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Industry Differences in the Effect of Export Market Entry: Learning by Exporting?

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Abstract:

There is extensive empirical evidence pointing to the existence of sunk costs to exporting. Only higher productivity firms can profitably cover these and enter export markets. This is the standard explanation for the regularity with which econometric analyses reports that exporters are more productive than non-exporters. But what happens to their productivity trajectory once they have entered? Theory points to the possibility of a further productivity boost, attributable to the effects of learning and competition, though as yet there is little empirical support for this. We investigate whether this is because the potential for this boost depends upon how exposed to competition the firm is already. We find that industry differences are important in determining whether learning effects boost productivity after export market entry.

JEL Codes: F12, F14, L25, L60

Keywords: exporting, productivity, learning

Outline

Non-technical Summary

The recent explosion of work looking at the causes and consequences of exporting at the firms level has thrown up a surprisingly consistent set of findings, despite large differences in the type of country under study, time period and methodology used. Export firms are generally found to be larger and more productive than non-exporters, and there is persistence in their behaviour. Firms that export in one period are likely to remain exporters in the next, and similarly non-exporters are likely to remain non-exporters. This is consistent with the idea of sunk-costs and self selection; the presence of sunk-costs to exporting means that only the most productive firms within the industry are able to make positive profits from exporting.

An area where there is less agreement is whether export market entry affects subsequent firm performance. Almost all studies have found that productivity growth of new exporters is faster than non-exporters in the pre-entry period but argue that this is again due to self-selection, firms improve their productivity in order to export, but exporting brings no additional benefit. However a growing number of studies have found that some firms in some countries do receive an additional benefit, determined by their size and the extent to which they participate in world markets, and that this effect lasts for a relatively short period of time.

In this paper we investigate further whether there are post-entry productivity effects which differ across industries depending on existing exposure to foreign firms. If export oriented firms benefit, for example because there are competition or learning effects, then the positive effect from export market entry should be lower in industries where competition is already strong in the domestic market. For example, the entry effect should be negatively correlated with exposure to existing international trade within the industry, or the extent to which production in the domestic market is undertaken by foreign firms.

These same variables are likely to affect the probability that a firm will start to export however. For example existing trade exposure is probably correlated with sunk-costs of entry and therefore more entry is likely in industries already exposed to high levels of trade. Similarly, the presence of large numbers of foreign firms undertaking domestic production would suggest that market entry is more likely though that route. Export market entry would therefore be expected to be negatively correlated with existing foreign production in the industry.

Using data on a sample of UK manufacturing firms over the period 1989-1998 we find that the probability of export market entry is correlated with both trade variables and levels of FDI. Entry is higher in industries exposed to high levels of arms-length trade and lower where there are high levels intra-industry trade and FDI. On the main question considered in the paper we find that compared to firms with similar pre-entry characteristics, productivity growth was significantly higher following export market entry for new exporters. However, this effect was consistently lower in industries in which existing exposure to foreign firms was greater.

1. Introduction

Since the pioneering work on the characteristics of US export firms by Bernard and Jensen (1996), the literature has expanded to cover a range of different countries which report a reasonably consistent set of findings. Export firms are for example, consistently larger on average and more productive than non-exporters, and there is persistence in their behaviour. Firms that export in one period are likely to remain exporters in the next, and similarly non-exporters are likely to remain non-exporters. Melitz (2003), using assumptions about the presence of sunk-costs to exporting and heterogeneous productivity among firms within the same industry, develops a model consistent with these findings. Only the most productive firms are able to make positive profits from exporting, and there is self-selection into these markets.

An area where there is less agreement is whether export market entry affects subsequent firm performance. Bernard and Jensen (1999) report that productivity growth of established exporters is no faster than that of non-exporters, but that the productivity growth of new export firms is faster than both exporters and non-exporters. This difference occurs in the periods both before and after entry. These results are consistent with Melitz (2003): self-selection effects drive the results for new export firms and there are no within-industry differences in productivity growth between established exporters and non-exporters.

Similar results have been reported for the UK. Grima, Greenaway and Kneller (2004) show that productivity growth in new export market entrants is faster than non-export firms in the periods before and after entry. Firms that were on divergent paths before entry remain so afterwards. However, the authors also show that when the sample of non-exporters is matched to firms that had similar characteristics to first time exporters in the pre-entry period, the results alter somewhat. Now firms that were on similar pre-entry productivity growth paths differ when one group becomes exporters, albeit where the effect lasts for only a short period. Using a larger sample Greenaway and Kneller (2004) replicate these results and find some evidence that this post entry effect is increasing in the degree of exposure to foreign markets by the firm. Both of these results are consistent with the possibility of an export market entry effect, but the evidence is suggestive rather than persuasive. By contrast, Baldwin and Gu (2004) report clear evidence of post-entry improvements in the performance of Canadian firms.

In this paper we investigate further whether there are post-entry productivity effects which differ across industries depending on exposure to foreign firms. If export oriented firms benefit, for example because there are competition or learning effects, then the positive effect from export market entry should be lower in industries where competition is already strong in the domestic market. For example, the entry effect should be negatively correlated with exposure to existing international trade within the industry, or the extent to which production in the domestic market is undertaken by foreign firms.[1]

We do not neglect the possibility that the same industry variables used to explore post-entry effects also affect the probability of entry. For example existing trade exposure is probably correlated with sunk-costs of entry and therefore more entry is likely in industries already exposed to high levels of trade. Similarly, the presence of large numbers of foreign firms undertaking domestic production would suggest that the proximity-concentration trade-off (Brainard, 1997) favours market entry though this route. Export market entry would therefore be expected to be negatively correlated with existing foreign production in the industry.

Using data on a sample of UK manufacturing firms over the period 1989-1998 we find that the probability of export market entry is correlated with both trade variables and levels of FDI. Entry is higher in industries exposed to high levels of arms-length trade and lower where there are high levels intra-industry trade and FDI. Compared to firms with similar pre-entry characteristics, productivity growth was significantly higher following export market entry. However, this effect was consistently lower in industries in which exposure to foreign firms was greater.

[1] Castellani (2002) and Delgado et al. (2002) have previously found that post export market entry productivity improvements are specific to export orientated and small firms respectively, whereas Clerides et al (1998) and Aw et al. (2000) find industry variation in the effect of entry.

With regard to the related question of whether more exporting generally leads to higher productivity growth[2], we find that conditional on a range of fixed industry and time effects, the rate of productivity growth was higher for both new export and non-export firms, the greater the industry exposure to international trade even though the entry effect itself was smaller.

The remainder of this paper is set out as follows. In the next section we discuss the Melitz (2003) model. This has no learning effects from entry but highlights why firms within the same industry make different choices about entry. Self-selection is an important feature of the UK. It also allows us to discuss possible explanations for cross-industry variation in export market entry. Sections 3 sets out our empirical methodology and data and Section 4 our results. These are presented in two parts, the determinants of entry and consequences of entry. Finally Section 5 concludes.

2. FIRM HETEROGENEITY, SUNK COSTS AND EXPORT MARKET ENTRY

There is a growing literature on exporting at the firm level and evidence is now available for around 20 countries. One of the most common findings is that export firms are on average larger and more productive than non-export firms. This is consistent with the prediction from theory that there are sunk costs of exporting.

Domestic firms have the choice of whether to serve just domestic or domestic and overseas markets, where the latter can be achieved, either by exporting from the home market or establishing foreign production facilities. Within industry variation in this choice requires some form of heterogeneity across firms.[3] Melitz (2003) and Helpman, Melitz and Yeaple (2004) generate this by assuming there are sunk-costs to market entry (both domestic and foreign) and firms differ in their productivity levels.

[2] Note that our analysis in microeconometric. There is an older, macro based literature using aggregate export and productivity data. See for example Greenaway and Sapsford (1994) and Edwards (1998)
[3] A similar conclusion is possible in the case of 'knife-edge' solutions in representative firms models, where firms are indifferent about becoming an exporter or not.

Head and Reis (2003) provide a useful simplification of Helpman, Melitz and Yeaple (2004) that remains consistent with the main stylised facts. The model is partial equilibrium, with an exogenously given wage rate *(w)* and constant marginal costs w/A_i. where A_i describes the productivity level of firm *i*. Consumers' utility is quadratic such that utility maximisation yields a linear demand curve and firm decisions can be modelled as if they were monopolists.

Domestic market entry incurs a fixed cost, f_D, export market entry the fixed cost, f_X, and FDI the fixed cost f_F. The model is static so that these represent re-occuring expenses that do not vary with output and initial costs of establishing the firm. The fixed costs of foreign market entry are assumed to exceed those of entry to the domestic market and for overseas production to exceed those of exporting, $f_D < f_X < f_F$. Exporting also incurs a per unit trade cost, τ, which represents both transport and non-transport costs (such as tariffs) that vary with output.

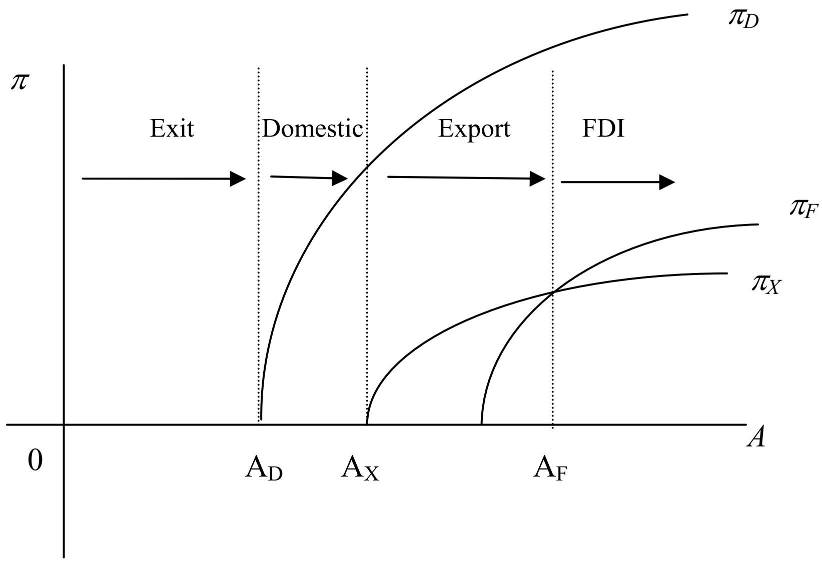
Profit from serving the domestic and export markets is given by:

$$\pi_D = [(1 - \frac{w}{A_i})/2]^2 - f_D$$

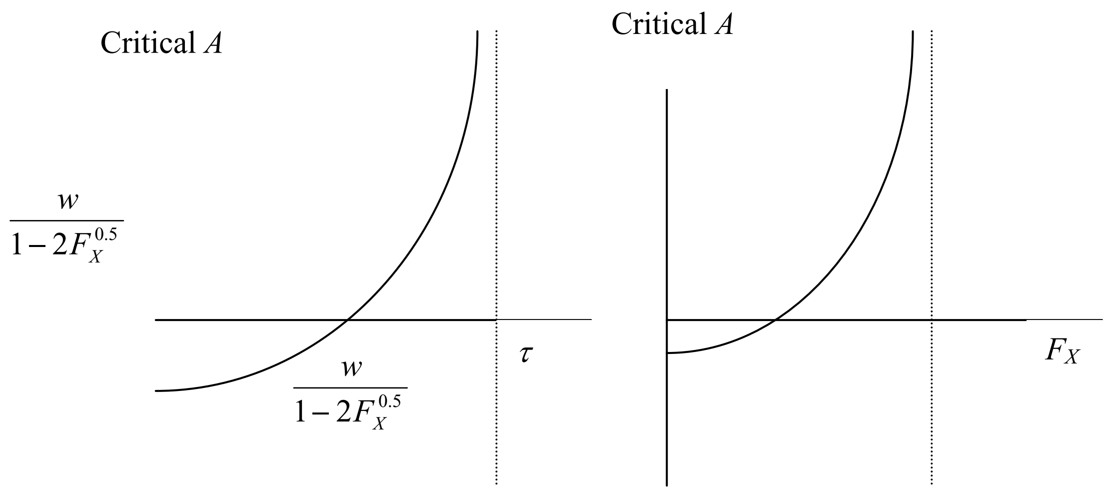
$$\pi_X = [(1 - \frac{w}{A_i} - \tau)/2]^2 - f_X$$

$$\pi_X = [(1 - \frac{w}{A_i})/2]^2 - f_F$$

The decision to export therefore varies across firms according to A_i, the firm specific productivity parameter, and across industries according to per unit trade costs τ and sunk costs F_X. Firms with low productivity, below $\frac{w}{1 - 2F_D^{0.5}}$, make negative profits from production and therefore choose not to produce. Firms with productivity greater than this, but less than $\frac{w}{1 - \tau - 2F_X^{0.5}}$ make positive profits from the domestic market but not from exporting. Finally firms with productivity greater than $\frac{w}{1 - \tau - 2F_X^{0.5}}$ make positive profits from both markets. These relationships are summarised in Figure 1, which describes profits obtainable for a given firm productivity from domestic and export markets.



It is also clear from Figure 1 that the critical value of A will vary as τ and F_X vary across industries. As sunk-costs of exporting and unit trade costs increase, the productivity necessary to ensure non-negative profits also increases. The two panels of Figure 2 describe how A varies with τ and F_X respectively.



3. EMPIRICAL METHODOLOGY AND DATA SAMPLE

In this section of the paper we briefly outline the methodology and the data employed. This is identical to that used in Girma et al. (2004), Greenaway and Kneller (2003, 2004) and further details can be found in those papers. Our interest is in the cross-time performance of the firm following export market entry.[4] In the absence of economic shocks or other firm specific changes in the determinants of performance this can be established using information on new export entrants in the periods before and after entry. This requires information about what would have happened to a firm had it not entered the export market, which is of course unobservable. Bernard and Jensen (1996) and others assume that all non-exporters are capable of providing this counterfactual. One objection to this is the heterogeneous nature of productivity between export and non-export firms in the Melitz (2003), Helpman, Melitz and Yeaple (2004) and the Head and Reis (2003) model outlined above. In support of this Greenaway and Kneller (2004) show that new export firms in the UK are in fact closer in their underlying characteristics to established exporters than to non-export firms. Wagner (2002), Girma et al. (2003), Greenaway and Kneller (2003) and Greenaway et al. (2003) choose instead to generate a control group using information on observable firm characterises in the pre-entry period, then combine this with difference-in-differences to control for observable post-entry changes.[5]

Formally, if Δy represents the growth rate of total factor productivity and $EXP_{it} \in \{0,1\}$ is an indicator (dummy variable) of whether firm i entered export markets for the first time in period t, then Δy^1_{it+s} is the change in TFP at time t+s, $s \geq 0$ following entry. It follows that Δy^0_{it+s} is the outcome of firm i had it not started exporting. The effect of exporting on firm performance at $t + s$ is defined as:

$$\Delta y^1_{it+s} - \Delta y^0_{it+s} \quad . \tag{2}$$

[4] In the parlance of the literature we identify the effect of treatment on the treated.

[5] For a comprehensive review on the microeconometric evaluation literature see Blundell and Costa Dias (2000).

As noted above the counterfactual, Δy^{0}_{it+s}, is unobservable and must therefore be generated. In common to most of the microeconometric evaluation literature (see Heckman et al, 1997), we define the *average* effect of exporting on entrants as:

$$E\left\{\Delta y^{1}_{t+s} - \Delta y^{0}_{t+s} \mid EXP_{it} = 1\right\} = E\left\{\Delta y^{1}_{t+s} \mid EXP_{it} = 1\right\} - E\left\{\Delta y^{0}_{t+s} \mid EXP_{it} = 1\right\} \quad (3)$$

and the counterfactual is estimated by the corresponding average value of firms that remain non-exporters: $E\left\{\Delta y^{0}_{it+s} \mid EXP = 0\right\}$.

However, unlike much of the literature we restrict the firms in this control group. We assume all of the difference in Δy (bar that caused by exporting) between exporters and the appropriately selected control group is captured by a vector of observables X and the pre-entry *level* of the outcome variable y_{it-1}. The basic idea of this matching is to select from the non-exporters those in which the distribution of the variables affecting the outcome is as similar as possible to the distribution for the new export firms. To do this, we adopt the propensity score matching method of Rosenbaum and Rubin (1983). Thus we first identify the probability of exporting (or propensity score) for all firms using the probit model

$$P(EXP_{it} = 1) = F(TFP_{it-1}, size_{it-1}, ownweship_{it-1}, wages_{it-1}, industry\ \text{var}iables) \quad (4)$$

Here *F is* the normal cumulative distribution function, and a set of regional, sectoral and time dummies are included. Let P_{it} denote the predicted probability of exporting at t for firm i, which is an actual (eventual) exporter. A non-exporting firm j, which is closest in terms of its propensity score to an exporting firm, is selected as a match for the former, using the nearest-neighbour method. More formally, at each point in time and for each new exporter i, a non-exporting firm j is selected such that

$$\left|P_{it} - P_{jt}\right| = \min_{k \in \{EXP_{kt}=0\}} \left\{P_{it} - P_{jt}\right\} \quad (5)$$

This is preferable to randomly or indiscriminately choosing the comparison group, which is likely to suffer from selection bias by picking firms with markedly different characteristics.

The data used in this study is a smaller version of that used in Greenaway and Kneller (2004), where the restriction occurs because of a lack of information on industry level variables such as trade exposure, for the full sample period. The primary source of information on both exporting and non-exporting firms is the *OneSource* database of private and public companies, both of which are derived from company accounts. As in that paper we restrict our analysis to domestically owned manufacturing firms with complete information on output and use of factor inputs.

In total we have 12,875 observations on UK domestic manufacturing firms for the period 1990 to 1998. Of these 10,848 are of non-export firms and 2,027 first time exporters. The basic sample characteristics of both are described in Table 1 for output, employment and TFP, where our estimate of TFP is calculated as residuals from an econometrically estimated production expressed relative to the 2-digit SIC industry. The results presented in the paper are robust to alternative methods of calculating TFP and measures of labour productivity. New export firms are on average larger than non-exporters and TFP is similar in the two sets of firms in the un-matched sample, by . t-tests for difference in the mean values for TFP, employment and output between new exporters and non-exporters indicates that any differences are statistically significant.[6] Controlling for cross-industry differences not accounted for in Table 1 via fixed effects and time effects suggests that productivity is again suggests that TFP (by 7 per cent), employment 27 per cent) and output (47 per cent) is higher in new export firms.

In Table 1 we also report the same information for the matched sample, where 693 non-exporters are used as a match for 826 new export firms. By restricting the sample we find that a number of earlier relationships are reversed. Non-export firms are on average larger than new-export firms, but have lower productivity. A simple t-test of difference in means indicates that none of the differences are significant however.[7] Again a similar conclusion is reached when we control for industry (3-digit) and time fixed effects. As expected matching has the effect of removing differences between new exporters and non-exporters in the pre-entry period compared to the full sample of non-export firms.[8]

[6] The relevant test statistics are 8.68, 7.96 and 5.31 for TFP, employment and productivity respectively.
[7] The hypothesis that the means are not equal is rejected at the 14th, 23rd and 20th confidence levels for TFP, employment and output respectively.

Table 1: Basic Data Characteristics of Exporters and Non-Exporters

Un-Matched Sample			
Non-exporters	*Obs*	*Mean*	*St. deviation*
Productivity	10821	-0.064	0.60
Output	10848	246.22	1247.8
Employment	10848	22781.66	158578.3
New exporters	*Obs*	*Mean*	*St. deviation*
Productivity	2024	0.021	0.56
Output	2027	413.40	2062.4
Employment	2027	39261.89	259570.6
Matched Sample			
Non-exporters	*Obs*	*Mean*	*St. deviation*
Productivity	693	-0.128	0.55
Output	693	325.368	1635.64
Employment	693	30432.9	198951.5
New exporters	*Obs*	*Mean*	*St. deviation*
Productivity	826	0.030	0.57
Output	826	251.14	645.99
Employment	826	21024.49	64268.47

Industry level determinants of export market entry are collated from a number of different sources. The share of foreign in total production is taken from Girma, Görg and Pisu (2004). The sunk-cost variable uses the same datasource and is calculated as the minimum TFP of all new export market entrants within the industry in each year[9]. The agglomeration of industries is measured at the 5-digit level and is from Duranton and Overmans (2002).

Two measures of international trade are used. The first is a measure of intra-industry trade at the 3-digit level calculated using the standard Grubel and Lloyd equation,

$$IIT = \frac{X + M - |X - M|}{X + M}.$$

This is a widely used measure of the extent to which trade in a particular industry takes the form of exporting and importing similar products. The index is bounded by zero and one. In the case of the former all trade is either imports or exports; whilst

[8] We also check the balancing hypothesis and find it to hold.
[9] A similar methodology is used to estimate sunk costs in Bernard, Jensen and Schott (2003)

when the index is one, imports and exports are identical. The index is a proxy for the intensity of competition in similar products.

The second measure combines trade exposure (industry exports over industry output) with the intra-industry trade index. Trade exposure is likely to be determined in part by sunk-costs into export markets and in part by the comparative advantage. Interacting the trade exposure index with intra-industry trade attempts to net out the effect of comparative advantage on trade exposure. Finally, industry R&D intensity is measured as the ratio of R and D expenditure (taken from ANBERD) to industry output (taken from STAN) at the 2-digit level.

The basic characteristics of industry level variables are reported in Table 2. Along with means and standard deviations we report the correlation of the variables with the ratio of new exporters to non-exporters in the industry. The number of new export firms is highly correlated with existing trade exposure, the foreign production share and R and D intensity, negatively correlated with sunk costs and shows little correlation with either intra-industry trade or industry agglomeration.

Variable	*Obs.*	*Mean*	*St. deviation*	*Correlation with new export/ non-export ratio*
Trade exposure	659	0.055	0.068	0.373
IIT	659	0.741	0.205	0.009
Foreign production share	868	0.461	0.284	0.136
Industry agglomeration	1756	0.029	0.062	0.024
R&D intensity	198	1.80	2.25	0.441
Sunk-costs	677	-0.381	0.607	-0.219

Note: Trade exposure, IIT, foreign production share and sunk-costs are measured at the 3-digit industry level. Industry agglomeration is measured at the 5-digit industry level and R&D intensity at the 2-digit industry level. Obs. Number of observations (number of industries * number of time periods).

4. EMPIRICIAL RESULTS

Export Market Entry

According to the heterogeneous firm model sketched out in Section, 2 the probability of export market entry is determined by the level of productivity of the firm and industry level determinants of fixed costs. This is a somewhat restrictive set of determinants and one the existing literature on export market entry has found can be extended to include other firm characteristics, such as size and human capital, and other industry and time invariant effects.

Estimation is via Probit models. These express the determinants of the 0/1 decision to export or not as a series of probabilities. Size is measured as the log of employment, human capital as the log of the real wage and productivity by TFP. Fixed time effects are included to control for the effect of shocks on the probability of export market entry. Regression 3.1 in Table 3 is our base regression. Here the probability of first time export market entry is a function of a series of firm level factors, such as size, TFP and wages, as well as industry level variables such as industry agglomeration and an estimate of sunk-costs. The probability of entry is increasing in firm size and the level of TFP, but decreasing in the level of real wages.[10] This latter is surprising, but not robust to the addition of fixed industry effects in regression 3.5. Here the probability of entry is increasing in the level of human capital. Size remains significant whereas TFP does not, although it has the expected sign. The cross-industry variation in TFP is important driver of the results for that variable in previous regressions. Given that by construction the TFP variable is measured relative to the industry mean we might interpret this sensitivity of the TFP variable as capturing the idea of differences in the level of sunk-costs across industries.

According to the results from regression 3.5, size and human capital have an approximately equal effect on the probability of exporting. At the sample mean the effect of an increase in size by one standard deviation increases the probability the firm will start to export by about 0.0357, which is about 25 per cent of the mean

[10] These results are robust to the inclusion of a measure of market power of the firm calculated at the 4-digit level. The existing market share of the firm is itself not a significant predictor of the probability of market entry by the firm outside of the firm level conditioning variables already included in the regression.

probability. The effect of an increase in real wages by one standard deviation increases the probability of export market entry by 0.0135.

Turning next to the industry level variables, Greenaway and Kneller (2004) report that co-location of other export firms in the same industry and region significantly increases the probability of export market entry. To capture this we use a measure of agglomeration of industries at the 5-digit level from Duranton and Overmans (2002). Industry concentration enters the regression with the expected positive coefficient. One interpretation of this is that potential export market entrants share information with other firms in the same industry and region raising the likelihood of entry. Another is that agglomerated industries have higher productivity, possibly because of the co-location of support industries and deeper labour markets, and firms with higher productivity are more likely to become exporters. The level of sunk-costs in the industry also negatively affects entry, although not significantly so. The final industry level variable controls for R and D intensity. To the extent that this proxies high productivity industries we might expect that this would raise the probability of entry, which is indeed what we find. This conclusion is reinforced by the loss of significance of this variable to the addition of fixed industry effects in equation 3.5.

Table 3: The determinants of export market entry

Regression No.	***3.1*** *Base regression*	***3.2*** *Adds trade exposure*	***3.3*** *Adds IIT*	***3.4*** *Adds FDI*	***3.5*** *Adds industry dummies*
log(EMP)$_{t-1}$	0.121 (11.10)**	0.144 (11.42)**	0.145 (11.43)**	0.144 (11.23)**	0.165 (10.64)**
log(WAGE)$_{t-1}$	-0.167 (4.14)**	-0.184 (3.92)**	-0.162 (3.40)**	-0.125 (2.60)**	0.140 (2.26)*
TFP$_{t-1}$	0.123 (4.57)**	0.174 (5.47)**	0.169 (5.28)**	0.152 (4.68)**	0.039 (1.08)
Industry Agglomeration	2.273 (7.48)**	2.168 (5.69)**	2.292 (5.96)**	2.158 (5.52)**	5.040 (8.60)**
Sunk-costs$_{t-1}$	0.001 (0.05)	-0.020 (0.73)	-0.027 (0.95)	-0.044 (1.53)	0.013 (0.40)
R&D intensity$_{t-1}$	0.156 (22.44)**	0.101 (11.54)**	0.103 (11.66)**	0.104 (11.53)**	0.064 (1.47)
Trade		6.029	6.551	7.206	4.711

Exposure$_{t-1}$		(14.44)**	(14.71)**	(15.60)**	(6.36)**
IIT$_{t-1}$			-0.500 (5.27)**	-0.474 (4.81)**	-1.106 (4.66)**
Foreign Production share$_{t-1}$				-0.505 (7.10)**	-1.043 (9.54)**
Constant	-1.355 (10.95)**	-1.509 (10.55)**	-1.212 (7.85)**	-1.119 (7.08)**	-1.279 (3.45)**
Observations	12875	9398	9398	9174	9097

In regressions 3.2 to 3.4 we add our trade variables. The first includes a measure of trade exposure in the industry, 3.3 our measure of intra-industry trade and 3.4 the size of the foreign manufacturing sector (FDI) in each 3-digit industry. We expect that the decision to start exporting is in part driven by the characteristics of the individual firm as explored above, and in part by the costs of exporting relative to the costs of serving foreign markets through overseas production, (the proximity-concentration trade-off). Production in a single location and exporting is more likely when there are cost advantages to concentration, and the duplication of production facilities in more than one country is more likely when there are advantages to market proximity.

The trade variables can be expected to reflect parts of this trade-off. High existing levels of trade exposure suggest low costs of arms-length trade. Similarly, high levels of foreign FDI suggest low sunk costs of market entry through this form. We include them as separate variables, rather than for example their ratio, because they will also reflect the comparative advantage of UK versus foreign firms.

Regression 3.2 reports the effect of adding a measure of existing trade exposure. This has minor effects on the parameter estimates for the firm specific and industry level variables and does not change their significance. The trade variable itself has a large positive coefficient. Its estimated marginal effect suggests that an increase by one standard deviation in trade intensity raises the probability of exporting by 0.064.

In an extension of Melitz (2003) to include intra-industry trade Falvey, Greenaway and Yu (2004) find that the self-selection effect is strongest when the degree of substitution across products is high. That is, the more homogeneous the goods being traded the stronger the effect. This makes entry less likely in industries where intra-industry trade is high. Using the Grubel-Lloyd index (at the 3-digit level) we find support for this. An increase in the index significantly lowers the probability of exit. It follows that entry is also lower the higher the degree of intra-industry trade.

FDI in the domestic economy has the expected negative coefficient and is statistically significant (regression 3.4). Higher levels of domestic production by foreign firms lower the probability that a domestic firm will export. This might reflect cost advantages from FDI relative to exporting, but is also consistent with a comparative advantage for foreign firms. If those firms have superior technology it is less likely that domestic firms will be able to compete in the foreign firms own domestic market and are less likely to have foreign sales of any form (exporting or FDI).

In the final regression of Table 3 we add 3-digit industry level fixed effects to test whether the results from elsewhere are generated solely by between industry differences in the data.[11] It would appear they are not. Industry agglomeration, trade exposure, intra-industry trade and FDI all remain significant, although the R and D intensity variable does not. The most noticeable change is on the measure of productivity at the firm level. Its coefficient, while still positive, drops markedly in size and is no longer significant.

Post-Entry Effects

Economic theory points to several ways in which, having become more productive in order to enter export markets, firms become even more productive by staying there. For example, interacting with other firms that deploy best practice technology and/or management processes results in exposure to new ways of doing things and in turn stimulates productivity improvement. Using survey data for Canadian firms Baldwin and Gu (2004) find support for all three of these channels.[12] Alternatively, it could be that productivity improvements are coincidental to earlier investments made by the

[11] Allowing for the possibility that the observations are not independent within groups, they are clustered, does not change the results from this regression.

[12] Following this evidence we explore whether pre export market entry investments explain post-entry improvements in productivity through the inclusion of lagged capital terms in regression 4.1. These terms are insignificant while the productivity effect remains.

firm and export entry is a consequence of improved productivity by the firm and has no effect in itself.

In Table 4 we report results from a regression that compares productivity growth in new exporters with a restricted sample of non-exporters, those with similar characteristics in the period before entry. This is again done using propensity score matching.[13] We assume that the post-entry effects last for up to three periods. These are collected as a single term in the regression and labelled 'entry effect'. As can be seen this term is statistically significant. Our results suggest that productivity growth of new export firms is on average 2.9 per cent faster than non-export firms.

Similar entry effects are generated for a range of other measures of performance (these regressions are not reported). It is estimated that employment growth increases by 2.7 per cent per annum, output by 2.8 per cent and labour productivity by 2 per cent relative to non-exporters and all are significant. The results are also robust to the use of alternative measures of TFP growth. Using an estimate of TFP calculated in a similar manner to the original indicator but adding either 3-digit SIC industry fixed effects to the production function or fixed firm characteristics yields similar results.[14] Using such measures the entry effect is calculated as 3 per cent and 1 per cent respectively.

Table 4: Effect of export market entry on firm performance

	4.1 Entry Effects	**4.2** R&D*entry	**4.3** IIT*entry	**4.4** Trade exposure* entry	**4.5** FDI *entry	**4.6**
Entry effect	0.029 (4.32)**	0.043 (4.46)**	0.087 (3.11)**	0.045 (4.80)**	0.054 (4.12)**	0.084 (2.81)**
R&D*entry		-0.026 (2.73)**				-0.012 (0.97)
R&D^2 *entry		0.004				0.002

[13] Removing the industry level variables from the probit regression underlying the matching process has very little effect on the post-entry effects found in Table 4. Their inclusion impacts largely on the number of new export firms for which a suitable match is found, adding additional information in the probit regression tends to restrict this number.
[14] The results in the remainder of Table 4 are also robust to the use of these alternative measures of TFP.

		(2.85)**				(1.26)
R&D$_{t-1}$		0.005 (0.69)				0.010 (1.37)
IIT*entry			-0.067 (1.96)+			-0.040 (1.10)
IIT$_{t-1}$			0.038 (1.28)			0.017 (0.53)
Trade exposure *entry				-0.340 (3.03)**		-0.212 (1.57)
Trade Exposure$_{t-1}$				0.264 (2.40)*		0.169 (1.27)
FDI*entry					-0.052 (2.01)*	-0.016 (0.40)
FDI$_{t-1}$					0.051 (1.50)	0.035 (0.83)
Common time Entry period	0.021 (2.09)*	0.021 (2.09)*	0.021 (2.08)*	0.022 (2.12)*	0.020 (1.98)*	0.022 (2.11)*
Common time 1-year later	-0.000 (0.03)	-0.000 (0.00)	-0.005 (0.56)	-0.004 (0.47)	0.000 (0.02)	-0.003 (0.36)
Common time 2-years later	-0.010 (1.12)	-0.010 (1.06)	-0.006 (0.65)	-0.005 (0.54)	-0.010 (1.08)	-0.004 (0.46)
TFP$_{t-1}$	-0.169 (9.63)**	-0.172 (9.65)**	-0.183 (9.01)**	-0.183 (9.00)**	-0.175 (9.69)**	-0.184 (8.99)**
$log(EMP)_{t-1}$	-0.010 (2.74)**	-0.009 (2.56)*	-0.009 (2.26)*	-0.009 (2.21)*	-0.010 (2.61)**	-0.009 (2.29)**
$log(WAGE)_{t-1}$	-0.069 (2.78)**	-0.074 (2.90)**	-0.081 (2.78)**	-0.081 (2.78)**	-0.074 (2.86)**	-0.081 (2.76)**
Constant	0.187 (2.81)**	0.185 (2.72)**	0.179 (2.20)*	0.196 (2.51)*	0.175 (2.54)*	0.188 (2.21)*
Observations	8234	8012	6744	6744	7847	6692
R-squared	0.14	0.15	0.16	0.16	0.15	0.17

In the remaining regressions we interact the export market entry effect with industry variables. All interactions behave as expected. For example, the effect of export entry on productivity is lower in industries already exposed to high levels of domestic R and D. At the mean level of R and D intensity in the industry the average effect of export market entry remains positive and productivity growth is around 2.8 per cent per year higher. The effect is non-linear (the squared term is also significant) such that the entry effect is at its minimum in industries with an intensity of around 3.25, the entry effect is just 0.1 of a percentage point per annum in these industries. Taking 0.5 per cent per annum as a cut off, 12 per cent of the total number of observations for the entry effect lie below this (R and D intensity is approximately between 2.25 and 4.25).

The trade variables behave in a similar manner. The effect of entry on productivity growth is lower in industries already exposed to high levels of trade and intra-industry trade. Again at the mean level of trade and IIT the average effect is positive, 3.3 per cent for IIT and 2.7 per cent for trade exposure. The entry effect passes through zero when the value of IIT is greater than 1.29 and trade exposure greater than 0.13. This critical value is beyond the sample range for IIT, while there are 220 observations (or 4.5 per cent of new exporters) beyond the critical range for trade exposure. Using (plus/minus) one standard deviation of the trade variables from their mean values to provide some estimate of the range of cross-industry differences in export market entry, we find that this lies between 0.003 per cent and 4.5 per cent for trade intensity and 2.4 per cent and 5.1 per cent for IIT.

It is interesting to note from regression 4.4 that productivity growth is increasing in trade exposure for both new exporters and non-exporters, although we do not claim to have identified the direction of causality in these regressions. Therefore while the additional benefit to productivity from export market entry is lower in industries with high trade exposure, productivity growth amongst *all* firms is higher. For example, at the mean level of trade exposure productivity growth of non-export firms is 1.3 percentage points below that of firms in industries that have a trade intensity one standard deviation greater than this: productivity growth is 1.4 per cent and 2.7 per cent respectively. The negative coefficient on the trade intensity entry effect opens the possibility that in the short-run the rate of productivity growth of new exporters is lower in industries that have high trade exposures, even though the long-run growth rate is higher. This is indeed what we find. Short-run productivity growth following export market entry is 4.1 per cent at the mean level of trade intensity (2.7 percentage points higher than non-export firms) and 3.8 per cent for firms in industries one standard deviation above the mean (1.1 percentage points above non-export firms).

Finally, the entry effect is also significantly lower in industries that already have high existing levels of exposure to foreign firms in the domestic market. At the industry mean level of FDI the entry effect remains positive at 3.1 per cent. The point at which it becomes negative is above the sample range (it is above 100 per cent). Productivity growth of domestic firms is increasing in the level of FDI within the industry but not significantly so. Again using (plus/minus) one standard deviation of this variable from the mean to provide some estimate of the range of cross-industry differences in export market entry, we find that this lies between 1.5 per cent and 4.5 per cent for foreign market exposure.

In regression 4.6 we consider which of these competition and technology variables best captures the cross-industry differences in the entry effect. Unfortunately the high correlation between the five entry interaction terms limits the conclusions that we can draw from this exercise. Whilst all of the variables retain their expected sign in the regression none are significant at standard levels, although jointly they remain so ($F[5,6649]=2.29$, p-value=0.044). To make some progress we instead consider whether after imposing the estimated entry interaction effect for one of the technology and competition variables from regressions 4.2 through to 4.5 is there any remaining variation in the data that can be explained by the inclusion of one of the other interaction variables. We find from this exercise that when we impose the estimated effect from R&D or trade exposure then the answer is no (although when we impose the R&D effect the trade exposure variable is significant at the 10.7 per cent level), whereas when we condition on the estimated effect from IIT and FDI the R&D and trade exposure variables are significant.[15] This suggests that R&D and trade exposure are the principal determinants of the cross-industry difference in the export market entry effect found above.

5. CONCLUSIONS

Bernard and Jensen (1999) argue that it is not that industries that are more exposed to international trade do not have faster rates of productivity growth, but that within an

[15] These regressions are available from the authors on request.

industry established exporters do not grow any faster than non-exporters. New entrants appear to grow faster, but this is reflected in faster growth irrespective of their decision to enter export markets. They grow faster both before and after entry. However Girma, Greenaway and Kneller (2004) and Greenaway and Kneller (2004) find instead that when we compare export and non-export firms with similar pre-entry performance, performance differs post-entry. These effects were relatively short-lived but positively related to the degree of exposure to export markets by the firm.

Using an identical methodology on data for Sweden, Greenaway, Gullstrand and Kneller (2004) find no evidence of post-entry effects, but Baldwin and Gu (2004) report strong effects in Canada. It may be possible to reconcile the apparent inconsistency in the results across countries if the second order effects from export market entry by reference to the scope for learning. For example the entry effect might be smaller if exposure to international trade is already high, or the gap to the technological frontier is small. These effects might be expected to differ also across industries within a country. We have explored this possibility using UK data. What we find is that post-entry productivity growth of new export firms is faster than non-export firms and the magnitude of these effects is influenced by industry characteristics. Specifically, this second order effect is lower in industries already exposed to high levels of trade and high levels of R and D intensity. From this we conclude that the potential for learning does vary across industries, depending upon the extent to which they are already exposed to high levels of international competition and in industries where R and D intensity is already high.

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