

Export Competition

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Abstract

The paper develops a simple model of foreign market entry with a continuum of heterogenous industries. In each industry ex ante symmetric firms produce a homogenous good and compete for rents in the domestic and the foreign market facing stochastic productivity. A fall in beachhead cost (globalization) leads to (i) more firms within an industry and more industries becoming exporters, (ii) a fall in industry export price but an increase in its variance, (iii) a rise in industry profits, national income and the gap between profit and labor income when the exporting country is sufficiently small, (iv) more unemployment and government unemployment benefit payments when labor is industry-specific, and (v) higher firm effort when productivity is endogenous.

JEL-Classifications: D4, F1, H2

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1 Introduction

Exporting firms differ from non-exporting firms in a number of ways: typically they are bigger, more efficient and fewer. These stylized facts can be explained with the help of entry cost into foreign markets like the need to comply with regulations in the importing countries, to setup a distribution network, and to establish a brand name (see Roberts and Tybout, 1997, Bernard, Jensen and Schott, 2003). These so-called *beachhead cost* are more or less independent of the amount of sales abroad and therefore represent a barrier to foreign market entry in addition to variable trade cost such as tariffs and transportation cost. As a consequence only few or even no firms may enter the foreign market in a specific industry. Little is understood as to how public policy affects equilibrium in such an environment even though the political implications may be quite important. For example, subsidization of exports differs from a policy of facilitating foreign market entry, even though in the end more exports occur. More traditional models of trade policy do not allow us to understand these issues because within an industry firms are typically assumed to be symmetric.

The theoretical literature on trade with heterogenous firms, which originates with the seminal work by Melitz (2003), and which is extended by Eaton and Kortum (2002), Bernard, Redding and Schott (2005), Baldwin (2005) and Yeaple (2005) among others, builds on the empirical literature mentioned above and allows us to address such issues by setting up a dynamic stochastic general equilibrium trade model with monopolistic competition. In the Melitz model firms face two types of uncertainty: First, a firm does not know its productivity when it pays a sunk cost for developing a product (variety) and, second, even after learning its productivity it must decide whether to exit or enter the domestic market, or also become an exporter without knowing how long it will be in the market. Since entering each market involves paying an additional fixed cost, firms self-select into these outcomes depending on their productivity draw. Within this framework little research has been done on understanding public policy beyond the analysis of trade liberalization via a fall in either variable trade cost or beachhead cost. The reason may be that the model has not been around for a long time. More likely, perhaps, is that the model is fairly complex and has some special features. For example, the model requires specific functional forms for the productivity and the firm survival probability functions in order to keep the analysis tractable. Firm entry is efficient and firm competition is reduced to the usual interaction in a monopolistic competition model and leads to constant markups.

In the present paper I develop a radically simple model of trade with heterogenous

firms which shares some but not all features of the Melitz model. The advantage is its simplicity which allows me to address policy issues and also to clearly distinguish between entry of firms within an industry and entry of new industries into exporting, something that is blurred in typical monopolistic competition models. The model abstracts from dynamic issues and focuses on only one uncertainty. Within an industry there are two ex ante symmetric firms who can serve the domestic market without paying a sunk cost, but must decide on costly foreign market entry before productivity is known. In other words, the model reverses the timing of the productivity draw and foreign market entry decision in the Melitz model.¹ Each firm's productivity is either positive or zero, where the latter is capturing the possibility of a firm forced into exiting the market. Across industries the productivity in case of a good shock differs and thus industries are heterogenous. In an industry equilibrium none, one or both firms enter the foreign market depending on the industry productivity parameter (in case of a good shock) and beachhead cost.

A nice feature of the model is that the number of firms in an industry entering the foreign market is unique and a weakly decreasing function of the beachhead cost and an increasing function of industry productivity. Several additional results follow immediately: Industry exports rise as beachhead cost fall because additional firms are drawn into the foreign market and compete price downwards. Conditional on exports taking place, the variance of the export price increases, however, because with two firms entering the market sometimes the monopoly price is charged (if only one of the firms has a good productivity draw) and sometimes marginal cost pricing prevails (if both firms have a good draw), whereas with only one firm in the foreign market the firm charges always the monopoly price. Moreover, a fall in beachhead cost changes not only the number of firms within an industry entering the foreign market, but also the number of industries exporting due to heterogeneity of productivity (in case of good shocks) across industries.

The direct effect of drawing more firms within an industry into becoming exporters is good for consumers in the importing country because the probability of imports taking place goes up and the expected price declines. For the exporting industry the welfare effect of additional entry is less clear cut because the beachhead cost are paid twice and the probability of capturing the foreign monopoly rent may increase or decrease. Interestingly, profits for all industries together (and thus national income of the exporting country) rise with a fall in beachhead cost if the foreign market is sufficiently large. This result may contribute in explaining the often heard conjecture that smaller countries are better able to deal with globalization.

¹Obviously, the model is fairly stylized. The timing is not unrealistic, however, because foreign market entry decision is a relatively long term decision.

The model is then extended to allow for some labor market friction that arises when workers must decide for which industry to work before a firm realizes its productivity, perhaps because industry-specific skills need to be acquired and cannot be learned in the short run. This creates the possibility of unemployment. A firm which has a bad productivity draw cannot pay workers the previously negotiated wage. Of course, workers enter an industry only until the expected wage is equal to what can be earned in other industries. Interestingly, globalization or a decrease in beachhead cost leads now to more unemployment precisely because a firm's expected labor demand is larger in the open economy than in the closed economy. The probability of a good productivity draw is unchanged, however, and thus in expected terms unemployment rises. In this sense globalization leads to more unstable market outcomes if a labor market friction is present.

The result has an interesting corollary if we assume that government pays unemployment benefits to an unemployed worker. The fall in beachhead cost leads not only to more exporting but also to more government expenditures, and thus generates the well-known positive nexus between the openness of an economy and the size of the welfare state. In contrast to Rodrik (1997), however, this correlation is not driven by more demand for government insurance by risk averse individuals when external risk rises. In addition, an increase in the benefit payment to an unemployed worker leads to higher government expenditures for given industry labor supply. There are important indirect effects reinforcing the direct effect however. With an increased benefit payment firms can afford to offer a lower wage in case of a good productivity draw. This reduction in cost induces more firms to enter the foreign market, which increases (potential) labor demand, thus industry labor supply, and eventually more unemployment.

While the base model allows for ex post firm heterogeneity due to different realizations in the productivity draw, firms cannot influence their productivity. In another extension of the model I allow firms to engage in costly effort to increase the productivity in case of a good draw. This opens up the possibility that firms operate with different but positive productivity ex post. Comparing the situation when both firms enter the foreign market compared to none entering it, I show that the effort is higher under the former, that is, globalization leads to higher productivity and more firm effort. This result is somewhat analogous to results in the trade and heterogeneous firms literature, where exporting firms have higher productivity in equilibrium, although for very different reasons. Here productivity is endogenous and chosen by the firm, whereas in the Melitz model more efficient firms survive as exporters (selection) and become bigger (share shifting).

In another extension I consider endogenous firm entry. Entry into the domestic market

is assumed to be costly as well. Firms enter until expected profits for each type of firm is competed down to zero. Qualitatively, the model behaves identical to the base model. In particular, the number of firms entering the foreign market is inversely related to beachhead cost.

The rest of the paper is organized as follows. In the following section I introduce the basic setup, which is followed in section 3 by the characterization of the equilibrium as a function of beachhead cost and industry productivity parameter. Section 4 deals with the case of industry-specific labor, while section 5 considers the case of firm effort and endogenous productivity. In section 6 the number of firms is endogenized through entry. Section 7 concludes.

2 The Model

Consider an open economy which produces goods in two sectors with one input factor (labor). The Z sector is characterized by constant returns to scale, where one unit of labor is transformed into one unit of output. The price of sector Z output is normalized to one. The second sector, called X , consists of a continuum of industries and will be the export sector in equilibrium.² Industries differ in their productivity. More precisely, productivity at the firm level and hence at the industry level is stochastic. The output of a firm in industry i is

$$x(i) = l(i) \cdot \begin{cases} a(i) & \text{with probability } q \\ 0 & \text{with probability } 1 - q, \end{cases} \quad (1)$$

where $a(i)$ is the productivity parameter and $l(i)$ is the amount of labor used. In other words, with some probability $q \in (0, 1)$ the firm has strictly positive but finite productivity $a(i)$, while with probability $1 - q$ the firm has an infinite unit labor requirement and cannot produce.³ Productivity may differ from industry to industry in case of good shocks. Labor productivity a is distributed continuously on some compact interval $[\underline{a}, \bar{a}]$ with constant density $f(a) = m$. The probability q is identical across industries.

In each industry there are two firms producing a homogenous good. Firms are symmetric *ex ante* but not necessarily *ex post*, as the probability distribution over the productivity

²In essence this is a Ricardian model. The rest of the world cannot produce goods in sector X because of low productivity. The country imports good Z or some other goods produced abroad and which are not explicitly modeled here.

³All results go through if productivity is positive but too low (in case of a bad shock) relative to the consumers' willingness to pay for the first unit.

parameter is identical but independent for each firm. Thus with probability q^2 both firms have a good shock and identical productivity $a(i)$. With probability $2q(1 - q)$ one firm has a good shock, while the other has a bad shock, and with probability $(1 - q)^2$ both firms draw a bad shock and will not produce at all. When both firms have a good shock, they compete in prices.

Each firm can serve the domestic market at no cost other than wages for workers hired. In addition a firm must decide whether to export to a foreign market. Entering the foreign market requires spending sunk cost F , which are called beachhead cost. Unlike variable trade cost like tariffs or transportation cost, the beachhead cost represent the cost of complying with local market regulations, setting up a sales network, etc. However, the firm must make the foreign market entry decision before it knows its productivity. When making its entry decision the firm maximizes expected profits. Clearly, the firm can make strictly positive profits only if it is the only firm with a positive shock and is thus a monopolist. In addition, entering the foreign market requires that the additional expected profits cover the fixed cost F of foreign market entry.

I now turn to the consumer side of the economy. There is a mass of L identical individuals, each of whom supplies one unit of labor inelastically and consumes the numeraire good and all goods from the X sector.⁴ Preferences are of the quadratic form

$$u(x, z) = z + \int \alpha x(i) - \beta x(i)^2 di, \quad (2)$$

where α and β are positive parameters. Consumption is financed through labor income and equal shares of profit income from the X -sector. Individuals are equally productive across industries and thus wages are equalized. Utility maximization implies that demand for any x good is a linear function of its own price only $x_d = x_d(p; i)$. All income effects are subsumed into the demand for good z . Thus total demand for good i is $X_d(p; i) = Lx_d(p; i)$ given price p . Assume that foreign demand is generated from a similar demand structure while countries allowed to differ in size. Let foreign's labor force be $L^* = \lambda L$, where $\lambda > 0$ is a scale parameter. Then foreign demand for home's exports of good i is simply $X_d^*(p; i) = \lambda X_d(p; i)$ at any common price p .

The timing of events is as follows. In a first stage firms make their decision simultaneously about foreign market entry. If entering, a firm has to pay immediately the sunk cost. Then productivity is realized. Firms with a bad draw exit the market. Firms with a good draw compete in prices and hire workers to produce goods, which are then sold

⁴One could introduce another sector Y , similar in structure to the X sector, which is located in the rest of the world. In that case the home country imports output from Y industries in addition to or instead of importing the numeraire good.

to consumers who maximize utility by choosing consumption quantities given prices and lump sum profit income. There exists one national labor market and a continuum of goods markets (one for each industry) and the market for good Z . Trade is balanced by Walras law. As mentioned above, the country necessarily exports sector X output because the foreign country does not produce but values these goods.

For each industry the game is solved backwards to determine the equilibrium entry and pricing decisions. After the productivity shock is realized there are zero or one or two firms in the market ("in the market" means firms having positive productivity). Since demand for the homogenous good depends only on own price, competition between two firms leads to marginal cost pricing. The wage w is given through sector Z and equals one. Dropping the industry index for expositional convenience, the equilibrium price for an industry with two firms is $p^c(a) = w/a = 1/a$, where the superscript c refers to competition. When only one firm operates with finite costs, the firm charges the monopoly price $p^m(a)$, assuming that for all industries the monopoly price is less than the willingness to pay for the first unit of a good α . When no firm has positive productivity, and hence production and consumption of the good are zero, the price is infinite (or above the consumers reservation price). Let π denote the profit in the domestic market. The profit is zero when no firm is active or when both firms compete in a Bertrand fashion. The monopoly profit for a firm serving the home market is π^m and for the foreign market is $\lambda\pi^m$ (because of the linearity of demand).

The above can be used to determine the expected profits at the foreign market entry stage of the game:

- When both firms do not enter the foreign market, the expected profit of each firm is

$$B = q(1 - q)\pi^m,$$

which is the monopoly profit weighted with the probability of being a monopolist. There are no fixed cost.

- If one firm enters the foreign market, but the other does not, then the latter obtains

$$D = B = q(1 - q)\pi^m.$$

This is identical to B because the firm has the same chance of being a monopolist in the domestic market. The exporting firm has expected profits of

$$\begin{aligned} C &= q^2\lambda\pi^m + q(1 - q)(1 + \lambda)\pi^m - F \\ &= q(1 - q + \lambda)\pi^m - F. \end{aligned}$$

The first term of C refers to the monopoly profit in the foreign market even if both firms have a positive shock. At the same time, firms compete fiercely at home and the competitive price leads to zero profits from the domestic market. There is no price arbitrage possible across markets because by assumption one of the firms did pay the fixed cost of foreign market entry. The second term of C refers to the case where only the exporting firm has a good shock and is thus a monopolist at home and abroad. The value of C is positive when F is sufficiently small, but is negative if not.

- When both firms enter the foreign market, each firm's expected profit is

$$A = q(1 - q)(1 + \lambda)\pi^m - F$$

which may or may not be positive. In contrast to B (and D) the differences are the size of the prize when the firm is the only one having a good shock, namely the monopoly profit at home and abroad, as well as the fixed cost.

Table 1 summarizes the payoffs of the entry game in a 2×2 matrix. Note that $C > A$, that is, the expected profit for the firm that exclusively enters the foreign market is greater than the expected profit for the firm when also the rival is a potential exporter. The next step is to identify the equilibria of the entry game. Denote by (i, j) , $i, j \in \{E, N\}$, the entry decisions of firm i and j , where E stands for entry into the foreign market and N for no entry. It is easy to see that (N, N) is an equilibrium of the entry game if $C < B$ or $q\lambda\pi^m < F$, which simply states that beachhead cost exceed the expected monopoly profit in the foreign market. Both firms entering is an equilibrium if $A > D$, which is equivalent to $q(1 - q)\lambda\pi^m \geq F$. Here the beachhead cost must be sufficiently small because the probability for being a monopolist is now only $q(1 - q)$. Finally, the situation with only one firm entering (E, N) or (N, E) is an equilibrium if $C > B$ and $A < D$, that is $q(1 - q)\lambda\pi^m < F \leq q\lambda\pi^m$.

An important property of the model is that the number of firms entering the foreign market within an industry is unique given fixed cost F . The entry tuples (E, E) and (N, N) cannot simultaneously be equilibria because this requires $A > D$ and $C < B$, which is inconsistent with our conclusions $C > A$ and $D = B$. Hence for each F the equilibrium number of firms entering the foreign market is unique and decreasing in F . Of course, when the equilibrium outcome involves only one firm entering the foreign market it is not determined which of the two firms it is. Given symmetry, however, this aspect is of no interest for all results derived further below.

3 Results

In this section I do comparative statics with respect to the beachhead cost and thus with the number of firms entering the foreign market. A fall in F can be interpreted as globalization. Of particular interest are the effects on equilibrium price, profits, export volume, among other variables. Equilibrium values of important variables change only at two critical points of F for any particular industry, namely $F = q\lambda\pi^m(a)$ and $F = q(1 - q)\lambda\pi^m(a)$, which depend on productivity a .

Result 1. Expected industry exports (weakly) increase when F falls.

The result is easy to prove as exports are zero under (N, N) , while expected exports equal $qX_d^*(p^m)$ for the case of one firm entering the foreign market. The export volume is even higher when both firms enter the foreign market (E, E) because expected exports amount to

$$q^2 X_d^*(p^c) + 2q(1 - q)X_d^*(p^m) = q[q(X_d^*(p^c) - X_d^*(p^m)) + (1 - q)X_d^*(p^m)] + qX_d^*(p^m),$$

which is clearly higher than $qX_d^*(p^m)$. The reasons are twofold. Exports are higher when both firms have a positive shock since price competition stimulates demand. In addition, there is twice the chance that one firm has a good shock, while the other has a bad one. Result 1 applies to aggregate exports of an industry. Interestingly, the result does not necessarily hold for an individual firm, even if we condition on that firm being an exporter. For example, comparing the case of (E, N) and (E, E) the expected exports of a firm that is entering the foreign market in both situations is unchanged if one assumes that the firms split the market when both are exporting under a good shock. Of course, this is the consequence of the linear demand structure which implies that the monopoly output is half of the competitive output.

Result 2. The mass of industries entering the foreign market increases when F falls.

The proof is straightforward given the above discussion. For given productivity a , there exists a critical threshold level of the fixed entry cost, $F = q\lambda\pi^m(a)$, which makes an industry an exporting one by inducing the first firm to enter the foreign market. Monopoly profit $\pi^m(a)$ is increasing in productivity a . When productivity is continuously distributed, a fall in F has the predicted consequence.

Result 3. Conditional on exports taking place, the expected export price in an industry decreases and the variance of the price increases when the number of firms entering the foreign market goes up.

When only one firm enters the foreign market, the firm charges the monopoly price in case of a good shock. The expected price is thus the monopoly price and its variance is zero (conditional on exports occurring). By contrast, when both firms enter, with probability q^2 the two firms end up charging marginal cost, while with probability $2q(1 - q)$ the firm with the good shock charges the monopoly price. Thus conditional on exports taking place the expected price is now lower and has positive variance. Result 3 implies that a fall in fixed cost of foreign market entry leads to lower prices but higher variance of imported goods.

I now turn to characterizing profits as function of fixed cost.

Result 4. A fall in F increases expected industry profits holding the number of firms entering the foreign market constant. Expected industry profits drop discontinuously, however, when entry cost fall below the critical level at which the second firm enters the foreign market.

The industry profit level corresponding to one and two firms entering the foreign market, respectively, is given by

$$2A = 2[q(1 - q)(1 + \lambda)\pi^m - F]$$

and

$$\begin{aligned} C + D &= [q^2\lambda\pi^m + q(1 - q)(1 + \lambda)\pi^m - F] + q(1 - q)\pi^m \\ &= q[2(1 - q) + \lambda]\pi^m - F \end{aligned}$$

The former is less than the latter when the two expressions are evaluated at the fixed cost $F = q(1 - q)\lambda\pi^m$, which is the critical level at which the second firm finds entry profitable. *Figure 1* plots the expected industry profit as a function of beachhead cost.

Result 5. Economy wide expected profits increase when F falls if the relative size of the foreign economy is sufficiently large. In that case globalization leads to an increase in the country's total income but an increasing gap between labor income and expected profits.

The prove for this result requires defining aggregate profits

$$\Pi = m \cdot \left[\int_{a_1(F)}^{\bar{a}} 2A da + \int_{a_2(F)}^{a_1(F)} (C + D) da + \int_{\underline{a}}^{a_2(F)} 2B da \right] \quad (3)$$

where m is the mass of industries at any given productivity level, $a_1(F)$ and $a_2(F)$ are the critical values at which the number of firms changes given fixed cost F . They are

implicitly defined by $q(1-q)\lambda\pi^m(a_1) = F$ and $q\lambda\pi^m(a_2) = F$, respectively. Using $B = D$, and differentiating with respect to F the change in economy wide profits equals

$$\begin{aligned}\frac{d\Pi}{dF} &= m \left[(a_1 + a_2 - 2\bar{a}) + \frac{da_1}{dF}(F + (q - 2q(1-q))\lambda\pi^m(a_1)) + \frac{da_2}{dF}(F - q\lambda\pi^m(a_2)) \right] \\ &= m \left[(a_1 + a_2 - 2\bar{a}) + \frac{da_1}{dF} \frac{Fq}{1-q} \right],\end{aligned}\quad (4)$$

where the second equality comes from using the definitions for a_1 and a_2 to substitute out profit terms. The first term within the square brackets, $a_1 + a_2 - 2\bar{a}$, is always negative and reflects the *direct* effect of an increase in F , that is, the increase in expenditures on fixed costs holding the number of firms entering the foreign market constant. The second term is the *indirect* effect, which is positive, and represents (i) the reduction in fixed costs when one firm is no longer entering the foreign market and (ii) the change in probability of having a monopoly in the foreign market from $2q(1-q)$ to q . The indirect effect is positive, as can be seen from the second line in (5). Using $da_1/dF = (\lambda q(1-q)\pi_a^m)^{-1}$, where the subscript indicates the derivative of the monopoly profit with respect to firm productivity, the derivative of the industry profit can be rewritten as

$$\frac{d\Pi}{dF} = m \left[(a_1 + a_2 - 2\bar{a}) + \frac{F}{(1-q)^2 \lambda \pi_a^m} \right]. \quad (5)$$

Note that the size of the foreign economy measured by λ is negatively correlated with the threshold productivity parameters a_1 and a_2 , that is $da_i/d\lambda < 0$. Thus an increase in λ makes the direct effect more negative and the indirect effect smaller. Therefore, for λ large enough the direct effect dominates the indirect one. The second statement in Result 5 follows immediately now because labor income is independent of the degree of internationalization. The wage rate equals one and labor supply is fixed.

4 Industry-specific labor and unemployment

In the above version of the model the labor market is completely flexible and workers are perfect substitutes across industries. For this reason all workers are employed after productivity shocks are realized and the wage is uniform across sectors and industries. In this section I take a different perspective. Workers cannot easily switch jobs *ex post*. Instead workers must decide in which industry/sector to work before shocks realize and they become unemployed if not hired by firms in the industry/sector for which they opted. The assumption is reasonable if jobs require industry-specific skills. Assume furthermore that the government pays any unemployed worker an unemployment benefit of $b \in (0, 1)$,

and thus less than the wage in numeraire sector. Note that workers can always choose to work in sector Z which guarantees an income of one. Workers are risk-neutral since all income effects enter the consumption of z due to the constant marginal utility of consuming z . They enter any industry of sector X only if the wage in case of a good shock is above 1. To simplify exposition even further, I assume only a single firm that has all the bargaining power. The firm offers a wage w' to workers, which can be enforced only when the firm has a positive shock, and number of jobs at this pay. In other words, any wage agreement is immaterial if the firm becomes bankrupt due to a bad productivity shock. The timing of the game is as follows: 1) Firms decide whether to enter foreign market, 2) firms offer a wage contract, 3) workers decide in which industry/sector to work, 4) productivity shock is realized, and 5) markets clear. When more workers enter an industry than offered by the firm, each worker has the same probability of being hired.

Solving the models backward, note that the firm's profits are increasing with lower wages. Wages cannot fall too much, however, because workers are no longer willing to opt for this industry. In addition, labor supply is indeterminate if the expected wage of working in the X sector, $qw' + (1 - q)b$ (assuming a worker is employed if a good shock occurs) is equal to the wage in the numeraire sector, but drops to zero if the expected wage drops below one. For this reason, the optimal wage contract and pricing decision is the solution to the following system of conditions when the firm does not enter the foreign market

$$1 = qw' + (1 - q)b \quad (6)$$

$$L_d = \frac{X_d(p^m(w'/a))}{a} = L_s, \quad (7)$$

where the second line represents the clearing of the industry labor market in case of a good shock and the firm charges the monopoly price given the wage that ensures enough labor supply for the production to be carried out. When the firm enters the foreign market, condition (7) becomes

$$\frac{X_d(p^m(w'/a)) + X_d^*(p^m(w'/a))}{a} = L_s. \quad (8)$$

Note that the equilibrium wage w' , which is greater than one, is still determined by (5).

For a particular industry that attracts L^i workers given the wage w' , the government's expected unemployment payments for industry i are

$$G^i = (1 - q)bL^i \quad (9)$$

which is increasing in labor used, the benefit payment per worker, and the probability of a bad productivity shock.

Result 6. When labor is industry-specific and the workers' decision is made before firm productivity shocks are realized, globalization leads to an increase in both unemployment and government unemployment payments.

The intuition is straightforward. Globalization leads to a larger market and more output per firm for a given wage. Since the wage is the same regardless of the firm's decision to enter the foreign market or not, the increase in labor demand when the firm wants to become an exporter induces greater labor supply, which in turn raises expected unemployment given the unchanged probability of firm failure. Essentially, as beachhead costs drop, more and more workers are drawn into the export sector.

Alternatively, consider an increase in the unemployment benefit b . This leads to more spending on unemployment holding industry labor supply constant. The change in b , however, triggers also changes in exporting behaviour, and thus labor demand, which in turn leads to even larger increases in government expenditures.

Result 7. An increase in the unemployment benefit b lowers the wage in an export industry in case of a good shock and raises labor supply. Government expenditures for unemployment benefits rise by more than change in b times the initial unemployment.

For given labor supply the effect can directly be seen from the government budget constraint. Labor supply is not constant however. Notice first that the wage offered by the firm w' must fall to keep workers indifferent as to where to work. The fall in production costs increases the firm's labor demand in case of a good shock, holding the foreign entry strategy constant. The induced labor supply increase leads to rising G . The fall in wage costs has a second effect though because it increases the profitability and thus the benefit of entering the foreign market. Becoming an exporter leads to more labor demand and through this channel the first effect on labor supply and government payments is reinforced.

5 Firm Effort

So far it was assumed that the firm's productivity and the probability of a good shock are exogenous. It is reasonable to assume that firms can influence both parameters to some extent. Here I focus on the case where the firm can increase its productivity in case of a good shock. Improving productivity through effort e , that is raising $a(i)$, however, is costly for the firm: The cost function $k(e)$ is increasing and convex with $k(0) = 0$. The decision to expand effort is made after the firm decides its foreign market strategy, but

before the shock is realized. As a consequence, it is now possible that both firms have a good shock, and can therefore produce at finite cost, but their productivity differs because effort was not identical. In this case the firm with the higher productivity engages in limit pricing. The equilibrium price is the minimum of the monopoly price and the marginal cost of the less productive firm.

How does firm effort vary with the number of firms in the market and thus with the fixed cost of entering foreign markets? This question is of interest because it allows me to address the empirical observation that exporting firms are often more productive than non-exporting firms, as also emphasized by the previous literature mentioned in the introduction.

Firm effort increases productivity from a to $a(1 + e)$. When firms compete in prices in the last stage and both firms chose the same effort level, the equilibrium price is equal to marginal cost $c = w/a(1 + e)$. For different effort levels $e_i > e_j$, the price is the minimum of the monopoly price $p^m(a(1 + e_i))$ and the marginal cost of the less productive firm, that is $p = c_j = w/a(1 + e_j)$. Consider now the situation when both firms do not enter the foreign market. Firm i maximizes expected profits

$$\begin{aligned} \pi_i = & -k(e_i) + q(1 - q)\pi^m(a(1 + e_i)) \\ & + q^2 \begin{cases} [\min\{p^m, c_j\} - c_i] \cdot X_d(\min\{p^m, c_j\}) & \text{if } e_i \geq e_j \\ 0 & \text{if } e_i < e_j, \end{cases} \end{aligned} \quad (10)$$

where p^m is a function of firm i 's cost. In a symmetric equilibrium firms expand the same effort and thus $c_i = c_j$. Equilibrium effort is found by maximizing (9) with respect to $e_i \geq 0$ and then using the symmetry property. The effort level can be compared to the situation where both firms enter the foreign market. The expected profit is similar to (9) with the exception that in the second term the monopoly profit and in the third term the market demand are each multiplied by $(1 + \lambda)$ to take into the account the increase in total sales.

Result 8. In a symmetric equilibrium, the effort of firms under (E, E) is higher than under (N, N) , that is, globalization leads to more productive firms.

The proof follows from writing the first order condition for a symmetric equilibrium with entry of both firms into the foreign market as $\partial\pi(e; \lambda)/\partial e = 0$. Using the implicit function theorem I obtain

$$\frac{de}{d\lambda} = -\frac{\partial^2\pi/\partial e\partial\lambda}{\partial^2\pi/\partial e^2} > 0,$$

because the denominator is negative when a profit maximum is reached and the direct effect of a larger foreign market is positive. The derivative is monotonic and hence the

effort in the situation when both firms do not enter the foreign market, which is equivalent to $\lambda = 0$, is less than in any situation where both firms are potential exporters.

Result 8 provides no direct comparison of the effort of exporting and non-exporting firms within the same industry, as the outcomes (E, E) and (N, N) do not simultaneously occur. In this sense, the comparison is across industries. Some insights can be generated for the case (E, N) , that is an industry in which one firm enters the foreign market while the other does not (assuming such a case occurs). The profit of the firm not entering the foreign market is given by (10). Relabel the effort and call it now e_{NX} for the non-exporting firm, and e_X for the firm entering the foreign market. The latter firm's profit is

$$\begin{aligned} \pi_X = & -k(e_X) + q\lambda\pi^m(e_X) + q(1-q)\pi^m(e_X) \\ & + q^2 \begin{cases} [\min\{p^m(e_X), c_{NX}\}] - c_X & \text{if } e_X \geq e_{NX} \\ 0 & \text{if } e_X < e_{NX}, \end{cases} \end{aligned} \quad (11)$$

where c_X and c_{NX} denote the marginal cost of the two types of firms (and which depend on effort). The first-order condition for a profit maximum with respect to effort choices are

$$k'(e_X) = q[\lambda + 1 - q] \frac{d\pi^m(e_X)}{de_X} + q^2 \begin{cases} \left(-\frac{dc_X}{de_X}\right) \cdot X_d(\min\{p^m(e_X), c_{NX}\}) & \text{if } e_X \geq e_{NX} \\ 0 & \text{if } e_X < e_{NX}, \end{cases} \quad (12)$$

$$k'(e_{NX}) = q(1-q) \frac{d\pi^m(e_{NX})}{de_{NX}} + q^2 \begin{cases} \left(-\frac{dc_{NX}}{de_{NX}}\right) \cdot X_d(\min\{p^m(e_{NX}), c_X\}) & \text{if } e_{NX} \geq e_X \\ 0 & \text{if } e_{NX} < e_X. \end{cases} \quad (13)$$

I now show that in equilibrium the effort of the non-exporting firm must be less than the effort of the exporting firm when the foreign market is sufficiently large. Suppose to the contrary that $e_{NX} \geq e_X$. Since the cost function for effort is strictly convex, $k'(e_{NX}) \geq k'(e_X)$ follows, and thus the right side of (12) must be smaller than the right side of (13). This cannot hold when λ is very large because the right side of (12) is monotonically increasing in λ , while all other terms in (12) and (13) are independent of country size. This leads to

Result 9. Assume the entry game leads to the outcome (E, N) or (N, E) , and a Nash equilibrium in effort levels exist. Then the effort of the firm entering the foreign market is larger than the effort of the firm not entering the foreign market if the size of the foreign market is sufficiently large. Thus in case both firms have good shock the exporting firm has higher productivity than the non-exporting firm.

This result is in line with the previous literature on trade with heterogenous firms. The mechanisms are quite different however. Here the entry decision and the determination of productivity are separated and made through two decisions.

6 Free Entry

In the base model the number of firms per industry is fixed at two. Results 4 and 5 suggest that additional firms would like to enter because in expected terms this is profitable. I now consider the possibility of entry of firms, assuming that entry into the market requires a sunk cost investment F_M . This allows me to endogenize the number of firms which serve only the domestic market (and pay only F_M) and the number of firms serving both the domestic and the foreign market (thus paying F_M and F). Firms must make the entry decisions and pay the sunk cost simultaneously before productivity is revealed. Let n_{NX} , n_X and $n = n_X + n_{NX}$ be the number of firms that enter only the domestic market, those that enter both markets, and the total number of firms.

The expected profit of a domestic firm and an international firm is

$$\pi_{NX} = q(1-q)^{n-1}\pi^m - F_M \quad (14)$$

$$\begin{aligned} \pi_X &= q(1-q)^{n-1}\pi^m + q(1-q)^{n_X-1}\lambda\pi^m - F_M - F \\ &= q(1-q)^{n_X-1}\pi^m[(1-q)^{n-n_X} + \lambda] - F_M - F. \end{aligned} \quad (15)$$

The first term in (14) and (15) is the monopoly profit in the home market weighted by the probability of gaining it, which requires that the firm has a good shock, while all other firms in the domestic market ($= n - 1$) have a bad shock. A firm entering the foreign market wins the foreign monopoly profit with a certain probability which in turn depends on the number of firms also in that market ($n_X - 1$). I assume that profits are positive when only one firm is in the market, that is, $q\pi^m > F_M$ and $q\lambda\pi^m > F$.

Result 10. Ignoring integer problems the number of domestic and international firms is given by

$$n_{NX} = 1 + \frac{\ln F_M - \ln q\pi^m}{\ln(1-q)} \quad \text{and} \quad n_X = 1 + \frac{\ln F - \ln q\lambda\pi^m}{\ln(1-q)}. \quad (16)$$

The proof comes from setting setting the expected profit terms, (14) and (15), equal to zero and solving for the number of firms. Note that when (14) is zero, the number of firms entering the foreign market does not depend on home market entry cost. Similar to the base model with a fixed number of firms there is now a negative relationship

between beachhead cost and number of firms in the foreign market, that is, $dn_X/dF < 0$ (differentiating (15) gives this result by noticing that $\ln(1 - q) < 0$). On the other hand, an increase in foreign market size leads to more firms entering the foreign market.

7 Conclusion

This paper has developed a simple model of ex post heterogeneous firms which compete for foreign market rents. Stochastic productivity and foreign market entry cost determine the equilibrium number of firms entering the foreign market. The model is fairly tractable and can be used in applied contexts such as to study unemployment, free entry of firms, firm effort. The trade structure can be generalized as well, in order to set up foreign competitors in existing industries and in industries where the home country may have a comparative disadvantage. This is left for future work.

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Firm 1 \ Firm 2	Enter E	Not Enter N
Enter E	A	D
Not Enter N	C	B

$$A = q(1-q)(1+\lambda)\pi^m - F$$

$$B = q(1-q)\pi^m$$

$$C = q(1-q+\lambda)\pi^m - F$$

$$D = q(1-q)\pi^m$$

