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Does Exporting Lead to Better Performance? A Microeconometric Analysis of Matched Firms.

By S. Girma, D. Greenaway and R. Kneller

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The Authors

Sourafel Girma and Richard Kneller are Research Fellows in The Leverhulme Centre for Research on Globalisation and Economic Policy and David Greenaway is Professor of Economics in the School of Economics, University of Nottingham.

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Abstract

Exporting involves sunk costs, so some firms export whilst others do not. This proposition derives from a number of models of firm behaviour and has been exposed to microeconometric analysis. Evidence from the latter suggests that exporting firms are generally more productive than non-exporters; they self-select in that they are more productive before they enter export markets; but entry does not make them any more productive. This paper investigates exporting and firm performance for a large panel of UK manufacturing firms applying, for the first time, matching techniques. We find that exporters are more productive and they do self-select. In contrast to other evidence, however, we also find that exporting further increases firm productivity.

Outline

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Non-Technical Summary

Exports figure prominently in the minds of policymakers. This would appear to reflect the instincts of many policymakers that exports are wealth creating, whereas imports are not. This preoccupation has resulted in extensive export promotion activity of one form or another, ranging from trade promotion activities, through to export subsidies to state trading monopolies. There is probably not a single government anywhere in the world that does not engage in export promotion of one form or another.

The evidence on which this policy intervention is based is however thin. Until recently, little was known about the characteristics of firms that export. Yet, this is central to the design of effective policy. For instance, should support be targeted at encouraging firms to enter exports markets or at firms already in those markets or should firms be encouraged to set up subsidiaries overseas and become multinationals rather than engage in armslength trade?

Economic theory generates three testable propositions regarding the behaviour of export firms. Firstly, firms that start exporting are more productive than those that do not. Entry costs associated with, for example, market research, product modification, compliance and so on mean that profit maximising firms will only enter export markets if their expected profits exceed the fixed costs of entry.

Secondly, firms that stop exporting are less productive than those that continue. Firms which become less productive will tend to leave export markets, though not necessarily in the period that productivity dips, since they will be faced with the prospect of paying again the entry fee should they choose to export again in the future.

Finally, the sunk costs/entry models also offer a framework for gaining insight into a third dimension of firm behaviour, namely learning. There are plausible reasons for thinking that, having entered export markets, firms become more productive. The central idea behind this is that a combination of learning from buyers, competition with other firms and generally gaining greater exposure to best practice results in cost improvements. As a consequence, exporters that were more efficient to start with become even more efficient by virtue of their presence in export markets.

Bernard and Jensen (1997) have pioneered a new literature on applying this economic theory to firm level data. There is now evidence on the relationship for a number (but still a small number) of countries using a range of investigative methods. This paper adds to that literature in two respects. First, it represents the first analysis of exports and productivity completed for a large panel of UK firms. Given that the UK is the fifth largest exporter of merchandise exports globally, it is clearly a non-trivial case to explore. Second, it applies matching analysis to the issue for the first time. This allows a more targeted evaluation of whether exporting causes firms to become even more productive.

We find from our panel of 8992 export and non-export manufacturing firms over the period 1988 to 1999 evidence of sunk-costs to exporting. Around 96 per cent of firms who export in one period do so again in the next period, whereas 94 per cent of firms who did not export continue not to do so in the next period also. We also find that exporters there are indeed generally larger, more productive and pay higher wages than non-export firms. In this sense UK firms appear very similar to non-UK firms studied within the current literature.

Unlike the current literature however, the paper does find evidence for UK firms that there is a boost to productivity in the periods after they start exporting. This evidence comes from using the matching analysis that is unique to this study. The difficulty in determining whether firms benefit from exporting is the lack of the counterfactual, what would have happened to these firms *had they remained non-exporters*. The matching technique overcomes generates the counterfactual by comparing firms that start to export with firms that had similar characteristics to these firms but which did not start to export. The matching technique offers the possibility of results that are more reliable than those generated by simply comparing export and non-export firms in a un-matched sample. Once this technique is applied we find evidence that in the period prior to entry into export markets productivity growth is similar in both types of firms. However, in the periods following entry productivity growth is faster for firms that started to export compared to firms that did not start to export. This leads us to conclude that exporting raises productivity growth.

1. Introduction

Exports figure prominently in the minds of policymakers. This is partly evidence based: at an aggregate level exports and economic growth are positively correlated[1]. But it also reflects the fact that the instincts of many policymakers are fundamentally mercantilist: exports are seen as key to wealth creation, imports are not. This preoccupation has resulted in extensive export promotion activity of one form or another, ranging from trade promotion activities, through to export subsidies to state trading monopolies. There is probably not a government worldwide that does not engage in export promotion of one form or another. That is quite remarkable. What is equally remarkable, however, is the limited extent to which intervention is informed by micro level evidence linking exporting and firm performance.

Until recently, little was known about the characteristics of firms that export. Yet, as Bernard and Jensen (1999) point out, that is central to the design of effective policy. For instance, should support be targeted at encouraging firms to enter export markets or at firms already in those markets? Or should firms be encouraged to set up subsidiaries overseas and become multinationals rather than engage in armslength trade? It is not possible to make informed policy choices, without robust information on the links between exporting and productivity.

Bernard and Jensen (1997) have pioneered a new literature on the microeconometrics of firm characteristics, exporting and productivity and there is now evidence on the relationship for a number (but still a small number) of countries using a range of investigative methods. This paper adds to that literature in two respects. First, it offers the first analysis of exports and productivity completed for a large panel of UK firms. Since the UK is the fifth largest exporter of merchandise exports globally, it is clearly a non-trivial case to investigate. Second, it applies matching analysis, allowing a more targeted evaluation of causality than has been completed thus far, both to exporting and export intensity. Matching is a technique used widely in the labour economics literature. To our knowledge, this is the first study to apply matching to identify differences in characteristics between exporting and non-exporting firms.

[1] See, for example, Edwards (1993), (1998).

Our paper is organised as follows. In Section 2 we set out the reasons why some firms export and some do not, as well as explaining why once firms begin exporting they could become more productive. This Section also briefly reviews the evidence adduced thus far and summarises the key results on the relative productivity of exporters and non-exporters and on causality between exporting and productivity. In Section 3 we outline our modelling strategy and report on sample characteristics. In Section 4 we estimate our model and report results. Like others, we find that exporters are more productive. In Section 5 we sharpen the focus to exporting and firm performance using our matching analysis and find evidence that firms become more productive even after they have commenced exporting. Section 6 concludes.

2. **Exporting, self-selection and learning**

It is widely accepted that the starting point for explaining why some firms export and others do not is sunk costs. Entry costs associated with, for example, market research, product modification, compliance and so on mean that profit maximising firms will only enter export markets if the present value of their profits exceeds the fixed costs of entry. Building on the work of Dixit (1989), Krugman (1989) and Roberts and Tybout (1996), both Clerides, Lach and Tybout (1998) and Bernard and Jensen (2001) have developed simple but elegant dynamic optimising models to analyse entry and exit decisions of exporting firms. The essentials can be gleaned from Figure 1, drawn from Clerides, Lach and Tybout (1998).

Clerides, Lach and Tybout assume a monopolistic competition setting which generates downward sloping demand curves and ensures that strategic interaction is not an issue. They further assume that marginal costs (c) are invariant to both output and market. Trade frictions, in the form of transportation costs and/or man made barriers, consume some of the revenue generated by exporting. Thus the firm's foreign demand and marginal revenue schedules lie everywhere below its domestic equivalents, as shown in Figure 1. Gross profits from exporting are therefore the shaded area. But net profits will be less, because of the fixed start up costs of becoming an exporter, (F). Clearly, entry will only take place when:

$$\pi f(c, z^f) > F \qquad (1)$$

where c is marginal costs and z represents demand shifters.

Clearly, if *F* is positive, as the Figure neatly shows, firms with marginal costs below some threshold will self select into export markets. This then underpins the proposition that firms which export will be more productive than firms that do not. The model also has something to say about exit. Firms that become less productive will tend to leave export markets, though not necessarily in the period in which productivity dips. In other words, in any given period, it may still be optimal to continue to export if (1) is not satisfied to avoid re-entry costs and/or in anticipation of cost reductions. This generates a further testable proposition: firms that exit export markets will be less productive but a fall in productivity may only appear with a lag.

The sunk costs/entry models also offer a framework for gaining insight into a third dimension of firm behaviour, namely learning. There are plausible reasons for thinking that, having entered export markets, firms become more productive. The central idea behind this is that a combination of learning from buyers, competition with other firms and generally gaining greater exposure to best practice results in reductions in c. As a consequence, exporters that were more efficient to start with become even more efficient by virtue of their presence in export markets. This then generates a third testable proposition, that exporting boosts productivity.[2]

These three propositions have been exposed to micro level investigation in a number of recent studies. Table 1 summarises details of eight papers on nine countries: Aw and Hwang (1995) on Taiwan; Bernard and Jensen (1995) (1999) on the US; Clerides, Lach and Tybout (1998) on Colombia, Mexico and Morocco; Bernard and Wagner (1997) on Germany; Kraay (1999) on China; Castellini (2001) on Italy; Delgado, Farinos and Ruano (2002) on Spain. The studies cover a range of time periods and use a variety of methodologies. Aw and Hwang (1995) and Castellini (2001) are cross-section analyses on firm level data, for one year in the former and four years in the latter. Delgado, Farinos and Ruano (2002) is a novel application of non-parametric analysis of productivity distributions for a five-year period, again using firm level data. All of the other studies work on panels at the firm or plant level and apply best practice panel data estimation.

With regard to outputs, every single study finds that exporters have higher productivity than non-exporters. They also typically find that exporting firms are bigger, more capital

[2] Clerides, Lach and Tybout (1998) solve their model numerically and generate transitions consistent with these outcomes.

intensive and pay higher wages. This in itself is quite striking since it is unusual to find such unanimity across the totality of a literature in any area of applied economics (even one as small as this). The literature is also at one on the self-selection hypothesis: exporters are more productive *before* they enter export markets. Some, like Bernard and Jensen (1999), Bernard and Wagner (1997) and Clerides, Lach and Tybout (1998) also investigate the characteristics of quitters and find that firms are less productive after they leave export markets. The learning hypothesis receives somewhat less support, however. Castellini (2001) reports some evidence suggesting that the productivity of exporting firms may increase with increases in export *intensity*. For Chinese firms, Kraay (1999) reports evidence of learning by exporting. But that is it. The evidence in Delgado, Farinos and Ruano (2001) is inconclusive and Bernard and Jensen (1995) (1999), Bernard and Wagner (1997), Clerides, Lach and Tybout (1998) and Aw and Hwang (1995) explicitly test for, but fail to find, any evidence to support the learning by exporting hypothesis.

In sum, the literature thus far consistently finds evidence to support the notion that firms that export are more productive than those that do not and that they become more productive in order to export. The majority of studies fail to find any evidence of further productivity benefits from exporting after entry has occurred.

Table 1 A Summary of the Key Features of Studies of Exports and Productivity

Study	Country	Sample	Methodology	Results
Bernard and Jensen (1999)	US	50-60,000 plants 1984-92	Linear probability with fixed effects	Self selection of exporters Absence of learning from exporting Higher productivity of exporters
Delgado, Farinos and Ruano (2001)	Spain	1,766 firms 1991-96	Non-parametric analysis of productivity distributions	Higher productivity of exporters Self selection of exporting firms Inconclusive evidence on learning
Aw and Hwang (1995)	Taiwan	2,832 firms 1986	Translog production function Cross section	Higher productivity of exporters Self selection Absence of learning from exporting
Castellani (2001)	Italy	2,898 firms 1989-94	Cross section	Higher productivity of exporters Learning associated with export intensity
Kraay (1999)	China	2,105 firms 1988-92	Dynamic panel	Higher productivity of exporters Learning from exporting
Clerides, Lach and Tybout (1998)	Colombia Mexico Morocco	All plants 2,800 firms All firms 1981-91 1986-90 1984-91	FIML of cost functions Panel data	Exporting firms more efficient than non-exporting firms Quitters less productive No learning from exporting in Colombia and Mexico Some learning from exporting in Morocco Spillovers from exporters to non-exporters
Bernard and Wagner (1997)	Germany	7,624 firms 1978-92	Panel data	Higher productivity of exporting firms Self selection of exporters

3. The Premium to Exporting

Until now, no firm level investigation of exporting and firm performance has been conducted on UK data, which is surprising given the fact that it is the fifth largest exporter of merchandise worldwide. We fill that gap with a panel analysis for a large sample of UK firms. In this Section we set out the features of our database and sample characteristics.

Database Construction and Sample Characteristics

Our primary data source was the *OneSource* database[3], which has a number of attractions: it is one of a very small number of datasets to contain recent firm level export data; information on employment, physical capital, output and wages are provided in a consistent way across firms; it has a time series element, allowing investigation of the dynamics of exporting/productivity links.

Our data set contained information on 8,992 companies over the period 1988 to 1999, yielding a total of 54,130 observations[4]. On average, there are six years of data per company. To allow intertemporal comparisons we converted current to constant price values using highly disaggregated price deflators[5]. For each of 101 three-digit sectors, we generate firm level measures of total factor productivity (TFP) as residuals from a Cobb-Douglas production function with time-specific effects. TFP for each firm is therefore expressed relative to the industry average. Of the 8,992 firms in our sample 4,031 have exported in at least one year. As a result of switching in and out of export markets the percentage exporting in any given year is lower than this however.[6] We found that behaviour is highly persistent. Around 96 per cent of firms who export in

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[3] For our analysis we used the OneSource CD-ROM entitled "UK companies, Vol. 1" for October 2000. This data is derived from the accounts that companies are legally required to deposit at Companies House.

[4] To ensure that we flush out any 'exporting' effects, we excluded a range of observations. First, foreign companies are omitted, since they arguably have different export motives (e.g. intra-firm trade) to domestically owned companies. Second, parent companies were omitted, since if they had consolidated accounts this would have led to double-counting. Third, only companies whose main activity is manufacturing were chosen. Fourth, the top and bottom one percentile firms in terms of employment, labour productivity and wages and firms with annual employment or wages growth exceeding 100% were omitted, to mitigate the impact of outliers.

[5] Although the use of firm level prices is the ideal way of constructing real values such data is not available and these five-digit price indices help to ameliorate problems associated with more aggregate (price deflators).

[6] Taking 1995 as a representative year in the middle of the sample period we find that 35 per cent of firms exported and 65 per cent did not.These results are robust to the use of 1993 as an alternative year.

one period do so again in the next period, whereas 94 per cent of firms who did not export continue not to do so in the next period also. The probability of a firm starting or stopping exporting across two years is correspondingly quite low. Only 6 per cent of non-exporters become exporters in the next period, while only 4 per cent of exporters stop exporting.[7] Most other work finds persistence, though it is generally not as marked as this. Like other authors we interpret this as *prima facie* evidence of sunk costs.

Across all years we have a maximum of 54,130 observations for each performance characteristic. Table 2 provides summary statistics according to whether firms have ever exported or never exported.[8]

Table 2:
Exporters versus non-exporters: Mean (and standard Deviation) of some variables

Variables	Exporters	Non-exporters
Employment (persons)	213 (350.4)	172 (345.0)
Sales (£000s)	16134 .8 (37519.9)	12957.4 (39736.2)
Wages (£000s)	15.3 (4.38)	15.1 (4.93)
Value added (£000)	5157.1 (10526.4)	4220 (12613.5)
Labour productivity (£000)	78.9 (55.4)	75.5 (54.68)
Total factor productivity	.037 (.45)	-.038 (.49)
Number of observations	27577	26159

On average export firms are larger than non-export firms, employing 213 and 172 workers respectively.[9] The relationship between size and export behaviour is again evident when size is measured by total sales, the mean level for the export group is 19,957 and 16,134 for the non-export group. [10] It also seems that exporters are on average more productive than non-exporters. The mean level of TFP is 3.7 per cent *above* the industry mean for export firms and 3.8 per cent *below* for non-exporting firms. At the median the average level of TFP is 0.9 per cent above the industry mean

[7] These results are robust across time. There is no obvious trend in the decision not to export.
[8] The summary statistics in Table 2 are similar for the alternative classification of export behaviour by year, although as expected the absolute differences between export and non-export firms are smaller.
[9] At the median average employment in non-export firms is 70, whereas for exporting firms it is 100. The fact that the median lies below the mean suggests the distribution of employment is skewed in both the sample of exporting and non-exporting firms towards smaller firms but the degree of skew is higher in non-exporting firms. This is confirmed by the measure of skewness, which is 5.53 for non-exporters and 4.43 for exporters.
[10] Again there is evidence that the distribution is skewed towards smaller firms. The median level of sales is 4,200 for the export group and 6,356 for export firms.

for the export group and 5.9 per cent below for the non-export group. Export firms also pay higher wages than non-exporters. Pairwise t tests suggest that all of these indicators differ significantly between the two samples. Thus the raw data suggest a strong relationship between exporting and performance.

Estimates of Export Premia

Our general estimating equation takes the following form:

$$y_{it} = \gamma E_i + D_{rjt} + \varepsilon_{it} \qquad (2)$$

where i, t, r and j index firms, time periods, industries and regions respectively, y denotes the *log* of employment, output (sales), wages , labour productivity or TFP; E is an export dummy, *D* represents the full set of four-digit industry, region and time dummies and ε is random error term. Our key findings are summarised in Table 3[11].

Table 3
The premium to exporting

Variables	Exporters v/s Non-exporters	Starters v/s never exporters	Stoppers v/s Always exporters
Employment	.302% (29.95)***	.007 (1.48)	-.02 (2.84)***
Output	.399% (37.99)***	.031 (2.36)**	-.024 *(2.06)***
Labour Productivity	.097 (19.66)***	.016 (2.36)**	-0.013 (1.18)
Total factor Productivity	.083% (19.34)***	-.035 (1.30)	-.041 (.96)
Wage rates	.047% (18.18)***	.008 *(1.86)**	.01 (1.03)
Number of observations	48569	33087	24490

Notes:
(i) In the last two columns the premium shows the average differential in the rate (in percentage points).
(ii) The figures in parenthesis are the heteroscedasticity-robust statistics associated with the point estimates of the relevant exporting premium.
(iii) * Significant at 10% **significant at 5%; *** significant at 1%
(iv) The number of observations slightly varies from one variable to another. Here we give the maximum number of observations that are available for each model specification.

The first column reports the premium to exporting obtained by those firms that ever exported with those that never exported. Exporting is positively and significantly

[11] For brevity and clarity of presentation, we choose not to report the estimates of the fixed regional, industry and time effects. They are, however, available from the authors upon request.

correlated with business performance no matter how measured. After controlling for fixed industry, time and regional effects exporting firms all have higher employment, sales, labour productivity, total factor productivity and average wages compared to those that never exported. For exporting firms, employment and output levels are higher by 30% and 40% respectively. Exporters have an average 10% labour productivity advantage, and this is not significantly eroded as we established that the total factor productivity of a typical exporting firm is 8.3% higher. This indicates that the labour productivity differential is not simply the result of higher capital intensity. Workers in exporting establishments appear to benefit from higher wages (by about 4.1%). Part of this differential might be due to the fact that exporters employ more skilled workers. In a further experiment, we controlled for productivity effects in the wages equation, but still find a wage premium of 2.4%.

It is important to ensure that these average effects are representative. We explore this by asking whether there is a discernible variation in the premium of exporting that is related to export intensity (the share of exports to total sales). We uncovered an inverted U-shaped relationship between employment and sales (as well as wages) and the share of output devoted to exporting. The implication of this is two-fold: first, the level of employment and output increases as exporting intensifies and, second, the rate at which this increase occurs decreases after some critical (threshold) level is reached. As is evident from Figure 2, for both employment and output the rate of growth increases at a decreasing rate after certain levels of export intensity. The employment premium of exporting keeps increasing at an increasing rate until the export share reaches 34%. The corresponding critical point for output is around 48%. In contrast, the results for TFP and labour productivity suggest they *keep increasing* at an increasing rate as firm-level exporting activity becomes more intensive. Thus the relationship between exporting and productivity gets stronger with the degree of exposure to export markets, suggesting that learning by exporting effects might be at work; a possibility we explore more rigorously below.

We also compare the *change* in performance of non-exporting firms with those that switch to exporting during the period as well as the relative performance of those that stop exporting and those that continue. The key findings are summarised in the last two columns of Table 3. Relative to firms that never exported, firms that entered the

export market during our period grow more quickly in terms of sales, labour productivity and wages. On the other hand the productivity of firms that exit does not appear to grow any slower than that of the continuously exporting firms. Their employment and output, however, have experienced a less rapid growth rate (by about 2 percentage points). This too is interesting and subject to further investigation below.

4. The determinants of exporting

Results from the previous literature (eg. Bernard and Jensen, 2001b), suggests that past experience, productivity, ownership status, human capital and productivity levels are all useful indicators of the current export status of a firm. If there are sunk-costs then whether the firm has previously exported should be a useful predictor of whether it exports now. Firms with higher levels of human capital and productivity have also been found to be more likely to export.

Table 4
The determinants of exporting

Regression #	1	2	3	4	5
	Exporting	Exporting	switch to export	Switch to no-export	Switch to no-export
Employment	0.044	0.041	0.015	-0.055	-0.053
	(4.54)***	(4.17))***	(1.39)	(2.58)***	(2.49)**
Wages	-0.007	-0.019	-0.020	0.018	0.068
	(0.15)	(0.43)	(0.39)	(0.21)	(0.77)
TFP	0.095	0.094	0.076	-0.064	-0.055
	(3.60)***	(3.60)***	(2.53)**	(1.27)	(1.07)
Ownership	0.073	0.066	-0.018	-0.132	-0.124
	(2.90)***	(2.66)***	(0.60)	(3.10)***	(2.89)***
Past Exporting	3.435	3.193			-0.539
	(137.85)***	(90.39)***			(5.21)***
Export share		2.512			
		(9.39)***			
Export share Squared		-2.787			
		(8.78)***			
Observations	43916	43916	36048	16187	16187

Notes:
(i) All regressors are lagged by one period.
(ii) Heteroskedastic robust t-statistics in parentheses.
(iii) * Significant at 10% **significant at 5%; *** significant at 1%

Table 4 reports estimates from Probit regressions, where size is measured as the log of employment, human capital as the log of the real wage and productivity by TFP. Ownership is measured using a dummy which equals 0 for independent UK owned firms and 1 for non-independent ones. Previous exporting experience is measured using a dummy for whether the firm exported in the previous period. Since the propensity to export is also likely to vary across regions and industries, we control for these differences by including regional and industry specific fixed effects. Finally, we also control for general business cycle effects via time dummies.

Our results indicate that the probability of exporting is, as expected, increasing in the size and productivity of firms, with the latter being more important. For a one per cent increase in productivity the probability of exporting increases by 9 per cent compared to 4 per cent from a unit change in the log of employment. The probability of exporting decreases with human capital intensity, although the effect is small and far from significance at conventional levels. As wage rates, with which we measure human capital, are likely to be positively correlated with productivity, the poor performance of this variable could be due to correlation with TFP. The type of ownership also appears to be important, subsidiaries are more likely to export by just over 7 per cent compared to independent firms.

Past export experience is a very powerful predictor of current export behaviour. Firms that exported in the previous period are over three times more likely to export than firms that did not. In regression 2 we explore whether the share of exports in total sales affects the probability of exporting. That is, are firms who are more export intensive more experienced and therefore more likely to continue to export than firms who dedicate a lower proportion of their total output to export markets? To answer this we add both the export share and its square interacted with the export dummy. The answer would appear to be 'yes', up to a point. Firms that are more experienced at participating in export markets as measured by the share of exports in total sales are more likely to continue to export, but this effect is decreasing as the share of exports in sales increases, the squared term is negative and significant. Increasing the amount of experience a firm has in export markets matters more when the share of exports to total sales is low than when it is high. As can be seen from Figure 3, the effect of experience on continuing to export is at its maximum when export intensity reaches

45%. In practice, the majority of firms lie well below this. Mean export intensity is 24.4 per cent and median export intensity 15.7 per cent. Less than 25 per cent of observations from export firms lie above 0.45.

We might expect the behaviour of permanent export firms, which dominate the sample in regressions 1 and 2, to be different from firms that either enter or leave. In regression 3 we explore the determinants of export behaviour for firms that switch to exporting and in regression 4 for firms that switch out of exporting[12]. The control group in regression 3 are those firms that continue not to export and in regression 4 those that continue exporting having previously exported in *t-1*. The results for firms that switch to exporting are noticeably different to those in regressions 1 and 2. Of the control variables now only TFP appears to significantly affect the probability of exporting. A unit increase in the log of TFP raises the probability of starting exporting by just over 7.5 per cent. This result confirms the finding in regression 1 that productivity is more important than size for export behaviour. For those firms that stop exporting, productivity appears unimportant relative to firms that continue to export however (regression 4). Higher TFP lowers the probability of exiting export markets as expected, but the coefficient on this variable is not statistically significant. What does appear to be important for firms to stop exporting is their size and status. Larger firms have a lower probability of stopping exporting than smaller firms and domestically owned subsidiaries have a 13 per cent lower probability of exiting.

In regression 5 we attempt to determine the impact of experience on stopping exporting. For firms that switch out we measure experience through the inclusion of the share of exports in total output. If firms are more experienced in export markets the probability of them exiting should be lower. This is exactly what we find. For every 10 per cent increase in the share of exports to total sales the probability of that firm exiting export markets falls by 54 per cent. The results for the other conditioning variables are robust to the inclusion of this new term.

[12] We do not include a measure of experience in these regressions for the obvious reason that firm behaviour has changed between period *t-1* and the current period.

5. Does exporting lead to better performance?

In section 3 we established a positive correlation between exporting and a host of business performance indicators. In this section we take the analysis a stage further with the question 'Does exporting *cause* firms to be more productive?'.

The microeconometric evaluation problem

Our aim is to evaluate the causal effect of exporting on Δy, where Δy represents the growth rate of employment, output, labour productivity or total factor productivity. Δy is sometimes referred to as the 'outcome' in the evaluation literature[13]. Let $EXP_{it} \in \{0,1\}$ be an indicator (dummy variable) of whether firm i entered the export markets for the first time at time period t, and Δy^1_{it+s} the outcome at time t+s, $s \geq 0$ following entry. Also denote by Δy^0_{it+s} the outcome of firm i *had it not* started exporting. The causal effect of exporting for firm i at time period t + s is defined as:

$$\Delta y^1_{it+s} - \Delta y^0_{it+s} \quad . \tag{3}$$

The fundamental problem of causal inference is that the quantity Δy^0_{it+s} is unobservable. Thus the analysis can be viewed as confronting a missing-data problem. In common to most of the microeconometric evaluation literature (cf. Heckman et al, 1997), we define the *average* effect of exporting on export market entrants as

$$E\{\Delta y^1_{t+s} - \Delta y^0_{t+s} \mid EXP_{it} = 1\} = E\{\Delta y^1_{t+s} \mid EXP_{it} = 1\} - E\{\Delta y^0_{t+s} \mid EXP_{it} = 1\} \tag{4}$$

Our casual inference relies on the construction of the counterfactual for the last term in equation (4), which is the outcome entrants would have experienced, on average, had they not participated in export markets. The counterfactual is estimated by the corresponding average value of firms that remain non-exporters: $E\{\Delta y^0_{it+s} \mid EXP = 0\}$.

An important feature in the construction of the counterfactual is the selection of a valid control group. We assume that all 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

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

basic idea of matching is to select from the reservoir of non-exporters those firms in which the distribution of the variables affecting the outcome variable is as similar as possible to the distribution of the exporting firm. To do so, 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 following probit model

$$P(EXP_{it}=1)=F(TFP_{it-1}, size_{it-1}, ownweship_{it-1}, wages_{it-1}) \quad (5)$$

Here *F is* the normal cumulative distribution function, and the full set of regional sectoral, and time dummies is also included[14]. 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 then selected as a match for the former, using the 'nearest-neighbour' matching method[15]. More formally, at each point in time and for each new exporter i, a non-exporting firm j is selected such that[16]

$$\left|P_{it}-P_{jt}\right|=\min_{k\in\{EXP_{kt}=0\}}\left\{P_{it}-P_{jt}\right\} \quad (6)$$

This type of matching procedure is preferable to randomly or indiscriminately choosing the comparison group because it is less likely to suffer from selection bias by picking firms with markedly different characteristics. In the final analysis we selected 781 non-exporting firms as a match for the 1387 new export markets entrants we have identified in our sample. To our knowledge this is the first study to have used a matching method to analyse the causal relationship between exporting and performance.

Having selected the comparison group, we adopt the difference-in-differences methodology[17] to isolate the role of exporting in the performance dynamics of firms.
As Blundell and Costa Dias (2000, p.438) argue, a combination of matching and difference-in-differences is likely to improve the quality of non-experimental evaluation studies. The difference-in-differences approach is a two step procedure. Firstly, the difference between the average growth rates before and after entry in the

[14] It goes without saying that the success of the matching method depends on correctly identifying the variables that determine export participation.
[15] The matching is performed in Stata Version 7 as described in Sianesi (2001).
[16] A non-exporting firm can be match to more than one exporting firms

export market is calculated for the exporting firms, conditional on past performance, size, age, industry, regional and time characteristics. However this difference cannot exclusively be attributed to exporting since the post-entry period growth rate might be affected by factors that are contemporaneous with entry. To cater for this the difference obtained at the first stage is further differenced with respect to the before and after difference for the control group of non-exporters. The difference-in-differences estimator therefore removes effects of common shocks, and provides a more accurate description of the impact of exporting.

The importance of appropriate matching cannot be over-emphasised. In the labour economics literature that evaluates the impact of a job training programme on earnings, it is frequently observed that enrolment into a program is more likely if a temporary loss in earnings occurs just before the start of the program, the so-called 'Ashenfelter's dip'. Since faster earnings growth is expected to follow such a dip (irrespective of whether the individual in question participates in the programme or not), difference-in-differences based on randomly matched individuals is likely to overestimate the earnings impact of training. The converse of this phenomenon might be present here, if exporting firms experience a surge of productivity just before entry[18], in which case they might be expected to grow less slowly in subsequent periods.

Econometric results

Our difference-in-differences equation based on the sample of matched firms can be written as:

$$\Delta y_{it} = \alpha y_{it-1} + \beta X_{it-1} + \sum_{s=-1}^{2} \gamma_s EXP_{it-s} + D_{jrt} + \varepsilon_{it} \qquad (7)$$

Where i, t, r and j index firms, time periods, industries and regions respectively, and D represents the full set of four-digit industry, region and time dummies. As before Δy denotes the change in employment, output (sales), wages, labour productivity or TFP, X is the vector of firm-specific control variables, and EXP_{it} is a dummy which is set to 1 if firm i switches to exporting at time t. Thus we study the contemporaneous and

[17] See Mayer (1994) for a review of this approach.
[18] Recall that we have already established that good performance predates exports market entry.

lagged (up to two years after entry) effects of exporting to consider whether changes to the growth of the various business performance indicators, if any, take time to occur. We also use an indicator which pre-dates exporting (E_{it+1}) with a view to further controlling for any performance-exporting relationship in the pre-exporting period that is not captured by the matching procedure.

Table 5
Does entry into the exports market improve performance?

	Employment growth	Output growth	Labour productivity growth	TFP growth
Wage growth	-0.167			
	(10.65)**			
Capital growth	0.107			
	(7.13)**			
Initial value	-0.021	-0.026	-0.085	-0.103
	(14.25)**	(12.47)**	(9.53)**	(19.64)**
Age	-0.001	-0.001	-0.012	-0.001
	(5.58)**	(4.40)**	(1.67)	(2.38)*
Pre-entry period	0.008	0.019	0.003	0.002
	(1.31)	(1.95)	(0.43)	(0.23)
Entry year	0.028	0.036	-0.122	0.016
	(3.46)**	(2.92)**	(0.12)	(1.64)
One year later	0.013	0.020	1.518	0.011
	(2.26)*	(2.43)*	(2.23)*	(1.60)
Two years Later	-0.002	-0.003	0.404	0.001
	(0.41)	(0.36)	(0.57)	(0.09)

Note:
(i) Initial values are the lagged values of the relevant variables, e.g.. in the TFP growth equation lagged value is the level of TFP in the previous period.
(ii) The point estimates give change in the growth rate of the relevant variable that is caused by exporting.
(iii) * Significant at 10% **significant at 5%; *** significant at 1%
(iv) The full set of four-digit industry, region and time dummies is included.
(v) Initial value refers to the lagged value of the relevant variable in level.

Our key findings are summarised in Table 5. In general we have found that older and bigger firms grow slower. A high initial performance *level* is also found to be associated with relatively modest growth rates, suggesting a β-convergence among the firms. Like Bernard and Jensen (1997) we found some evidence to suggest that the decision to begin exporting raises the growth of employment and output. The growth rate of output (employment) is raised by 3.6 (2.8) and 2 (1.3) percentage points in the first and second periods of exporting. It fact growth of output outstrips that of employment, suggesting post-entry productivity improvement. Evidence also exists

that the faster rate of growth of employment and output predate the decision to export. Where our results differ from those of Bernard and Jensen (1997) in an important way is in the uncovering of a causal relationship from exporting to TFP growth. On entry year, exporting firms experience a TFP growth rate which is higher by about 1.6 percentage points than would be the case had they remained non-exporters. Moreover TFP continues to grow by an extra percentage point in the following year. By contrast, TFP growth prior to entry is found to be no faster than that of the non-exporting one. This suggests that our matching strategy has succeeded in selecting control firms in a manner that adjusts for potentially confounding effects of the pre-exporting period productivity characteristics. (The results for labour productivity follow the same patterns as TFP).

As we saw in Section 4, export intensity plays an important role in the performance dynamics of firms. We further explore whether the effect depends upon the growth rate of export intensity. To do so we augment our baseline specification as:

$$\Delta y_{it} = \alpha y_{it-1} + \beta X_{it-1} + \gamma_{-1} EXP_{t+1} + \gamma_{o} EXP_{it} + \sum_{s=1}^{2} \gamma_{s} \Delta \text{exp int}^{*} EX_{it-s} + D_{jrt} + \varepsilon_{it} \qquad (8)$$

That is we interact the two lagged export entry dummies by the (contemporaneous) export intensity growth rate. The findings are reported in Table 6 and they provide some interesting insights. In the period following entry, the rate of growth of output increases with the share of exports in total output. A 10 percentage points increase in export intensity causes output growth to accelerate by about 2.5 percentage points. However, the export-intensity parameters are insignificant in the employment equation, implying that any output growth must have resulted from a more efficient utilisation of factors of production (including labour). This point is reinforced by inspection of the productivity results. An increase in the share of exports raises the rate at which TFP grows in the period after entry. The estimate, which is statistically significant, suggests that a firm increasing its share of exporting by 10 percentage points enjoys an additional 2.1 percentage points TFP growth, whereas those firms that did not increase export intensity do not benefit from this additional productivity boost[19]. In the sample, only 25% of the newly exporting firms have significantly

[19] In other words the entry effect on TFP for those firms is confined to the 1.6 percentage point growth at entry year.

increased their export intensity, so that the benefit of exporting at the post-entry period is not universal.

Table 6
Export markets entry, export intensity and performance

	Employment growth	Output growth	Labour productivity growth	TFP growth
Pre-entry period	0.008	0.019	.007	.002
	(1.31)	(1.97)**	(0.83)	(0.24)
Entry year	.028	.036	.009	.016
	(3.46)***	(2.92)***	(0.87)	(1.64)*
One year later	.012	.017	.007	.009
	(2.13)**	(2.15)**	(1.09)	(1.31)
Interaction term	.074	0.246	0.175	0.207
	(1.05)	(2.03)**	(1.67)	(2.03)**
Two years *later*	-.002	-.004	.003	0.0
	(0.35)	(0.47)	(0.48)	(0.05)
Interaction *Term*	-0.035	0.078	0.103	0.035
	(0.48)	(0.60)	(0.89)	(0.33)

Notes:
(i) * Significant at 10% **significant at 5%; *** significant at 1%
(ii) The interaction term is the product of the relevant post-entry dummy with the corresponding export intensity growth rate.

To summarise, our difference-in-differences estimates point to the conclusion that exporting has helped improve performance; most of the effects of exporting are confined to the first two years following entry, and the rate of growth of export intensity plays an economically important role. The accuracy of the difference-in-differences methodology is dependent on the assumption that exporting and non-exporting firms are similarly affected by macro factors that are contemporaneous with entry. During most of our study period (1988-99), British manufacturing firms have had to operate under exchange rate uncertainty. It is possible that exporting firms respond to exchange rate uncertainties in a different way from non-exporting firms. If so, and if this had a deleterious impact on their performance, our estimation method will *underestimate* the true degree of the performance-enhancing effect of exporting. This conjecture appears to be have found some justification from difference-in-

differences estimates based on all firms (i.e. unmatched sample) which are reported in Table 7. Compared to the results in Table 4, it seems that there is a more pronounced and significant productivity boost a year after entry. These findings are only suggestive, however, as the two sets of results are not strictly comparable. Results based on the matched sample are the only ones that can allow us to make a causal inference from exporting to performance dynamics.

Table 7
Export market entry and performance:
Difference-in-difference estimates from the unmatched sample

	Employment growth	Output growth	Labour productivity growth	TFP growth
Pre Entry year	0.0110	0.0275	0.0129	0.0112
	(2.00)*	(3.34)**	(1.85)	(1.59)
Entry year	0.0258	0.0338	0.0096	0.0170
	(3.89)**	(3.24)**	(1.09)	(2.02)*
One year later	0.0112	0.0231	0.0131	0.0158
	(2.37)*	(3.21)**	(2.17)*	(2.69)**
Two years later	-0.0003	0.0002	0.0052	0.0030
	(0.06)	(0.02)	(0.84)	(0.47)

Note:
(i) The baseline specification described in Equation 2) is used.
(ii) Robust t-statistics in parentheses
(iii) * significant at 5%; ** significant at 1%
(iv) Estimated coefficients or the control variables in equation (8) are available from the authors on request.

Export markets exit and performance dynamics

Having established that export markets entry leads to better performance, we also investigate whether exit from export markets causes firms to lose their productivity advantage. Again we used a matched difference-in-differences methodology where the *population* of firms that stopped exporting is matched with continuously exporting firms. For the propensity score matching techniques, the probabilities of exit are calculated based on the probit estimates reported in the last column of Table 3. The econometric results, which are reported in Table 8, suggest that the decision to stop exporting does not cause firms to grow at a slower rate. The contemporaneous effects of exit are in general not significant. More surprisingly though, it seems that exit from export markets may even be followed by some growth of labour productivity and TFP. A possible explanation for this is the insight provided by Clerides, Lach and

Tybout (1998) – if firms have incurred sunk costs to enter export markets in the first place, they will attempt to improve profitability prior to exit to avoid re-entry costs.

Table 8
Does exit out of the exports market affect performance?

	Employment growth	Output growth	Labour productivity growth	TFP growth
Pre-entry Period	.036	.049	.038	.036
	(2.45)**	(2.48)**	(2.38)**	(2.35)**
Entry year	0	-.016	-0.007	-.006
	(0.06)	(1.09)	(0.60)	(0.55)
One year later	-004	.026	.027	.03
	(0.37)	(1.60)	(2.08)**	(2.29)**
Two years later	.011	.008	-.001	.005
	(1.09)	(0.50)	(0.04)	(0.38)

Notes:
(i) Analysis based on firms that exported throughout the sample period and those that made a switch to non-exporting.
(ii) The estimates give the change in the growth rate of the relevant variable that is *caused* by stopping to export.
(iii) * Significant at 10% **significant at 5%; *** significant at 1%
(iv) Specifications include firm age as well as industry and regional dummies.

6. Conclusions

Promoting exports is a high priority for most Governments, on the assumption that it is good for productivity and growth. Until recently, however, there was little robust evidence linking exporting and performance at the firm level. Following the seminal work of Bernard and Jensen, a number of microeconometric studies have now been completed on a range of developed and developing countries.

In this paper we apply a novel methodology to investigate exporting and firm performance for a large panel of UK firms. In applying matching analysis we ensure that the characteristics of exporters and non-exporters are as close as they can be, allowing us to drive out effects that can be reliably attributed to exporting. We find that exporters are typically larger and more productive than non-exporters and like all other analysts we find that they self-select, in that they were more productive before they entered. Some of our other key findings are in contrast to others, however. First, we find some evidence to support the notion that although less productive firms will

ultimately exit export markets, they will not necessarily be less productive when they actually do so. Second, exporting may boost productivity. The latter is particularly interesting given results from other work. This may be a consequence of the methodology we have used or may be due to underlying structural differences. For example, since the US is a larger and more competitive market, with more firms closer to the technological frontier, potential learning benefits from exporting are likely to be less than for UK firms. This is an issue worthy of further investigation.

Figure 1:

Gross Operating Profits from Exporting

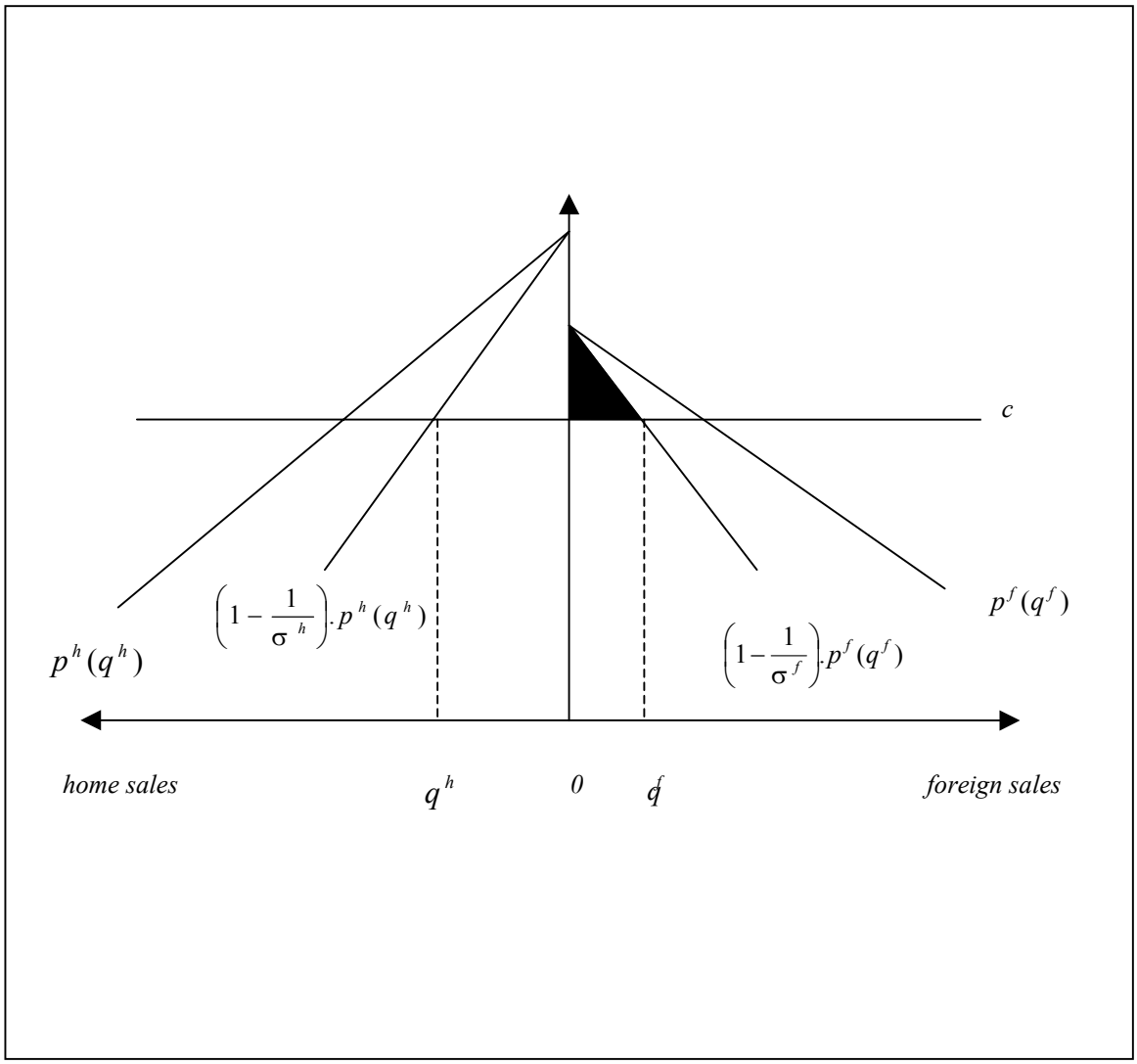
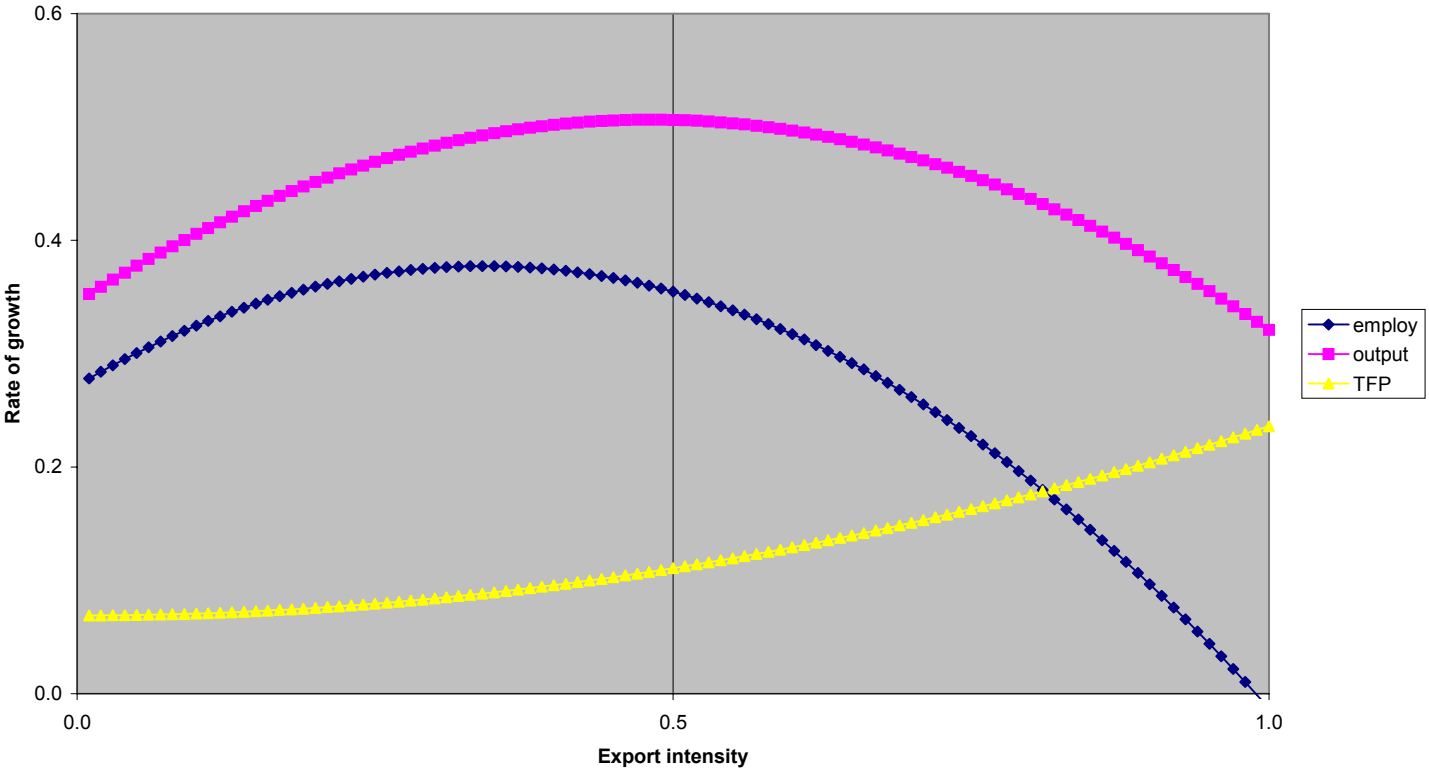


Figure 2: Export intensity and performance growth

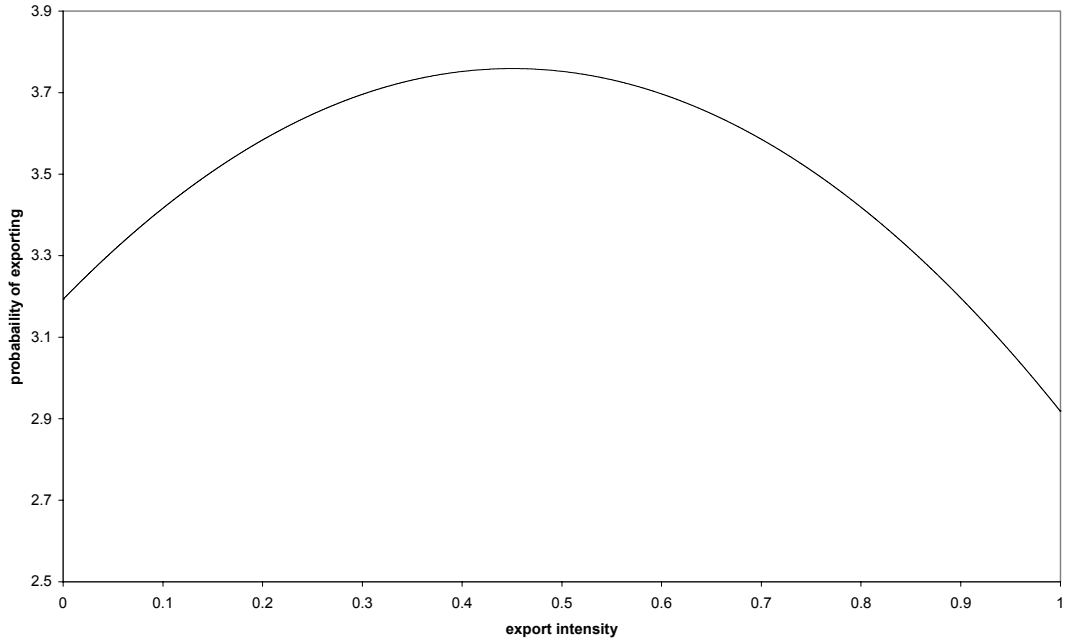


Notes:

(i) The employment growth (say y) function underlying Figure 1 is $y = 0.272 + 0.616x - 0.901x^2$, where x denotes export intensity.

(ii) The corresponding functions for output and TFP are is $y = 0.346 + 0.666x - 0.691x^2$ and given by $y = 0.069 + 0.167x^2$

Figure 3:
Export Experience and the Probability of Exporting



Note: For each level of export intensity the probability of exporting is calculated using the coefficients reported in the second column of Table 3.

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