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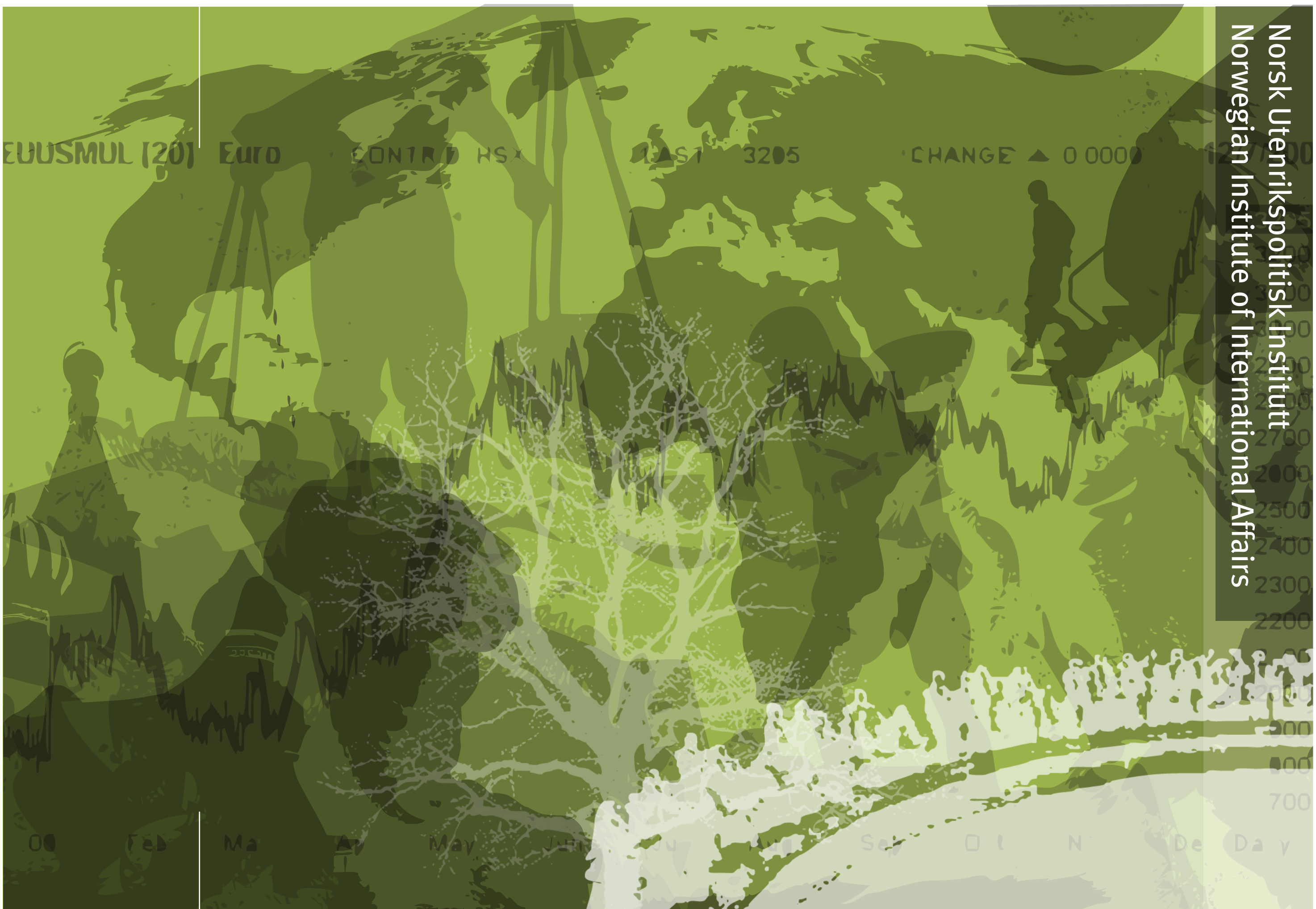

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The reverse home market effect in exports: A cross-country study of the extensive margin of exports

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Abstract
This paper presents a simple new trade theory model with results that contradict those from standard models in two ways. Firstly, a home market effect in domestic sales of manufactured goods is found to co-exist with a reversed home market effect in exports of manufactured goods. While small countries have a disadvantage in domestic sales of manufactured goods given their access to small domestic markets, they have an advantage in exports of manufactured goods given their access to large export markets. Secondly, initially equal firms split into exporters and non-exporters in equilibrium; and market conditions, rather than firm-level differences in marginal costs, are the main determinants of the number of manufacturing firms that export. In consequence of these two results, for a small country the number of manufacturing of firms that export is higher than proportional to country size. The extensive margin of exports, defined as the proportion of firms that export, decreases with relative size of the home market. Empirical support for the latter prediction is found in a cross-sectional dataset on firm level exports for 116 countries.

Keywords: Creverse home market effect; monopolistic competition; national product differentiation; fixed export costs; firm-level data, fractional logit

JEL classification: F12, F13, F14

1 Introduction

Will trade liberalisation lead to deindustrialisation of small countries? A well-known result from new trade theory models is the home market effect (HME), first introduced formally by Krugman (1980). The argument is as follows: increasing returns and transport costs in manufacturing industries make access to a large home market advantageous. It is therefore less profitable for manufacturing firms to be established in small countries. In consequence, small countries may offer lower wages, or have a share of the world's production and exports of manufactured goods that is less than proportional to their share of labour. Some authors predict that the effect will be reinforced by trade liberalisation (Helpman and Krugman 1985, pp. 205–209, henceforth: HK 1985), while others predict that the effect will follow an inverse U relationship, where it is weakened for very low trade costs (Krugman and Venables, 1990). This has led to concern as to whether small countries are likely to have lower income per capita or become deindustrialised.

However, several studies show that small countries in general do not have lower GDP per capita than large ones. (See e.g. Easterly and Kraay, 2000; Rose, 2006.[1]) Moreover, in several small countries, manufactured goods account for a large proportion of their total exports. Examples include many prosperous countries, among them Singapore, Finland and Luxembourg, but also less developed countries. Eastern European countries, like the Slovak Republic and Estonia, and other emerging markets, like Mauritius and Namibia, have experienced growth in GDP per capita, and the proportion of manufactured goods in their total exports is relatively high. This may indicate that being a small country is not as great a disadvantage as indicated by the literature on the HME.

[1] Furthermore, Ramondo and Rodríguez-Clare (2010) and Ramondo, Rodríguez-Clare and Saborío-Rodríguez (2012) discuss the issue of small countries being much richer than predicted by models of idea-based growth.

A weakness of HME models is that lower profitability of *domestic sales* of manufactured goods in small countries often induces lower profitability of *exports* of manufactured goods. In other words, the HME applies not only to domestic sales of manufactured goods, but also to exports of such goods. However, relatively small countries may have access to relatively large export markets, and this could make exports more profitable in small countries than in large ones. Generally, this mechanism is present in models with constant returns to scale, but in the HME models it is normally completely dominated by the disadvantage of access to a small home market. This might not be a good description of real life. Even if a relatively small home market is a disadvantage for domestic sales of manufactured goods, it can be an advantage for exports of manufactured goods. This could yield a reverse HME in exports, where small countries have a more than proportional share of the world's export of manufactured goods. The first aim of this paper is to show how an HME in domestic sales of manufactured goods may coexist with a reverse HME in exports of manufactured goods in a simple model of international trade. To my knowledge, no other authors have discussed this dichotomy.

Why do some firms become exporters while others do not? What factors determine the number of firms that export? The literature has generally focused on firm differences in answering these questions. After the pioneering article of Melitz (2003) it has become common to include fixed export costs and firm differences in marginal production costs in trade models. This ensures that only the most productive firms will find it profitable to export. However, not only firm differences, but also the relative size of the foreign market may be important for firms' export decisions. If the home market is small and the foreign market is large, many firms may find it profitable to export, whereas a relatively small foreign market may have room for only a few exporters. A weakness of HME models, whether dealing with homogeneous or heterogeneous firms, is that, as long as there is free entry of firms, they often predict that the number of manufacturing exporters will increase with relative size of the home market due to the HME. In other words, it decreases with the relative size of the foreign market. The HK 1985 model is a benchmark HME model which is used as point of departure for many other models. There are no fixed export costs and firms are homogeneous, thus the model predicts that either all firms will export or no firms will. Consequently, the HME in the total number of manufacturing firms leads directly to an HME in the number of exporters. The result may be seen as an undesired side effect of the fact that homogeneous-firms models are not able to separate between exporting and non-exporting firms. However, the effect is also found in the much used Melitz-style extension of HK 1985, where only a proportion of firms export (a model like that is e.g. presented in Baldwin and Forslid, 2010). In that model, the extensive margin of exports, defined as the proportion of firms that export, will be independent of country size.[2] This leads to the same negative relationship between the number of manufacturing exporters and the size of the foreign market as found in its homogeneous-firms counterpart.

The second aim of this paper is to show how export market conditions, rather than firm differences in marginal costs, can be the main determinants of the number of exporters. It is not surprising that different firms behave differently as in Melitz-type models. In the model presented here, however, I show that even firms that are initially equal may behave differently in equilibrium and become heterogeneous with respect to export status. The model contains many of the same properties as Melitz-type models, despite no firm-level differences in production costs. For example, the intensive margin of trade is independent of variable trade costs but decreases with reductions in fixed export costs, just as in Lawless (2010). Furthermore, there is an anti-variety effect from reductions in variable trade costs just as in Baldwin and Forslid (2010). Despite these similarities, the model differs sharply from standard models when it comes to predictions about the number of firms that export. In equilibrium the total number of manufacturing *firms* in a small country relative to that in a large country is less than proportional to relative country size, due to the HME. At the same time, the relative number of manufacturing *exporters* is more than proportional, due to the reverse HME. As a consequence, the extensive margin of exports, defined as the

2 Note that this definition of the extensive margin of export differs somewhat from other papers. Normally, it refers to the number of firms that export, but in this paper it refers to the proportion of firms that export.

proportion of firms that export, will be higher in small countries than in large ones.

The third aim of this paper is to present empirical evidence of larger extensive margins of exports in small countries than in large countries – which we would observe in the presence of a reverse HME in exports. Very little evidence exists on this point. To my knowledge only one study has dealt with this issue, and then only briefly, without econometric testing. The International Study Group on Exports and Productivity (2008) compares firm level data on exporters and non-exporters between 14 countries and finds that the extensive margin of exports is 'loosely decreasing in the size of the domestic markets' (p. 5). In this paper, I use firm level data for exports of manufactured goods for 116 developing countries from the Enterprise Surveys dataset. Results show that, for the average country, a doubling of relative home market size is associated with a 12.3% decrease in the extensive margin of exports.

The paper is organised as follows: Section 2 gives an overview of related literature, Section 3 presents the theoretical model, Section 4 presents the empirical evidence, and Section 5 offers some conclusions.

2 Related literature

Traditional trade models, characterized by constant returns to scale (CRS) and comparative advantage, generally predict that countries are net exporters of goods for which they have low domestic demand (Davis and Weinstein, 1999). Krugman (1980), on the other hand, showed that under increasing returns to scale (IRS) and trade costs there will be an HME: a country with relatively low domestic demand for an IRS good will have lower profitability in the production of this good. This results in less IRS firms locating in a country like that and the country getting a lower-than-proportional share of the world's *production* as well as *exports* of the IRS good. Consequently, in contrast to the case for CRS goods, countries will be net importers of IRS goods for which they have low domestic demand. Alternatively, if firm relocation is not possible, the HME results in lower wages instead of less firms. The HME has been shown to be robust to several different model specifications (for an overview, see Felbermayr and Jung, 2012).

The benchmark model of two countries, two sectors, and one factor, presented in HK 1985, will serve as the basis for the discussion in the present paper. This model posits one homogenous good CRS sector with perfect competition and no trade costs, and one IRS manufacturing sector with monopolistic competition and trade costs. As long as there is some production of the homogenous good in both countries, wages will equalise. In this case, the HME will result in the relative number of manufacturing firms in the small country being less than proportional to relative country size. Whereas firms are homogeneous and face variable export costs only in the HK 1985 model, the effect also arises in the corresponding Melitz-type model with fixed export costs and firm-level differences in marginal costs (see e.g. Baldwin and Forslid, 2010 for a model like that). These models are frequently used as point of departures for other models. A weakness of both models is that the less-than-proportional number of manufacturing firms in the small country induces a less-than-proportional number of manufacturing exporters. Consequently, the relative number of manufacturing exporters increases with relative size of the home market and hence decreases with the relative size of the export market. The reason is that, in the case of the homogeneous firms model, either all firms or no firms export; and, in the case of the Melitz-type model, that the extensive margin of exports (defined as the proportion of firms that export) is independent of country size. In both models, average sales per firm in the domestic market are equal in the two countries, as are average exports. Consequently, the HME applies to a country's production and exports as well as to its number of firms and exporters.

Several empirical studies have attempted to find evidence of the HME. Some has focused on the production side, others on the export side, of the HME hypothesis. Some studies also take into account that there may be 'home-bias' in demand (consumers may have stronger preferences for domestically produced goods than for foreign produced goods). In a survey of early contributions, Head and Mayer (2004) conclude that the evidence is mixed: 'One can see some support for HMEs in some industries in some specifications. However reverse HMEs (coefficients on demand of less than one or on home biased demand of less than zero) are more frequent.' (p. 2642). Conclusions from more recent contributions are also ambiguous. For example, Crozet and Trionfetti (2008) study the relationship between production shares and demand shares. They find some evidence of HMEs, but the economic significance is small. On average, the HME influences specialization in only about 12.5% of the 25 countries under study, and in these countries it influences specialization in 62% of the manufacturing activity. Hanson and Xiang (2004) focus on the relationship between export shares and GDP. They present a model of multiple countries and industries and show that industries with high transport costs and more differentiated products will concentrate in large countries due to the HME. They find strong empirical support for this pattern. However, their results have been questioned by Pham, Lovely and Mitra (2009), who apply different methodological procedures on the same data and find little evidence of a HME.

Also several theoretical contributions have shown that the HME does not necessarily arise in models where production is characterized by IRS. A reverse HME in exports can occur if firm entry is restricted. For example, Medin (2003) introduces a specific factor in fixed production costs, into the HK 1985 model. In practice this means that entry is restricted by the endowment of the specific factor and that the relative number of manufacturing firms becomes proportional to relative country size. Also in Chaney (2008) the mass of firms is exogenously given and proportional to country size. In both these models the decision to export is separated from the decision to sell in the domestic market by fixed export costs, and the number of exporters becomes negatively related to relative home market size. This is the effect that is referred to as the “foreign market effect” in Medin (2003). Similarly, a reverse HME in export values rather than the number of exporting firms arises when there is only one firm in each country. This is shown in the model with Cournot competition and homogeneous goods in Feenstra, Markusen and Rose (2001).

Other modifications of the cost side of the HK 1985 model can also affect the HME. Davis (1998) shows that the HME may disappear if the CRS sector is subject to sufficiently high transport costs. Further, Okubo and Rebeyrol (2006) show that higher fixed production costs in the large country can produce a reverse HME with respect to the number of manufacturing firms and exporters.

Also demand-side modifications of the HK 1985 model may cause a reverse HME. In Yu (2005) manufactured and homogenous goods enter the utility function as CES aggregates rather than Cobb-Douglas aggregates. If the elasticity of substitution between the manufactured and the homogenous goods is lower than one, consumers’ expenditure share for manufactured goods in the small country is higher than in the large country. This makes it more profitable to establish a manufacturing firm in the small country, and a reverse HME in the number of manufacturing firms and exporters will arise. In a Cournot competition model with linear demand, Head, Mayer and Rise (2002) show that a reverse HME in the number of manufacturing firms and exporters may emerge when products are differentiated by nations rather than firms, as long as products are sufficiently differentiated.

3 Theory

None of the above-mentioned models distinguishes the HME in the number of manufacturing firms from the reverse HME in the number of manufacturing exporters. By contrast, the model presented here allows for these two effects to coexist. It merges the notion of benefit of a large foreign market, predicted by traditional trade models, with the notion of disadvantage of a small home market, predicted by the HME literature. To my knowledge no other articles have discussed this dichotomy.

I follow Venables (1994) in introducing fixed export costs, national product differentiation, and a two-level nested CES subutility function for manufactured goods into the HK 1985 model. This allows a firm's export decision to be separated from its decision to sell in the domestic market. As a consequence, initially equal firms divide into exporters and non-exporters in equilibrium and hence become heterogeneous with respect to export status.[3] As opposed to Venables (1994), the present model considers countries of different sizes, with multiple manufacturing industries within each country.

The number of manufacturing industries in each country is exogenously given, whereas the number of firms within each industry is allowed to vary freely. The model thus combines the idea of restricted entry, found in e.g. Medin (2003) or Chaney (2008)[4], with the idea of free entry, found in e.g. HK

3 Medin (2003) presents another model with the same feature. Both models introduce fixed export costs into the HK 1985 model. However, in order to render possible an equilibrium with the coexistence of exporters and non-exporters, more structure has to be added to the HK 1985 model. In Medin (2003) more structure is added to the supply side, while in the present model more structure is added to the demand as well as to the supply side. In an appendix in Medin (2003) a model similar to the present model (albeit with only one manufacturing industry in each country) is outlined, but the full model is not written out. Also Yeaple (2005) presents a model of initially equal firms where exporters and non-exporters coexist. In that model, labour is heterogeneous, and firms become different with respect to choice of production technology, type of labour employed and export status. None of these models describe the coexistence of an HME in the number of manufacturing firms and a reverse HME in the number of manufacturing exporters. In Medin (2003) the number of manufacturing firms is proportional to country size; the two other models consider countries of equal size.

4 Note that here it is industry entry, rather than firm-entry that is restricted.

1985 or Baldwin and Forslid (2010). As in the latter two models, trade costs and IRS in production of manufactured goods lead to lower profitability of manufacturing production in the small country. Since the number of industries is exogenous, this cannot result in a lower-than-proportional number of industries. Instead it results in a lower number of firms within each industry and also in a lower-than-proportional total number of firms. However, this HME in the number of firms does not induce an HME in the number of exporters. Due to national product differentiation, large demand in the large country is directed towards foreign as well as domestic manufactured goods. Since the export decision is separated from the decision to sell in the domestic market by fixed export costs, this allows for a larger number of exporters within each industry and also a larger-than-proportional total number of exporters in the small country. The model serves as an illustration of the highly polar case where demand-side conditions and restricted entry create a reverse HME in the number of exporters, but, at the same time, IRS, trade costs and free entry create an HME in the number of firms selling in the domestic market. As a consequence of the reverse HME in exports, the extensive margin of exports (defined as the proportion of firms that exports) is larger in small countries.

3.1 Setup of the model

There are two countries, home and foreign, indexed by $i, j = h, f$, where h is smaller than f. Labour l, is the only input, and it is supplied inelastically. There are two economic sectors in each country. The first sector produces a homogenous good with CRS and zero export costs, and this ensures that wages are equalised between the two countries. As is customary, I normalise the wage to 1. The only income is wage; thus total income, y, equals l. The other sector consists of many manufacturing firms, each producing a unique variety, indexed by ω . $\omega \in \Omega$, where Ω is the set of all potentially available goods. Firms have constant marginal production costs φ. In addition, they have to pay a fixed cost to enter the domestic market, F, and a fixed export costs, G.[5]

[5] Note that F is interpreted as a domestic market entry cost, not a fixed production cost. This is in line with interpretation in several recent contributions, including Baldwin and Forslid (2010) and Felbermayr and Jung (2012). Mathematically, the model would look the same if F were

There are also variable iceberg export costs ($\tau > 1$). As the present article studies market size asymmetries rather than firm asymmetries, I disregard the modelling of firm differences in marginal production costs that is now common in trade models (see Melitz, 2003). Consequently, I assume that φ, as well as F and G are equal for all firms, independently of country of origin, so that all firms are symmetric. Manufacturing firms are grouped into industries that are country-bounded, and there is an exogenous number of m symmetric industries within a country.[6]

Preferences are represented by a three-level utility function. The first level is a Cobb-Douglas aggregate of homogenous and manufactured goods, with expenditure share of manufactured goods equal to μ. In the following analysis, I assume that μ is sufficiently small to ensure that both countries produce the homogenous good, so that wages will be equalised (see Appendix 3 for details). Subutility for manufactured goods is a two-level nested CES aggregate. The inner level is a CES aggregate over varieties belonging to the same industry, with elasticity of substitution equal to ε. This approach allows us to treat all varieties from the same industry as an aggregated composite industry good. The outer level is a CES aggregate over composite industry goods for which the elasticity of substitution is equal to η. Since industries are country-bounded, this implies that consumers will want to differentiate their consumption between foreign and domestically produced goods, as well as between varieties from the same country. It is reasonable to expect varieties within the same industry to be more substitutable than varieties between industries, thus I assume that $\varepsilon > \eta > 1$.[7]

interpreted as fixed production costs, as long as the proportion of firms that export is lower than 1 in both countries (see below).

6 Such national product differentiation could reflect Ricardian comparative advantages, or comparative institutional advantages. It could also reflect the existence of immobile country-specific factors. The model does not have enough structure to let both the number of industries and the number of firms be endogenous.

7 Similar nested CES functions are frequently used in multiproduct firm models to distinguish varieties produced by the same firm from varieties produced by different firms. See Allanson and Montagna (2005), Arkolakis and Muendler (2010), and Bernard, Redding and Schott (2011). Venables (1994) and Jorgensen and Schroder (2006) use it to separate domestically-produced varieties from foreign-produced ones, as here.

I assume that m is lower in the small country. This seems reasonable, as large countries may have access to a wider range of inputs (e.g. natural resources) or may have a greater variety of preferences. There may also be economies of scale and the industry level which make room for more industries in large countries. The assumption is supported by empirical evidence. For example, Parteka and Tamberi (2013) investigate several measures of export diversification in manufacturing industries for 60 countries over 20 years. They find a positive relationship between country size (measured in either population size or GDP) and export diversification indices. In particular, I assume that the relative number of industries is proportional to the relative country size, i.e. $Y=M<1$, where $M = m_h/m_f$ and $Y = y_h/y_f$. For the sake of comparison, I will also consider the case where $M=1$. Nevertheless, this case appears less realistic, as it contradicts the empirical evidence mentioned above; and it makes the demand effect from the large country towards small-country products unreasonably large.[8] The results from the analysis below will hold also when $Y<M<1$. However, the size of M may affect the range of expenditure share of manufactured goods (μ) that renders possible an equilibrium with non-specialisation in both countries (see Appendix 3 for details). Further, it may affect the ranges of Y, G and τ that render possible an equilibrium with proportions of firms that export below 1 in both countries (see Appendix 4 for details). Since all industries within a country are symmetric, the number of firms in an industry in country i (n_i) and the proportion of these that sell in country j, (s_{ij}) will be equal across all industries within the country.

Firms are monopolistically competitive, so the producer price for a single variety is a constant mark-up over marginal costs and it is equal for all firms, independent of country and industry of origin:

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

[8] For $M=1$, an equal number of foreign and domestic composite industry goods would enter the utility function, regardless of how small the smallest country were. If the large country were 100 times larger than the small and there were no export costs, foreign demand towards small-country manufactured goods would be 100 times higher than foreign demand towards large-country manufactured goods.

Using (1), we can characterise demand by the following expressions (see Appendix 1 for derivation).[9]

Demand from country *i* for a firm from country *j*:

(2) $c_{ji} = \mu Y_i Q_i^{\eta-1} P_{ji}^{\varepsilon-\eta} \tau_{ji}^{1-\varepsilon} p^{-\varepsilon}$

The price index for manufactured goods in country *i*:

(3) $Q_i = \left(m_i P_{ii}^{1-\eta} + m_j P_{ji}^{1-\eta}\right)^{\frac{1}{1-\eta}}$

The price index in country *i* for a composite industry good produced in country *j*:

(4) $P_{ji} = (s_{ji} n_j)^{\frac{1}{1-\varepsilon}} \tau_{ji} p$

Since there are four possible combinations of *h* and *f*, (2) and (4) represent four equations each, while (3) represents two equations, one for each country.
I assume symmetric variable export costs, thus $\tau_{ij} = \tau_{ji} = \tau$, $i \neq j$. There are no domestic trade cost, thus $\tau_{ii} = \tau_{jj} = 1$. s_{ij} denote proportion of firms from country *i* that sell in country *j*. Either all firms sell in their domestic market and only some of them export (i.e. $s_{ii} = 1$ and $s_{ij} < 1$); or all firms export and only some sell in their domestic markets (i.e. $s_{ii} < 1$ and $s_{ij} = 1$).[10] The relationship between export costs and market size determines which of the s_{ij} will equal one, and in the following I assume that these are related in a way that ensures that $s_{ii} = 1$ and $s_{ij} < 1$.[11] This is reasonable, as empirical evidence generally shows that only a fraction of firms export, and very few firms that export do not sell also in their domestic markets. For example, in a representative

9 Since firms and industries are symmetric, we can disregard indexing them. It is sufficient to characterize a firm and an industry by country of origin.

10 Also possible is a situation where all firms export in *h*, while only a fraction exports in *f*: i.e. $s_{ij} = s_{jj} = 1$ and $s_{ii} < 1$, $s_{ji} < 1$. See Appendix 4 for details.

11 Criteria for this to happen are discussed in Appendix 4. Also see Felbermayr and Jung (2012) for a similar discussion in a model with firms with different marginal costs.

sample of firms from developing countries from the Enterprise Survey dataset, some 21.5% of them exported some of their output, whereas only 1.5% exported all their output (see section 4.1. in the present paper for details about the dataset). WTO (2008) and Bernard *et al.* (2011) present surveys of empirical evidence on firm level exports.
In equilibrium there are two types of firms in each country: non-exporters and exporters (the latter also sell in their domestic market). Since there are constant marginal production costs and separate fixed costs of entry in the domestic market and the export market, a firm's profits in the two markets can be analysed separately. These are given by:

$$(5)\ \pi_{ii} = (p - \varphi) z_{ii} - F$$

$$(6)\ \pi_{ij} = (p - \varphi) z_{ij} - G$$

z_{ii} and z_{ij} represent the sales of a firm from country i in the domestic market and export market respectively; together, they amount to the firm's total output, z_i. There is free entry of firms in both markets; thus, profits in each market must equal zero. Inserting (1) in (5) and (6) and setting profits equal to 0 yields two separate free entry conditions, one for firms selling in the domestic market only, and one additional condition for firms that also export. In equilibrium there will be a total number of n_i firms, but only a subset $s_{ij} n_i$ of these will export. Hence, z_{ii} is positive for all firms, while z_{ij} is positive only for exporters.[12] By rearranging, we can solve for a firm's sales in its domestic and foreign market respectively:

$$(7)\ z_{ii} = \frac{\varepsilon - 1}{\varphi} F$$

[12] Note that the definition of a 'firm' is that it produces a unique variety ω. An alternative interpretation of the model is that exporters and non-exporters are different firms that produce different unique varieties.

$$(8)\ z_{ij} = \frac{\varepsilon - 1}{\varphi} G$$

(7) shows that all firms sell the same amount in their domestic market, independent of country of origin. Similarly, (8) shows that all exporters sell the same amount in their export market. (1), (3) and (4) in (2) yield four demand functions (for domestically and foreign produced varieties in the two countries); and (7) and (8) represent four supply functions (for domestic sales and exports in the two countries). By setting supply equal to demand, we can solve for the four endogenous variables: s_{ij} and n_i. See Appendix 2 for derivation of the equilibrium.

The present model differs from Melitz-type models in the mechanisms that create coexistence of exporters and non-exporters. In Melitz-type models some firms start exporting because they are different from others. The main determinant of whether or not a firm exports is its productivity. By contrast, in the present model, all firms are initially equal, but we get an equilibrium where firms become different with respect to export status. It is not possible *a priori* to tell which firms will become exporters and which will not. The export market is simply not large enough to include all firms.[13] It is not my intention to claim that firms do not differ in their marginal production costs, but in this paper I have chosen to work with initially equal firms because I wish to focus on export market conditions, rather than firm differences in marginal production costs, as determinants of firms' export status. All firms face demand from the domestic market, but exporters face demand from abroad as well. This tends to increase the number of exporters. On the other hand, exporters face fixed and variable export costs, and this tends to reduce the number of exporters. The extensive margin of exports, s_{ij}, depends on the relative importance of these mechanisms.

[13] Examples of other models that have the same feature are Venables (1994), Medin (2003) and Yeaple (2005). Conceptually this is not different from the fact that in the Dixit-Stiglitz model there is a potential number of Ω firms in the economy, but the market is not big enough for all of them; thus, in equilibrium, only a subset actually produce.

3.2 The HME in the number of firms

The total number of firms in country i is given by:

$$(9)\quad m_i n_i = y_i \frac{\mu}{\varepsilon F} \frac{1}{1 + \frac{m_j}{m_i} t^{\beta} T^{\beta}}$$

$$t = \tau^{1-\varepsilon} \leq 1 \quad T = \frac{F}{G} \leq 1 \quad \beta = \frac{\eta - 1}{\varepsilon - \eta} > 0$$

$$\frac{\partial m_i n_i}{\partial t} < 0 \quad \frac{\partial m_i n_i}{\partial T} < 0$$

The number of firms within an industry n_i will be lower in the small country for $M=Y$ as well as for $M=1$. $t^{\beta} T^{\beta}$ is an aggregate of variable export costs and domestic market entry costs relative to fixed export costs. It is a measure of openness. It is reasonable to assume that firms face higher fixed export costs than domestic market entry costs, as costs related to conducting market analyses, setting up distribution networks, acquiring information about laws, rules and business cultures, etc. are likely to be higher in a less familiar market. I therefore focus on the case where fixed export costs are higher than domestic market entry costs ($G>F$). This ensures that $t^{\beta} T^{\beta} < 1$.[14] $t^{\beta} T^{\beta} = 1$ implies no variable export costs $(t = 1)$ and fixed export costs equal to entry costs in the domestic markets $(T = 1)$. The expression is equal to 0 if either variable or fixed export costs are infinitely high.

As in standard models, this model produces a HME in domestic sales summarized as follows:

PROPOSITION 1. (The home market effect in the number of firms):

The number of manufacturing firms selling in the domestic market in the small country will be less than proportional to country size.

[14] See Melitz (2003), Baldwin and Forslid (2010) or Felbermayr and Jung (2012) for a similar measure. Note that $T^{\beta} t^{\beta} < 1$ is a necessary but not sufficient condition for the existence of non-exporters in both countries. See Appendix 4 for details.

Proof: The number of firms located in the home country relative to the number of firms located in the foreign country is given by:

$$(10) \quad MN = Y \frac{1 + Mt^{\beta} T^{\beta}}{1 + M^{-1} t^{\beta} T^{\beta}}$$

$$N = \frac{n_h}{n_f} \quad Y^2 < MN \le Y \quad \frac{\partial N}{\partial Y} > 0 \quad \frac{\partial N}{\partial T} \le 0 \quad \frac{\partial N}{\partial t} \le 0$$

For $M=Y$, the relative number of firms, MN, this is less than proportional to Y. In other words, the small country has a less-than-proportional number of manufacturing firms, and the model therefore produces an HME. Since all firms sell the same amount in their domestic markets, independent of country of origin (see Equation 7), the HME applies to the number of manufacturing firms as well as to total domestic sales.

The mechanism behind the HME in the number of firms is similar to that in standard models (e.g. HK 1985 and Baldwin and Forslid, 2010)[15]. There are proportionally fewer industries in the small country. All consumers want to consume some of each composite industry good, thus each small-country industry experiences lower domestic demand than each large-country industry. This makes each small-country industry is less profitable. If the number of industries in a country were allowed to vary, this would have lead to a lower-than-proportional number of industries in the small country.[16] However, since the number of industries is exogenous, the lower profitability instead results in fewer firms within each industry.

For $M=1$, domestic demand towards a domestic industry is proportional to country size. $MN=Y$, and there is no HME.

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[15] Note, however that the HME is dampened as compared to those models for large country size differences or high degree of openness. The reason is that consumers want to diversify their consumption between foreign and domestic composite industry goods, thus the small country will never get deindustrialised.

[16] This is analogous to the lower-than-proportional number of firms in HK 1985 and Baldwin and Forslid (2010).

3.3 The reverse HME in the number of exporters

A key result from the model which will be tested empirically in Section 4 is summarised as follows:

PROPOSITION 2. (Higher extensive margin in the small country):
The extensive margin of exports, defined as the proportion of firms that export, will be higher in the small country.

Proof: The extensive margin of exports in country *i* is given by:

$$(11) \quad s_{ij} = \left(\frac{n_i}{n_j}\right)^{-1} t^{\beta} T^{\beta+1} = \left(\frac{y_i}{y_j}\right)^{-1} \frac{m_i}{m_j} \frac{1+\left(\frac{m_i}{m_j}\right)^{-1} t^{\beta} T^{\beta}}{1+\frac{m_i}{m_j} t^{\beta} T^{\beta}} t^{\beta} T^{\beta+1} \qquad i \neq j$$

$$\frac{\partial s_{ij}}{\partial (y_i/y_j)} < 0 \qquad \frac{\partial s_{ij}}{\partial t} \geq 0 \qquad \frac{\partial s_{ij}}{\partial T} \geq 0$$

Both for $M=Y$ and $M=1$, the derivative with respect to relative home market size is negative. In other words, the extensive margin is larger in relatively small countries, and an increase in relative home market size leads to a decrease in the extensive margin of exports. [17]

The explanation for this is that demand for any composite industry good will be higher in the large country, since there are more consumers there. Consequently, manufacturing firms within an industry in the small country face higher demand from abroad than the case in the large country, and exports of manufactured goods becomes more profitable in the small country.

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[17] Some other models produce similar results. For example, Felbermayr and Jung (2012) have developed a Melitz-type model with asymmetric countries and no CRS sector. For the small country, the relative mass of firms is less than proportional to relative country size, so there is a home market effect with respect to the number of firms. As in the present model, the proportion of firms that export is larger in the small country. Nevertheless, the size of the relative mass of exporting firms is uncertain; thus, we cannot know whether there is a reverse home market effect in the number of exporters. Also Medin (2003) and Chaney (2008) predict that the extensive margin of exports will be larger in small countries, but there is no HME in those models.

Using (11) we get the following expression for the relative extensive margin of exports (the relative proportion of firms that export in *h* versus *f*):

$$(12)\quad S = N^{-2} = Y^{-2}M^{2}\left(\frac{1+M^{-1}t^{\beta}T^{\beta}}{1+Mt^{\beta}T^{\beta}}\right)^{2}$$

$$S = \frac{s_{hf}}{s_{fh}} \qquad 1 < S \le Y^{-2} \qquad \frac{\partial S}{\partial Y} < 0 \qquad \frac{\partial S}{\partial t} \ge 0 \qquad \frac{\partial S}{\partial T} \ge 0$$

The number of firms that export in country *i* is given by:

$$(13)\quad m_i s_{ij} n_i = y_j \frac{\mu}{\varepsilon F}\frac{\frac{m_i}{m_j}t^{\beta}T^{\beta+1}}{1+\frac{m_i}{m_j}t^{\beta}T^{\beta}} \qquad i \ne j$$

$$\frac{\partial m_i s_{ij} n_i}{\partial t} > 0 \qquad \frac{\partial m_i s_{ij} n_i}{\partial T} > 0$$

The relationship between the number of exporters and home market size is summarized as follows

PROPOSITION 3. (The reverse home market effect in the number of exporters):

The number of manufacturing exporters in the small country will be higher than proportional to country size.

Proof: From (12) we see that the relative number of exporters within an industry in *h* versus *f*, SN, is equal to N^{-1}. Inserting from (10) we get the relative number of all exporters:

$$(14)\quad MSN = MN^{-1} = Y^{-1}M^{2}\frac{1+M^{-1}t^{\beta}T^{\beta}}{1+Mt^{\beta}T^{\beta}}$$

$$Y < MSN \le Y^{-1} \qquad \frac{\partial MSN}{\partial t} \ge 0 \qquad \frac{\partial MSN}{\partial T} \ge 0$$

For the small country, the relative total number of exporters is more than proportional to relative country size (both for $M=Y$ and for $M=1$), even though the relative number of firms is less than proportional to country size (due to the HME).

The reason for this is that the larger relative extensive margin of exports in the small country more than outweighs the less than proportional relative number of firms. This can be seen from the fact that S lies between 1 and Y^{-2}. I call this result the 'reverse HME' in exports. The result contradicts the HK 1985 model and its Melitz-style extension (Baldwin and Forslid, 2010) and corresponds to the "foreign market effect" in Medin (2003).[18] A higher M reinforces the reverse HME in exports, and is strongest for $M=1$. Since all firms export the same amount, independent of country of origin (see Equation 8), the reverse HME applies to the number of exporters as well as to the country's total export value.

3.4 Export shares and specialisation

If $M=Y$, $MSN<1$, the large country will be a net exporter of manufactured goods. If M increases, the reverse HME in exports is reinforced, and the small country will gain a growing share of the world trade in manufactured goods. This is because a greater number of manufacturing industries in the small country will mean greater demand from abroad for small-country manufactured goods. On the other extreme where $M=1$, $MSN=Y^{-1}$. There is no HME in domestic sales ($MN=Y$) and the small country will be a net exporter of manufactured goods. For intermediate values of M, trade in manufactured goods may be balanced.

Since industries are country-bounded, there is no direct competition with foreign firms within an industry. Competition is only indirect and via the demand share for the whole industry. Further, within an industry there is only one-way trade. There is, however two-way trade in manufactured goods, across industries.

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18 Although here the effect is dampened by the HME as compared to Medin (2003) unless $M=1$

Unlike in standard models such as HK 1985 or Baldwin and Forslid (2010), the small country will never become deindustrialised, as consumers in both countries want to consume domestic as well as foreign composite industrial goods. Nevertheless, if consumers' expenditure share for manufactured goods exceeds a critical value, μ^*, one of the countries may specialise in manufacturing production. In that case, wages will no longer be equalised, but will increase in the country that specialises. If $M=Y$, the large country may specialise; and if $M=1$, it is the small country that may specialise. Specialisation is most likely to occur when the countries differ considerably in size. Furthermore, in the case where $M=1$, specialisation is most likely to occur for low export costs; but in the case where $M=Y$, specialisation is most likely to occur for intermediate values of export costs (see Appendix 3 for details).

3.5 Welfare effects

Welfare in country i is given by:

$$(15)\quad w_i = AQ_i^{-\mu} = Ap^{-\mu}\left(\frac{\mu}{\varepsilon F}y_i\right)^{\frac{(\varepsilon-\eta)\mu}{(\varepsilon-1)(\eta-1)}}\left(m_i + m_j t^{\beta}T^{\beta}\right)^{\frac{(\varepsilon-\eta)\mu}{(\varepsilon-1)(\eta-1)}} \quad i \neq j$$

$$A = \mu^{\mu}(1-\mu)^{(1-\mu)}$$

$$\frac{\partial w_i}{\partial y_i} > 0 \quad \frac{\partial w_i}{\partial m_i} > 0 \quad \frac{\partial w_i}{\partial m_j} > 0 \quad \frac{\partial w_i}{\partial t} > 0 \quad \frac{\partial w_i}{\partial T} > 0$$

See Appendix 2 for derivation of the second equality. Relative welfare in h versus f, $W = w_h/w_f$ is given by:

$$(16)\quad W = Y^{\frac{\mu}{\varepsilon-1}}\left(\frac{M + t^{\beta}T^{\beta}}{1 + Mt^{\beta}T^{\beta}}\right)^{\frac{(\varepsilon-\eta)\mu}{(\varepsilon-1)(\eta-1)}}$$

$$W < 1 \quad \frac{\partial W}{\partial Y} > 0 \quad \frac{\partial W}{\partial t} \geq 0 \quad \frac{\partial W}{\partial T} \geq 0$$

As in the standard models, welfare is highest in the large country and increase with the size of the home market. For

Y=M welfare also increases with the size of the foreign market (which is equivalent to an increase in the number of foreign industries). To understand the mechanism behind this we will look at the number of consumed varieties, which is given by:

$$(17)\quad n_i^c = m_i n_i + m_j s_{ji} n_j = \frac{\mu}{\varepsilon F} y_i \frac{1+\frac{m_j}{m_i} t^\beta T^{\beta+1}}{1+\frac{m_j}{m_i} t^\beta T^\beta} \qquad i \neq j$$

$$\frac{\partial n_i^c}{\partial y_i} > 0 \quad \frac{\partial n_i^c}{\partial m_i} > 0 \quad \frac{\partial n_i^c}{\partial m_j} > 0 \quad \frac{\partial n_i^c}{\partial t} < 0 \quad \frac{\partial n_i^c}{\partial T} = ?$$

An increase in the size of the home market or the number of domestic industries yields access to more varieties and increases welfare. An increase in the number of foreign industries (which is equivalent to an increase in the size of the foreign market for Y=M) reduces the number of consumed varieties. This tends to reduce welfare. Nevertheless it also increases the number of composite industry goods, which tends to increase welfare. The latter effects dominates, thus the net effect on welfare is positive.

For M=1, the size of the foreign market does not affect welfare.

3.6 Effects of trade liberalization

3.6.1 The number of firms that sell in the domestic market and the number that export

(13) shows that both for M= Y and M=1, the derivatives of $m_i s_{ij} n_i$ with respect to T and t are positive. Hence increased openness, whether through reduced variable or fixed export cost, increases the number of firms that export. As compared to increased t, trade liberalisation through increased T has an additional positive effect (this appears from the fact that in the nominator T is raised to the power of $\beta+1$ rather than just β). The reason is that increased T also leads to a reduction of the intensive margin of exports (each firm's

export volume), given by z_{ij} in (8). With lower fixed export costs, an exporting firm will break even in the export market selling a smaller amount than before. This allows for more exporters. Reduced variable export costs, on the other hand, does not affect the intensive margin of exports. Empirical evidence in Lawless (2010) suggest that the intensive margin of exports is negatively related to fixed export costs and independent of variable export costs, just as predicted in the present model. She shows that this result will arise in a Melitz-type model under the assumption of Pareto distributed marginal production costs. The present model shows that the result also arises in a model where firms have equal marginal production costs.[19]

(9) shows that both for $M=Y$ and $M=1$, the derivatives of $m_i n_i$ with respect to T and t are negative, thus trade liberalisation leads to a decline in the number of firms in both countries. The reason for this is that demand is shifted from domestically produced composite industry goods to foreign produced composite industry goods because the price index for the latter $\left(P_{ji}, i \neq j\right)$, is reduced. This in turn leads to an increase in the expenditure share for these goods (see Appendix 2). The reduction in P_{ji} happens because the number of accessible varieties from each foreign industry increases (this effect is strongest for increased T), and because the price of each imported variety declines (this effect only happens for increased t). From (9) we see that increased T and t have a symmetric effect on $m_i n_i$.

3.6.2 The HME and the reversed HME

The effects on the HME and the reversed HME can be summarised as follows:

PROPOSITION 4. (Trade liberalisation reinforcement effects):

Trade liberalisation reinforces the home market effect as well as the reverse home market effect.

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19 The result also arises in other models with fixed export costs and initially equal firms, such as Medin (2003) and Venables (1994), but the issue is not discussed in those articles.

Proof: Examining the derivatives of MN with respect to t and T in (10) shows that the HME is magnified by trade liberalisation (whether through increases in t or T) when $M=Y$. Examining the derivatives of MSN with respect to t and T in (14) shows that the reverse HME is magnified by trade liberalisation when $M=Y$.[20]

When trade costs are very high, domestic demand towards each industry is almost equal in the two countries. When trade is liberalised (whether through reductions in t or T), however, demand for imports increases more in the small country than in the large country because the latter produces more composite industrial goods. Therefore each industry in the small country experience a larger fall in domestic demand than each industry in the large country, and the relative number of firms falls.

Even though overall demand for imports increases more in the small country, each large-country industry experience a lower increase in demand from abroad than each small-country industry. The reason is that the number of industries is higher in the large country. The decline in small-country consumers' expenditure on the few domestic composite industry goods must therefore be spread over the increase in their expenditure on the many foreign composite industry goods. Consequently, increased demand from abroad will be larger for a small-country industry than for a large-country industry. This yields a greater increase in the number of exporters in the small country than in the large one.

3.6.3 Welfare

From (17) we see that the number of consumed varieties declines with reductions in variable trade costs. The model thus yields an "anti-variety" effect, just as in Baldwin and Forslid (2010).[21] As in Baldwin and Forslid (2010), there may or may not be an "anti-variety" effect from reductions in fixed trade costs. Reductions in both variable and fixed trade

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[20] For $M=1$ there is no effect on neither MN nor MSN from trade liberalization.

[21] Here the anti-variety effect applies to both the large and the small country, while in Baldwin and Forslid (2010) the large country may experience a pro-variety effect for small levels of trade costs.

costs lead to a lower number of produced varieties in both countries (see Equation 9) and an increase in the number of exported varieties (see Equation 13). The effect on the number of exported varieties, however, is stronger for reduced fixed trade costs, thus the net effect on the number of consumed varieties may be positive.

Despite that the number of consumed varieties can decline, (15) shows that welfare increases with trade liberalisation, whether through reductions in variable or fixed trade costs. To understand this, we should note that the number of imports from a foreign industry is always lower than the number of consumed varieties from a domestic industry, but that trade liberalisation leads to a convergence of two numbers (see equation A6 in Appendix 2). This convergence is welfare improving, as consumers want to differentiate their consumption on the two types of composite industry goods.[22]

The fact that welfare increases despite that the total number of consumed goods may decline is in line with Baldwin and Forslid (2010). Thus the present model shows that these effects may also occur in a model with firms with equal marginal production costs.

However, as opposed to standard models, such as HK 1985 and Baldwin and Forslid (2010), the present model contains a welfare convergence effect for $M=Y$, summarised as follows:[23]

[22] This can also be seen from the fact that reduced trade costs increases P_{ii} and reduces P_{ji} (see Appendix 2). For $M=1$ the reduction in P_{ji} is larger than the increase in P_{ii}, thus welfare increases. For $M=Y$, the effects on P_{ii} and P_{ji} differ in the two countries. For the small country, P_{ii} increases a lot, and P_{ji} declines a little because the HME in domestic sales as well as the reversed HME in exports are reinforced. Since consumers in the small country consume more foreign produced composite industry goods, the reduction in P_{ji} has a higher weight in the overall price index, Q_i, than the increase in P_{ii} (see Equation 3). For the large country the opposite is true: the reduction in P_{ji} is larger, but has a lower weight. The net effect on welfare is positive in both cases. Consequently access to more foreign produced varieties is more important than access to fewer domestically produced varieties.

[23] For $M=1$, W is independent of trade costs.

PROPOSITION 5. (Convergence of welfare):
Welfare is always higher in the large country, but trade liberalisation leads to a more equal welfare level in the two countries.

Proof: (16) shows that welfare is always higher in the large country, and the derivatives of W with respect to t and T show that relative welfare increases with trade liberalisation for the case where $Y=M$.

4 Empirical evidence

Equation (11) shows that the extensive margin of exports, defined as the proportion of firms that export, s_{ij} is a function of the relative home market size, y_i/y_j . In the presence of a reverse HME in exports, we should expect the extensive margin of exports to decrease with relative home market size. Let us now test this prediction.

4.1 Data and regression variables

4.1.1 The extensive margin of exports and the relative home market size

Empirical analysis on firm level export data has been a fast-growing field in international economics.[24] Unfortunately, firm level data that compare exporters and non-exporters are available only for selected countries, and studies are often not comparable between countries – with a few exceptions. The International Study Group on Exports and Productivity (2008) has compared firm level data on exporters and non-exporters for 14 countries. It finds that the extensive margin of exports is 'loosely decreasing in the size of the domestic markets' (p. 5). To my knowledge this is the only empirical study to deal with the relationship between the extensive margin of exports and country size. As this was not a major issue for the Study Group, it is done very briefly without econometrically testing the relationship.[25] There are no good datasets that include comparable data for most countries in the world, and this is therefore a difficult task. Even so, in this section I attempt to present first evidence on the importance of relative country size for the extensive margin of exports, using firm level data from the Enterprise Surveys dataset. This dataset is currently the best available, but has its limitations, as it covers only developing countries. Thus,

24 Examples include Roberts and Tybout (1997) on Colombian firms; Bernard and Jensen (2004) on US firms; Eaton, Kortum and Kramarz (2004) on French firms; Lawless (2009) on Irish firms; Wagner (2001) on German firms; Moxnes (2010) on Norwegian firms; and several others.

25 As the dataset covers only 14 countries, it is difficult to use it for drawing inferences.

'Asia/Oceania' does not include developed countries such as Japan and South Korea, or indeed China and India; and 'Europe' does not include any Western European countries. However, most countries in Africa and Latin America are included. Moreover, the data cover a large number of countries – 119 in total – and can be used to construct comparable unbiased estimates of the extensive margins of exports in these countries.

The data are based on surveys among a representative sample of all firms in the non-agricultural formal private economy in each country, and were collected between 2006 and 2011. The data are mainly cross-sectional, but some countries appear in different years than others. In addition, a few countries appear in more than one year, in which case I use the most recent observations. Most observations are from 2009 and 2010. The survey is stratified by business sector, location and firm size; and the population of firms that form the basis of the sample is consistently defined in all countries. The same methodology and the same core questionnaire are applied in all countries, making data comparable across countries. See Enterprise Surveys (2012) for further details.

In the present study, I include manufacturing firms only, which are drawn from the entire manufacturing sector in the countries in question. The data contain firm level information about the proportion of output exported.[26] I define a firm as being an exporter if it exports at least 20% of its output. The reason for this is that firms that export a very small amount may be testing the export market for the first time or may be exporting by coincidence, and most of them will probably not survive in the market (see Eaton *et al.*, 2008). It is not likely that these firms have paid the full fixed export cost, G. In Appendix 5, I show that results are robust against defining as 'exporters' firms that export any amount. Using this information, I construct an estimate of the proportion of manufacturing firms that export in each country, i.e. the extensive margin of exports. The estimate is calculated using sampling weights and is hence unbiased. This is the dependent variable. It corresponds to s_{ij} in Equation (11) and is called *extensive margin of exports*. The

[26] If this information is missing, the observation is deleted from the sample.

main explanatory variable of interest here is the home country's GDP in per cent of the rest of the world's GDP (including countries not in the sample). It corresponds to y_i / y_j in Equation (11) and is called *relative home market size*.[27]

Table 1 presents these two variables for the whole sample, as well as for four regional subsamples. Due to missing explanatory variables for three countries, the table and the regression analyses include only 116 countries.[28] As shown in the first column of Table 1, the extensive margin of exports is small, with an average of 0.14. For three countries in the sample (Iraq, Liberia and Vanuatu) the estimated extensive margin of exports indicates no exporting firms in the manufacturing sector. Also the relative home market size is small: on average, home market GDP constitutes only 0.12% of the rest of the world's GDP. The median is much smaller than the mean (only 0.02), indicating that there are many small countries in the sample. Investigating the variables at the regional level shows that Europe has a much higher average extensive margin of exports (0.27) than the other regions.

Table 1. Extensive margin of exports and relative home market size in 116 countries from the Enterprise Surveys dataset

Group of countries	All		Europe		Asia/Oceania		America		Africa	
Variable	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size	Extensive margin of exports	Relative home market size
Min	0.000	0.001	0.085	0.005	0.000	0.001	0.001	0.001	0.000	0.001
Median	0.116	0.018	0.248	0.063	0.083	0.014	0.139	0.030	0.073	0.011
Mean	0.137	0.120	0.267	0.187	0.121	0.081	0.125	0.224	0.092	0.029
Max	0.543	2.231	0.543	1.027	0.435	0.665	0.296	2.231	0.260	0.454
No of observations	116	116	20	20	25	25	31	31	40	40

Note: Extensive margin of exports = estimate of the proportion of manufacturing firms that export in each country. An exporter is defined as a firm that exports at least 20% of its total output. Relative home market size= home country GDP in per cent of the rest of the world's GDP in constant year 2000 US dollars.

27 GDP is measured in constant (year 2000) US dollars and the data are taken from the World Development Indicators. I lack data for Barbados for 2010, and use figures for 2009 instead.

28 I lack GDP data for Afghanistan, and distance for Kosovo and Montenegro.

4.1.2 Export costs

According to Equation (11), not only relative home market size, but also export costs, can affect the extensive margin of exports. Reductions in either fixed or variable export costs are predicted to increase the extensive margin of exports. Distance is commonly used as a proxy for export costs. Variable export costs may increase with distance due to higher transportation costs, while fixed export costs may increase with distance due to factors such as greater legal and cultural disparities. In addition, Krautheim (2012) shows that in the presence of exporting spillovers, fixed export costs increase with distance. Consequently, I expect more remote countries to have a lower extensive margin of exports. While the model in Section 3 is a two-country model, the data used for regression analyses include many countries, so a variable that corresponds to τ and G (which are embedded in t and T respectively in Equation 11) should reflect a country's distance to the rest of the world. I therefore calculate the variable *remoteness*, which is an output-weighted average of country *i*'s distance to the rest of the world, where weights are equal to the proportion of country *j*'s GDP to the rest of the world's GDP. This is a commonly used measure of average distance (Melitz, 2006).

$$remoteness_i = \sum_{j=1}^{n} x_j d_{ij} \qquad x_j = \frac{GDP_j}{GDP_w - GDP_i} \qquad i \neq j$$

d_{ij} is distance from country *i* to country *j*, where $d_{ii} = 0$, and GDP_w equals world *GDP*. In the regression analysis I use remoteness to control for both fixed and variable export costs.

Data for distance between pairs of countries is provided by the CEPII database *dist_cepii* (Mayer and Zignago, 2011). I use the great circle distance measured in kilometres between largest cities (the *dist* variable).

4.1.3 Other control variables

Equation (11) predicts that only the relative home market size and export costs will affect the extensive margin of export (recall that m_i/m_j is equal to either y_i/y_j or unity). However, a simplifying, albeit unrealistic, assumption behind the model presented in Section 3 is that cost functions are equal across all firms independent of country of origin: hence, all firms are equally productive. However, exporters are known to be more productive than non-exporters, and evidence indicates that more productive firms self-select into exporting (see Wagner, 2007). If technology levels differ between firms or countries and are correlated with GDP, we may therefore get biased estimates for the coefficient for relative home market size. To correct for differences in technology levels, I include *GDP per capita*, *GDP per capita* squared, and *average firm size*.

Less developed countries often have access to a lower level of technology than more developed ones. This may reduce the competitiveness of manufacturing firms and lead to a lower extensive margin of exports. For highly developed countries, on the other hand, the relationship may be reversed. These countries are characterised by a shift in employment from manufacturing to service industries (Syrquin, 1988). There are many possible explanations for this (Rowthorn and Ramaswamy, 1999). One is that the high cost of labour reduces competitiveness in manufacturing industries, leading them to relocate to less-developed countries. In this case we could expect an inverse U relationship between level of development and the extensive margin of exports. Alternatively, the relationship might be unambiguously positive. For example, higher productivity growth in manufacturing industries than in services or declining income elasticity of demand for manufactured goods can lead to reduction in manufacturing employment, but not as a consequence of lower competitiveness. To correct for level of development, I include *GDP per capita* in the analysis. I also include *GDP per capita squared* to test for a possible inverse U relationship. Data are taken from the World Development Indicators and are measured in constant (year 2000) 1000 US dollars. [29]

Even if countries have access to the same overall level of technology, firms within the same country may differ in productivity. Differences in economic conditions between countries may then lead to differences in average productivity levels. For example, Melitz and Ottaviano (2008) predict that firms in large countries will have higher average productivity levels because tougher competition will force the least productive firms out of the market.

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[29] The World Development Indicators database lacks GDP and GDP per capita data for Barbados for 2010, so I use figures for 2009 instead.

Felbermayr and Jung (2012), on the other hand, predict the opposite, on the grounds that high demand in large countries makes room for less productive firms. I do not have data for firm productivity, but firm size can be used as a proxy. The Enterprise Survey data contains information about whether a firm is small (< 20 employees), medium-sized (20 - 99 employees), or large (> 100 employees). Assigning to these categories values of 1, 2 and 3, I construct the variable *average firm size*, which indicates the average firm size in the country (I include only firms for which I have information about export status). Since the variable does not measure the actual average number of employees, we should not pay attention to the size of its coefficient, only the sign.

4.2 Results

In the empirical analyses I estimate a reduced form of (11), namely the following equation:

(18) *extensive margin of exports* $= \alpha$
$+ \beta_1$ *relative home market size*
$+ \beta_2$ *GDP per capita*
$+ \beta_3$ *GDP per capita squared*
$+ \beta_4$ *remoteness* $+ \beta_5$ *average firm size* $+ \varepsilon_i$

The main variable interest is β_1. According to Equation (13), we should expect a negative sign.

Since the dependent variable is a proportion that lies between zero and one (including three 0's), it is not appropriate to estimate the model using OLS. Instead I use an estimator developed by Papke and Wooldridge (1996), later known as fractional logit.[30] Wagner (2001) discusses various econometric methods for dealing with proportions, and in the context of microeconometrics of exporting he applies the same estimator. In Appendix 5, I show that results are robust to applying OLS instead of fractional logit.

Since some countries are observed in different years, I include year dummies, as well as dummies for the regions that appear in Table 1. I also perform separate analyses for each region to see whether results are driven by a particular region.

30 Also see Wooldridge (2012), pp. 748 -753 for a textbook discussion on fractional dependent variables and Ramalho, Ramalho and Murieta (2011) for a recent discussion. Computations were done by using the Stata command glm, proposed by Baum (2008).

Table 2. Determinants of the extensive margin on exports– results from fractional logit models based on the Enterprise Surveys dataset.

	All		All		Europe		Asia/Oceania		Latin America		Africa	
	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects
Relative home market size	–0.2731	–0.0323	–1.1605***	–0.1226***	–1.2997***	–0.2494***	–3.5453**	–0.2860**	–0.7518***	–0.0793***	–2.2500*	–0.1768*
	(0.2230)	(0.0265)	(0.3120)	(0.0319)	(0.3932)	(0.0786)	(1.4433)	(0.1192)	(0.2045)	(0.0215)	(1.1971)	(0.0958)
GDP per capita			0.1644***	0.0174***	0.2638***	0.0506***	1.6533	0.1334	0.1521**	0.0160**	–0.2907	–0.0228
			(0.0430)	(0.0047)	(0.0829)	(0.0167)	(1.1132)	(0.0915)	(0.0726)	(0.0079)	(0.4087)	(0.0321)
GDP per capita squared			–0.0058**	–0.0006**	–0.0081	–0.0016	–0.5935	–0.0479	–0.0065*	–0.0007*	0.0831	0.0065
			(0.0025)	(0.0003)	(0.0054)	(0.0011)	(0.4662)	(0.0379)	(0.0035)	(0.0004)	(0.0800)	(0.0062)
Remoteness			0.0000	0.0000	0.0010	0.0002	0.0001	0.0000	–0.0001	–0.0000	–0.0001	–0.0000
			(0.0001)	(0.0000)	(0.0008)	(0.0001)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Average firm size			1.4494***	0.1531***	0.5039	0.0967	2.5858***	0.2086***	1.0200	0.1075	1.9897***	0.1563***
			(0.3001)	(0.0303)	(0.6647)	(0.1279)	(0.5201)	(0.0405)	(0.8616)	(0.0909)	(0.4783)	(0.0348)
Constant	–1.8085***		–4.8437***		–8.8817		–7.4478***		–3.4645***		–4.2797***	
	(0.0873)		(0.7510)		(5.4562)		(1.5783)		(1.2177)		(1.1400)	
Log pseudo–likelihood	–34.14	–34.14	–31.36	–31.36	–7.622	–7.622	–6.082	–6.082	–8.328	–8.328	–8.841	–8.841
No of Observations	116	116	116	116	20	20	25	25	31	31	40	40
Predicted extensive margin		0.1369		0.1201		0.2590		0.0885		0.1208		0.0900
Doubling the relative home market size		–2.8309		–12.2536		–18.0051		–26.1787		–14.7041		–5.6948

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parentheses. Marginal effects and predicted extensive margins are evaluated at the mean of the independent variables. Year dummies are included in all regressions; regional dummies are included in the regressions for the whole sample.

Table 2 presents results from the regression analyses. Coefficients as well as marginal effects (evaluated at the mean of the other independent variables) are reported.[31] The first four columns present results based on the whole sample, where the first two show results without control variables. The other columns present results based on the regional subsamples.

The coefficient for the main variable of interest, *relative home market size*, is positive but not significant in the regression without controls. However, when control variables are included, it becomes significant and of the expected sign in the whole sample, as well as in all subsamples (albeit only at 10% level for Africa).[32] Hence, results support the hypothesis of a higher extensive margin of exports in small countries.

What about the economic significance of the effect? The marginal effects should be interpreted relative to the predicted extensive margin of exports (evaluated at the mean of the other independent variables), which is shown in the second last row of Table 2. In the last row I have calculated the predicted effects from doubling the *relative home market size*. For the average country in the whole sample this would lead to a reduction in the extensive margin of exports by 12.3%.[33]

Are these results robust to alternative specifications? Table 1 shows that median *relative home market size* is much lower than the mean: thus, the sample consists of many relatively small countries and a few large ones. A concern is therefore

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31 Coefficients for dummies for years and regions are not reported, but are available upon request.

32 The number of observations is somewhat low for the regional subsamples, and results for Asia/Oceania and Africa are not robust to alternative specifications (see Appendix 5). Therefore, results for the regional subsamples should be interpreted with care.

33 For the whole sample, the marginal effect is equal to 0.123. The predicted extensive margin of exports is 0.120; thus an increase in relative home market size by one percentage point is predicted to lead to a decrease in the extensive margin of exports by 103% (i.e. below 0, which is not possible). We should, however, bear in mind that average relative home market size for the sample countries is only 0.120% (see Table 1), thus an increase of one percentage point is a very large increase. If, instead, we double the relative home market size, the predicted reduction in the extensive margin of exports is 103%*0.120= 12.3%. It can be argued that this reasoning is imprecise, since doubling of the relative home market size cannot be considered a marginal change, and this is a non-linear model. However, results from the linear model in Appendix 5 are close to the ones presented here (except for Asia/Oceania), so the approximation seem fairly good.

whether the results are driven by a few large countries. This is not the case. Omitting the 5% or the 10% largest countries from the sample does not alter the significance of the coefficient for *relative home market size*. In fact, the marginal effect becomes even higher in these reduced samples (about twice that in the full sample).[34] In Appendix 5, I present results from two other sensitivity analyses. First, I estimate Equation (18) using OLS. The marginal effects of *relative home market size* are similar to those from the main analysis and are reported in Table A1. Secondly, I perform an analysis redefining the extensive margin of exports. Instead of defining a firm as an exporter if it exports at least 20% of its output, I now define a firm as an exporter if it exports *any* amount. Obviously, this increases the extensive margin of exports – new summary statistics are shown in Table A2. Results from the regression analyses are reported in Table A3; they show that, also in this case, the marginal effects are similar to those in the main analyses.[35]

The coefficient for *average firm size* is positive and significant in the whole sample as well as for Asia/Oceania and Africa, and the results are robust to alternative specifications (see Appendix 5). Thus, larger average firm size is generally associated with a higher extensive margin of exports. The coefficient for *GDP per capita* is significant and of the expected sign for the whole sample, as well as for Europe and Latin America. Further, the coefficient for *GDP per capita squared* is negative and significant for the whole sample, as well as for Latin America. Consequently, there is some evidence of an inverse U relationship between the extensive margin of exports and welfare level, but the results are not robust to alternative specifications (see Appendix 5). Surprisingly, the coefficient for *remoteness* is not significant – in the whole sample, or in any of the subsamples. I tried replacing *remoteness* with alternative measures of average distance to the rest of the world such as an unweighted average. None of the alternative measures produced significant results for average distance. I also tried replacing

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34 Moreover, omitting the 5% or 10% smallest countries does not alter the results for relative home market size in terms of significance or size of the marginal effect.

35 I also experimented with calculating the relative home market size using population size rather than GDP. Results regarding the coefficient for relative home market size were not altered in terms of significance, but the marginal effects were somewhat lower. Since it is income level, rather than population size, that determines demand, I chose to present the results with GDP as a measure of country size.

GDP per capita and *remoteness* with their logs, and *GDP per capita squared* with (log of GDP per capita) squared. There was little change in the results regarding relative home market size.

To conclude, the empirical analyses support the hypothesis of larger extensive margins of exports within manufacturing industries in small countries than in large countries. Doubling the *relative home market size* is associated with a decrease in the extensive margin of exports by 12.3% for the average country.

5 Conclusions

In this paper I have presented a model of trade in manufactured goods where the well-known HME in the number of manufacturing firms coexists with a reverse HME in the number of manufacturing exporters. While small countries have lower profitability in domestic sales of manufactured goods due to increasing returns to scale, trade costs and access to a small home market, they have higher profitability in exports of manufactured goods, due to access to a large foreign market. For the small country, this leads to the relative number of manufacturing firms selling in the domestic market being less than proportional to the relative country size. The relative number of manufacturing exporters on the other hand, will be more than proportional to the relative country size. One consequence of this is that the extensive margin of exports of manufactured goods, defined as the proportion of firms that export, becomes higher in relatively small countries. These results contradict those from benchmark HME models, whether dealing with homogeneous or heterogeneous firms, which predict that the extensive margin of exports is independent of country size.

The prediction of larger extensive margins of exports in small countries is tested using data on firm level exports from 116 developing countries from the Enterprise Surveys dataset. Using a fractional logit analysis, I find that, for the average country, a doubling of home country GDP relative to the rest of the world's GDP is associated with a decrease in the extensive margin of exports of manufactured goods by 12.3%.

The dataset used in the present study has obvious limitations, as it covers only developing countries. A topic for future research is to obtain comparable firm level data for more developed countries, so that we would be able to test the relationship for these countries as well. Another topic for future research is to test more directly the hypothesis of the co-existence of an HME in domestic sales and a reverse HME in exports. As obtaining comparable data on the number of firms and exporters for a large set of countries would be very difficult, this could be done by using values of domestic sales and exports instead.

Appendices

Appendix 1. Derivation of demand functions

The outer level of the subutility function for manufactured goods in country *i* is given by:

$$U_i = \left(\sum_{k_i=1}^{m_i} C_i(k_i)^{\frac{\eta-1}{\eta}} + \sum_{k_j=1}^{m_j} C_i(k_j)^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \qquad i \neq j$$

k_i indexes an industry located in country *i*. The inner level is given by:

$$C_i(k_j) = \left(\sum_{\omega_j=1}^{s_{ji}n_j} c_i(k_j,\omega_j)^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1}}$$

The price index in country *i* for manufactured goods produced within an industry located in country *j* is given by:

$$P_i(k_j) = \left(\sum_{\omega_j=1}^{s_{ji}n_j} \left(\tau_{ji}\, p(k_j,\omega_j) \right)^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}$$

Since firms are symmetric, this reduces to Equation (4) in the text. The price index for manufactured goods in country *i* is given by

$$Q_i = \left(\sum_{k_i=1}^{m_i} P_i(k_i)^{1-\eta} + \sum_{k_j=1}^{m_j} P_i(k_j)^{1-\eta} \right)^{\frac{1}{1-\eta}} \qquad i \neq j$$

Since industries are symmetric, this reduces to Equation (3) in the text. As pointed out by Helpman and Krugman (1985, p. 120), consumer expenditure shares on each product in a separable utility function of this kind depend on prices and the number of varieties only. By utility maximization of the outer level of the CES function, we get the following expression for demand in country *i* for a composite industry good produced in country *j*:

$$C_{ji} = \mu Y_i \frac{P_{ji}^{-\eta}}{Q_i^{1-\eta}}.$$

The share of expenditure for manufactured goods allocated to C_{ji} is hence equal to

$$\text{(A1)} \quad \alpha_{ji} = \left(\frac{P_{ji}}{Q_i}\right)^{1-\eta}$$

Now, for a firm from country *j*, demand from country *i* is given by:

$$\text{(A2)} \quad c_{ji} = \mu Y_i \alpha_{ji} \frac{\tau_{ji}^{1-\varepsilon} p^{-\varepsilon}}{P_{ji}^{1-\varepsilon}}$$

Since firms are symmetric and industries only differ by country of origin, I have omitted ω and k from the above expressions and let the first subscript denote the country where the good is produced, and the second subscript denote the country where the good is sold. Inserting from (A1) in (A2) gives equations (2) in the text.

Appendix 2. Derivation of the equilibrium

The equilibrium conditions for domestically produced goods and imports respectively in country *i* are given by:

$$\text{(A3)} \quad c_{ii} = z_{ii} \Leftrightarrow \mu y_i \frac{\varepsilon - 1}{\varepsilon\varphi} \frac{n_i^{\frac{\varepsilon-\eta}{1-\varepsilon}}}{\left(m_i n_i^{\frac{1-\eta}{1-\varepsilon}} + m_j (s_{ji} n_j)^{\frac{1-\eta}{1-\varepsilon}} \tau^{1-\eta}\right)} = \frac{\varepsilon - 1}{\varphi} F \qquad i \neq j$$

$$\text{(A4)} \quad c_{ji} = z_{ji} \Leftrightarrow \mu y_i \frac{\varepsilon - 1}{\varepsilon\varphi} \frac{(s_{ji} n_j)^{\frac{\varepsilon-\eta}{1-\varepsilon}} \tau^{1-\eta}}{\left(m_i n_i^{\frac{1-\eta}{1-\varepsilon}} + m_j (s_{ji} n_j)^{\frac{1-\eta}{1-\varepsilon}} \tau^{1-\eta}\right)} = \frac{\varepsilon - 1}{\varphi} G \qquad i \neq j$$

Dividing (A4) by (A3) and rearranging yields the following expression for the number of imported varieties relative to the number of domestic varieties in country *i*.

$$\text{(A5)}\quad \frac{s_{ji}n_j}{n_i} = t^{\beta}T^{\beta+1} < 1 \qquad i \neq j$$

$$t = \tau^{1-\varepsilon} \leq 1 \qquad T = \frac{F}{G} \leq 1 \qquad \beta = \frac{\eta - 1}{\varepsilon - \eta} > 0$$

(A5) is the key to solving the equilibrium. It shows that the number of imports from a foreign industry is always lower than the number of consumed varieties from a domestic industry. Nevertheless, trade liberalisation, whether through increased T or t, leads to a convergence of two numbers. From (A5) we can also see that the number of imports relative to the number of domestically produced varieties is given by: $\frac{m_j s_{ji} n_j}{m_i n_i} = \frac{m_j}{m_i} t^{\beta} T^{\beta+1} \quad i \neq j$, which will be Y^{-2} times larger in the small country for $M=Y$.

(A3), (A4) and (A5) represent two equations each: one for *h* and one for *f*. Inserting (A5) for country *i* in (A4) for country *i* and rearranging gives Equation (9) in the text. Dividing (A3) for home by (A3) for foreign, using (A5) for both home and foreign, and rearranging yields Equation (10) in the text. The first part of Equation (11) in the text follows directly from (A5), while the second part follows from inserting from (9). By combining (A5) and (9) we get Equation (13) in the text.

Inserting for (9) and (11) in (4) we get the following expressions for P_{ii} and P_{ji}

$$P_{ii} = p\left(\frac{\mu}{\varepsilon F} y_i\right)^{\frac{1}{1-\varepsilon}} \left(m_i + m_j t^{\beta} T^{\beta}\right)^{\frac{1}{\varepsilon-1}} \qquad i \neq j$$

$$P_{ji} = p\left(\frac{\mu}{\varepsilon F} y_i\right)^{\frac{1}{1-\varepsilon}} \left((t^{\beta}T^{\beta})^{\frac{\varepsilon-1}{1-\eta}} m_i + m_j (t^{\beta}T^{\beta})^{\frac{\varepsilon-\eta}{1-\eta}}\right)^{\frac{1}{\varepsilon-1}} \qquad i \neq j$$

$$\frac{P_{ii}}{P_{ji}} = (t^{\beta}T^{\beta})^{\frac{1}{\eta-1}} < 1 \qquad \frac{\partial P_{ii}}{\partial t} > 0 \qquad \frac{\partial P_{ii}}{\partial T} > 0 \qquad \frac{\partial P_{ji}}{\partial t} < 0 \qquad \frac{\partial P_{ji}}{\partial T} < 0$$

Using this in (3), we express Q_i as:

$$Q_i = p\left(\frac{\mu}{\varepsilon F} y_i\right)^{\frac{1}{1-\varepsilon}} \left(m_i + m_j t^{\beta} T^{\beta}\right)^{\frac{(\varepsilon-\eta)}{(1-\varepsilon)(\eta-1)}} \qquad i \neq j$$

Inserting for P_{ji} and Q_i in (A1), we can express the expenditure share for a foreign composite industry good for consumers in country *i* as:

$$\alpha_{ji} = \frac{1}{m_j} \frac{t^{\beta}T^{\beta}}{\left(\frac{m_i}{m_j} + t^{\beta}T^{\beta}\right)} \qquad i \neq j$$

$$\frac{\partial \alpha_{ji}}{\partial t^{\beta}T^{\beta}} > 0$$

Appendix 3. Criteria for specialisation in production of manufactured goods

Labour used in the manufacturing sector in country *i* is equal to:

$$\text{(A6)} \quad l_i^I = m_i n_i \left(\varphi z_{ii} + F\right) + m_i n_i s_{ij} \left(\varphi z_{ij} + G\right) = m_i n_j \varepsilon F \left(\frac{n_i}{n_j} + t^{\beta}T^{\beta}\right) \quad i \neq j$$

The last equality follows from (7), (8) and (A5) for country *j*. By inserting from (9) for both countries, we can express relative labour used in the manufacturing sector in country *i* versus country *j* as:

$$\text{(A7)} \qquad \frac{l_i^I}{l_j^I} = \frac{\frac{y_i}{y_j} + \frac{y_i}{y_j}\frac{m_i}{m_j} t^{\beta}T^{\beta} + \frac{m_i}{m_j} t^{\beta}T^{\beta} + t^{2\beta}T^{2\beta}}{1 + \frac{m_j}{m_i} t^{\beta}T^{\beta} + \frac{y_i}{y_j}\frac{m_j}{m_i} t^{\beta}T^{\beta} + \frac{y_i}{y_j} t^{2\beta}T^{2\beta}} \qquad i \neq j$$

$$\frac{\partial \mu^*}{\partial (y_i / y_j)} > 0$$

For specialisation to occur in a country, the total labour force in that country must be employed in the manufacturing sector, i.e. $l_i^I \geq y_i$, where we use the fact that $l_i = y_i$. This will happen if consumers' expenditure share for manufactured goods, μ, is higher than a critical value, μ^*. Define $L^I = \frac{l_h^I}{l_f^I}$, which denote relative labour used in the manufacturing sector in *h* versus *f*. From (A7) we see that for *M*=*Y*, L^I is lower than relative country size ($L^I < Y$), thus specialisation may occur in the large country. For *M*=1, L^I is larger than *Y*, thus specialisation may occur in the small country. For intermediate values of *M*, the probability of specialisation is lower, but for sufficiently high μ, specialisation may occur in either country, depending on the size of *M*.

For *M*=*Y*, we find μ^* by setting $l_f^I \geq y_f$ and inserting from (9) in the second part of (A6):

$$\mu^* = \frac{1 + Y^{-1} t^{\beta} T^{\beta} + Y t^{\beta} T^{\beta} + t^{2\beta} T^{2\beta}}{1 + Y^{-1} t^{\beta} T^{\beta} + Y t^{2\beta} T^{2\beta} + t^{\beta} T^{\beta}}$$

$$\frac{\partial \mu^*}{\partial Y} > 0$$

For *M*=1, we find μ^* by setting $l_h^I \geq y_h$ and inserting from (9) in the second part of (A6)

$$\mu^* = \frac{1 + t^{\beta} T^{\beta}}{1 + Y^{-1} t^{\beta} T^{\beta}}$$

$$\frac{\partial \mu^*}{\partial Y} > 0 \quad \frac{\partial \mu^*}{\partial t} < 0 \quad \frac{\partial \mu^*}{\partial T} < 0$$

In both cases, specialisation is most likely to occur when the countries differ greatly in size. The effect of trade liberalisation is somewhat different in the two cases. Trade liberalisation has two opposite effects on labour used in the manufacturing sector: i) it reduces labour used in domestic sales of manufactured goods, and ii) it increases labour used in exports of manufactured goods. For the case where $M=1$, the derivatives of μ^* with respect to t and T are negative. In the small country, ii) dominates over i), and trade liberalisation leads to increased use of labour in the manufacturing sector. This increases the probability of specialisation. For $M = Y$, the derivatives of μ^* with respect to t and T are ambiguous. But $\mu^* < 1$ for $0 < t^{\beta}T^{\beta} < 1$ and $\mu^* = 1$ for either prohibitive export costs or for completely liberalised trade. Thus, in the two limit cases where $t^{\beta}T^{\beta} = 0$ and $t^{\beta}T^{\beta} = 1$, specialisation will not occur. Further, μ^* declines when $t^{\beta}T^{\beta}$ is near 0 and increases when $t^{\beta}T^{\beta}$ is near 1. This is because ii) dominates in the large country when export costs are high, and i) dominates when export costs are low. This could indicate that specialisation is most likely to occur for intermediate values of export costs.

Appendix 4. Criteria for non-exporters in both countries

Equation (12) shows that the extensive margin of exports is larger in the small country, and Equation (11) shows that trade liberalisation increases the extensive margin of exports in both countries. Therefore, if export costs decrease, the extensive margin of exports will reach 1 in the small country first. Consequently, there will be non-exporters in both countries as long as Y is not too small relative to openness. From (11), we can write the proportion of firms that export in h as:

$$s_{hf} = \frac{a(t,T)}{b_{hf}(t,T)} \qquad a(t,T) = t^{\beta}T^{\beta+1} \qquad b_{hf}(t,T) = YM^{-1}\frac{1+Mt^{\beta}T^{\beta}}{1+M^{-1}t^{\beta}T^{\beta}}$$

Note that $b_{hf}(t,T)$ here equals the relative number of firms in *h* versus *f*, *N*. Criterion for the existence of non-exporters in *h*:

$$s_{hf} < 1 \Leftrightarrow a(t,T) < b_{hf}(t,T)$$

Let us focus on the case where t=1 and T<1, i.e. there are only fixed costs of exporting.[36] The derivatives of the functions a and b_{hf} with respect to T are given by:

$$\frac{\partial a}{\partial T} = (1+\beta)T^{\beta} > 0$$

$$\frac{\partial b_{hf}}{\partial T} = \frac{Y\beta T^{\beta-1}(M^2-1)}{(M+T^{\beta})^2} < 0$$

In addition, for M=Y, we have:

$$a(0)=0 \text{ and } a(1)=1$$

$$b_{hf}(0)=1 \text{ and } b_{hf}(1)=Y$$

Consequently, $b_{hf}(T)$ is a downward sloping curve, while $a(T)$ is an upward sloping curve that cuts the $b_{hf}(T)$ curve from below for a value of $a(T)$ between Y and 1. This corresponds to values of T between $Y^{\frac{1}{\beta+1}}$ and 1. Thus $T < Y^{\frac{1}{\beta+1}}$ is a sufficient but not necessary condition for $s_{hf} < 1$, while $T < 1$ is a necessary but not sufficient condition for $s_{hf} < 1$. The two points will be close when β is large, i.e. when η is large. In other words, if composite industry goods from different countries are good substitutes, the proportion of firms that export will reach 1 in the small country only when trade is highly liberalised and/or countries differ greatly in size. If they are poor substitutes, on the other hand, this will happen for intermediate values of trade costs and/or country size differences. This is

36 The case for t<1 and T=1 is almost analogous.

reasonable, as a high η means that a domestic composite industry goods can easily substitute a foreign composite industry goods in the large country; thus, demand for small-country products from abroad is lower.

It can be shown that if T increases further beyond the intersection of $a(T)$ and $b_{hf}(T)$, all firms will export in the small country, while only a fraction will sell in the domestic market. In the large country, on the other hand, only a fraction will export while all firms sell in the domestic market. If T increases even further so that fixed export costs become lower than the domestic market entry costs i.e. $T > 1$, all firms may export in both countries, whereas only a fraction may sell in their domestic markets. The value of T for this to happen is given by the intersection between $b_{hf}(T)$ and $\frac{1}{a(T)}$.[37] A necessary but not sufficient condition for this to happen is $T > Y^{-\frac{1}{\beta+1}}$, whereas a sufficient but not necessary condition is $T > Y^{-\frac{2}{\beta+1}}$.

For M=1, $T < Y^{\frac{1}{\beta+1}}$ is a sufficient and necessary condition for $s_{ij} < 1$. Consequently, in this case the range of Y and T that makes possible an equilibrium with non-exporting firms in both countries is narrowed as compared to the case where $M=Y$. For values of $Y^{\frac{1}{\beta+1}} < T < Y^{-\frac{1}{\beta+1}}$, all firms will export in the small country, whereas only a fraction export in the large country. For $T > Y^{-\frac{1}{\beta+1}}$, all firms will export in both countries, while only a fraction will sell in their domestic markets.

[37] Note that $b_{hf}(T)$ is now equal to n_f/n_h, which denotes the number of exporters in the large country divided by the number of exporters in the small country (since all firms export).

Appendix 5. Results of sensitivity analyses

Table A1. Determinants of the extensive margin on exports – results from OLS regression based on the Enterprise Surveys dataset

	All	All	Europe	Asia/Oceania	Latin America	Africa
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
Relative home market size	–0.0281	–0.1000***	–0.2215**	–0.1701	–0.0613***	–0.1901*
	(0.0195)	(0.0263)	(0.0902)	(0.1362)	(0.0139)	(0.0995)
GDP per capita		0.0195***	0.0415*	0.1301	0.0159*	–0.0325
		(0.0066)	(0.0193)	(0.1905)	(0.0089)	(0.0346)
GDP per capita squared		–0.0006	–0.0007	–0.0504	–0.0007	0.0086
		(0.0004)	(0.0013)	(0.0810)	(0.0004)	(0.0070)
Remoteness		–0.0000	0.0002	0.0000	–0.0000	–0.0000
		(0.0000)	(0.0002)	(0.0000)	(0.0000)	(0.0000)
Average firm size		0.1421***	0.1105	0.2441***	0.1062	0.1835***
		(0.0344)	(0.1521)	(0.0614)	(0.1084)	(0.0502)
Constant	0.1406***	–0.1293*	–1.1498	–0.3950*	–0.0131	–0.0882
	(0.0105)	(0.0759)	(1.2913)	(0.2019)	(0.1453)	(0.1027)
Observations	116	116	20	25	31	40
R–squared	0.0070	0.5376	0.7232	0.4933	0.1969	0.3596
Predicted extensive margin	0.1372	0.1372	0.2674	0.1206	0.1246	0.0923
Doubling the relative home market size	–2.4577	–8.7464	–15.4901	–11.4246	–11.0202	–5.9728

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parenthesis. The regressions for the whole sample include regional dummies, and all regressions include year dummies.

Table A2. Extensive margin of exports in the Enterprise Surveys dataset, all firms that export any amount

Group of Countries	All	Europe	Asia/ Oceania	Latin America	Africa
Variable	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports	Extensive margin of exports
Min	0.000	0.163	0.000	0.026	0.000
Median	0.178	0.381	0.103	0.194	0.109
Mean	0.198	0.388	0.156	0.201	0.128
Max	0.775	0.775	0.477	0.516	0.394
No of obs.	116	20	25	31	40

Note: Extensive margin of exports = estimate of the proportion of manufacturing firms that export in each country. An exporter is defined as a firm that exports any amount

Table A3. Determinants of the extensive margin on exports– results from fractional logit models based on the Enterprise Surveys dataset. All firms that export

	All		All		Europe		Asia/Oceania		Latin America		Africa	
	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects	Coeff.	Marg. effects
Relative home market size	0.0864	0.0137	–0.8160***	–0.1179***	–0.9854**	–0.2335**	–3.7905***	–0.4002***	–0.4087**	–0.0643**	–1.1529	–0.1185
	(0.1923)	(0.0305)	(0.2455)	(0.0350)	(0.4664)	(0.1103)	(1.3535)	(0.1464)	(0.1609)	(0.0258)	(0.8808)	(0.0902)
GDP per capita			0.1808***	0.0261***	0.1406	0.0333	2.4766**	0.2615**	0.2184***	0.0344***	–0.4552	–0.0468
			(0.0499)	(0.0072)	(0.1714)	(0.0404)	(1.0478)	(0.1107)	(0.0733)	(0.0123)	(0.3094)	(0.0318)
GDP per capita squared			–0.0071**	–0.0010**	0.0033	0.0008	–0.8715**	–0.0920**	–0.0105***	–0.0016***	0.1154*	0.0119*
			(0.0032)	(0.0005)	(0.0105)	(0.0025)	(0.4279)	(0.0446)	(0.0037)	(0.0006)	(0.0622)	(0.0063)
Remoteness			0.0000	0.0000	0.0005	0.0001	0.0000	0.0000	–0.0000	–0.0000	–0.0001	–0.0000
			(0.0001)	(0.0000)	(0.0010)	(0.0002)	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Average firm size			1.7259***	0.2494***	0.5832	0.1382	2.3708***	0.2503***	2.0473**	0.3223**	2.2563***	0.2319***
			(0.3063)	(0.0443)	(0.6549)	(0.1548)	(0.5579)	(0.0513)	(0.8462)	(0.1375)	(0.4398)	(0.0392)
Constant	–1.4064***		–4.8938***		–5.2163		–6.4631***		–5.0194***		–4.6379***	
	(0.0906)		(0.5709)		(6.8756)		(1.5625)		(1.3227)		(0.8657)	
Log pseudo–likelihood	–42.18	–42.18	–37.64	–37.64	–8.595	–8.595	–7.051	–7.051	–10.73	–10.73	–10.49	–10.49
No of observations	116	116	116	116	20	20	25	25	31	31	40	40
Predicted extensive margin		0.1369		0.1369		0.3857		0.12		0.1957		0.1163
Doubling the relative home market size		–1.2009		–10.3346		–11.3208		–27.0135		–3.9603		–4.2889

Note: *, ** and *** correspond to significance at the 10%, 5% and 1% levels. Robust standard errors in parenthesis. Marginal effects and predicted extensive margins are evaluated at the mean of the independent variables. Year dummies are included in all regressions, and regional dummies are included in the regressions for the whole sample.

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