on the fall in prices that accompanies productivity improvement. It eventually translates into an increase in the range of goods the emerging global middle class can purchase. At this stage, it is

interesting to draw a parallel between these results and the increasing share of world manufactured exports from China in nearly all categories since the Eighties. In the 1980s, China was exporting mainly clothing, footwear, and other light manufactures, but in the 1990s it increasingly diversified with especially rapid growth in office machinery, telecommunications, travel goods, and furniture (see IMF World Economic Outlook, 2004).

Going back to the above example, Chinese producers of television sets see their world market share increase. Their European competitors produce at a smaller scale which tightens their profits. This reduces the global profit-multiplier in Europe. More Chinese households now buy toys for their offspring and some of them even travel to Europe. The toy industry in Europe may switch back to IRS and tourism activity expands in Europe. But these gains cannot outweigh the losses incurred in the television set industry. Last but not least, cheaper priced goods combined with international demand spillovers also lead both Chinese and European IRS production to diversify in various sectors, e.g., by increasing the scale of the consumer electronics or motor vehicle industries, depending on the priority of such goods in households' preferences.

Not surprisingly, in contrast to the Ricardian model with non-homothetic preferences in Matsuyama (2000), a scenario of immiserizing growth in country 2 is impossible here. In his framework, country 2 specializes in goods with low income elasticities whose demand does not increase in response to the fall in prices. Thus, it may lose from its terms of trade deterioration following labor productivity improvement. In fact, the relatively cheaper goods imported from country 2 only provide the opportunity for rich households in country 1 to expand their consumption of goods with high income elasticity of demand that are only produced in country 1. The present model differs from Matsuyama's model in two respects. As previously mentioned, there is no complete geographic specialization. Second, depending on δ and the terms of trade, technical catch-up enables the lagging trade partner to expand its scale of output and attain markup opportunities which are ruled out in a Ricardian analysis. Therefore, country 2 cannot lose from its productivity improvement while its trade partner may either win or lose depending on the initial technological gap.

What is the intuition behind the ambiguous impact of technological catch-up in the technically more advanced trade partner? As shown in Figure 2 and given that $\partial M_i/\partial \gamma_{ii}^* < 0$, gains in factor efficiency in the lagging trade partner will strengthen the multiplier effect in the advanced country (γ_{11}^*

falls) when the initial technological gap is above some threshold ($(A_1/A_2)_{Th}$) but, when A_1 and A_2 are close enough together, the opposite will happen (γ_{11}^* increases). Note that before technological catch-up world demand for country 1 products is divided into three categories[7]: (i) a range of goods with lowest income elasticities of demand $(0, \underline{q})$ that all households from both trade partners are able to purchase, (ii) an intermediate range of goods $(\underline{q}, \overline{q})$ which is acquired by all country 1 households and a smaller proportion of country 2 households, (iii) a range of goods with higher income elasticities of demand that only rich enough households from either trading partner can purchase. As far as the first range of goods is concerned, the world demand for country 1 products falls as a result of the decrease in λ_1. The net impact on the second and third categories of increase in A_2 depends on the extent of two effects which shift demand for these products in opposite directions: (i) the decrease in the share of world income spent on goods produced by country 1 firms, and (ii) the increase in the global-middle-class (by country 1 standards) purchasing power.

4.3 Differences in Home Market Size

We now turn to an analysis of the effect of trade between economies which differ only by the size of their population, i.e., $G_1(\gamma) = G_2(\gamma)$ and $A_1 = A_2$. If China moves up the technology ladder to become an important competitor for mature industrialized countries, it also has the ability to retain its share of goods with low income elasticities of demand in the global marketplace, thanks to its reserves of labor in the agricultural sector. This may have an adverse direct impact on NIEs and ASEAN countries. However, it

[7]Let us define

$$\underline{q} = \left[\underline{\gamma}_j \frac{p_j \overline{y}_j L_j}{p_1}\right]^{\inf_{j=1,2}} \text{ and } \overline{q} = \left[\underline{\gamma}_j \frac{p_j \overline{y}_j L_j}{p_1}\right]^{\sup_{j=1,2}}$$

Substituting (4), (6) in (10), we obtain

$$D_1^q = \begin{cases} \lambda_1(L_1 + L_2) \text{ for all } q \leq \underline{q}, \\ \lambda_1 \left(L_1 + \left(\frac{\beta-1}{\beta}\frac{1}{L_2}\frac{y_2}{p_1 q}\right)^{\beta} L_2\right) = \lambda_1 \left(L_1 + \left(\frac{\beta-1}{\beta}\frac{L_1}{L_2}\frac{1-\lambda_1}{\lambda_1}\frac{\overline{y}_1}{q}\right)^{\beta} L_2\right) \text{ for all } \underline{q} < q \leq \overline{q}, \\ \lambda_1 \left(\left(\frac{\beta-1}{\beta}\frac{1}{L_1}\frac{y_1}{p_1 q}\right)^{\beta} L_1 + \left(\frac{\beta-1}{\beta}\frac{1}{L_2}\frac{y_2}{p_1 q}\right)^{\beta} L_2\right) = \left(\frac{\beta-1}{\beta}\frac{\overline{y}_1 L_1}{q}\right)^{\beta} \phi(\lambda_1) \text{ for all } q > \overline{q}. \end{cases}$$

also creates an important source of income for the emerging Chinese middle class, which may benefit NIEs and ASEAN. How do worldwide demand complementarities affect the patterns of trade and industrialization between countries of different labor force size and growth?

Let country 2 be the more populous country ($L_2 > L_1$). Because scale economies in autarky depend only on the local market size, country 2 will have higher average productivity and a larger number of IRS firms, employing a higher share of labor. Each country 2's industry also produces a greater quantity than its foreign counterpart ($D_2^q = L_2(1 - G_2(\gamma_2^q)) > D_1^q = L_1(1 - G_1(\gamma_1^q)), \forall q$). Can the larger market size of country 2 provide country 1 with the customer base which is missing locally?

Suppose there is an equal share of world income devoted to goods produced in each country, then there will be excess labor demand in country 1 requiring a terms of trade adjustment such that p_1/p_2 must be greater than one. To guarantee labor-market equilibrium in both trade partners, the proportion of households which consume country 1 goods (λ_1) must be less than 1/2. Interesting enough, λ_1 remains greater than $L_1/(L_1+L_2)$. Let country 1 import relatively cheaper varieties from country 2 in a proportion $1-\lambda_1$ with $\lambda_1 = L_1/(L_1 + L_2)$. For those households in country 1 which buy country 2 goods, this implies purchasing power gains which allow them to increase the range of goods they can import. Excess labor demand in country 2 results, which leads to an improvement in its terms of trade. Eventually, λ_1 rises above $L_1/(L_1 + L_2)$ which implies $\gamma_{11}^* < \gamma_1^*$ (see (23)). With $\partial M_i/\partial \gamma_{ii}^* < 0$, country 1's multiplier rises by opening to trade while the opposite holds true in country 2 where $\lambda_2 < L_2/(L_1 + L_2)$ which implies $\gamma_{22}^* > \gamma_2^*$.

In terms of average productivity, our framework predicts that international demand complementarities benefit the smaller trade partner. The intuition to why country 1 multiplier rises is that the trade-induced enlargement of demand for the small country's firms operating under IRS is biased towards sectors producing goods with lower income elasticities of demand, thanks to the large number of country 2's relatively poor households in the world distribution of income. Indeed, given (16), γ-income classes of households with similar purchasing power in terms of goods produced in country 1 (2), are such that $\gamma_{11}^* > \gamma_{12}^*$ ($\gamma_{22}^* < \gamma_{21}^*$). Since average productivity is greater in country 2, it implies $\gamma_{21}^* > \gamma_{11}^* > \gamma_{22}^* > \gamma_{12}^*$. If the type-$\gamma_{12}^*$ household is relatively poor by country 2 standards, it is middle class by country 1 standards. Given that $L_1 < L_2$, and $\lambda_1 > L_1/(L_1 + L_2)$, demand for goods $q < q_1^*$ produced by country 1 firms using IRS technologies is therefore higher

under free trade (see (10)), increasing profits in the corresponding sectors.

The counterpart in country 2 is that firms producing goods with higher income elasticities of demand can draw labor out of the sectors producing goods $q < q_1^*$. At the aggregate level, IRS production activities decrease in country 2 ($\partial L_i^{IRS}/\partial \gamma_{ii}^* < 0$) while, at the same time, firms which produce goods with relatively higher income elasticities of demand expand production. Some firms even switch to the increasing returns production technology ($\partial q_i^*/\partial \gamma_{ii}^* > 0$).

Eventually, the small country narrows its domestic IRS industrial activities to concentrate in higher-priority products niches, while the large country diversifies its production activities using IRS technologies. The share of exports of goods with lower (higher) income elasticities of demand in aggregate output is therefore higher in the small (large) country.

The change in the relative price of labor following an expansion in country 2's population is similar to an improvement in its labor efficiency. Terms of trade in country 2 must deteriorate to keep trade balanced, which yields an increase in λ_2. However, the accompanying drop in λ_1 is less than proportional to the change in $L_1/(L_1 + L_2)$. On the one hand, the effect on country 2's global multiplier is unambiguous: Its IRS firms must now serve a larger set of households because L_2 increases, and also because λ_2 grows relative to the above baseline to ensure labor markets equilibrium. Likewise, with a Pareto income distribution, Equation (6) yields $\delta q_i^*/\delta L_i^* > 0$ and $\delta q_i^*/\delta \gamma_{ii}^* > 0$. The positive impact of the increase in the labor force on the number of sectors which have adopted IRS technology may even offset the negative impact associated with the decrease in γ_{22}^*, resulting from the terms-of-trade deterioration in country 2.

On the other hand, the rise in country 2's population has an ambiguous impact on country 1's economy depending on whether γ_{11}^* goes up or down. If the fraction of world income spent on country 1 products (λ_1) falls, then world demand for country 1's products in the range $(0, \underline{q})$, i.e., $D_1^q = \lambda_1(L_1 + L_2)$, may nevertheless increase as a result of a larger world market. In fact, the lower the degree of substitution (δ), the less λ_1 decreases and the more the rise in L_2 contributes to the multiplier, raising average productivity in country 1. *Ceteris paribus*, this leads country 1 to specialize in goods with lower income elasticities of demand. Conversely, if δ is high enough so that D_1^q shrinks, then better terms of trade in country 1 along with higher average productivity in country 2 yield an increase in the aggregate demand for the other two categories of goods (see Footnote 7): $(\underline{q}, \overline{q})$ and $(\overline{q}, \infty)$. The intuition for

this result is again that λ_1 decreases less than proportionally with $L_1/(L_1 + L_2)$, thanks to international demand complementarities. Eventually, whether country 1's global multiplier increases or not depends on which firms are most affected by the changes in the global income distribution and in the terms of trade brought about by the rise in L_2.

5 Conclusion

The literature on international trade and development has concentrated on international technology spillovers (see, for instance, Keller 2004), but neglected international demand spillovers. Our contribution seeks to fill the gap. It is motivated by the emerging middle class in BRIC and its impact on smaller emerging countries as well as on advanced economies. This paper presents a many-industry and two-country general equilibrium model in which demand spillovers contribute to propagate scale economies both across industries and national boundaries. We relax the traditional assumption of homothetic preferences to focus on the role played by the global income distribution both in the international structure of production and in the trade pattern between countries that differ in size. Similarly to the strand of literature dealing with technical externalities, empirical work on this topic is now required to assess the importance of international demand spillovers at both aggregate and sectoral levels.

Our results raise additional questions which could be profitably addressed in the future. First, an important implication of our model is that income transfers have very different effects if they are across or within countries or if they occur within the leader or the follower economy. Let us consider a policy that would promote a more equal distribution in country i of an amount $\tau(w_i\overline{h}_i L_i + \pi_i)/L_i$ among all households in country i, where τ is the marginal tax rate. Let $\gamma^\tau = (1-\tau)\gamma + \tau/L_i$ denote the associated post-tax ownership share of a type-γ household. The redistribution eventually exerts a positive effect on the adoption of IRS technology in both trade partners, therefore demonstrating potential benefits of reducing both across- and within-country inequality.

Secondly, in the light of (8), a tariff (t) placed on imports from the industrialized country (i) modifies the relative price and the share of output in the technically backward country spent on imports. Equation (8) would be rewritten: $p_i(1+t)/p_j = ((1-\lambda_i)/\lambda_i)^\delta$, $i \neq j$. Type-γ marginal households

adjust to the imposition of such a tariff. This in turn affects the magnitude of the multiplier and average productivity in both trade partners. Returning to the infant industry argument discussed above, our model provides an explanation of why emerging countries should favor a reduction in both the level and dispersion of trade barriers to accompany labor productivity improvement. At this stage, we can only draw a parallel between our model's implication in terms of trade policy and the decrease in tariffs which has accompanied China's emergence, from an average of 39.9 in 1993 to 12.3 in 2002 while their dispersion fell from 29.9 to 9.1 over the same period (see IMF World Economic Outlook, 2004). As well as the exposure to foreign competition and the asymmetry in size between trade partners, our multi-sectors model also provides hints about a household's attitude towards trade depending on both its love of variety and its global economic status. We think it would be fruitful to investigate further such dimensions to evaluate trade policy issues. Mayda and Rodrik (2003) provide useful empirical evidence to start with about preferences over trade depending on (i) an agent's level of human capital, (ii) the trade exposure of the sector in which she is employed, and (iii) her relative economic status.

Finally, our contribution has focused mainly on the dichotomy between autarky and free trade. In particular, we investigate how booming company profits brought about by a global middle class buying power may promote international cumulative processes in the medium run. However, economic growth remains exogenous in our model. "Endogenous growth" models with either variety expanding or quality upgrading of products, which introduce differing income elasticities of demand for different goods have recently emerged in the literature. For example, Zweimüller (2004) and Foellmi and Zweimüller (2006) examine the impact of non-homothetic preferences and therefore inequality on innovation and consequent economic growth. Solow (2005) expresses some surprise at the lack of attention to the interaction of demand-side and supply-side variations, i.e., to economics of the medium run, within many-industry and multi-country growth frameworks. These interactions remain a valuable, open and empirically relevant issue to be addressed.

6 Appendix

6.1 International Price Equilibrium

This Appendix provides a proof that if country 1 firms adopting IRS technology in the no-trade model set prices simultaneously, then their unique Nash equilibrium price strategy in the open economy, takes the form

$$p_1^q = \frac{\alpha w_1}{A_1} \text{ if } \frac{\alpha - 1}{\alpha} \left[\frac{1}{\sigma} \left[\left[1 + \frac{\alpha}{\gamma_j L_j} \right] \left[\frac{g_j(\widetilde{\gamma}_{1j})\widetilde{\gamma}_{1j}}{1 - G_j(\widetilde{\gamma}_{1j})} \right] \right]^{\sup_{j=1,2}} + \frac{1}{\delta} \right] < 1,$$

with $g_j(\widetilde{\gamma}_{1j})$ the density of population of type-$\widetilde{\gamma}_{1j}$ households in country j. (A corresponding equation applies to country 2).

Proof. A single firm which produces q in country 1 cannot set a price higher than the competitive price ($\alpha w_1/A_1$) without losing its monopoly power. As a consequence, the question to be solved is whether a firm producing good q in country 1 may raise its profits (π_1^q) in the open economy by lowering the price below $\alpha w_1/A_1$. For the answer to be negative, the marginal profit should satisfy

$$\frac{\partial \pi_1^q}{\partial \widetilde{p}_1} = \frac{\partial \widetilde{D}_1^q}{\partial \widetilde{p}_1} \left(\widetilde{p}_1 - \frac{w_1}{A_1} \right) + \widetilde{D}_1^q > 0 \Leftrightarrow -\frac{\partial \widetilde{D}_1^q}{\partial \widetilde{p}_1} \frac{\widetilde{p}_1}{\widetilde{D}_1^q} \left(\frac{\widetilde{p}_1 - w_1/A_1}{\widetilde{p}_1} \right) < 1, \quad (24)$$

with $\widetilde{p}_1 < \alpha w_1/A_1$. $\widetilde{D}_1^q$ is the effective demand for good q produced in country 1 at $\widetilde{p}_1$, and prices chosen by other firms are kept constant at $\alpha w_1/A_1$. In other words, the product of the own price elasticity of demand and the price-cost margin should not exceed unity.

The monopolist's effective demand or *ex post* customer base may now be divided into two categories:

(i) households in both countries of type $m_1 \leq \lambda_1$; that is, households with marginal utility per unit price for variety q such that

$$(m_1)^\delta \frac{(1+q)^{-\sigma}}{\widetilde{p}_1} > (m_1)^\delta \frac{(1+\widetilde{q})^{-\sigma}}{p_1}.$$

Households characterized by $\gamma \geq \widetilde{\gamma}_{1j}$ with

$$\widetilde{\gamma}_{1j} = \frac{(\widetilde{p}_1)^{1/\sigma}(p_1)^{(\sigma-1)/\sigma}q - p_1}{w_j\overline{h}_jL_j + \pi_j},\ j = 1, 2,$$

now consume good q produced in country 1. For $\widetilde{p}_1 < p_1$, The marginal households in country j of good q produced in country 1 are poorer ($\widetilde{\gamma}_{1j} < \gamma_{1j}$), thus increasing the customer base.

(ii) households in both countries of type $\lambda_1 < m_1 \leq \widetilde{\lambda}_1$; that is households with marginal utility per unit price for variety q such that

$$(m_1)^{\delta}\frac{(1+q)^{-\sigma}}{\widetilde{p}_1} > (1-m_1)^{\delta}\frac{(1+\widetilde{q})^{-\sigma}}{p_2}.$$

For $\widetilde{p}_1 < p_1$, households characterized by $\gamma \geq \widehat{\gamma}_{1j}$ in countries $j = 1, 2$, with

$$\widehat{\gamma}_{1j} = \left(\frac{1-m_1}{m_1}\right)^{\delta/\sigma}\frac{(\widetilde{p}_1)^{1/\sigma}(p_2)^{(\sigma-1)/\sigma}q - p_1}{w_j\overline{h}_jL_j + \pi_j} \text{ and } \widetilde{\gamma}_{1j} \leq \widehat{\gamma}_{1j} \leq \gamma_{1j},$$

now also consume good q produced in country 1.

Thus, the effective demand for good q at price $\widetilde{p}_1$, is

$$\widetilde{D}_1^q = \sum_j \widetilde{D}_{1j}^q,$$

with $\widetilde{D}_{1j}^q = \lambda_1(1 - G_j(\widetilde{\gamma}_{1j}))L_j + \int_{\lambda_1}^{\widetilde{\lambda}_1}(1 - G_j(\widehat{\gamma}_{1j}))L_j dm_1.$

With some manipulation, the inequality in (24) may be written as

$$\left[\frac{1}{\sigma}\sum_j \frac{g_j(\widetilde{\gamma}_{1j})\widetilde{\gamma}_{1j}}{1 - G_j(\widetilde{\gamma}_{1j})}\frac{\widetilde{D}_{1j}^q}{\widetilde{D}_1^q} + \frac{1-\widetilde{\lambda}_1}{\delta}\sum_j \frac{\widetilde{\lambda}_1}{\lambda_1}\frac{D_{2j}^q}{\widetilde{D}_1^q}\right]\left[\frac{\widetilde{p}_1 - w_1/A_1}{\widetilde{p}_1}\right] < 1.$$

Notice first that

$$\sum_j \frac{\widetilde{D}_{1j}^q}{\widetilde{D}_1^q} = 1 \Rightarrow \frac{1}{\sigma}\left[\left[1 + \frac{\alpha}{\underline{\gamma}_jL_j}\right]\left[\frac{g_j(\widetilde{\gamma}_{1j})\widetilde{\gamma}_{1j}}{1 - G_j(\widetilde{\gamma}_{1j})}\right]\right]^{\sup_{j=1,2}} > \sum_j \frac{g_j(\widetilde{\gamma}_{1j})\widetilde{\gamma}_{1j}}{1 - G_j(\widetilde{\gamma}_{1j})}\frac{\widetilde{D}_{1j}^q}{\widetilde{D}_1^q}.$$

Secondly, we have

$$\sum_j \frac{\widetilde{\lambda}_1}{\lambda_1}\frac{D_{2j}^q}{\widetilde{D}_1^q} < \sum_j \frac{\widetilde{D}_{1j}^q}{\widetilde{D}_1^q}.$$

It follows that country 1 firms which adopt the IRS technology will never sell their good at a price below $\alpha w_1/A_1$ if

$$\frac{\alpha-1}{\alpha}\left[\frac{1}{\sigma}\left[\left[1+\frac{\alpha}{\gamma_j L_j}\right]\left[\frac{g_j(\widetilde{\gamma}_{1j})\widetilde{\gamma}_{1j}}{1-G_j(\widetilde{\gamma}_{1j})}\right]\right]^{\sup_{j=1,2}} + \frac{1}{\delta}\right] < 1,$$

which corresponds to MSV's inelastic demand assumption (see their Appendix p. 561-563). However, in our international economy framework, it also means that trade does not induce pro-competitive effects in either the IRS or in the CRS sectors. ■

6.2 Uniqueness of the General Equilibrium in the Open Economy

Let us substitute (17) into (18) and rewrite the latter as follows

$$TB(\lambda_i; A_i, A_j, L_i, L_j, G_i, G_j, F, \alpha, \delta) = 0.$$

Differentiating $TB(\lambda_i; .)$ with respect to λ_i, we show that the trade equilibrium is unique if

$$(1-\lambda_i)\frac{\partial M_i}{\partial \lambda_i}\frac{\lambda_i}{M_i} + \lambda_i \frac{\partial M_j}{\partial \lambda_j}\frac{\lambda_j}{M_j} < 1.$$

As with the inelastic demand assumption discussed above, this condition excludes a concentration of the population around a particular type-γ in either country. It is simply a weighted average of each trading partner's profit-multiplier elasticity with respect to the proportion of households in the world population who consume their products. The weights λ_i and $1-\lambda_i$ are given by the proportion of households in the world population who prefer to consume goods produced in country i, respectively country j. This can be seen as the counterpart of the Marshall-Lerner condition in a standard Mundell-Fleming model.

Finally, recall that $0 < \lambda_i < 1$, and assume that

$$\frac{\partial M_i}{\partial \lambda_i}\frac{\lambda_i}{M_i} > \frac{\partial M_j}{\partial \lambda_j}\frac{\lambda_j}{M_j}.$$

If one normalizes the effective labor force to 1, uniqueness of the international equilibrium only depends on the income distribution in both countries. Using the break-even conditions in (17) and the implicit function theorem we obtain the following inequality between the proportion of profits held by the middle class (T_{ii}) and the proportion of profits spent on the range of goods produced by the competitive fringe ($1 - \gamma_{ii}^* N_{ii}^* - T_{ii}$)

$$T_{ii} < 1 - \gamma_{ii}^* N_{ii}^* - T_{ii} \Rightarrow \frac{dTB(\lambda_i; .)}{d\lambda_i} > 0.$$

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