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Intra-industry Trade Between Asymmetric Countries with Heterogeneous Firms

by

Rod Falvey, David Greenaway and Zhihong Yu

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The Authors

Rod Falvey is a Professor of International Economics in the Leverhulme Centre for Research on Globalisation and Economic Policy (GEP), University of Nottingham; David Greenaway is a Professor of Economics and Director of GEP at Nottingham; Zhihong Yu is a Postgraduate Research Student in GEP, University of Nottingham.

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Abstract

This paper constructs a two-country intra-industry trade model with efficiency differences at both national and firm level, to focus on the impact of trade on asymmetric countries. We show that in both countries opening up to trade strengthens the self-selection effect, raises average industry revenue, profit and efficiency and generates welfare gains. However, cross-country efficiency gaps lead to substantial differences in the magnitude of these trade-induced changes. The more efficient country has a greater proportion of exporting firms and a higher failure rate, which makes entry more risky. However, for successful entrants expected revenue is higher and entry is therefore also more profitable. Since the rationalisation effect is also stronger in the more efficient country, welfare gains from trade are higher.

JEL classification: F12, L11
Key words: firm heterogeneity, cross-country efficiency gaps, intra-industry trade

Outline

Non-technical summary

Classical trade theory emphasizes that one of the most important gains from trade liberalization is the trade-induced cross-industry resource reallocation towards the more efficient sectors. Recent developments in firm-level models of intra-industry trade led by Melitz (2003) among others, have revealed how trade can lead to *inter-firm* market share reallocation towards the more efficient firms, which raises aggregate industry productivity and enhances welfare. Since Melitz restricts his analysis to identical countries, these benefits are symmetrically distributed across countries in his model. However, since there exist significant efficiency gaps even across the most advanced industrial nations in the world, it then seems to be important to reveal the asymmetric effects of trade on countries that differ in their efficiency levels when the with-industry productivity heterogeneity is playing an important role.

Existing theoretical literature has provided mixed picture on this issue. Montagna (2002) demonstrates that exposure to free trade will induce more low productivity firms to enter into the more efficient country, in which the average industry productivity is therefore reduced and the consumer welfare might even be hurt under some circumstances. In contrast, Jean (2002) shows that trade opening will improve the industry productivity in the more efficient country as well as in the less efficient one, due to the import-driven or export-driven forces.

In this paper, we tackle this question by extending Melitz's model to a two-country world with cross-country efficiency gap and size variation. Following Helpman, Melitz and Yeaple (2003), it is assumed that the two economies produce one homogenous good and a differentiated good. In the differentiated good sector, entry is unrestricted and potential entrants face pre-entry productivity uncertainty characterized by an exogenous common distribution. We assume that both economies get access to the best practice of technology but the home country has a superior firm productivity distribution with a higher productivity end. In each economy, each entrant pays an irreversible investment as an "entrance ticket" and then draws its productivity level. In equilibrium, the free entry condition will endogenously determine the productivity threshold required for survival, which in turn determines the industry productivity.

In the open economy, when there is intra-industry trade in differentiated products, we identify the "home efficiency effect": if country sizes are identical, the more efficient home country will have a larger number of firms, higher proportion of exporters, greater average firm revenue and run a trade surplus in the differentiated good sector. However, the home country buys these benefits at the price of a higher failure rate among its domestic entrants. Secondly, in contrast to the results from Montagna, we find that exposure to trade pushes up the productivity threshold in both countries. As a consequence, failure rates among unproductive entrants will increase and the industry productivity levels are raised, which enhances the consumer's welfare. While the numbers of firms are reduced in both countries, total revenue of an average firm rises. Finally, though the direction of the effects of trade on industry performance and welfare is the same across countries, the magnitudes of the trade-induced changes vary significantly. For firms in the more efficient country, exposure to trade is a double-edged sword: the failure rate among entrants rises sharply but the increase in average revenue and profit among successful entrants is also greater. As a result of the stronger rationalisation effect, the more efficient also benefit by more on the industry productivity improvement and can reap greater welfare gains.

1. Introduction

The new trade theory models of Krugman (1980) and Helpman and Krugman (1985) assume identical monopolistically competitive firms. As a consequence, since love of variety and scale economies lead to two-way trade, all firms export and firms from the same country are identical in size, exports and world market share, even in the presence of transport costs and different market sizes.

Recently, however, a substantial empirical literature has identified robust firm level evidence on productivity heterogeneity and its link to exports (Bernard and Jensen 1995, 1999a,b, 2001, Bernard and Wagner 1997, Aw, Chung and Roberts 1998, Bigsten, Collier Dercon et al. 2000, Clerides, Lach and Tybout 1998, Girma, Greenaway and Kneller 2003, 2004). As summarised by Bernard, Eaton, Jensen and Kortum (2003): "*Most strikingly, exporters are in the minority; they tend to be more productive and larger; yet they usually export only a small fraction of their outputs. This heterogeneity of performance diminishes only modestly when attention is restricted to producers within a given industry...*" (p. 1268). In addition, there is a growing body of empirical evidence that trade may lead to substantial industry efficiency gains through inter-firm reallocation and rationalisation (Tybout and Westbrook 1995, Bernard and Jensen1999b, Pavcnik, 2002. Tybout 2003 provides a survey). These stylised facts highlight the importance of incorporating firm efficiency heterogeneity into new trade theory.

A new wave of "heterogeneous firm trade models" has emerged to do just that, with key contributions from Melitz (2003), Montagna (2002), Jean (2002), Bernard, Eaton, Jensen and Kortman (2003), and Helpman and Melitz and Yeaple (2003). These extend new trade theory to incorporate firm productivity differences. The pioneering model, Melitz (2003), based on Dixit-Stiglitz monopolistic competition, generates firm heterogeneity from an un-parameterised distribution that characterises firms' pre-entry efficiency uncertainty. In the presence of fixed entry, production and export costs, more productive firms self-select into both domestic and export markets. Survivors are those whose productivities exceed a given threshold, and exporters those whose productivities exceed an even higher threshold. Trade liberalisation forces the least efficient firms to exit by raising the domestic entry threshold and reallocates market share towards more efficient exporting firms by lowering the export threshold. Melitz shows how trade generates industry efficiency improvements and welfare gains for all countries. In order to focus on the role of within industry firm productivity differences, Melitz only considers trade between countries with identical size and firm productivity distributions. As a consequence the impact of trade is symmetric across countries.

What happens if we allow trade between asymmetric countries with different productivity distributions and market sizes? Here we extend the Melitz (2003) and Helpman, Melitz and Yeaple (HMY) models to investigate the impact of trade on asymmetric countries, with a particular focus on the role of cross-country efficiency gaps on trade and welfare. We construct a two country, two sector model with both within industry firm productivity differentials and cross-country efficiency differences. The differentiated good sector is characterized by Dixit-Stiglitz monopolistic competition, while the constant returns to scale homogenous good sector adjusts to maintain balanced trade. Pre-entry productivity uncertainty is modelled by an exogenous distribution over firm costs. In the closed economy, entry leads to an endogenous cost ceiling required for firms to survive. In equilibrium, countries which differ in both size and efficiency levels exhibit similar characteristics in the differentiated good sector: the probability of survival, average firm size and profit are identical, though the cost ceiling and average cost are lower in the more efficient country. In the open economy, the trade pattern depends on relative market sizes and the efficiency gap. When there is intra-industry trade in differentiated products, the probability of failure, the proportion of exporting firms, and average firm size and profits are all higher in the more efficient country. We find that trade reduces the survival ceilings and raises industry efficiency in *both* countries, but the rationalisation effect is stronger in the more efficient country. As a consequence, exposure to trade generates welfare gains for both, but the more efficient country enjoys a larger efficiency gain and welfare improvement.

Our results on the effects of trade on firm characteristics confirm those in Jean (2002), who considers the different trading outcomes that can arise at different levels of trade costs when firms face uncertain productivity *ex ante*, and countries differ in their productivity distributions (which are uniform in his case). These outcomes are sensitive to assumptions on firm entry and exit, however, and our results contrast with those of Montagna (2001), who also assumes different distributions of firm productivity in the two trading partners, but in her case entrants know their productivity in advance, and hence both the autarky and trading equilibria are characterised by the entry of all firms with productivities above a (equilibrium specific) threshold. The expansion or contraction of the differentiated goods industry then involves the entry or exit of the least efficient firms. Montagna shows that allowing (costless) international trade fully integrates the two markets and all producing firms become exporters, with the relatively more efficient country being the net exporter of differentiated goods. The differentiated good industry in the more (less) efficient country expands (contracts) with the entry (exit) of its least efficient firms, and average industry efficiency therefore falls (rises). Indeed, under certain circumstances, Montagna indicates that this efficiency effect could lead to a welfare loss in the net exporter.

The rest of the paper is organised as follows. Section 2 sets up the model. The closed economy equilibrium is derived in Section 3. Section 4 discusses the open economy equilibrium and section 5 summarises the impact of trade. Section 6 concludes.

2. Model Setup

Consider two countries, home and foreign (*), endowed with a single factor (labour) used to produce in two sectors H and D. Sector H produces a homogenous good and D a differentiated good.

2.1 Demand and production

Preferences of a representative consumer are Cobb-Douglas across the outputs of D and H, with β $(1-\beta)$ being the fraction of expenditure on D (H). Production in sector H exhibits constant returns to scale. We choose H as the numeraire and normalise the wage rate to one.[1] In sector D, market structure is assumed to be Dixit-Stiglitz monopolistic competition, and preferences across varieties of D are of a standard CES love of variety form.[2] This yields a constant elasticity of demand function for each variety produced by a corresponding unique firm: $q_i = Ap_i^{-\varepsilon}$ where

$$A = \beta L P^{\varepsilon - 1}$$

and $P = \left(\int_{v \in V} p(v)^{1-\varepsilon} dv \right)^{\frac{1}{1-\varepsilon}}$ denotes the aggregate price index. The cost function of firm i is $c_i = a_i q_i + F_D$, where a_i denotes the marginal units of labour input required to produce one unit of output, which is firm specific, and F_D denotes fixed production costs which are identical across firms. Taking A as given, the pricing rule of a profit-maximising firm with marginal cost a_i is $p(a_i) = a_i / \rho$.

As HMY show, a firm's domestic sales and operating profit can then be written as functions of its own cost level a_i:

$$r(a_i) = A\left(\frac{a_i}{\rho}\right)^{1-\varepsilon} \quad \text{and} \quad \pi(a_i) = Ba_i^{1-\varepsilon} - F_D \qquad [1]$$

where $B = (1-\rho)\rho^{\varepsilon - 1} A$. Firm revenue and operating profit are monotonically decreasing in a firm's own cost level a_i, but increasing in A and B. Note that A (and B), which are treated as exogenous by individual firms, reflect market size and the extent of competition, which will be referred to as the "business environment" below.

2.2 Firm entry, exit and heterogeneity

There exist a large number (strictly speaking a continuum) of potential entrants in sector D. To enter, each firm has to make an irreversible investment (i.e. a sunk fixed entry cost) of F_E. After entry, firms draw a marginal unit cost from a common *ex ante* exogenous cumulative distribution *G(a)*. In line with HMY, we use the Pareto distribution to parameterise productivity, and hence the distribution of the cost draw is:

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[1] We assume one unit of labour is required to produce one unit of H, therefore the price of the homogeneous good is also unity. The size of sector H adjusts to maintain full employment.

[2] Total utility is $U = H^{1-\beta} D^{\beta}$ with sub-utility function $D = (\int_{v \in V} q^{\rho}(v) dv)^{1/\rho}$, elasticity of substitution $\varepsilon \equiv 1/[1-\rho]$, and where $q(v)$ and V denote the consumption of variety v and the available variety set, respectively. Consumption of differentiated goods can be treated as consuming an aggregate D with price index P.

$$G(a) = \left(\frac{a}{\overline{a}}\right)^k, \qquad a < \overline{a}, k > \varepsilon + 1$$

where $\overline{a}$ is the upper bound of marginal cost *a*. Once an entrant's cost is revealed, it will decide whether to stay or exit depending on whether its operating profit is positive or not. If we let a_D denote the "survival ceiling" (i.e. the maximum cost level at which a firm can avoid operating losses), then

$$\pi(a_D) = Ba_D{}^{1-\varepsilon} - F_D = 0 \qquad \text{where } 0 < a_D < \overline{a} \qquad [2]$$

Since profit is decreasing in a firm's cost, entrants whose marginal cost is higher than a_D will find it unprofitable to produce and exit immediately. Entrants with marginal costs lower than the ceiling will find it profitable to operate, pay the fixed production cost F_D and serve the market. Hence entry and exit follow a self-selection process: more efficient (lucky) firms survive and less efficient (unlucky) firms fail. The *ex ante* probability of successful entry and of failure, denoted as p_s and p_f, can be written as:

$$p_s = G(a_D) \qquad \text{and} \qquad p_f = 1 - G(a_D)$$

Since only entrants with marginal cost lower than a_D can survive, the cumulative distribution of operating firms is given by:

$$W(a) = \frac{G(a)}{G(a_D)} = \left(\frac{a}{a_D}\right)^k, a \leq a_D$$

Here *W(a)* characterises productivity heterogeneity across operating firms. From [1], more efficient firms will have lower prices, larger sales, higher market shares and higher profits.

In addition to country size, we also allow the cost distribution over firms to differ across countries. We write the foreign distribution as:

$$G^*(a) = \left(\frac{a}{\overline{a}^*}\right)^k, a < \overline{a}^*$$

and assume that $\overline{a} \leq \overline{a}*$. These distributions are illustrated in Figure 1. Both countries have access to best practice technology, but foreign entrants can find themselves with technologies inferior to any available at home. Consequently, the home cost distribution is dominated by the foreign distribution, indicating that home is the more efficient country. We limit the cross-country asymmetries to country size (L, L^*) and the maximum cost bound ($\overline{a}, \overline{a}^*$), and let all other parameters be identical across countries.

3. The Closed Economy

3.1 Equilibrium

It is useful to begin by considering the outcome if the number of entrants is exogenously fixed at N_E. The aggregate price can then be written as

$$P = \left(\int_0^{a_D} N_E p(a)^{1-\varepsilon} dG(a) \right)^{\frac{1}{1-\varepsilon}} = \left\{ N_E^{\frac{1}{\varepsilon-1}} \rho \left[V(a_D) \right]^{\frac{1}{\varepsilon-1}} \right\}^{-1} \qquad [3]$$

where $V(y) = \int_0^{y} a^{1-\varepsilon} dG(a) = \overline{a}^{-k} y^{k-(\varepsilon-1)} K$, and $K = \dfrac{k}{k-(\varepsilon-1)} > 1$. Using [2], the corresponding survival ceiling is:

$$a_D = \left(\frac{L\beta(1-\rho)}{N_E F_D K} \right)^{\frac{1}{k}} \overline{a} \qquad [4]$$

which is decreasing in the number of entrants, but increasing in market size. If the number of entrants is relatively small so that the implied value of $a_D > \overline{a}$, all entrants will choose to serve the market. Where N_E is sufficiently large, the implied ceiling will be less than the cost upper bound, which leads to self-selection among entrants, and potential entrants estimate their expected profit by:

$$E(\pi) = \int_0^{a_D} \pi(a) dG(a) - F_E = F_D \left(K-1 \right) G(a_D) - F_E = \frac{\beta L(1-\rho)}{N_E} \frac{\varepsilon - 1}{k} - F_E \qquad [5]$$

which is an increasing function of the survival ceiling, and a decreasing function of the number of entrants.

We assume that entry is in fact unrestricted, and there is an incentive to enter as long as E(π) is positive. Entry intensifies competition and pushes a_D to a lower level (say) a'_D according to [4]. This will lead to exit of existing firms whose marginal costs are between a_D and a'_D. This simultaneous entry and exit will continue until the number of operating firms is so large that expected profit $E(\pi)$ is driven to zero. In equilibrium therefore, the survival ceiling, and numbers of entrants (N_E) and operating firms (denoted as *N*) are endogenously determined by:

$$a_D = \overline{a}\left(\frac{F_E}{F_D}\right)^{\frac{1}{k}}\left(K-1\right)^{\frac{-1}{k}} \quad [6]$$

$$N_E = \frac{L\beta(1-\rho)k}{F_E(\varepsilon-1)} \quad [7]$$

$$N = N_E G(a_D) = \frac{L\beta(1-\rho)}{F_D K} \quad [8]$$

An increase in F_E will lead to fewer entrants and a higher survival ceiling, whereas an increase in F_D leads to fewer operating firms and a lower survival ceiling. A higher degree of product homogeneity, reflected by a higher ε, leads to lower a_D, N_E and N. Note that the survival ceiling is proportional to the cost upper bound, whereas the number of entrants and operating firms are proportional to country size. The more efficient country has a lower survival ceiling, and the larger country has more entrants and operating firms[3].

[3] More precisely, we have $\frac{a_D^*}{a_D} = \frac{\overline{a}^*}{\overline{a}} > 1$ and $\frac{N^*}{N} = \frac{N_E^*}{N_E} = \frac{L^*}{L}$

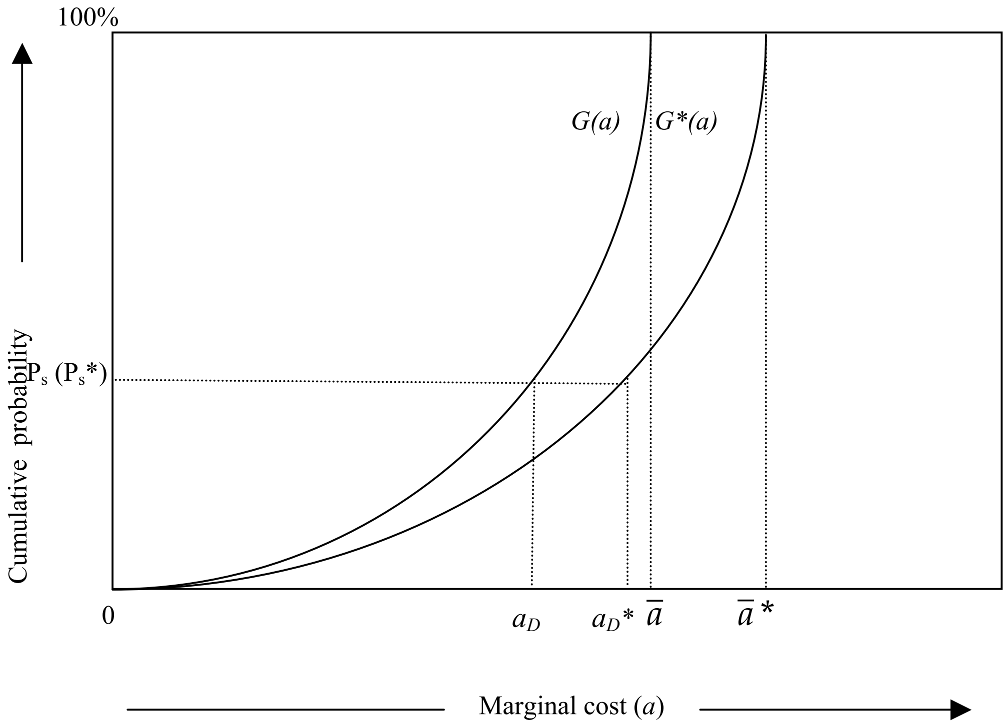

Figure 1: *Cumulative probability distribution of productivity and the probability of survival in the closed economies*

One important question is whether its lower survival ceiling makes the more efficient market more risky - in terms of probability of failure - for potential entrants? The *ex ante* probabilities of survival and failure are:

$$p_s = p_s^* = \frac{F_E}{F_D(K-1)}, \qquad p_f = p_f^* = 1 - \frac{F_E}{F_D(K-1)} \qquad [9]$$

where $p_s = G(a_D)$, $p_s^* = G^*(a_D^*)$ and $\frac{F_E}{F_D(K-1)} \leq 1$.

As illustrated in Figure 1, the probabilities of survival are equal across countries. Because the *ex ante* probability of failure is independent of the cost upper bound, the failure rate among entrants will be equal across countries despite their different market sizes and cost distributions. Higher entry costs or lower fixed production costs lead to a smaller failure rate, which *weakens* the self-selection effect[4], although equi-

[4] This is consistent with the stylized facts from a firm level comparison of self-selection effects in Taiwanese and Korea manufactures (Aw et al, 2003). They found that, compared to Korea a country

proportional changes in F_E and F_D have a zero net effect on the probability of failure and the survival ceiling. Furthermore, p_f is increasing in ε, but decreasing in *k*, indicating higher risk in a market with more homogeneous products or a lower degree of firm productivity dispersion.

From [2] $B = a_D^{\varepsilon - 1} F_D$, which implies that in equilibrium the business environment variables *A* and *B* are independent of market size, but increasing in $\bar{a}$. The intuition here is that, with free entry, a larger country spends more on differentiated goods, which attracts a greater number of firms. These two effects offset each other, so that a potential entrant is indifferent to the size of the market it will be competing in. However, *A* and *B* are lower in the more efficient country, which from [1] indicates that, if it survives, a firm with given cost a_i will be smaller and earn less profit in that market due to the strength of the competition.

3.2 Industry performance and welfare

In equilibrium, average firm performance, as measured by average cost $\breve{a}$, price $\breve{p}$, revenue $\breve{r}$ and profit $\breve{\pi}$ are:

$$\breve{a} = \int_0^{a_D} a dW(a) = \frac{k}{k+1} a_D \quad , \qquad \breve{p} = \int_0^{a_D} p(a) dW(a) = \frac{k}{(k+1)\rho} a_D$$

$$\breve{r} = \int_0^{a_D} r(a) dW(a) = \frac{K}{1-\rho} F_D$$

$$\breve{\pi} = \int_0^{a_D} \pi(a) dW(a) = \frac{\breve{r}}{\rho} - F_D = \left(\frac{K}{(1-\rho)\rho} - 1 \right) F_D$$

Average firm cost and price are proportionally increasing in the survival ceiling, so that average efficiency is higher and average price lower, in the more efficient country. Average revenue and profit, however, are independent of the survival ceiling and are therefore equalised across countries. Industries with higher fixed production costs (F_D), a higher degree of product homogeneity (ε) or a lower degree of firm productivity dispersion (k) will earn higher average revenue and profit.

with significantly higher entry costs, Taiwanese industries exhibit stronger self-selection effects: they are characterised by smaller within-industry productivity dispersion and a smaller proportion of low productivity plants, due to the low entry costs in Taiwan manufacturing.

All of these measures reflect the unweighted mean of firm performances. However these firms differ in size, and a growing body of empirical literature on industry productivity dynamics focuses on average industry productivity.[5] The sales-weighted average cost is[6]:

$$\tilde{a} = \int_0^{a_D} Ns(a) a dW(a) \qquad [10]$$

where the weights $s(a) = r(a)/R$ are the firms' sales shares and $R=\beta L$ denotes total sales of all domestic firms. Using [8] and rearranging, yields average industry (variable) cost

$$\tilde{a} = \frac{k-\varepsilon+1}{k-\varepsilon+2} a_D \qquad [11]$$

which is also proportionally increasing in the survival ceiling. Thus both average firm and average industry efficiency are superior in the more efficient country: $\frac{\tilde{a}}{\tilde{a}^*} = \frac{\breve{a}}{\breve{a}^*} = \frac{a_D}{a_D^*} < 1$.

Welfare per capita (u) is then given by:

$$u = \frac{U}{L} = \psi P^{-\beta} \qquad [12]$$

where $\psi = (1-\beta)^{1-\beta} \beta^{\beta}$ is a constant. Welfare per capita is negatively related to and determined by P only. The aggregate price in equilibrium can be written as a function of a_D and L

[5] See for example Levinsohn and Petrin (1999), Aw, Chen and Roberts (2001), Fernandes (2003), Tybout and Westbrook (1995) and Pavcnik (2002).

[6] Melitz (2003) uses the weighted harmonic mean of the productivity levels to represent the aggregate industry productivity, where the weights index the relative output.

$$P = a_D \left(\beta L\right)^{\frac{-1}{\varepsilon-1}} F_D^{\frac{1}{\varepsilon-1}} \eta \qquad [13]$$

where $\eta = \left\{(1-\rho)^{\varepsilon-1} \rho\right\}^{-1}$. P is decreasing in market size and increasing in the survival ceiling, because a larger country attracts a greater number of producers which drives down the aggregate price, and firms in the more efficient country will charge lower prices. Other things equal, consumers in a larger or more efficient country, will be better off. Substituting [6] into [13], one can show that P is increasing in both F_E and F_D [8], thus welfare per capita will be higher where fixed entry and production costs are lower.

4 Open Economy

We adopt the standard simplifying assumption that the homogenous good is costlessly tradable and both countries have positive production in this sector[9]. Hence wage rates are equalised across countries.

4.1 Costless Trade

In the absence of trade costs on differentiated products, all firms will sell in both markets, implying entrants in either country will face identical fixed costs and business environments, which equalises their survival ceilings. Since the productivity distribution of the home country stochastically dominates that of the foreign country, entrants in the home country will always have a higher probability of drawing a lower cost, and thus are more likely to survive and therefore face a higher expected profit. Hence all potential entrants will prefer to enter the home country and export. The trade pattern is then straightforward: production of the differentiated good will be concentrated in the more efficient home country, which produces in both sectors and

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[8] The aggregate price can be written as $P = \overline{a}\left(\beta L\right)^{\frac{-1}{\varepsilon-1}} F_E^{\frac{1}{k}} F_D^{\frac{1}{\varepsilon-1}-\frac{1}{k}} \left(K-1\right)^{-\frac{1}{k}} \eta$.

[9] This requires that the preferences are not too strongly biased towards the differentiated good. Otherwise, the labour demand in the differentiated good sector may exceed the total labour endowment in a country. The necessary conditions are provided in footnote 21 below.

exports (imports) differentiated goods (good H), while the foreign country specialises in the production of the homogenous good[10].

4.2 Trade costs and intra-industry trade

Now assume there are two types of trade costs: melting-iceberg transport costs $t \geq 1$[11], and a fixed cost F_X associated with exporting, which is independent of entrants' potential export sales [12]. If trade costs are so low (*eg* in the neighbourhood of zero) that all operating firms find it profitable to sell in the foreign market, then entrants in different countries still face identical business environments, as well as the same survival ceiling. Hence the trade pattern is as described in 4.1 above.

However, if trade costs are sufficiently high that only a proportion of domestic firms find it profitable to sell in the foreign market, then entrants in different countries face different business environments. Consequently, this will generate different survival ceilings across countries. If the cross-country efficiency gap is not too large, there will be entrants in both countries[13]. Positive numbers of entrants lead to positive production in the differentiated good sector in both countries, and as a result each exports differentiated goods leading to intra-industry trade[14].

Domestic market entry conditions remain as above, however. Firms face uncertainty about their productivity before entry; and once this has been resolved post-entry they must decide whether to stay or exit. Sales in their domestic market incur a fixed cost (F_D), thus for survival in the domestic market a firm's marginal cost must fall below a survival ceiling (a_D) defined as before, as shown in HMY:

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[10] Montagna avoids this outcome when there are no trade costs by assuming that entrants know their marginal costs before entry.

[11] The melting iceberg trade cost assumption implies that differences in firm level "efficiency" apply to both the production and transportation of goods.

[12] In our one period model, F_X includes both sunk export costs and fixed export costs. See Roberts and Tybout (1997), Clerides, Lach and Tybout (1998) for a discussion of the nature and source of the fixed export costs.

[13] The links between trade costs, country efficiency differences and the different possible patterns of trade in this type of model are discussed in more detail in Jean (2002).

[14] Under our assumptions, production in sector D must lead to exports, because the Pareto distribution of costs suggests that in both countries there always exist a proportion of entrants with very low costs, who will always find it profitable to export.

$$a_D^{1-\varepsilon} B = F_D \ , \qquad a_D^{*1-\varepsilon} B^* = F_D \qquad [14]$$

Such firms are now potential exporters, and their profits from entry into the relevant export market are given by:

$$\pi_X(a) = (at)^{1-\varepsilon} B^* - F_X \quad \text{and} \qquad \pi_X^*(a) = (at)^{1-\varepsilon} B - F_X \qquad [15]$$

which yield export ceilings a_X and a_X^* that equate the export profits with zero:

$$a_X^{1-\varepsilon} B^* = F_X t^{\varepsilon-1} \ , \qquad a_X^{*1-\varepsilon} B = F_X t^{\varepsilon-1} \qquad [16]$$

If $a_X \geq a_D$ and $a_X^* \geq a_D^*$, all successful entrants become exporters. We rule out this empirically unimportant case by restricting attention to cases where $a_X < a_D$ and $a_X^* < a_D^*$, which indicates the co-existence of exporters and non-exporters in both countries.[15] We impose two conditions that ensure that this is the case below.

Hence for potential entrants expected profit in each country can be written as:

$$\begin{aligned} E(\pi) &= \int_0^{a_D} \pi_D(a) G(a) + \int_0^{a_X} \pi_X(a) dG(a) - F_E \\ &= BV(a_D) + t^{1-\varepsilon} B^* V(a_X) - F_D G(a_D) - F_X G(a_X) - F_E \end{aligned} \qquad [17a]$$

$$\begin{aligned} E^*(\pi) &= \int_0^{a_D} \pi_D^*(a) G(a) + \int_0^{a_X} \pi_X^*(a) dG(a) - F_E \\ &= B^* V^*(a_D^*) + t^{1-\varepsilon} BV^*(a_X^*) - F_D G^*(a_D^*) - F_X G^*(a_X^*) - F_E \end{aligned} \qquad [17b]$$

4.3 Equilibrium

Free entry will drive expected profits to zero in both countries. If we substitute [14] and [16] into [17], the equilibrium ceilings can then be obtained. The resulting

[15] Country-specific empirical studies show the proportion of exporting firms range from 21% (US) to over 80% (Sweden). See Greenaway, Gullstrand and Kneller (2003) for a review. Jean (2002) rules out the case where all firms export by assuming that the ability to export is conditional on non-negative profits in the domestic market.

expressions turn out to be quite unwieldy functions of fixed and variable trade costs, however. To simplify the presentation we impose the further assumption that the fixed costs of entering the export market are identical to domestic production fixed costs[16]:

Assumption 1. $F_X = F_D$.

Once this assumption is made the equilibrium survival and export ceilings are:

$$a_D = \alpha_D \left(\frac{1-\mu t^{-k}}{1-t^{-2k}} \right)^{\frac{1}{k}} \qquad a_D^* = \alpha_D^* \left(\frac{1-\mu^{-1} t^{-k}}{1-t^{-2k}} \right)^{\frac{1}{k}} \qquad [18]$$

$$a_X = \alpha_D \left(\frac{\mu - t^{-k}}{1-t^{-2k}}) \right)^{\frac{1}{k}} t \qquad a_X^* = \alpha_D^* \left(\frac{\mu^{-1} - t^{-k}}{1-t^{-2k}}) \right)^{\frac{1}{k}} t \qquad [19]$$

where α_D and α_D^* denote the autarky survival ceilings. As anticipated in the discussion above, the relationship between each country's survival and export ceilings when open and their corresponding survival ceilings when closed, depend on the magnitude of the inter-country efficiency difference, as captured by $\mu \equiv (\bar{a}^*/\bar{a})^k \geq 1$, and the size of the trade costs as captured by $t \geq 1$. The co-existence of exporters and non-exporters in each country requires:

$$\frac{a_D}{a_X} = t \left(\frac{1-\mu t^{-k}}{\mu - t^{-k}} \right)^{\frac{1}{k}} > 1 \quad \text{and} \quad \frac{a_D^*}{a_X^*} = t \left(\frac{1-\mu t^{-k}}{\mu - t^{-k}} \right)^{\frac{-1}{k}} > 1 \qquad [20]$$

We impose two conditions that are sufficient for these inequalities to be satisfied.

Condition 1: *per unit (iceberg) trade costs exist*

$$t > 1 \qquad [21]$$

This condition ensures that a positive proportion of successful entrants will *not* find it profitable to operate in the foreign market and therefore remain purely domestic.

[16] We emphasise that this restrictive assumption is used for presentation purposes only, and, except as noted below, the results that follow can all be established under more general assumptions as demonstrated in an alternative version of the paper available from the authors.

Condition 2: *the cross-country efficiency gap is not too large*

$$\mu < \phi = \left(\frac{t^{k} + t^{-k}}{2} \right) \qquad [22]$$

If μ exceeds this upper bound all firms in the more efficient country export[17]. For notational convenience we define $\tau \equiv t^{-k}$, and note that Condition 1 implies that $\tau < 1$, while Condition 2 implies that $\tau^{-1} > \mu > \tau$ and $1 > \mu\tau$.

There is now a self-selection effect in both domestic and export markets: the more efficient entrants survive in the domestic market, and the most efficient survivors export. Using [18] and [19], the relative ceilings are:

$$\frac{a_D}{a_D^*} = \frac{a_X^*}{a_X} = \left(\frac{1-\mu\tau}{\mu-\tau} \right)^{\frac{1}{k}} < 1 \qquad [23]$$

The more efficient country has a lower survival ceiling but a higher export ceiling. This has the interpretation that it is more difficult to survive but easier to export in the more efficient country. Let $p_x = G(a_x)$ and $p_x' = \frac{p_x}{p_s} = W(a_X)$ represent the *ex ante* and *ex post* probabilities of exporting, respectively.

Comparing p_s, p_x and p_x' across countries, we find:

$$\frac{p_s}{p_s^*} = \frac{1-\mu\tau}{1-\mu^{-1}\tau} \leq 1 \qquad \frac{p_x}{p_x^*} = \frac{\mu-\tau}{\mu^{-1}-\tau} \geq 1 \qquad [24]$$

$$\frac{p_x'}{p_x'^*} = \left(\frac{a_X / a_D}{a_X^* / a_D^*} \right)^{k} = \left(\frac{\mu-\tau}{1-\mu\tau} \right)^{2} \geq 1 \qquad [25]$$

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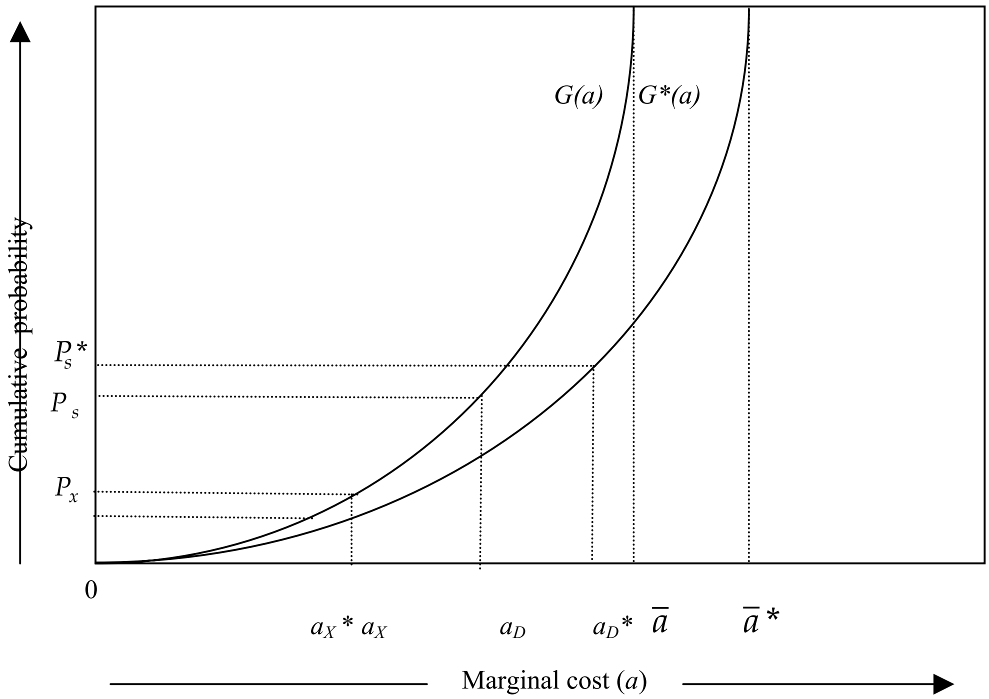
[17] When μ=1, both inequalities in [20] are satisfied if *t >1*. When μ >1, the second inequality always holds, since $\frac{1-\mu t^{-k}}{\mu - t^{-k}} < 1$. The first inequality requires $\left(\frac{1-\mu t^{-k}}{\mu - t^{-k}} \right) > t^{-k}$, which generates [22].

As shown in Figure 2, in the more efficient country the probability of survival is lower and the probability of exporting higher. The self-selection effect is stronger (weaker) for entry into the domestic (export) market of the more efficient country.



Interestingly the *ex post* probability of exporting p'_x is also greater in the more efficient country. Since p'_x also represents the proportion of exporting firms, [25] implies that this proportion is independent of relative market size, but is greater in the more efficient country[18]. A more efficient country has a lower survival ceiling, but a higher export ceiling, which leads to a greater share of exporting firms.

To solve for the number of domestic firms in each country, we first note that expenditure on the differentiated good in either country is split between domestic firms and foreign firms:

[18] Using a representative firm framework, Medin (2003) derives conditions under which the smaller country will have the larger share of exporting firms. In the presence of firm heterogeneity, our model provides an alternative determinant of the relative degree of industry export orientation.

$$\beta L = R_X^* + R_D \quad \text{and} \quad \beta L^* = R_X + R_D^* \qquad [26]$$

where $R_X = N \int_0^{a_X} r_x(a)dW(a)$, $R_D = N\int_0^{a_D} r_D(a)dW(a)$, $R_X^* = N^* \int_0^{a_X^*} r_X^*(a)dW^*(a)$ and $R_D^* = N^* \int_0^{a_D^*} r_D^*(a)dW^*(a)$ represent the gross export and domestic revenues of home and foreign based firms, respectively. We can then solve for the equilibrium N and N^* as[19]:

$$N = N_A\left(\frac{1-(v\gamma)^{-1}\tau}{1-\tau^2}\right) \quad \text{and} \quad N^* = N_A^*\left(\frac{1-v\gamma\tau}{1-\tau^2}\right) \qquad [27]$$

where N_A and N_A^* denote the corresponding numbers of firms in the closed economy given by [8], $\gamma = \frac{L}{L^*}$ denotes relative country size and $v = \left(\frac{a_D^*}{a_D}\right)^k = \frac{\mu-\tau}{1-\mu\tau} \geq 1$ denotes the survival ceiling ratio, which is increasing in μ ($v \geq 1$ as $\mu \geq 1$). From [27] we see that N and N^* are positive if and only if relative country size is within a certain range[20]:

$$\frac{1-\mu\tau}{\mu\tau-1} = \underline{Y}(\mu;t) < \gamma < \overline{Y}(\mu;t) = \frac{\tau-\mu}{\mu-\tau} \qquad [28]$$

Figure 3 illustrates the conditions required for intra-industry trade. Area B is bounded by $\gamma = \overline{Y}(\mu,t)$ and $\gamma = \underline{Y}(\mu,t)$, the intra-industry trade boundaries. When the combination of μ and γ falls within B, [28] is satisfied, and there will be positive numbers of firms in both countries and intra-industry trade. Otherwise, if the combination of μ and γ falls outside the intra-industry trade boundaries in area C (or A), the first (second) inequality in [28] does not hold, and there will be no firms in the

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[19] Rewriting [26] as $N\frac{V(a_D)}{G(a_D)} + N^*\frac{V^*(a_X^*)t^{1-\varepsilon}}{G^*(a_D^*)} = \frac{(1-\rho)\beta}{B}L$

and $N^*\frac{V^*(a_D^*)}{G^*(a_D^*)} + N\frac{V(a_X)t^{1-\varepsilon}}{G(a_D)} = \frac{(1-\rho)\beta}{B^*}L^*$, allows us to solve for N and N^*.

[20] This range is nonempty since [28] can be rewritten as $v^{-1}\tau^{-1} > \gamma > v^{-1}\tau$, and $\tau^{-1} < \tau$.

foreign (home) country. The foreign (home) country then specialises in good H and imports differentiated goods[21].

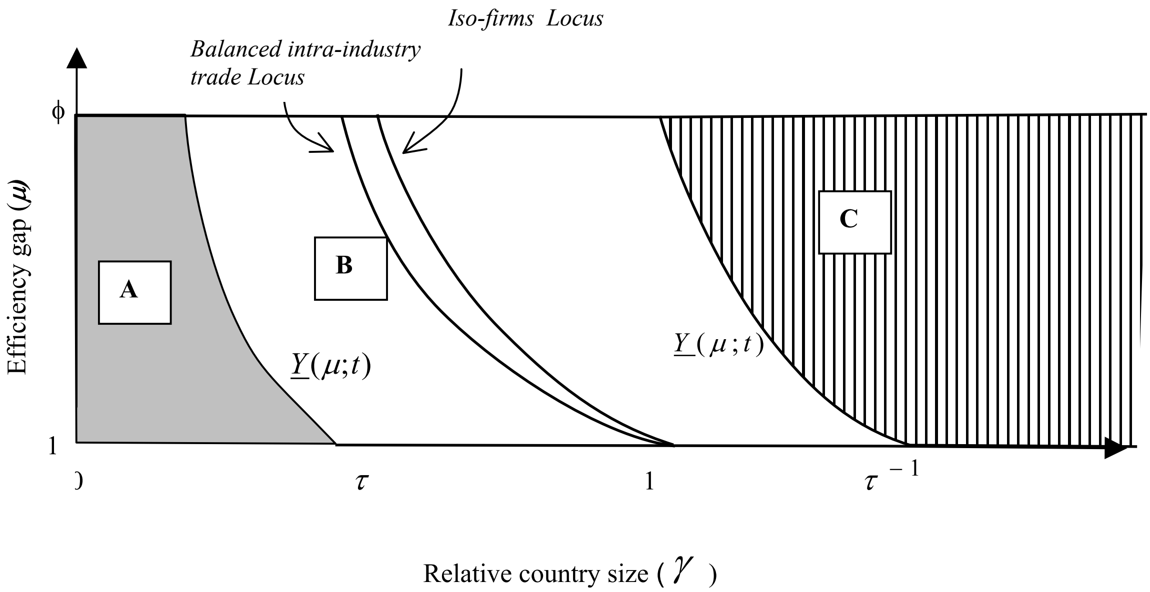

Figure 3 also shows which country has more domestic producers and larger gross export sales of differentiated goods. Using [27] and noting from [8] that $\gamma = N_A / N_A^*$, the relative number of operating firms, and relative export sales in sector D in the case of intra-industry trade are given by:

$$\frac{N}{N^*} = \frac{\gamma - v^{-1}\tau}{1 - \gamma v \tau} \quad \text{and} \quad E = \frac{R_X}{R_X^*} = v^2 \frac{N}{N^*} = \frac{v\gamma - \tau}{v^{-1} - \gamma\tau} \qquad [29]$$

Setting these ratios to unity, we derive an *iso-firms locus* (on which $N = N^*$), and a *balanced trade in differentiated goods locus* (on which $R_X = R_X^*$):

$$\gamma = N(\mu;t) = \mu v^{-1} = \mu \frac{1-\mu\tau}{1-\mu^{-1}\tau} \quad \text{and} \quad \gamma = E(\mu;t) = \mu^{-1} v^{-1} = \frac{\mu^{-1} - \tau}{\mu[\mu - \tau]} \qquad [30]$$

[21] Recall that to ensure positive production of the homogeneous good in both countries, we require an upper bound on the expenditure share of the differentiated good. This can be shown to be $\beta < \min\left\{\frac{1-\tau\mu^{-1}}{1-v\gamma\tau}, \frac{1-\tau\mu}{1-\tau(v\gamma)^{-1}}\right\}$, where the terms in parentheses are the bounds for the home and foreign countries respectively.

Since $N(\mu,t)=\mu^2E(\mu,t)$, we have $N(\mu,t)\geq E(\mu,t)$ as $\mu\geq 1$. To the right (left) of the $N(\mu;t)$ locus the more efficient country has a larger (smaller) number of domestic firms. Similarly, on the $E(\mu;t)$ locus trade is balanced in the differentiated good sector for both countries and there is no trade in the homogenous good. To its right (left) the more efficient country runs a trade surplus (deficit) in differentiated products. Both curves slope downward, because a larger relative efficiency or a larger market size tend to increase a country's relative number of firms and relative export sales. Interestingly, it is possible for the more efficient country simultaneously to have fewer firms (to be to the left of N) and a trade surplus in differentiated products (to be to the right of E). This reflects the relatively lower costs of its exporters. For a given efficiency gap, an increase in trade costs causes both loci to pivot upwards.

These results extend those in HMY, who show that when marginal cost distributions are identical across countries, there is a home market effect: a larger country will have more producers and run a trade surplus in the differentiated good sector. Our analysis shows that in the presence of cross-country efficiency differences the relative number of domestic producers and the intra-industry trade balance depend on the trade-off between relative market size and the efficiency gap. Other things equal, a more efficient country has more firms and greater relative export sales in sector D.

4.4 Industry performance and welfare

In the open economy, average firm efficiency, revenue and profit in the two countries are given by[22]:

[22] In the open economy, an operating firm's gross revenue *r(a)* is the sum of its domestic revenue r_D and export revenue r_x. As such average firm revenue or profit can be written as $\breve{r} = \int_0^{a_D} r_D(a)dW(a) + \int_0^{a_X} r_X(a)dW(a) = \breve{r}_D + p'_X\breve{r}_X$, where $\breve{r}_D = \int_0^{a_D} r(a)dW(a) = \frac{KF_D}{1-\rho}$ denotes the average domestic sales, $\breve{r}_X = \int_0^{a_X} r_X(a)dW_X(a) = \frac{KF_X}{1-\rho}$ denotes the average export sales, and $W_X(a) = \left(\frac{a}{a_X}\right)^k$ denotes the cost distribution of all exporting firms. Note that $\breve{r}_D$ and $\breve{r}_X$ are independent of the thresholds and thus are identical across countries. Reasoning analogously, we can derive the average profit given by [33]. Under our simplifying assumption ($F_D = F_X$), average domestic and export sales are the same.

$$\breve{a} = \int_0^{a_D} a dW(a) = \frac{k}{k+1} a_D \qquad \breve{a}^* = \int_0^{a_D^*} a dW(a) = \frac{k}{k+1} a_D^* \qquad [31]$$

$$\breve{r} = \frac{K}{1-\rho}\left(F_D + F_X p'_x\right) \qquad \breve{r}^* = \frac{K}{1-\rho}\left(F_D + F_X p'^*_x\right) \qquad [32]$$

$$\breve{\pi} = \left(\frac{K}{(1-\rho)\rho} - 1\right)\left(F_D + F_X p'_x\right) \qquad \breve{\pi}^* = \left(\frac{K}{(1-\rho)\rho} - 1\right)\left(F_D + F_X p'^*_x\right) \qquad [33]$$

On average, firms in the home country are more efficient, and have higher sales and profits due to a lower domestic survival ceiling. Moreover, since average revenue and profit are increasing in p'_x, the home country has higher average revenue and profit as a consequence of its greater proportion of exporting firms.

Turning to aggregate industry efficiency, which we measure as the weighted average of firm efficiency levels for all *domestic producers,* where the weights represent the share of a firm's gross output in total output, we have (for the home country)

$$\tilde{a} = \int_0^{a_D} s(a) aNdW(a) = \int_0^{a_D} s_D(a) aNdW(a) + \int_0^{a_X} s_X(a) aNdW(a) \qquad [34]$$

where $s_x(a) = \frac{r_X(a)}{R_D + R_X}$ and $s_D(a) = \frac{r_D(a)}{R_D + R_X}$ denotes the share of an individual firm's export and domestic sales in total output. Therefore aggregate efficiency is a function of trade costs and cost ceilings:

$$\tilde{a} = \tilde{\alpha} \frac{a_D}{\alpha_D}\left(\frac{1+v\tau\lambda}{1+v\tau}\right) \qquad \tilde{a}^* = \tilde{\alpha}^* \frac{a_D^*}{\alpha_D^*}\left(\frac{1+v^{-1}\tau\lambda^*}{1+v^{-1}\tau}\right) \qquad [35]$$

where $\tilde{\alpha}$ and $\tilde{\alpha}^*$ denote the average efficiency levels in autarky, $\lambda = \left\{ \frac{\mu - \tau}{\tau^{-1} - \mu} \right\}^{\frac{1}{k}}$ and $\lambda^* = \left\{ \frac{1 - \mu\tau}{\mu\tau^{-1} - 1} \right\}^{\frac{1}{k}}$. It can then be shown that $\tilde{a} < \tilde{\alpha}$ and $\tilde{a}^* < \tilde{\alpha}^*$[23], so aggregate industry efficiency is higher than in autarky in both countries. Furthermore, the home country keeps its aggregate industry efficiency advantage in the open economy (i.e. $\tilde{a} < \tilde{a}^*$)[24].

Welfare per capita in the home country can be written as in the closed economy:

$$u = \psi P^{-\beta}, \quad \text{where } P = a_D \left(\beta L\right)^{\frac{-1}{\varepsilon - 1}} F_D^{\frac{1}{\varepsilon - 1}} \eta \qquad [36]$$

which is independent of the size and cost ceilings of its trade partner, but increasing in its own size and decreasing in its own survival ceiling a_D. If $L=L^*$, we get $\frac{u}{u^*} = \left(\frac{P^*}{P}\right)^\beta = \left(\frac{a_D^*}{a_D}\right)^\beta$. Welfare per capita is higher in the more efficient country as a consequence of its lower aggregate price, and relative welfare is determined by a_D^* / a_D. Since the latter is increasing in μ, a widening of the efficiency gap will increase the welfare gap across countries, and make the home country relatively better off.

5. The impact of trade

Inspection of the survival ceilings in the open economy in [18] reveals that $a_D < \alpha_D$, $a_D^* < \alpha_D^*$, and $\hat{a}_D > \hat{a}_D^*$, where a $\wedge$ represents the proportional change from autarky values. It is not surprising that exposure to trade lowers the survival ceiling in both countries, since the opening up of the export market attracts more domestic entrants, which forces the marginal firms to leave. That the productivity threshold rises more sharply in the more efficient country, indicates a stronger rationalisation effect there.

[23] Equation [18] and Condition 2 imply a_D / α_D, a_D^* / α_D^*, λ and λ^* are all less than unity.

Since the rationalisation effect is driven by the new exporting opportunity, its effects should be greater in the more efficient country which has the superior probability of exporting. Moreover, inspection of [31] to [33] and [35] reveals that both average firm and average industry efficiency are higher in both countries in the trading equilibrium, and both rise more sharply in the more efficient country. It is therefore clear that, in this model, exposure to trade has a positive effect on industry efficiency in both countries, with a greater impact on the more efficient country. These results contrast with those of Montagna (2002) where the trade-induced expansion of the industry in the more efficient country leads to a reduction in industry efficiency. This difference in outcomes is attributable to different assumptions on firm entry. Here we follow Melitz (2003), Jean (2002) and HMY (2003) in assuming that entrants draw their costs from the same distribution as existing firms. Montagna (2002) assumes firms know their costs *ex ante* and hence the only entrants are firms who would not have found production profitable in autarky (i.e. those having marginal costs above the autarky ceiling).

Failure rates among entrants have increased in both countries after trade, because of the lower survival ceilings. Since failure rates were equal in autarky, and that of the more efficient country is the higher in the trading equilibrium, this implies that the proportional increase in the failure rate is greater in the more efficient country. Exposure to trade makes the superior efficiency level of the home country a disadvantage for its entrants' survival.

Although trade makes entry into both countries more risky, in compensation it increases average revenue and profit for some *successful* entrants by providing additional export revenue and profit. As shown in [32], trade adds an extra value associated with exporting ($\frac{KF_X}{1-\rho} p'_x$), to successful entrants' average revenue, although average domestic sales of all surviving producers ($\breve{r}_D = \frac{KF_D}{1-\rho}$) remain unchanged from autarky[26]. Recall that average firm revenues and profits are equal

[24] One can show that $\tilde{a}/\tilde{\alpha} < \tilde{a}^*/\tilde{\alpha}^*$, and since $\tilde{\alpha} < \tilde{\alpha}^*$, we have $\tilde{a}/\tilde{a}^* < 1$.

[26] It may seem surprising that exposure to import competition does not reduce the average domestic sales of all surviving domestic producers. However note that opening to trade also eliminates the least

across countries in autarky but that the more efficient country has the greater average revenue and profit in the open economy.

To sum up, trade has dual effects for entrants: the probability of failure is higher but so is the profitability conditional on successful entry. While entrants in the more efficient country suffer a greater threat of failure, they are compensated by a higher expected revenue and profit if they can survive the tougher competition.

From [27], it follows that $N < N_A$ and $N_A < N_A^*$. Trade reduces the number of varieties produced domestically in both countries, but from the consumer's view the loss of domestic varieties could be more than compensated by access to new foreign varieties, and if consumers love variety, they will be better off. This is the outcome in Krugman (1980) under a representative firm framework with zero trade costs. However, this need not be the case here. As pointed out by Melitz, it is possible that a smaller number of foreign varieties replace the discontinued domestic varieties when fixed export costs are high. Under our simplifying assumption, the imported varieties exactly compensate for the reduction in domestically produced varieties.[27] But in general in this model, it can be shown that trade leads to a decrease or increase in total varieties consumed in both countries as F_X is greater or less than F_D. The direction of this displacement effect, i.e. whether the number of imported varieties exceeds or falls short of the displaced domestic firms, is independent of relative country sizes and the efficiency gap, but depends solely on the comparison between fixed export costs and production costs.

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productive firms whose domestic sales were the smallest, and therefore has a positive effect on average domestic sales. In this model these two effects offset each other so that the net effect of openness on average domestic sales is zero. Exposure to trade also brings the opportunity of export sales and profits. Thus the overall effect of openness on firm revenue and profit is positive, but is stronger for the more efficient country as a consequence of its higher share of exporting firms.

[27] Using [8] and [27], the loss of domestic varieties is $\Delta N = N_A - N = N_A^* \left\{ \frac{v^{-1} - \gamma\tau}{1-\tau^2} \right\} \tau^{-1}$, while the number of imported varieties is $N_X^* = N^* p_x'^* = N_A^* \left\{ \frac{v^{-1} - \gamma\tau}{1-\tau^2} \right\} \left\{ \frac{a_X^*}{a_D^*} \right\}^k v$. Using [20] we then find $\Delta N = N_X^*$.

In Krugman (1980) the increase in the numbers of varieties available to consumers is the major source of gains from trade. However, as shown in Melitz, with firm heterogeneity it is the rationalisation effect, which leads to a fall in the price of differentiated goods, that generates welfare gains[28]. Since rationalisation takes place in both countries and is stronger in the more efficient country, i.e. $\hat{a}_D > \hat{a}_D^* > 0$, we have $\hat{u} > \hat{u}^* > 0$. Trade increases welfare in both countries, since consumers enjoy a higher aggregate quantity of the aggregate differentiated good with a lower price. But in the more efficient country the proportional welfare improvement is greater.

6. Conclusions

Building on the work of Melitz (2003), we have constructed a heterogeneous firm trade model with asymmetric countries, to analyse the impact of trade on industry performance and welfare across countries with different efficiency levels and market sizes. We showed that in the closed economy, asymmetric countries have identical failure rates among entrants and average industry revenue and profit. If cost distributions are identical across countries, the larger country has more entrants, more survivors and its consumers have higher welfare because its firms are more numerous which implies a lower aggregate price. If countries are identical in size, then welfare is higher in the more efficient country as a result of the lower average cost of its firms.

When opened to trade, we find that the key results from Melitz (2003) are robust. In both countries, exposure to trade lowers the survival ceiling, and raises the pre-entry probability of failure, average industry revenue, profit and efficiency, as well as generating welfare gains. In the open economy, however, we show that the key endogenous characteristics are asymmetric: first, the failure rate among entrants is higher in the more efficient country; second, the proportion of exporting firms is higher in the more efficient country, as a result of the lower survival ceiling and the higher export ceiling; third, average total revenue and profit are higher in the more efficient country, as a consequence of the higher proportion of exporting firms; fourth, in addition to the "home market effect", we identify a "home efficiency effect", such

[28] Again this outcome is sensitive to entry assumptions. Montagna argues that trade may hurt the more efficient country, when the degree of love of variety is low, due to an adverse rationalisation effect.

that, if country sizes are identical, the more efficient country will have more operating firms, more exporting firms and run a trade surplus in differentiated goods when there is intra-industry trade.

Thus, though the direction of the effects of trade on industry performance and welfare is the same across countries, the magnitudes of the trade-induced changes vary significantly. For firms in the more efficient country, exposure to trade is a double-edged sword: the failure rate among entrants rises sharply but the increase in average revenue and profit among successful entrants is also greater. Finally, the more efficient country can reap greater welfare gains, as a consequence of the stronger rationalisation effect.

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