Exporting and Productivity in Business Services: Evidence from the United States

James H Love and Mica Ariana Mansury
Economics and Strategy Group
Aston Business School
Aston University
Birmingham B4 7ET
UK

Email: j.h.love@aston.ac.uk
Tel: 0121 204 3162

Abstract
Does exporting make firms more productive, or do more productive firms choose to become exporters? Given the amount of resources devoted by governments to supporting exporters, this is an important question. This paper considers the link between exporting and productivity for a sample of firms in US business services. We find that larger, more productive firms are more likely to become exporters, but that these factors do not necessarily influence the extent of exporting. This conforms with previous literature that there is a self-selection effect into exporting. We then test for the effect of exporting on productivity levels after allowing for this selection effect. We model both the relationship between exporting and productivity, and a simultaneous relationship between export intensity and productivity after allowing for selection bias. In both cases we find a clear association, indicating that productivity is positively linked both to exporting and to increased exposure to international markets.

Key words: Exporting, Productivity, Services, Self-selection, United States

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1. Introduction

Does exporting make firms more productive, or do more productive firms choose to become exporters? Given the amount of resources devoted by governments to supporting exporters, this is an important question. There are reasons to expect exporting to boost productivity, both through the exposure to foreign competition which exporting brings, and through 'learning by exporting'. However, the broad thrust of previous research is that more productive firms self-select into export markets, with relatively little evidence that exporting leads to higher productivity thereafter.

In recent years there has been renewed interest in the link between international trade and economic growth. At the macroeconomic level, this is based on the theoretical link between openness and growth, but increasingly attention is switching to the microeconomic relationship between exporting and productivity. This is partly driven by a policy agenda which is questioning the rationale and economic effects of the trade promotion activities frequently undertaken by national governments[1], and has led to a body of research considering the link between trade and productivity at the establishment level.

The broad thrust of the research is that more productive firms self-select into export markets, but there is mixed evidence on whether exporting leads to higher productivity thereafter (see review in Wagner, 2007). Despite the wealth of research on the issue, almost all the empirical evidence derives from manufacturing: very little is known about exporting and its links to productivity in the service sector. In part this is because of a lack of research generally on services, with a tendency in the past to consider services as residual, dependent on manufacturing, technologically backward, and frequently providers of non-tradable services. This perspective on services is now changing; for example, there is now general acceptance that services are frequently innovative, with more attention paid to how service innovation differs from that in manufacturing[2]. Nevertheless, service sector exporting remains relatively little researched.

[1] For example, in the UK there has been a major review of government support for both trade and inward investment activities (DTI, 2006)

[2] For example, Kanerva et al (2006) argue that the nature of innovation in the service sector relies less on the stock of accumulated capabilities which e.g. R&D and patenting activity provides in manufacturing, providing more leeway in services to use external innovation linkages as a method of rapidly moving towards best practice. See Love and Mansury (2007) for a review of this literature.

The lack of research specifically on service exporting and productivity may be important in determining whether findings from manufacturing apply with equal force in services. For example, the finding that large, productive manufacturing enterprises are much more likely to be exporters is often taken as evidence that these firms are better able to overcome the sunk costs of exporting. If these sunk costs are primarily informational in nature, one might expect them to apply with equal force to both manufacturing and services[3]. However, in detecting a positive effect of exporting on productivity, Baldwin and Gu (2004) and Van Biesebroeck (2005) both identify increased product specialisation and the exploitation of scale economies as key reasons for this effect. If the sunk costs of exporting are partly the costs of ramping up capacity in advance of entering a foreign market, then to the extent that scale economies are a less important feature of services than of manufacturing, the self-selection mechanism may be weaker in services, and the link from exporting to productivity less marked. This argument can be extended to the issues of trade costs[4], more generally. As trade costs overall fall, mainly through tariff reduction and trade liberalization in manufactures (Curtis and Chen, 2003), other elements such as transportation and information costs are becoming relatively more important. Since services generally face little in the way of transportation costs, there may be fewer barriers to smaller and less efficient firms entering export markets in services.

The present paper adds to the literature by considering the link between exporting and productivity for a sample of firms in US business services. We begin by considering whether exporters are different in terms of key economic characteristics from non-exporters. Having established that this is the case, we then turn to the factors which cause firms to become exporters. We find that larger, more productive firms that innovate are more likely to become exporters, but that these factors do not necessarily influence the extent of exporting. This appears to conform with previous literature that

[3] Although, of course, there may be sectoral differences in these informational costs through the activities of trade associations etc.

[4] "Trade costs, broadly defined, include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail)." (Anderson and van Wincoop, 2004, pp 691-2).

there is a self-selection effect into exporting. While we want to allow for this selection effect, we also wish to allow for the possibility that exporting can have an impact on productivity level through, for example, learning effects. We therefore model both the relationship between exporting and productivity, and a simultaneous relationship between export *intensity* and productivity after allowing for selection bias. In both cases we find a positive association, indicating that both exporting and its extent are linked to productivity.

2. Theory and Literature on Exporting and Productivity

There are sound theoretical reasons to expect exporters to be more productive than non-exporters. This may arise because productive firms are more likely to become exporters, and/or because exporting makes firms more productive. These two scenarios are not mutually exclusive, but from both a public policy and a firm strategy perspective it is important to know whether one or both of these operates. *From both the economics and the resource based view of the firm*

Recent theoretical work on exporting in the economics literature starts from the understanding that there are fixed cost involved in entering export markets, and therefore only the more productive firms are able to do so (Clerides et al, 1998; Helpman et al 2004)[5]. Firms contemplating entry to foreign markets have to engage in market research, set up new distribution networks, negotiate with potential new partners, and may have to modify their product range, all of which incur costs. Only those with sufficiently low marginal costs have the profits large enough to cover these fixed costs of entry. Thus exporters are more productive than non-exporters not specifically because of benefits derived from exporting, but because they are more productive firms to begin with, and can therefore overcome the fixed costs of entering foreign markets. *This is also consistent with the export development literature coming from the RBV (explain). Note that this fixed cost argument also suggests that the*

[5] The theoretical model of Helpman et al (2004) is developed in the context of the choice between exporting and FDI. In their model the most productive firms find it profitable to produce offshore by FDI, medium productivity firm serve foreign markets by exporting, and the least productive firms serve only the domestic market.

productivity effect is not likely to persist among exporters i.e. productive firms are not necessarily likely to export ***more*** *than less productive firms once they are over the fixed cost hurdle of becoming exporters.*

In this case, one would expect that to see strong evidence of self selection into export markets, and this is indeed borne out by the empirical evidence. In a recent contribution, Wagner (2007) reviews fifty-four micro-based empirical studies on exporting published between 1995 and 2006, and finds overwhelming support for the existence of this self-selection mechanism: highly productive firms are systematically more likely to become exporters than their less productive counterparts.

The theoretical and empirical literature reviewed above leads to the first hypotheses:

H1: Productive firms self-select into exporting, but productivity has no effect on the extent of exporting.

The second possibility is that firms' productivity improves *as a result* of their exporting activity. Again, there are theoretical reasons to expect this. By definition exporters are exposed to foreign competition which is more intense than that experienced by firms restricted to domestic markets, forcing exporters to become more efficient in order to compete internationally. In addition there is the possibility of 'learning by exporting', principally involving being exposed to superior foreign knowledge and technology which also helps to boost the productivity of exporting firms (Clerides et al 1998). The nature of this effect may be two-fold: a one-off productivity effect arising from exposure to export markets *per se*; and an effect arising from the extent of exporting, with productivity rising as exposure to export markets rises.

The empirical evidence on productivity benefits from exporting is somewhat mixed. In a series of papers using US data Bernard and Jensen (1995, 1999, 2004) consistently fail to find any support for the hypothesis that exporting improves productivity. For example, in the last of these studies, Bernard and Jensen (2004) find no evidence that the productivity growth of individual plants is raised by exporting,

but rather that plants raise their productivity just before entering export markets and have relatively flat productivity levels thereafter. Castellani (2002), Greenaway et al (2005) and Arnold and Hussinger (2005) produce broadly similar results for Italian, Swedish and German manufacturing firms respectively[6]. However, others do find some positive relationship running from exporting to productivity. Using a large sample of UK manufacturing firms, Greenaway and Kneller (2004) initially find evidence of post-exporting productivity improvements, but this effect disappears when exporters are compared not with non-exporters generally, but with a matched sample of non-exporters which display similar characteristics to the exporters. Using data on Canadian manufacturing plants, Baldwin and Gu (2004) also find some evidence of productivity growth following export-market entry, and are able to identify empirically three mechanisms by which this occurs: learning by exporting (mainly through use and knowledge of foreign technologies); exposure to more intense competition; and increased product specialisation leading to exploitation of scale economies. Van Biesebroeck (2005) also finds support for the importance of scale economies in a study of exporting among manufacturing firms in nine African countries. After allowing for the selection effect, he finds that firms increase their productivity advantage after becoming exporters, largely through the ability to exploit scale economies which access to foreign markets provides. And in a study of the Taiwanese electronics industry, Aw et al (2007) find that exporting significantly boosts productivity, especially if accompanied by investment in R&D and/or labour training.

Notwithstanding the mixed empirical evidence, the theoretical work leads to two hypotheses on the impact of export performance on productivity:

H2: Exporting leads to higher productivity even after allowing for the self-selection effect.

H3: Export intensity leads to higher productivity even after allowing for the self-selection effect

[6] Greenaway et al (2005) are also unusual in finding no evidence of performance differences between exporters and non-exporters.

Now consider how the service issue looks in relation to these hypotheses. How are services different and what do we know about them? Do the hypotheses still stack up?

Services

How services differ

How this might influence the exporting prod link

What the empirical evidence says

How we can improve things

Although the theoretical predictions on the exporting-productivity link appear clear, one notable feature of the empirical work above is that it is characterised by an almost total concentration on manufacturing industry. This is also true of the bulk of the literature in the export performance literature (Madsen 1989; Styles and Ambler 1994, 2000; Cavusgil and Zou 1994) (**these in la et al 2005)** The question then is whether there are specific features of services, and exporting in services, that may cause us to alter the hypotheses on the nature of the link (don't like this). Services are often regarded as being different from manufacturing in four key respects: inseparability, heterogeneity, intangibility and perishability (Bodewyn et al 1986).

There appears to be only one paper directly examining the determinants of exports in services[7]. Gourlay et al (2005) study the determinants of export behaviour for a panel of over 1000 UK service firms for the period 1988 to 2001. They find that firm size and R&D intensity (R&D expenditure as a percentage of sales) both have a strong positive effect on both the probability and intensity of exporting. However, there is no consideration of the possible selection effect (productivity is not used as a determinant of exporting), and no attempt to consider the possible effect of exporting on productivity. There are several reasons for this lack of empirical evidence on the link

[7] There is a literature on service sector exporting in the marketing literature, but this is concerned mainly with explaining firms' foreign market entry mode (e.g. exporting versus licensing versus FDI). See Gourlay et al (2005) for a summary.

between exporting and productivity in services; for example, Greenaway and Kneller (2004) point that export data on services is not generally available at least from official sources, and until recently there was relatively little interest in or research on productivity in services, although this is now changing (Griffith et al, 2004; Broadberry and Ghosal, 2005; Crespi et al, 2006). This suggests that there is scope for empirical work from unofficial surveys, and details of one such survey are given below.

The lack of research specifically on service exporting and productivity may be important in determining whether findings from manufacturing apply with equal force in services. For example, the finding that large, productive manufacturing enterprises are much more likely to be exporters is often taken as evidence that these firms are better able to overcome the sunk costs of exporting. If these sunk costs are primarily informational in nature, one might expect them to apply with equal force to both manufacturing and services[8]. However, in detecting a positive effect of exporting on productivity, Baldwin and Gu (2004) and Van Biesebroeck (2005) both identify increased product specialisation and the exploitation of scale economies as key reasons for this effect. If the sunk costs of exporting are partly the costs of ramping up capacity in advance of entering a foreign market, then to the extent that scale economies are a less important feature of services than of manufacturing, the self-selection mechanism may be weaker in services, and the link from exporting to productivity less marked. This argument can be extended to the issues of trade costs[9], more generally. As trade costs overall fall, mainly through tariff reduction and trade liberalization in manufactures (Curtis and Chen, 2003), other elements such as transportation and information costs are becoming relatively more important. Since services generally face little in the way of transportation costs, there may be fewer barriers to smaller and less efficient firms entering export markets in services.

So we ant to know whether hypos 1-3 above apply with equal force to services

[8] Although, of course, there may be sectoral differences in these informational costs through the activities of trade associations etc.

[9] "Trade costs, broadly defined, include all costs incurred in getting a good to a final user other than the marginal cost of producing the good itself: transportation costs (both freight costs and time costs), policy barriers (tariffs and nontariff barriers), information costs, contract enforcement costs, costs associated with the use of different currencies, legal and regulatory costs, and local distribution costs (wholesale and retail)." (Anderson and van Wincoop, 2004, pp 691-2).

Then there is the issue of the type of services involved. See the paper on typology of services and the different types of effects this may have with relation to exporting. ***How does this affect the framing of hypotheses?*** *This is really only speculation Overall unclear how services will differ from manufacturing firms, so keep the hypotheses as they are*

3. Data and Descriptives

Business services (SIC 73) are defined by the US government as establishments primarily engaged in providing services, for business establishments on a contract or fee basis. Data were collected via a postal questionnaire which was mailed in 2004 to all US businesses listed under SIC 73 on the Dunn & Bradstreet business database. Of the 3140 questionnaires mailed, 206 usable responses were obtained, representing a response rate of 6.5 %. In common with the population of SIC 73, the largest grouping of respondents comes from computer services (32%), business services not elsewhere classified (20.4%) and advertising (5.3%). No other sub-2-digit grouping represented more than 5% of respondents, and despite the relatively low response rate the sub-sectoral distribution of respondents is statistically representative of the Dunn & Bradstreet SIC 73 database (Table 1). The questionnaire collected information on the firms' performance and innovative activity over the past three years, and the extent of their involvement in export markets. Data were also collected on a variety of firm-specific attributes which could be related to exporting and productivity, including size, age and workforce qualifications.

Table 2 shows descriptive statistics for the economic performance and internal resource indicators of the sample, split between exporters and non-exporters. Although exporters have higher average productivity (value added per employee) and sales growth than non-exporters, the differences between them are not significant. There is therefore no obvious initial support for the hypothesis that exporters self-select into exporting because they are more productive. However, exporters are larger, older and are more likely to be part of a group than non-exporters. To the extent that these characteristics are linked to successful performance, this does suggest that

exporters are different in at least some important ways from non-exporters, which might be part of a self-selection mechanism.

4. Model and Estimation

In this section we first examine in more detail whether there is evidence that more productive firms self-select into export markets. Then we turn to the link between exporting and productivity, considering first a treatment model of this relationship, and secondly a simultaneous model of the relationship between export intensity and productivity after allowing for selectivity.

The self-selection hypothesis

We start with a model of the determinants of exporting and of export intensity. This also allows us to consider whether the determinants of exporting are the same as those of export intensity: for example, does productivity have a different effect on the likelihood of becoming an exporter from that on the extent of the firm's export activity? In common with most micro-based models of exporting (Wakelin, 1998; Roper and Love, 2002; Gourlay et al, 2005; Roper et al 2006), we estimate a model using several indicators of the firm's internal resources (R_i), plus its performance in terms of productivity and growth (P_i):

$$EX_i = \beta_0 + \beta_1 R_i + \beta_2 P_i + \varepsilon_i \qquad (1)$$

where EX_i is a measure of exporting. The internal resource variables (R_i) relate to (employment) size, capital intensity, the qualifications of the workforce, and the age of the enterprise. Variables are also included indicating whether the firm is independent, the nature of its service provision, and whether the firm is an innovator.

When the dependent variable EX_i is expressed in terms of exports as a proportion of total sales, models of this type are typically estimated either by Tobit (e.g. Roper and Love 2002, Wagner,1995) or by the quasi-likelihood estimation method for fractional dependent variables suggested by Papke and Wooldridge (1996) (Wagner, 2001;

Roper et al, 2006) [10]. However, this modeling approach makes the implicit assumption that the signs on β_1 and β_2 are the same both for the probability of being an exporter and for the extent of exporting (Cragg, 1971). Since we are particularly interested in how size and productivity affects these two outcomes separately, we test the implicit assumption of sign equality on β_1 and β_2 against the unrestricted form which does not make this restriction. This is done by estimating equation (1) by probit followed by a truncated regression on exporters, and conducting a likelihood ratio test against the restricted (Tobit) model. The resulting test statistic[11] shows that the restriction is invalid, and Table 3 therefore reports the results from the probit and truncated regression models.

The probit results are shown in the first column of Table 3. As might be expected, large firms are more likely to be exporters, albeit at a decreasing rate as size increases. In addition, being an innovator – defined as having introduced at least one new service in the last three years – substantially increases the likelihood of innovating, as does having a highly-educated workforce. By contrast, independent businesses are less likely to be exporters, perhaps indicating the benefits of group membership in overcoming the fixed costs of overseas market entry, while firms which produce mainly customised services are less likely to export. Finally, the probit results show that higher productivity – but not growth – markedly increases the likelihood of being an exporter. In common with previous research (Aw et al, 2007) the truncated regression results for innovation intensity (second column) are less well defined, presumably because export intensity is driven by more firm-specific heterogeneous factors than the discrete exporting decision. These results also show a markedly different pattern from the probit results. The effect of being an innovator and of being an independent firm are the reverse of those in the probit model; thus once a firm is an exporter, being independent actually boosts the extent of its exporting activity, while innovators export less (conditional on being exporters). The first of these may indicate that while drawing on a group's resources helps an enterprise overcome the fixed costs of entering export markets, once this is done non-independent enterprises have less control over the extent of their exporting activity than do independents, perhaps

[10] In practice, Roper et al (2006) observe that the signs and significance levels obtained using the fractional response model are very similar to those obtained using Tobit.

[11] Defined as $\lambda = 2(\ln L_{probit} + \ln L_{truncation} - \ln L_{tobit})$

through an 'allocated growth' effect. The innovation effect is harder to rationalise, but may also be an indirect consequence of the allocated growth mechanism to the extent that innovating and exporting are positively correlated (r=0.29). Perhaps most importantly, there is no size effect or effect of productivity; large, productive exporters are no more export intensive than other exporters.

Overall, the results of the probit and truncated regressions support the self-selection hypothesis that large, productive firms are more likely to become exporters. However, the finding that once they do so they are no more export intensive than other exporters implies that the benefits of size and efficiency lie principally in overcoming the sunk entry costs of exporting rather than in making such firms more export intensive. These findings are precisely in line with previous research on manufacturing industry (Aw et al, 2007)

Testing the relationship between exporting and productivity

With *prima facie* support for the self-selection hypothesis established, we next move on to consider the less well-understood link between exporting and productivity. There are two aspects to this. The first is whether – conditional on well-performing firms self-selecting into exporting – any resulting performance effects arise from the *decision* to export rather than from the extent of exporting *per se*[12]. In this scenario, being an exporter raises productivity even after allowing for the selectivity effect. The other possibility is that the *extent* of exposure to international markets matters i.e. that firms which export a higher proportion of their total sales gain from such increased exposure through the mechanisms identified empirically by Baldwin and Gu (2004) and Van Biesebroeck (2005) i.e. learning by exporting through knowledge of foreign technologies, exposure to more intense competition, and increased product specialisation leading to exploitation of scale economies.

[12] There are two possible explanations even within this hypothesis. In one scenario, firms ratchet up productivity in advance of becoming exporters in order to compete with more productive international firms, not because they benefit from being exporters (Bernard and Jensen 2004), while in the other scenario productivity benefits flow as a result of exposure to international markets (Van Biesebroeck, 2005). Clearly, it is impossible in a cross-sectional model to distinguish between these two subtle timing variations on the productivity benefits of being an exporter, and in practical terms it may not matter; either way, the decision to become an exporter raises productivity.

Ideally, panel data is required to test these hypotheses in order to allow for the dynamic aspects of the exporting-productivity relationship. However, even within the confines of a cross-sectional model it is possible to go some way towards testing both of these hypotheses. The first can be tested using a model of the form:

$$PROD_i = \alpha_0 + \alpha_1 R^0_i + \alpha_2 EX_i + \varepsilon_i \quad (2a)$$

$$EX^*_i = \gamma \boldsymbol{X} + \mu \quad (2b)$$

$$EX_i = 1 \text{ if } EX^*_i > 0, \text{ and } EX_i = 0 \text{ if } EX^*_i = 0$$

Where $PROD_i$ is value added per capita in firm *i*, and R^0_i is a subset of the firm resource indicators which previous research shows are linked to productivity in business services (Mansury and Love, 2006). EX^*_i is a dummy innovation variable and $\boldsymbol{X}$ is the vector of determinants of exporting from equation (1). In the above case, because EX_i is both the sample selection criterion and a regressor in the second stage of estimation, a variation on the selection model such as the treatment effects model is appropriate. To allow for correlation between EX_i and ε_i equations (2a) and (2b) are estimated using 2SLS, using the predicted probabilities from probit equation (2b) as the instrument for EX_i (Greene, 1998, 716-7).

Results are shown in Table 4. After allowing for the self-selection effect exporting is still strongly associated with productivity, providing support for a positive performance effect of being an exporter independent of the fact that more productive firms choose to be exporters. We therefore find support for the findings of Baldwin and Gu (2004), Aw et al (2007) and Van Biesebroeck (2005) on the positive link between exporting and performance. The results also indicate that firm size has a U-shaped relationship with productivity, and that capital intensity and independent status are positively associated with productivity. Surprisingly, a highly qualified workforce is negatively related to productivity.

The final element is to consider whether the *extent* of exporting matters; that is, the link between export intensity and productivity. Unlike the exporter treatment model discussed above, here the sample selection criterion EX^*_i does not appear in the

productivity equation, and so we can allow both for selectivity and simultaneity between export intensity and productivity. We therefore estimate a simultaneous model of the form:

$$PROD_i = \varphi_0 + \varphi_1 R^0_i + \varphi_2 EXINT_i + \varepsilon_{1i} \quad (3a)$$

$$EXINT_i = \delta_0 + \delta_1 R^1_i + \delta_2 PROD_i + \varepsilon_{2i} \quad (3b)$$

$$EX^*_i = \gamma \boldsymbol{X} + \mu \quad (3c)$$

$$EX_i = 1 \text{ if } EX^*_i > 0, \text{ and } EX_i = 0 \text{ if } EX^*_i = 0$$

Where $EXINT_i$ is the proportion of exports in total sales and R^1_i is a subset of the firm resource indicators found to be significant in the truncation model estimated earlier. To show the effect of allowing for simultaneity between export intensity and productivity, the results are compared with those from a model that allows for self-selection into exporting but not for simultaneity (i.e. a standard Heckman model). In each case results are reported for exporters only.

The results of estimating equations (3a) and (3b) are shown in Table 5. Considering first the export intensity results (equation 3b), the results indicate that there is little difference between the simultaneous and Heckman models. In both cases only being independent (positively) and innovating (negatively) affect export intensity. There is no productivity effect, nor is there any evidence of a sample selection effect in either form of estimation. The simultaneous selection model therefore confirms the results of the simple truncation model reported in Table 3: once a firm becomes an innovator, productivity has no further effect on export intensity.

Of more interest, however, are the results of the productivity estimation. The first notable result is the strong sample selection effect (λ) in both the simultaneous and standard Heckman estimations, again confirming that more productive firms self-select into exporting. The coefficient signs and significance on employment size, capital intensity and workforce qualifications are similar to those seen in the exporter treatment model (Table 4). The key difference between the simultaneous and simple Heckman models lies in the effect of export intensity on productivity: there is no

effect in the Heckman model, but a positive and significant effect (at the 10% level) in the (preferred) simultaneous model. We therefore find some support for the hypothesis that there is a positive association between the *extent* of exporting and productivity, even after allowing for the (significant) self-selection effect and for simultaneity between export intensity and productivity. For our sample of service exporters, therefore, there is not only evidence that exporting and productivity are positively associated, but at least some suggestion that productivity is positively linked to greater exposure to international markets.

5. Conclusions

In contrast to the wealth of evidence on manufacturing, there is virtually no research examining the link between exporting and productivity in services. Since services account for over 70% of GDP in the United States, the United Kingdom and several other major OECD countries, this may be an important omission. Of course, not all services are easily tradable: however, business services alone account for an average of around 25% of GDP for the OECD as a whole[13], and these often involve services which are tradable internationally.

Using a relatively small but representative sample of US business services firms, we find evidence that large, productive firms self-select into export markets, and that productivity is positively associated both with exporting and the extent of exporting after allowing for this selection effect. Before drawing firm conclusions from these results, we must acknowledge the limitations of the study. As indicated above, although representative of the sub-sectors of SIC73, the sample is small, and there can be no guarantee that a larger sample would find exactly the same results. In addition, possibly the major limitation of the study is its cross-sectional nature which precludes consideration of the lagged and dynamic elements of the relationship between exporting and productivity. For this reason we are careful to avoid drawing definitive conclusions on causality, and can say with confidence only that exporting and productivity have a clear correlation after allowing for self-selection. Finally, and

[13] Source: OECD in Figures (2005 edition).

linked to the last point, our data relate to productivity levels rather than productivity growth.

Despite these limitations, perhaps the most interesting feature of the empirical results is how similar they are to some of those found in studies of exporting in manufacturing. Apart from the strong selection effect, which is almost universal in previous research, we find support for the findings of Baldwin and Gu (2004), Aw et al (2007) and Van Biesebroeck (2005) on the positive link between exporting and performance. Notably this contrasts with other research on US (manufacturing) data (Bernard and Jensen, 1995, 1999, 2004) where no such link is found. However, because of the cross-sectional data used, we are unable to explore the issue of whether productivity rises just before or after the entry into exporting i.e. whether the *decision* to export leads to productivity improvements. Future research on this issue would help to shed light on this aspect of service exporting, and on another key issue: the reason for the selection effect and the nature of sunk costs in exporting. Our data do not permit any analysis of this issue, but there is undoubtedly scope for examining how size and efficiency help service firms overcome the sunk costs of entering export markets. The fact that the selection effect is so strong in our sample appears to give *prima facie* support for the view that these costs may be more to do with information gathering and contract enforcement rather than involving the need for capacity ramping before entry, but in the absence of more detailed investigation this remains speculation.

Table 1. Sub-sectoral Distribution of Population and Sample

Main sub-sectors	Dunn & Bradstreet (% firms)	Responses (% firms)
Computer Services	27.9	32.0
Business Services NEC	15.9	19.9
Advertising Services	8.2	7.8
Other sub-groups	47.9	40.3
Total	100	100
χ^2 (3 df)	6.01	
p-value	0.111	

Table 2. Descriptive and Performance Indicators: Exporters and Non-exporters

	Exporters (mean)	**Non-Exporters (mean)**
Performance		
Productivity ($ log)	11.4	10.8
Sales growth (%)	37.1	32.8
Employment growth (%)	14.8	22.9
Internal Resource Indicators		
Employment	23308*	4376
Capital intensity ($000)	127.2	260.4
Degree level employees (%)	45.2	35.8
Age (years)	46.6*	26.6
Independent (proportion)	0.49*	0.69
Innovators (proportion)	0.91	0.68
N	100	106

* Difference significant at 5% or better on a 2-tailed t-test.

Table 3. Determinants of exporting and export intensity: probit and truncated regression models

	Probit Model		Truncated Model	
Variable	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**
Constant	-0.671	-2.553	17.107	1.152
Employment (10^{-4})	0.162	3.055	-0.568	-0.341
Employment squared (10^{-6})	-0.670	-3.012	4.704	0.578
Capital intensity (10^{-7})	-0.144	-0.536	0.906	0.028
Workforce with degree	0.002	1.684	0.042	0.418
Workforce with no qualifications	0.000	0.056	-0.191	-0.725
Age	0.001	0.429	-0.043	-0.624
Independent	-0.145	-1.628	9.089	1.663
Customised services	-0.164	-1.767	-4.269	-0.839
Tailored services	-0.020	-0.216	-1.336	-0.246
Suitable for large groups	0.070	0.738	2.825	0.588
Standardised	-0.057	-0.562	3.901	0.779
Innovator	0.245	2.270	-15.588	-1.885
Sales growth (log)	0.001	0.007	-2.052	-1.387
Productivity (log)	0.037	1.938	-0.608	-0.599
Sigma			41.3418	6.158
Log-Likelihood	-100.098		-381.089	
Pseudo R^2 (ML)	0.239			
N	180		90	
Test of validity of probit-truncated model versus tobit model (χ^2_{14})	401.54			

Notes:
The dependent variables are exporter (0/1) and proportion of exports in total sales respectively.
Reported coefficients are marginal effects (for binary variables these represent the effects of a discrete change from 0 to 1).

Table 4: Determinants of productivity (2SLS treatment model)

Variable	**Coefficient**	**t-ratio**
Constant	7.920	7.606
Employment (10^{-4})	-0.864	-2.680
Employment squared (10^{-5})	0.374	2.566
Capital intensity (10^{-6})	0.407	2.409
Workforce with degree	-0.021	-1.871
Workforce with no qualifications	-0.009	-0.430
Age	-0.005	-0.582
Independent	1.231	1.792
Exporter	7.936	3.917
Log likelihood	-496.57	
DW	2.09	
N	180	

Table 5. Determinants of export intensity and productivity (sample selection models)

	Export Intensity				Productivity			
	Simultaneous Model		Standard Heckman Model		Simultaneous Model		Standard Heckman Model	
Variable	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**	**Coefficient**	**t-ratio**
Constant	68.982	0.885	55.497	1.544	14.735	5.190	16.862	7.206
Employment (10^{-4})	-2.372	-0.531	-1.738	-0.581	-0.892	-1.811	-0.881	-2.015
Employment squared (10^{-5})	1.129	0.580	0.886	0.634	0.353	1.555	0.367	1.816
Capital intensity (10^{-6})	-1.551	-0.302	-2.187	-0.562	1.232	2.144	1.210	2.394
Workforce with degree					-0.028	-1.314	-0.031	-1.630
Workforce with no qualifications					0.019	0.380	0.002	0.062
Age					-0.003	-0.238	-0.006	-0.472
Independent	14.502	1.939	13.809	2.140	-0.230	-0.161	0.942	0.864
Innovator	-34.340	-1.711	-31.623	-2.165				
Productivity (log)	-0.324	-0.083	0.363	0.236				
Export intensity					0.106	1.608	0.009	0.700
λ	-19.135	-0.664	-14.561	-0.870	-6.116	-2.804	-5.882	-2.992
Log likelihood	-415.27		-415.16		-225.36		-175.85	
N	90		90		90		90	

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