

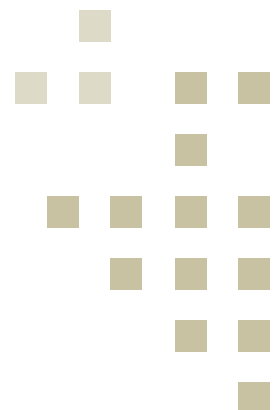


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Firms' export decisions – fixed trade costs and the size of the export market

Hege Medin*

[Abstract] This article presents two models of international trade under monopolistic competition. In increasing returns sectors firms face fixed, in addition to variable, trade costs, therefore both exporters and non-exporters may coexist. While nonexporters benefit from access to large *domestic* markets, exporters benefit from access to large *foreign* markets. Consequently, a small country has a higher share of exporting firms than a large one. In contrast to standard models, increasing returns sectors turn out more open in small countries than in large ones, and small countries may be net exporters of such commodities, despite the disadvantage of a smaller home market.

Keywords: *Monopolistic competition, product differentiation, home market effect, fixed trade costs*

JEL classification: F12, F15

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1 Introduction

What determines international trade patterns and the production structure in different countries? The emergence of the new trade theory a couple of decades ago made a considerable step forward in answering this question by emphasizing the role of market size and market access in the presence of economies of scale, monopolistic competition, product differentiation, and trade costs. The theory predicts that the size of the domestic market is important for firms' profitability when production is characterized by increasing returns to scale and there are trade costs. A country with a large domestic market for a certain good will have a share of the world's production of that good that is more than proportional to the size of the domestic market. This effect, which is often called the home market effect, also implies that the country's share of the world's exports of the good will be higher than proportional (Krugman, 1980), thus profitability of exports is predicted to increase with the size of the domestic market and decrease with the size of the foreign market. This is in contrast to the predictions from the theory of constant returns and comparative advantage where countries are net importers of goods for which they have large domestic demand (see Davis and Weinstein, 1996 for a comparison). In this paper I support the idea that, in the presence of scale economics, profitability of *production* increases with the size of the domestic market, but I argue that profitability of *exports* increases with the size of the foreign rather than the domestic market.

Standard new trade theory models also predict that either all firms or no firms within a given industry export, and that trade liberalization leads to an equal increase in each firm's export volume. In this paper I argue that both exporters and non-exporters may

coexist within the same industry because there are fixed costs in exporting. I further argue that trade liberalization may increase the share of firms that export as well as each firm's export volume. The share of firms that export may, however, differ between countries of different size.

The home market effect was first introduced by Krugman (1980) in a model of two equally sized countries with different demand patterns. Helpman and Krugman (1985) later presented a model where there is one constant returns to scale sector, which produces a homogeneous agricultural good, in addition to one increasing returns to scale sector, which produces a differentiated manufactured good. Agriculture is freely tradable, while manufactures are subject to trade costs. Demand patterns are equal in the two countries but they differ in size, so the larger country, which has the largest absolute demand for manufactures, has a larger than proportional share of the world's production and exports of manufactures.

In the Helpman and Krugman (1985) model, trade liberalization leads to an increase in the home market effect: as trade costs decline, manufacturing production becomes less profitable in the small country, and below a certain level of trade costs it gets deindustrialized. While this model assumes only one factor of production and factor price equalization, Krugman and Venables (1990) show that development in the home market effect is somewhat different when two factors are considered and factor prices can vary between the countries. The level of manufacturing production related to trade costs will now follow a U-relationship: for high trade costs, trade liberalization leads to a decline in the number of manufacturing firms in the small country. As the manufacturing sector declines, the price of the factor used intensively in manufacturing also declines. Consequently, below a certain level of trade costs, factor price differences

become sufficiently large to cancel out the home market effect, and manufacturing production starts to recover in the small country.

While trade models of monopolistic competition normally show a positive relationship between the domestic market size and exports for increasing returns goods, oligopolistic competition may result in higher profitability for small-country exporters than for large-country exporters, because the former benefit from access to a relatively larger foreign market. Whether or not small-country exporters experience the largest gains from trade liberalization now depends on the magnitude of the positive effect from a large foreign market relative to the negative effect from a small domestic market.¹ Despite the lack of such foreign market size effects in exports in models with monopolistic competition, these effects are probably central in the real world. Manufacturing sectors in small countries are often believed to be more open than in large, and empirical evidence on the home market effect is ambiguous (see e.g. Davis and Weinstein, 1996).

As already mentioned, the standard theory predicts that either all firms or no firms export, but in the real world both exporters and non-exporters coexist within the same industry. This can be explained by a fixed element in trade costs, which may reflect non-tariff trade barriers and costs related to market research, setting up foreign distribution networks or establishing foreign contacts. Venables (1994) presents a theoretical model with fixed trade costs, and he shows that trade liberalization leads to an increase in the share of exporting firms, rather than an increase in each firm's export. Trabold (1998) finds empirical evidence for these results, investigating the effects of the southern enlargement of the EEC in 1986. Several empirical studies also conclude that fixed trade costs are important (see e.g. Bernard and Wagner, 2001 or Roberts and

Tybout, 1997), and due to improvement in transport technology and global reduction in trade barriers the last decades, such costs may have become relatively more important as compared to variable trade costs. Today, to a larger degree than earlier, trade liberalization occurs through deeper economic integration, such as mutual recognition of standards and foundation of common markets. Such policy is probably better analyzed by reduced fixed, rather than variable, trade costs. Nevertheless, fixed trade costs are rarely considered in theoretical models despite their empirical importance, and Venables (1994) represents an exception in that respect.²

In this paper I present two models of international trade under monopolistic competition, which differ from the standard models in two ways. Firstly I assume that firms face both fixed and variable trade costs. This assures that exporters and non-exporters may coexist within the same industry, and my models yield the same predictions about effects from trade liberalization in a given country as Venables (1994). However, in contrast to the Venables model, I consider countries of different size. Consequently, I can explore how the market structure in different countries develops differently, and a more general explanation for the results found in Trabold (1998) is thus provided.

Secondly the two models contrast standard models in that exporting firms benefit from access to large *foreign* rather than *domestic* markets, and this effect turns out to be important for the determination of the number of exporters as well as for each firm's export volume. Both models presented here yield similar predictions about trade patterns despite that they rely on different assumptions. In the first model (the Armington approach) foreign and domestically produced manufactures are imperfect substitutes, and all consumers want to consume some of each type. In the second model (the Specific Factor approach) the number of manufacturing firms in a given country

is determined by endowment of a specific factor of production, thus consumers can only get access to new varieties by importing. Both these mechanisms assure that the absolute larger demand in the large country is aimed at small-country products as well as large-country products. However, in the Armington approach the reason for this result lies in the demand structure, while in the Specific Factor approach it lies in the cost structure. It is thus shown that both demand side and supply side mechanisms can yield a positive relationship between exports and the size of the foreign market in models of monopolistic competition.

The structure of the models is similar to that of Helpman and Krugman (1985), yet the predictions about trade patterns between countries of different size differ sharply from that model. For high trade costs, a larger share of manufacturing firms are exporters in small countries than in large, thus in contrast to the standard theory the manufacturing sector is predicted to be more open in small countries. Small countries are also net exporters of manufactures. For intermediate trade costs, all firms export in the small country. Now the large country gains shares of the export market for manufactures, but as in Krugman and Venables (1990) the effect may be reversed for low levels of trade costs. However, as opposed to that model, the large country will always have a smaller than proportional share of the world's exports of manufactures, and the small country will never get deindustrialized.

Section 2 presents the two models, section 3 discusses some results, and section 4 concludes.

2 The models

The point of departure for the two models in this paper is the standard model of international trade under monopolistic competition, where preferences are of the Dixit and Stiglitz (1977) type. The version of the model presented in Helpman and Krugman (1985) (the HK model) will serve as a reference to the standard modelling. In contrast to the HK model, both models presented here assume fixed trade costs in manufacturing, and the modelling of trade costs is based on Venables (1994). A manufacturing firm can choose between access to a larger market, which involves higher overall fixed costs, or access to a smaller market, which involves lower fixed costs. This feature yields some similarity with certain models of horizontal FDI, where firms can choose between supplying the foreign market through exporting, which involves variable trade costs, but low fixed costs; or through establishing a subsidiary, which involves no variable trade costs, but higher fixed costs. (See Markusen and Venables, 2000.)

The first model (the Armington approach) is a direct extension of the Venables (1994) model, which also differs from the HK model in that foreign and domestically produced manufactured goods are imperfect substitutes, thus a so-called Armington assumption is introduced.³ According to Venables (1994), this, in addition to the assumption about fixed trade costs, is sufficient to render possible an equilibrium with the coexistence of exporters and non-exporters. The assumption implies that the manufacturing industry in one country produces goods that by definition cannot be produced elsewhere, and I show here that it yields a foreign market size effect in exports.

In the second model (the Specific Factor approach), preferences are modelled as in the HK model. However, in contrast to that model, fixed production costs in manu-

facturing are assumed to use a specific factor not used elsewhere in the economy. This assumption is indirectly suggested by Venables (1994) as an alternative to the Armington assumption in order to render possible an equilibrium with both exporters and non-exporters, and I show that it also implies that there is a foreign market size effect in exports. The same assumption is applied by Forslid (1999) and Ottaviano (2001) in agglomeration models, and it is indirectly used in Smith and Venables (1991) in a model of regional integration. The assumption can be justified by thinking of fixed production costs in manufacturing as costs related to R&D or management.

2.1 The Armington approach

2.1.1 The model

Two countries, home (h) and foreign (f), are endowed with one factor of production: labor. There are two sectors: the agricultural sector, characterized by constant returns to scale, and manufacture, characterized by increasing returns to scale. Free trade in agriculture assures that wages are equalized in the two countries, and we let this be the numeraire sector by choosing units so that the price of agriculture and the wage equal unity. The manufacturing sector consists of many firms that each produces a unique variety of the manufactured good. Each firm faces fixed production costs (F) and constant marginal production costs (c). If a firm chooses to export it faces iceberg trade costs. Such costs imply that a share of the traded good disappears during transportation, so in order for one unit to reach the country of destination, $t \geq 1$ units must be exported ($t = 1$ implies no variable trade costs). In addition exporters must pay a fixed amount (G) in order to start exporting. All manufacturing firms

are symmetric with respect to technology, and the elasticity of substitution between different varieties of the manufactured good ($\varepsilon > 1$) is constant and equal in the two countries. Consequently, the producer price (p) of a given variety of the manufactured good must be equal across firms independently of country of origin. Manufacturing firms are monopolistically competitive, and from the equalization of marginal revenue and marginal cost, we can derive:

$$(1) \quad p - c = \frac{c}{\varepsilon - 1}$$

For domestically produced commodities the consumer price equals the producer price, but for foreign produced commodities, the consumer price must be corrected for trade costs, and equal tp .

There are four possible kinds of firms: exporters and non-exporters in both countries. Sales in market l of a firm from country k is z_{kl} . Using (1) the profits corresponding to the four kinds of firms are given by:

$$(2) \quad \pi_h^t = \frac{c}{\varepsilon - 1} (z_{hh} + z_{hf}) - (F + G)$$

$$(3) \quad \pi_h^{nt} = \frac{c}{\varepsilon - 1} z_{hh} - F$$

$$(4) \quad \pi_f^t = \frac{c}{\varepsilon - 1} (z_{ff} + z_{fh}) - (F + G)$$

$$(5) \quad \pi_f^{nt} = \frac{c}{\varepsilon - 1} z_{ff} - F$$

The profit of a non-trading firm in country k is given by π_k^{nt} and the profit of a trading firm in country k is π_k^t . All firms in a given country face the same domestic demand independently of whether or not they export (since products are symmetric), but exporters also face demand from abroad. This tends to increase the number of

exporters. On the other hand, exporters face higher overall fixed costs because they have to pay a fixed trade cost in addition to the fixed production cost, and this tends to reduce the number of exporters. Whether all firms, some firms or no firms export depends on the relative importance of these two mechanisms.⁴

There is free entry and exit, so firms will enter the different markets until their profits equal zero. Equilibrium sales of each firm are thus determined by setting profits equal to zero in equations (2) to (5). We get:

$$(6) \quad z_{hh} = z_{ff} = \frac{(\varepsilon-1)F}{c}$$

Due to the symmetry in technology and demand, we see from (6) that each firm's domestic sales are equal independently of country of origin. This is in line with the standard HK model, and the expressions in (6) are in fact equal to the production volume of each firm in that model. However, in the HK model, the expressions in (6) represent both domestic and foreign sales. Here, on the other hand, equilibrium sales in the export markets are given by:

$$(7) \quad z_{hf} = z_{fh} = \frac{(\varepsilon-1)G}{c}$$

From (7) we see that also each firm's export volume is equal independently of country of origin. This is also consistent with the HK model. However, (6) and (7) show that domestic sales are determined by fixed production costs, while sales in the export market are determined by fixed trade costs. This is in contrast to the HK model, where each firm's sales in the domestic versus the foreign market are determined by the size of the *variable* trade costs.

Consumers have preferences for variety as in the HK model. However, in addition

to distinguishing between different varieties of the manufactured good, consumers also distinguish between the aggregate of manufactured varieties produced domestically, and the aggregate of varieties produced abroad. These two aggregated goods enter the utility function as a CES aggregate, with elasticity of substitution equal to η . η is assumed to be higher than unity but lower than ε , thus the elasticity of substitution between different varieties is higher than the elasticity of substitution between home and foreign manufactured aggregates. This formulation of utility is the same as in Venables (1994) and Smith and Venables (1991). Finally, as in the HK model, utility is a Cobb-Douglas aggregate of the agricultural good and the aggregate of manufactures, with budget share for manufactures equal to μ . In the home country, demand for home and foreign produced manufactures will now equal respectively (see the appendix for details):

$$c_{hh} = \frac{\mu y_h p^{-\eta} n_h^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{p^{1-\eta} n_h^{\frac{1-\eta}{1-\varepsilon}} + (pt)^{1-\eta} (s_f n_f)^{\frac{1-\eta}{1-\varepsilon}}} \quad c_{fh} = \frac{t \mu y_h (pt)^{-\eta} (s_f n_f)^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{p^{1-\eta} n_h^{\frac{1-\eta}{1-\varepsilon}} + (pt)^{1-\eta} (s_f n_f)^{\frac{1-\eta}{1-\varepsilon}}}$$

The total number of manufacturing firms in country k is n_k , and the share of these that export is s_k ($k = h, f$). Since there are no profits in equilibrium, the equilibrium income in country k , y_k , must equal total returns to labor, which must again be equal to the exogenously given endowment of labor, as wages are normalized to unity. We measure the relative country size ($\frac{y_f}{y_h}$) in the ratio of foreign to home country's factor endowments and denote this γ . In order to analyze effects of different country size, I assume that the foreign country is larger than the home country, i.e. $\gamma > 1$. In the case where there are some non-exporters in both countries ($0 < s_k < 1$), setting demand equal to sales ($c_{kl} = z_{kl}$) in (2) to (5), and then setting profits equal to zero, determine the endogenous variables s_h, s_f, n_h and n_f . If $s_h = 1$ and $s_f < 1$, we must remove (3)

from the model. I will focus on the case where there are some non-exporters in both countries, as this yields analytical results. Numerical solutions for the case where all firms export in either one or both countries will be provided in section 2.1.3. Note also that if we set $h = f$, the two countries are equal, so we end up with two instead of four kinds of firms, and we will be back in the Venables (1994) model.

2.1.2 Non-exporters in both countries

To solve the model, we insert for demand in (6) and (7).

$$\mu y_h \frac{(s_f n_f)^{\frac{\varepsilon-\eta}{1-\varepsilon}} t^{1-\eta} p^{-\eta}}{p^{1-\eta} n_h^{\frac{1-\eta}{1-\varepsilon}} + (s_f n_f)^{\frac{1-\eta}{1-\varepsilon}} (tp)^{1-\eta}} - \mu y_f \frac{(s_h n_h)^{\frac{\varepsilon-\eta}{1-\varepsilon}} t^{1-\eta} p^{-\eta}}{p^{1-\eta} n_f^{\frac{1-\eta}{1-\varepsilon}} + (s_h n_h)^{\frac{1-\eta}{1-\varepsilon}} (tp)^{1-\eta}} = 0$$

$$\mu y_h \frac{n_h^{\frac{\varepsilon-\eta}{1-\varepsilon}} p^{-\eta}}{p^{1-\eta} n_h^{\frac{1-\eta}{1-\varepsilon}} + (s_f n_f)^{\frac{1-\eta}{1-\varepsilon}} (tp)^{1-\eta}} - \mu y_f \frac{n_f^{\frac{\varepsilon-\eta}{1-\varepsilon}} p^{-\eta}}{p^{1-\eta} n_f^{\frac{1-\eta}{1-\varepsilon}} + (s_h n_h)^{\frac{1-\eta}{1-\varepsilon}} (tp)^{1-\eta}} = 0$$

Dividing the two equations and rearranging yields: $\frac{n_f}{n_h} = \sqrt{\frac{s_h}{s_f}}$. Inserting this into one of the above equations now gives the following results:

$$(8) \quad \frac{n_f}{n_h} = \gamma, \quad \frac{s_f}{s_h} = \frac{1}{\gamma^2}$$

Inserting (1), (8) and for demand into equations (2)-(5), and setting profits equal to zero, we get the solutions for the endogenous variables:

$$(9) \quad s_h = \gamma \left(\frac{G}{F} t^{\eta-1} \right)^{\frac{1-\varepsilon}{\varepsilon-\eta}}$$

$$(10) \quad n_h = \frac{y_h \mu}{F \varepsilon} \frac{1}{1 + \left(\frac{G}{F} t^{\varepsilon-1} \right)^{\frac{1-\eta}{\varepsilon-\eta}}}$$

$$(11) \quad s_f = \frac{1}{\gamma} \left(\frac{G}{F} t^{\eta-1} \right)^{\frac{1-\varepsilon}{\varepsilon-\eta}}$$

$$(12) \quad n_f = \frac{y_f \mu}{F \varepsilon} \frac{1}{1 + \left(\frac{G}{F} t^{\varepsilon-1} \right)^{\frac{1-\eta}{\varepsilon-\eta}}}$$

$$\frac{ds_k}{dt} < 0, \quad \frac{ds_k}{dG} < 0, \quad \frac{dn_k}{dt} > 0, \quad \frac{dn_k}{dG} > 0, \quad \frac{dn_k}{ds_k} \leq 0$$

First we can note that the derivatives with respect to trade costs and the shares of firms that export are equal to those from the Venables (1994) model. Equations (9) to (12) thus show that the results regarding effects of trade liberalization in a given country also hold in a more general model.

Further, (8) shows that the relative number of firms equals the relative country size, and (10) and (12) show that the number of firms in a given country is proportional to its size. This is in contrast to the standard HK model where large countries, in the presence of trade costs, will have a larger than proportional number of firms due to the home market effect.

(8) also shows that the small country will have the largest proportion of exporting firms. This is because the Armington assumption assures that all consumers want to consume some of each manufactured aggregate. Since there are more consumers in the large country, each small-country firm faces a higher demand from abroad than each large-country firm, thus in the short run exporting is more profitable for small-country firms. This assures that in the long run more small-country firms can export enough to cover the fixed trade costs (G). We can therefore conclude that while the standard HK model predicts the manufacturing sector in each country to be of the same openness (because the export volume of each firm is equal, and all firms export), this model predicts the manufacturing sector in the small country to be more open than in the large one.

By multiplying (9) and (10) or (11) and (12) we get the number of exporting firms in the respective country. We see that this is proportional to the size of the foreign market, while the domestic market size plays no role. Thus, while manufacturing production still depends positively on the size of the domestic market, there is rather a *foreign* market

size effect in exports. The reason behind this result is that a positive G assures that profitability of exports is independent of profitability of production as long as there are some non-exporters. This contrasts the standard HK model where both exports and production depend positively on the size of the domestic market and negatively on the size of the foreign market, because the production and export decisions are linked together.

We are now ready to introduce the indicator of net trade in manufactures, namely the relative export share (E). It represents the share of the world's export of manufactures in the foreign country relative to the share in the home country, and it equals $\frac{ps_f n_f z_{fh}}{ps_h n_h z_{hf}}$. Inserting from (7) and (8) gives:

$$(13) \quad E = \frac{1}{\gamma}$$

Note that E is the ratio of the absolute value of exports of manufactures in foreign versus the home country, thus we have not corrected for country sizes. From (13) we see that $E < 1$, since we have assumed that the foreign country is larger than the home country ($\gamma > 1$). Hence, despite the fact that there are fewer manufacturing firms in the small country, it will be a net exporter of manufacturing products. This contrasts the standard HK model, where it is the large country that has the largest (and higher than proportional) share of the world's export of manufactures. We can further notice that even if exports from each country approach 0 as t or G increases, there will always be some exporting firms, thus E will always have a strictly positive value.

Both the relative number of firms and the relative export share are independent of trade costs when there are some non-exporters in both countries. The reason for this is again that the export decision is separated from the production decision, so changes

in trade costs affect the domestic market only via changes in the number of exporting firms and not via changes in each firm's sales in the domestic market. Since exporters are larger than non-exporters, a decrease in trade costs followed by an increase in the number of exporters, must decrease the total number of firms, as demand for labor has increased (Venables, 1994). However, these changes are symmetric in the two countries because demand for imports increases proportionally as trade costs decrease. This can be verified by noting that both the relative growth in n_h and n_f and the relative growth in s_h and s_f with respect to trade costs are equal (see equations (10) and (12); and (9) and (11) respectively).

2.1.3 All firms export in either one or both countries

The results above are only valid for the case where there are some non-exporters in both countries. From (8) we know that the smallest country has the largest share of exporting firms. If either G and/or t becomes sufficiently low, the small country will reach a situation where all firms export and from (9) we see that this will happen when trade costs are low enough to assure that $\gamma(\frac{G}{F}t^{\eta-1})^{\frac{1-\varepsilon}{\varepsilon-\eta}} \geq 1$. When this criterion is fulfilled, the non-traded sector disappears from the small country, thus (3) must be removed from the model and $s_h = 1$ must be inserted in demand.

In the appendix it is shown that by setting profits equal to zero, we can express the relative export share as:

$$(14) \quad E = s_f t^{\eta-1} \frac{G}{F} \left(\frac{n_f}{n_h} \right)^{\frac{1-\eta}{1-\varepsilon}}$$

If G and/or t is further decreased, we will eventually reach a situation where all firms export also in the large country. Now (3) and (5) must be removed from the

model, and $s_h = s_f = 1$ must be inserted in demand.

In the appendix it is shown that by setting profits equal to zero, the relative export share will now be:

$$(15) \quad E = \frac{y_h \left(\frac{n_f}{n_h}\right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}}{y_f \left(\frac{n_h}{n_f}\right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}}$$

E must be independent of G because all firms export, so changes in G cannot affect firms decisions of whether or not to export (see the appendix).

Figure 1 to 2 illustrate the results from numerical simulations of the cases where all firms export in either one or both countries, and show development in the relative export share as a function of variable trade costs. The size of the foreign country is set twice the size of the home country, thus from (13) we know that for $s_h, s_f \in [0, 1)$, $E = \frac{1}{2}$. This must be the case when trade costs are relatively high, and it is shown in the right part of the figures. The mid-part of figure 1 shows the case when all firms become exporters in the small country ($s_h = 1, s_f < 1$). Now the small country loses market shares to the large country because increasing exports has become relatively more expensive in the small country. In the large country, exports can still be increased by letting a non-exporter start exporting, and this has a fixed costs of G . In the small country, however, a new exporter can only be created by establishing a new firm, which has a fixed cost of $F + G$. In the small country, profitability of exports thus starts to depend on the size of the domestic market, and the home market effect for exports reappears. It is worth noting, however, that even if the large country gains market shares, the effect is not large enough to assure that it becomes a net exporter of manufactures in any of the numerical simulations conducted. This is also intuitive, because overall demand for imports is twice as high in the large country than in the

small country.

The left part of figure 1 represents the case where all firms export in both countries ($s_h = s_f = 1$). Now increasing exports has the same cost in both countries, but large domestic demand in the large country assures that it still has more exporting firms and hence a higher share of international trade than when $s_h, s_f \in [0, 1)$. However, as trade is liberalized, demand for import increases. Because there are more consumers in the large country, demand for small-country products now increases faster than demand for large-country products. In other words, the home market effect is weakened. When variable trade costs are zero ($t = 1$), the relative export share is again equal to $\frac{1}{2}$ because, with equal consumer prices, consumers want to divide expenditure equally between domestically produced and foreign produced manufactures. In this case the number of firms is equal in the two countries, but each small-country firm exports twice as much as each large-country firm.

FIGURES 1 AND 2 ABOUT HERE

Figure 2 shows the consequences of increased G . Higher G implies lower profitability from exporting, thus a lower t is required in order for both s_h and s_f to reach 1. In figure 2, G is sufficiently high to assure that $s_h = s_f = 1$ only will happen when $t = 1$. We see that the large country's market share may start to decline even if it still has some non-exporters. The reason for this is that the cost difference of establishing a new exporter in the large and small country becomes less significant for high values of G relative to F . At the same time each small-country firm increases its export volume in order to meet the increasing foreign demand, while the export volume in each large country firm remains constant. ⁵

2.2 The Specific Factor approach

2.2.1 The model

As in the Armington approach, this model considers two countries and two sectors. The agricultural sector has the same features as before, but manufacturing production now needs two factors: skilled labor (L) to cover fixed production costs, and unskilled labor (N) to cover all other costs. This may reflect the idea that manufacturing firms need a fixed amount of R&D or management services. Alternatively we may think of F as real capital. This assumption implies that we get a new endogenous variable: the wage of skilled labor, w_k . Note, however, that w_k does not affect marginal costs, and hence not firms' pricing rule given by (1). Nor does it affect the equalization of unskilled wages between the two countries.

Since skilled labor is used in a fixed amount in each manufacturing firm, in country k the number of firms is uniquely determined by $L_k = n_k F$. This implies that the relative number of firms will be directly given by the ratio of the foreign to the home country's factor endowments:⁶

$$(16) \quad \frac{n_f}{n_h} = \frac{L_f}{L_h} = \gamma$$

This is the same result as in the Armington approach, but here it is a direct consequence of the assumption about the specific factor used in fixed production cost, and it is thus valid even if all firms export in either one or both countries.⁷ As before we assume that the foreign country is largest, thus $\gamma > 1$. Note however that γ no longer represents the relative income level. With profits equal to zero, total income in country k consists of returns to skilled and unskilled labor. Since w_k is endogenous, y_k must

also be endogenous. It is given by:

$$(17) \quad y_k = w_k L_k + N_k$$

Using (1), profits of each type of firm can be expressed as:

$$(18) \quad \pi_h^{nt} = \frac{c}{(\varepsilon-1)} z_{hh} - w_h F$$

$$(19) \quad \pi_h^t = \frac{c}{(\varepsilon-1)} (z_{hh} + z_{hf}) - (w_h F + G)$$

$$(20) \quad \pi_f^{nt} = \frac{c}{(\varepsilon-1)} z_{ff} - w_f F$$

$$(21) \quad \pi_f^t = \frac{c}{(\varepsilon-1)} (z_{ff} + z_{fh}) - (w_f F + G)$$

As in the Armington approach, equilibrium sales in each market are determined by setting profits equal to zero. Each manufacturing firm's equilibrium sales in the domestic market are now given by:

$$(22) \quad z_{kk} = \frac{(\varepsilon-1)w_k F}{c}$$

From (22) we see that in contrast to the Armington approach, z_{kk} is endogenous because the value of fixed production costs is endogenous and equal to $w_k F$ rather than just F . However, exporters' sales in foreign markets are still given by (7), because all exporting costs use unskilled labor.

Preferences are modelled as in the standard HK model with no distinction between home and foreign produced varieties of the manufactured good, thus domestic demand for a domestically produced and a foreign produced variety respectively is given by (see Helpman and Krugman, 1985):

$$c_{hh} = \frac{\mu(w_h L_h + N_h) p^{-\varepsilon}}{\left(p^{1-\varepsilon} \frac{L_h}{F} + (pt)^{1-\varepsilon} s_f \gamma \frac{L_h}{F}\right)} \quad c_{fh} = \frac{t\mu(w_h L_h + N_h)(tp)^{-\varepsilon}}{\left(p^{1-\varepsilon} \frac{L_h}{F} + (pt)^{1-\varepsilon} s_f \gamma \frac{L_h}{F}\right)}$$

We have inserted from (17), and used the fact that $n_k = \frac{L_k}{F} = \gamma \frac{L_l}{F}$ ($k \neq l$).

2.2.2 Non-exporters in both countries

If there are non-exporting firms in both countries ($s_h, s_f \in [0, 1)$), setting equations (18) to (21) equal to zero and inserting for demand will determine the endogenous variables s_h, s_f, w_h and w_f . From (18) and (20) we can now find s_f and s_h as functions of w_h and w_f respectively. Inserting this in (19) and (21), give the following solutions for w_h and w_f :

$$(23) \quad w_h = w_f = t^{\varepsilon-1} \frac{G}{F}$$

(23) shows that the price of skilled labor is equalized in the two countries. This is because countries are equal in all other aspects than size. As in the Armington approach, profitability of production is separated from profitability of exports as long as there are some non-exporters in both countries. Differences in foreign demand do thus not affect the price of skilled labor, since this factor is not used in the export activity. As in the Armington approach, manufacturing production is positively related to the size of the domestic market, while exports are positively related to the size of the foreign market. This can be verified by looking at the solutions for s_h and s_f :

$$(24) \quad s_h = \gamma \frac{\mu}{\varepsilon} \frac{N}{G} \frac{F}{L} - \gamma \frac{t^{\varepsilon-1}(\varepsilon-\mu)}{\varepsilon}$$

$$(25) \quad s_f = \frac{1}{\gamma} \frac{\mu}{\varepsilon} \frac{N}{G} \frac{F}{L} - \frac{1}{\gamma} \frac{t^{\varepsilon-1}(\varepsilon-\mu)}{\varepsilon}$$

$$\frac{ds_k}{dt} < 0, \quad \frac{ds_k}{dG} < 0$$

(24) and (25) show that the share of exporting firms decreases with fixed and variable trade costs, which is consistent with Venables (1994). The Specific Factor approach thus offers an alternative explanation for some predictions from that model, and for the findings of Trabold (1998).

To find the relative export share, we must first look at the ratio of s_f to s_h . By investigation of (24) and (25) we see that it is given by:

$$(26) \frac{s_f}{s_h} = \frac{1}{\gamma^2}$$

Using this together with (7) and (16), the relative export share must be:

$$(27) E = \frac{p^s s_f n_f z_{fh}}{p^s s_h n_h z_{hf}} = \frac{1}{\gamma}$$

We see that results regarding the relative number of firms, the relative share of firms that export and the relative export share are identical to the results from the Armington approach (compare equation (8) to (16) and (26); and (13) to (27)). Thus also this model gives a theoretical explanation for why increasing returns sectors in small countries are more open than in large. Further, it also predicts the small country to have the lowest number of manufacturing firms, but the largest share of the world's export of manufactures. Also, the relative export share is independent of trade costs. However, now a part of the explanation for these results lies in the cost structure rather than in the demand structure. In the Armington approach the small country benefited from large foreign demand because it produced special goods that could not be produced in the large country. Here, the products from the small country may be produced in the large country, but there is an upper limit to how many varieties a country can produce because skilled labor is a scarce resource. In this sense the model has the same features as a model with restricted entry. Because consumers value variety, large demand in the large country now results in large imports rather than large production of each local variety.

We may also note that, in contrast to the Armington approach, export of manufac-

tures might be zero. The reason for this difference is that in the Armington approach consumers always want to consume some foreign and some domestically produced varieties, since these are imperfect substitutes. Consequently, there is always some demand for imports, regardless of how high the import prices get. In the Specific Factor approach, however, foreign and domestic varieties are perfect substitutes, so high trade costs might imply that demand for imports is so low that no firm can export enough to cover the fixed trade costs. From (24) and (25), we see that this will happen for the same level of trade costs in the two countries, namely when G and/or t is large enough to assure that $\frac{\mu}{\varepsilon} \frac{N}{G} \frac{F}{L} - \frac{t^{\varepsilon-1}(\varepsilon-\mu)}{\varepsilon} = 0$. In this case E is not defined.

2.2.3 All firms export in either one or both countries

In contrast to the Armington approach, we are now able to derive analytical solutions for the case where all firms export in either one or both countries.

Again, we know that the share of exporters will be highest in the small country, thus s_h will equal 1 at higher trade costs than s_f . This will happen when t and/or G is low enough to assure that $\gamma \frac{\mu}{\varepsilon} \frac{N}{G} \frac{F}{L} - \gamma \frac{t^{\varepsilon-1}(\varepsilon-\mu)}{\varepsilon} \geq 1$ (see equation 24). Equation (18) must now be dropped from the model, and $s_h = 1$ must be inserted in demand. In the appendix it is shown that setting profits equal to zero now gives the following expression for the relative export share:

$$(28) \quad E = \frac{1}{\gamma} + t^{\varepsilon-1} \frac{\varepsilon-\mu}{\varepsilon} + \frac{1}{\varepsilon} \mu - \frac{G}{F} \frac{L}{N} \frac{(t^{\varepsilon-1}(\varepsilon-\mu)+\mu)(t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon)}{\varepsilon\mu} \frac{1}{\gamma}$$

$$\frac{dE}{dG} < 0$$

If trade costs are further reduced, all firms may start to export also in the large

country. In this case we must drop both (18) and (20) and insert $s_h = s_f = 1$ in demand. In the appendix it is shown that setting profits equal to zero now gives the following expression for the relative export share:

$$(29) \quad E = \frac{1}{\gamma} \frac{t^{\varepsilon-1} \left(1 - \frac{\mu}{\varepsilon}\right) + \frac{\mu}{\varepsilon} + \frac{1}{\gamma}}{t^{\varepsilon-1} \left(1 - \frac{\mu}{\varepsilon}\right) + \frac{\mu}{\varepsilon} + \gamma}$$

$$\gamma \geq E \geq 1, \quad \frac{dE}{dt} < 0, \quad \frac{dE}{dG} = 0$$

Figure 3 shows development in the relative export share as a function of t .

FIGURE 3 ABOUT HERE

As in the Armington approach, $E = \frac{1}{2}$ when there are non-exporters in both countries (the right part of the figure). When all firms export in the small country, increased foreign demand due to trade liberalization can no longer result in an increase in the number of exporters, only increased export volume in each firm. Thus large-country consumers cannot get access to new varieties by importing. However, in the large country there are still some non-exporting firms, so small-country consumers can still get access to new varieties if trade is liberalized. Because consumers value variety, growth in large-country consumers' demand for small-country products is now dampened. This leads to an increase in the large country's share of the world's export of manufactures. Consequently, in the small country trade liberalization leads to an increase in each firm's export, z_{hf} , while the number of exporters, n_h , is constant, but in the large country each firm's export, z_{fh} , is constant while the number of exporters $s_f n_f$ increases.

From (29) we see that when all firms export in both countries, the large country has gained sufficient market shares to assure that it becomes a net exporter. This is in contrast to the Armington approach, where all numerical simulations suggested that

the small country was a net exporter of manufactures for all ranges of trade costs. Note, however, that in contrast to the HK model the export share will always be lower than proportional to the relative country sizes. We also see that E declines as t is reduced. This is because neither country can now provide new varieties, and the advantage for large-country firms disappears. Consumers switch their demand towards imports as trade is liberalized, and this has a larger impact on each firm in the small country because overall demand is higher in the large country. When variable trade costs equal zero ($t = 1$), both countries will have an equal share of the world's exports of manufactures, but the export volume of each firm is twice as high in the small as in the large country. This is in contrast to the Armington approach, where the relative export share equals the inverse of the relative country size when variable trade costs are zero.

As in the Armington approach, decreased fixed trade costs only affect the case where $s_h = 1$ and $s_f < 1$. Increased G implies lower profitability from exporting, thus a lower t is required in order for both s_h and s_f to reach 1. This case is shown in figure 4.

3 Discussion

The previous section has shown that by modifying the standard HK model of international trade under monopolistic competition, the home market effect might disappear. The models predict small countries to have the largest proportion of exporting firms in manufacturing sectors, and to be net exporters of manufactured goods, at least for high levels of trade costs.

I believe that the models describe mechanisms that are empirically important, but

it may be argued that they predict the advantage for small-country firms to be too large when trade costs are high. The small country's export of manufactures is then predicted to be twice the large country's export of manufactures. If the large country were 10 times as large as the small country, the difference in export shares would be 10 because only the foreign market size matters for exports. Even if access to large foreign markets is important, some may argue that the role of the domestic market size in exports should not be completely ignored.

The result may be modified in several ways. One possibility is to let consumers in both countries have higher preferences for large-country products than for small-country products. This can be justified by assuming that there is a positive marketing effect for large-country products, because these are better known. Another possibility is to let the large country have more than one manufacturing sector. These approaches modify the strong advantage for small-country firms. However, they involve much more complex algebra, thus I prefer to present the simple models here in order to concentrate the point about larger openness in manufacturing sectors in small countries.

A weak point about both analyses is that they have concentrated on the case where no country specializes in manufacturing production, thus factor prices are equalized. This is likely to be the case if μ is not too high or countries are not too different in size. If this is not the case, the small country might specialize in the production of manufactures, and this may lead to increased wages and prices in that country. However, in contrast to the standard model, both countries will always have some manufacturing production, so the small country will never get deindustrialized.

4 Conclusion

The aim of this paper has been to give a theoretical background for explaining that sectors characterized by increasing returns are more open in small countries than in large. In order to do so I have presented two models that differ from standard models of international trade under monopolistic competition in two ways. Firstly, I have assumed that manufacturing firms face fixed in addition to variable trade costs, and this assures that there might be both exporting firms and non-exporting firms in the same industry. This assumption also assures that increased exports does not only happen through an increase in each firm's export, as in the standard models, but also through an increase in the number of exporters. These results have been supported by empirical analyses, but they are poorly analyzed in theoretical models. Secondly, I have introduced mechanisms, both on the demand side and on the supply side, that assure that exporting firms benefit from access to large foreign markets. Despite that such mechanisms may seem obvious, they are inconsistent with the standard theory, where increased foreign market size *reduces* the number of domestic exporters. These two points assure that the share of firms that export in increasing returns sectors is higher in small countries than in large ones, consequently these sectors are more open in small countries.

Despite the structural similarity between the models presented here and the standard theory, predictions about trade between countries of different size differ sharply. In the models presented here, for high levels of trade costs, small countries are net exporters of goods produced with increasing returns, so the well-known home market effect from the standard theory disappears. Trade liberalization may lead to a decline

in the smallest country's export share of increasing returns goods, but, in contrast to the standard model, it can never get deindustrialized. Further, the large country will always have a lower than proportional share of the world's trade in increasing returns goods.

We have seen that the models presented here have features that are shown to be empirically important. These features causes the models to give predictions about trade patters and commercial structure between countries of different size that differ sharply from the standard models. I therefore believe that they may contribute to a better understanding of the mechanisms that determine bilateral trade patterns and the consequences of trade liberalization.

Footnotes

¹See Cabrales and Motta (2001) for a model of oligopolistic competition and vertical product differentiation, where small-country firms, under certain conditions, may experience the largest gains from trade liberalization.

²A few unpublished papers also treat the issue: Evans (2000) looks at heterogeneous fixed export costs and Melitz (1999) considers fixed export costs in a model where firms have different marginal production costs. Also Mathä (2000) includes fixed export costs in a model of countries of different size. Nevertheless, in his model either all firms or no firms export, just as in the standard model.

³This formulation of preferences is also found in Smith and Venables (1991).

⁴In the case where both exporters and non-exporters coexist, we cannot say anything about which firms become exporters, since all varieties are symmetric. Some firms simply do not find it profitable to export because foreign demand is not sufficiently high to assure that all firms can export enough to cover the fixed export costs. Note, however, that this indeterminacy of which firms become exporters is not conceptually different from the indeterminacy in the standard HK model of which goods are produced in which country.

⁵When $s_h = 1$ and $s_f < 0$, the growth in the number of exporters in the small country (n_h) is dampened relative to the growth in the number of exporters in the large country ($s_f n_f$). After a while $s_f n_f$ will normally exceed n_h . However, if G is high enough we might have that $n_h > s_f n_f$ even if $t = 1$.

⁶Note that γ also equals $\frac{N_f}{N_h}$, as there are no differences in relative factor endowments.

⁷I.e. n is exogenously given by the endowment of skilled labor. This assumption can be modified by introducing a third non-traded sector, which uses both skilled and unskilled labor in a Cobb-Douglas technology. If, in addition, we assume that utility is a Cobb-Douglas aggregate of the three different types of goods, we will still get factor price equalization between the two countries. This assures that $\frac{n_f}{n_h} = \gamma$ still holds for the case where there are both non-exporters and exporters in each country.

Appendix

The Armington approach

Preferences

All consumers are assumed to be equal within a given country, so aggregated utility in county k equals:

$$U_k = A^{1-\mu} C_k^\mu \quad k \neq l$$

A is consumption of the agricultural good and C_k is consumption of the aggregated manufactured good. Sub-utility for manufactures is given by:

$$C_k = \left(C_{kk}^{\frac{\eta-1}{\eta}} + C_{lk}^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \quad k \neq l$$

C_{lk} is consumption in county k of manufactures produced in country l . It is given by:

$$C_{lk} = \left(\sum c_{lk}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

c_{lk} is consumption in country k for a variety of the manufactured good produced in country l . Utility maximization yields the following expression for demand (see Helpman and Krugman, 1985 and Venables, 1994):

$$(A1) \quad c_{lk} = \mu y_k \alpha_{lk} \frac{p_{lk}^{-\varepsilon}}{P_{lk}^{1-\varepsilon}}$$

The price of a variety produced in country l and sold in country k is p_{lk} . α_{lk} is the endogenous budget share for manufactured goods from country l in country k . The specification of utility assures that each of the four C_{lk} will have its own price index, which is given by (see Helpman and Krugman, 1985 and Venables, 1994):

$$(A2) P_{lk} = (\sum p_{lk}^{1-\varepsilon})^{\frac{1}{1-\varepsilon}} = (n_{lk} p_{lk}^{1-\varepsilon})^{\frac{1}{1-\varepsilon}}$$

The number of manufacturing firms from country l that export to country k (n_{lk}) must equal a fraction s_l of the total number of firms in country l (n_l). Thus the number of exporting firms may also be expressed as:

$$(A3) n_{lk} = s_l n_l \quad \text{where } 0 \leq s_l \leq 1 \quad k \neq l$$

We have defined $n_{ll} = n_l$. The overall price index for manufactured goods in country k , Q_k , is given by:

$$(A4) Q_k = (P_{kk}^{1-\eta} + P_{lk}^{1-\eta})^{\frac{1}{1-\eta}} \quad k \neq l$$

The budget share must equal $\alpha_{lk} = \frac{P_{lk} C_{lk}}{E_k}$, where $E_k = Q_k C_k$ is expenditure on manufactures in county k . From Shepard's lemma we know that $C_{lk} = -\frac{dE_k}{dP_{lk}} = \frac{C_k P_{lk}^{-\eta}}{Q_k^{-\eta}}$.

We thus get:

$$(A5) \alpha_{lk} = \left(\frac{P_{lk}}{Q_k}\right)^{1-\eta} = \frac{P_{lk}^{1-\eta}}{P_{kk}^{1-\eta} + P_{lk}^{1-\eta}} \quad k \neq l$$

Setting $p_{lk} = t p_{kk} = t p$ ($k \neq l$), setting (A5) in (A1) and inserting from (A2) and (A3) then yields the following expression for demand in country k for a given manufactured variety produced in country l :

$$(A6) c_{lk} = \mu y_k t \frac{(tp)^{-\eta} (s_l n_l)^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{p^{1-\eta} n_k^{\frac{1-\eta}{1-\varepsilon}} + (tp)^{1-\eta} (s_l n_l)^{\frac{1-\eta}{1-\varepsilon}}} \quad k \neq l$$

Demand for a given domestically produced product in country k is:

$$(A7) c_{kk} = \mu y_k \frac{p^{-\eta} n_k^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{p^{1-\eta} n_k^{\frac{1-\eta}{1-\varepsilon}} + (tp)^{1-\eta} (s_l n_l)^{\frac{1-\eta}{1-\varepsilon}}} \quad k \neq l$$

From (A6) and (A7) we see that the ratio of the equilibrium sales in country k can be expressed as:

$$(A8) \quad \frac{z_{lk}}{z_{kk}} = \frac{c_{lk}}{c_{kk}} = t^{1-\eta} \left(\frac{s_l n_l}{n_k} \right)^{\frac{\varepsilon-\eta}{1-\varepsilon}} \quad k \neq l$$

All firms export in the small country

In this case, z_{hf} will no longer equal $z_{fh} = \frac{(\varepsilon-1)G}{c}$. However, z_{ff} is still given by $\frac{(\varepsilon-1)F}{c}$. By inserting this and $s_h = 1$ in (A8), we get $z_{hf} = t^{1-\eta} \left(\frac{n_h}{n_f} \right)^{\frac{\varepsilon-\eta}{1-\varepsilon}} \frac{(\varepsilon-1)F}{c}$. The relative export share can now be expressed as

$$E = \frac{ps_f n_f z_{fh}}{pn_h z_{hf}} = s_f \frac{n_f}{n_h} \frac{\frac{G(\varepsilon-1)}{c}}{t^{1-\eta} \left(\frac{n_h}{n_f} \right)^{\frac{\varepsilon-\eta}{1-\varepsilon}} \frac{(\varepsilon-1)F}{c}} = s_f t^{\eta-1} \frac{G}{F} \left(\frac{n_f}{n_h} \right)^{\frac{1-\eta}{1-\varepsilon}}$$

All firms export in both countries

Setting the two zero profit conditions for exporters equal, inserting for demand, and manipulating, we get:

$$\gamma \frac{\left(\frac{n_f}{n_h} \right)^{\frac{\varepsilon-\eta}{1-\varepsilon}} - t^{1-\eta}}{1 - \left(\frac{n_f}{n_h} \right)^{\frac{\varepsilon-\eta}{1-\varepsilon}} t^{1-\eta}} = \frac{\left(\frac{n_f}{n_h} \right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}}{\left(\frac{n_f}{n_h} \right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}}$$

The expression shows that the relative number of firms is independent of fixed trade and production costs. We also see that for $t = 1$, $\frac{n_f}{n_h} = 1$. The equilibrium export volumes in home and foreign country respectively are given by:

$$z_{hf} = \mu y_f \frac{n_h^{\frac{\varepsilon-\eta}{1-\varepsilon}} t^{1-\eta}}{p \left(n_f^{\frac{1-\eta}{1-\varepsilon}} + n_h^{\frac{1-\eta}{1-\varepsilon}} t^{1-\eta} \right)} \quad \text{and} \quad z_{fh} = \mu y_h \frac{n_f^{\frac{\varepsilon-\eta}{1-\varepsilon}} t^{1-\eta}}{p \left(n_h^{\frac{1-\eta}{1-\varepsilon}} + n_f^{\frac{1-\eta}{1-\varepsilon}} t^{1-\eta} \right)}$$

After some manipulation we can now express the relative export share as:

$$E = \frac{pn_f z_{fh}}{pn_h z_{hf}} = \frac{1}{\gamma} \frac{\left(\frac{n_f}{n_h} \right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}}{\left(\frac{n_h}{n_f} \right)^{\frac{1-\eta}{1-\varepsilon}} + t^{1-\eta}} \quad E \geq \frac{1}{\gamma} \quad \text{if} \quad \frac{n_f}{n_h} > 1$$

Since $\frac{n_f}{n_h}$ is independent of G and F , this must also be the case for E . In all numerical simulations from section 2.1.3, we have that $\frac{n_f}{n_h} > 1$. If this holds generally, the relative export share will always be higher when $s_h = s_f = 1$ than when $s_h, s_f \in [0, 1)$, thus large-country exporting firms will be more profitable in the former case.

The Specific Factor approach

All firms export in the small country

The solutions to the endogenous variables are now given by:

$$w_f = \mu\gamma N t^{\varepsilon-1} \frac{1}{L(t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon)}$$

$$w_h = \frac{G(t^{\varepsilon-1}-1)}{F} + \frac{\mu\gamma N}{L(t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon)}$$

$$s_f = \frac{1}{\gamma} \frac{N}{G} \frac{F}{L} \frac{\mu(\gamma(\varepsilon-\mu)t^{\varepsilon-1}+\varepsilon+\mu)}{\varepsilon(\gamma(\varepsilon-\mu)t^{\varepsilon-1}+\varepsilon)} - \frac{1}{\gamma} \frac{t^{\varepsilon-1}(\varepsilon-\mu)+\mu}{\varepsilon}$$

In this case z_{hf} will no longer equal $z_{fh} = \frac{(\varepsilon-1)G}{c}$. However, z_{ff} is still equal to $\frac{(\varepsilon-1)F}{c}$. The specification of demand assures that the ratio of equilibrium sales of imports to domestically produced manufactures in country k will always equal $\frac{z_{lk}}{z_{kk}} = t^{1-\varepsilon}$, which means that $z_{hf} = t^{1-\varepsilon} z_{ff} = t^{\varepsilon-1} \frac{(\varepsilon-1)w_f F}{c}$. The relative export share can be expressed as:

$$E = \frac{p s_f n_f z_{fh}}{p n_h z_{hf}} = s_f \gamma t^{\varepsilon-1} \frac{G}{w_f F}$$

Inserting for w_f and s_f gives:

$$E = \frac{1}{\gamma} + t^{\varepsilon-1} \frac{\varepsilon-\mu}{\varepsilon} + \frac{1}{\varepsilon} \mu - \frac{G}{F} \frac{L}{N} \frac{(t^{\varepsilon-1}(\varepsilon-\mu)+\mu)(t^{\varepsilon-1}\gamma(\varepsilon-\mu)+\varepsilon)}{\varepsilon\gamma\mu} \quad E'_G < 0$$

All firms export in both countries

The equilibrium export volumes in the home and foreign country respectively are given by:

$$z_{hf} = \gamma \frac{(w_f L + N) t^{1-\varepsilon}}{\gamma \frac{L}{F} + \frac{L}{F} t^{1-\varepsilon}} \quad \text{and} \quad z_{fh} = \frac{(w_h L + N) t^{1-\varepsilon}}{\frac{L}{F} + \gamma \frac{L}{F} t^{1-\varepsilon}}$$

Using this, the relative export share can be expressed as:

$$E = \frac{pn_f z_{fh}}{pn_h z_{hf}} = \frac{(w_h L + N)}{(w_f L + N)} \frac{(\gamma + t^{1-\varepsilon})}{(1 + \gamma t^{1-\varepsilon})}$$

The following expression can be derived from demand and the zero profit conditions for exporting firms:

$$\frac{(w_h L + N)}{(w_f L + N)} = \frac{(1 - \frac{\mu}{\varepsilon} \gamma \frac{1-t^{1-\varepsilon}}{\gamma + t^{1-\varepsilon}})}{(1 - \frac{\mu}{\varepsilon} \frac{1-t^{1-\varepsilon}}{1 + \gamma t^{1-\varepsilon}})}$$

Which can be inserted in the expression for E . The relative export share will then be given by:

$$E = \frac{(t^{\varepsilon-1} (1 - \frac{\mu}{\varepsilon}) + \frac{1}{\gamma} + \frac{\mu}{\varepsilon})}{\gamma (t^{\varepsilon-1} (1 - \frac{\mu}{\varepsilon}) + \gamma + \frac{\mu}{\varepsilon})} \quad \frac{1}{\gamma} > E \geq 1 \quad E'_t < 0 \quad E'_G = 0$$

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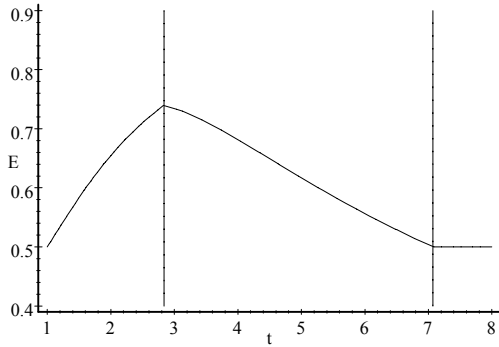
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Figures

Figure 1

Development in the relative export share

The Armington approach



Simulation made for parameter values equal to:

$$y_h = 1, y_f = 2, \eta = 2, \varepsilon = 3, F = \frac{10}{1000}, G = \frac{2}{1000}, \mu = \frac{1}{3}$$

The case where $s_h, s_f < 1$ implies that $t > 7.07$

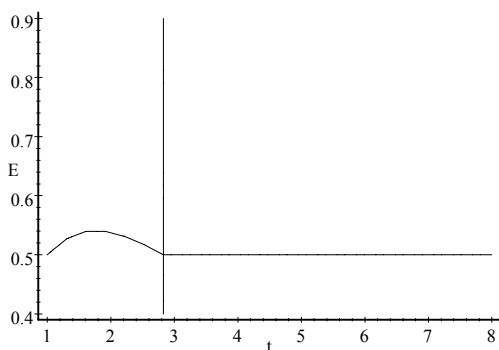
The case where $s_h = 1$ and $s_f < 1$ implies that $2.84 < t \leq 7.07$

The case where $s_h = s_f = 1$ implies that $t \leq 2.84$

Figure 2

Development in the relative export share

The Armington approach



Simulation made for parameter values equal to:

$$y_h = 1, y_f = 2, \eta = 2, \varepsilon = 3, F = \frac{10}{1000}, G = \frac{5}{1000}, \mu = \frac{1}{3}$$

The case where $s_h, s_f < 1$ implies that $t > 2.83$

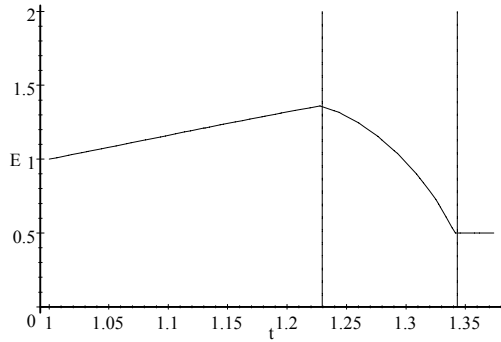
The case where $s_h = 1$ and $s_f < 1$ implies that $2.83 \geq t > 1$

The case where $s_h = s_f = 1$ implies that $t = 1$

Figure 3

Development in the relative export share

The Specific Factor approach



Parameter values are equal to:

$$\gamma = 2, \varepsilon = 6, \mu = \frac{1}{3}, N = 100, L = 2, F = \frac{10}{1000}, G = \frac{6}{1000}$$

For $t > 1.37$, E is not defined

The case where $s_h, s_f < 1$ implies that $t > 1.34$

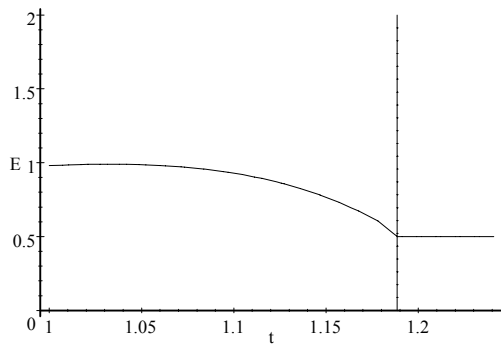
The case where $s_h = 1$ and $s_f < 1$ implies that $1.34 \geq t > 1.23$

The case where $s_h = s_f = 1$ implies that $t \leq 1.23$

Figure 4

Development in the relative export share

The Specific Factor approach



Parameter values are equal to:

$$\gamma = 2, \varepsilon = 6, \mu = \frac{1}{3}, N = 100, L = 2, F = \frac{10}{1000}, G = \frac{10}{1000}$$

For $t > 1.24$, E is not defined

The case where $s_h, s_f < 1$ implies that $t > 1.19$

The case where $s_h = 1$ and $s_f < 1$ implies that $t \leq 1.19$

There are no values of t for which $s_h = s_f = 1$

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