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Overseas Links as Export Conduits

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This paper investigates the relationship between exports and overseas links using data from the UK Community Innovation Survey. Overseas vertical and horizontal links are associated with an average increase in export intensity of 74 and 156 per cent for vertical and horizontal overseas links respectively. Firm size shows no significant interactions with overseas links. The data suggests that overseas links are a relatively infrequent form of conducting trade. My findings support the role of government in fostering overseas links as, despite their rarity they are effective export conduits.

JEL Codes: F14; F23; L240; L140
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1 Introduction

Countries such as the UK devote considerable time and money to helping domestic firms to team up with partners abroad. Particular care is taken with smaller, resource constrained firms to ensure that they can afford to showcase their products at international conferences. For instance recent Tradeshow Access Programme (TAP) operated by the UK Trade and Investment Group provides exhibition grants for small firms and organises groups of firms from similar industries to meet prospective foreign partner firms. Overseas links are not well covered in the literature and media. However, given work by various Governments to help firms initiate overseas links, it is time for an appraisal of links as effective trade conduits.

The issue of firm size plays a role here, recalling the targeting of small firms for exhibition subsidies. Given the potential role of firm size in helping absorptive capacity, larger firms may well experience comparatively high exports when using overseas links. Absorptive capacity is key to understanding how a firm can expect to benefit from an external link (HARRIS and LI 2005).[1] However, the ambiguity in literature regarding the predicted effect

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1 In a macroeconomic study MACGARVIE (2005) finds that domestic R&D capability is important to helping a firm assimilate knowledge from foreign firms.

of firm size on absorptive capacity means that we still do not know whether small firms are disproportionately handicapped by their size when members of overseas links. One expected outcome of overseas links for a domestic firm, is that horizontal rather than vertical links translate into higher export levels, regardless of a firm's size.[2]

This paper looks at the association between exports, membership of overseas links and firm employment size and examine whether differences in export intensity arise when firms use overseas links. Furthermore it is examined whether any differences are independent of a firm's size. The UK data, similar to the Belgian data used by CASSIMAN and VEUGELERS (2002), uses individual responses to the European Community Innovation Survey (CIS).

As expected, there is an appreciable difference in the benefits to all firms, regardless of their size, from membership of horizontal and vertical links. This underlines the very different *raison d'être* of different types of overseas links. Specifically, we find that overseas vertical links are associated with an increase in export intensity of about 74 per cent while vertical links are associated with an average increase in export intensity of approximately 156 per cent.

No evidence of any significant size/overseas link interactions is found, but additionally observe that innovators report higher export intensities. This is consistent with evidence from BERNARD and JENSEN (2004), who conclude that more innovative firms (those who differentiate their products by changing the product mix) are more likely to export.

My findings that overseas links represent important conduits for exports, underpins the role of government institutions such as the UK Trade and Investment body in the UK, which promote contacts with overseas firms by supporting small businesses, businesses entering markets of strategic interest (for example Gulf Co-operation Council States or China) and recently firms from the high technology sector. It is clear that fostering overseas links at such venues may offer businesses a viable way of increasing exports, in some circumstances doing away with the need for FDI.

The paper is structured in the following way. Section 2 provides background on the benefits to exporting from size and inter-firm links and generates a

2 We follow the intuition outlined in KNELLER and PISU (2007) and explained in greater detail in the next section.

set of testable hypotheses. Section 3 describes the model while Section 4 introduces the data used. The analysis section follows this and Section 5 concludes.

2 Background

Before commencing the discussion of exporting and size, it is worth noting that the recent literature on inter-firm links suggests a change in the purpose of links. Tacit, as opposed to formalised links, are predicted by RAUCH (2001) to diminish in importance with the passage of time. This change in the role of networks is expected to arise as it becomes easier to write and enforce contracts. RAUCH predicts a fundamental change in the purpose of networks from a distributive to a more knowledge driven role. Such a change is predicted to assist technology spillovers and product differentiation (RAUCH 2001). We first look briefly at the literature on exporting before turning directly to the literature describing how firm size plays a role in overseas links.

2.1 Exporting is costly

The literature on exporting, which considers sunk costs, suggests that more productive firms are able to sustain these costs (GHIRONI and MELITZ 2004; BERNARD and JENSEN 2004; MELITZ 2003; AW, ROBERTS and WINSTON 2007). Sunk costs are said to arise when a firm exports. Only a subset of relatively more productive firms export, while the remaining, less productive firms are content to serve their domestic market. According to BLEANEY and WAKELIN (2002):

> "Not only are exporting firms larger in size than non-exporting firms, but they also appear superior according to most measures of efficiency. These findings, which have emerged from research on firms in Germany, the United States and some developing countries, have been rationalised in terms of a fixed cost of exporting which less efficient firms do not find worth paying".

Although BLEANEY and WAKELIN fail to find efficiency differences between exporters and non-exporters, they do find a strong and non-linear relationship between size and the exporting probability. Similarly, both BERNARD and JENSEN (2004) and ROBERTS and TYBOUT (1997) find that larger firms are more likely to export.[3] Specifically, BERNARD, EATON, JENSEN and KORTUM (2003) and HELPMAN, MELITZ and YEAPLE (2004) suggest that the export decision of a firm can be calculated by the firm's ex ante productivity level relative to the sunk cost of export market entry.

Additionally, a number of additional recent studies show how size is an important determinant of exporting capacity (LOVE and ROPER 2001; LACHENMAIER and WÖSSMANN 2006; BARRIOS, GÖRG and STROBL 2003; RUANE and SUTHERLAND 2005); BLEANEY and WAKELIN 2002). In sum, both the theory predicts and recent evidence shows that more efficient and larger firms are more likely to export.

2.2 Exports and Overseas Links

The idea that overseas links promote exports is conditioned on the substitutability between internal capacity and capacity that is "bolted on" to a firm's operations as a result of an overseas link.

STERLACCHINI (2001) argues that overseas links promote export intensity:

> "The affiliation of a firm with an industrial or business group enhances its financial and commercial capabilities, and this should increase its opportunities for internalisation and its propensity to export".

LEFEBVRE, LEFEBVRE and BOURGAULT (1998) using Canadian firm level data shows that overseas links assist exports where firms in their sample with links reported higher export intensities. Both MCLAREN (1999) and SCHMITZ (1999) treat overseas links as a conduit for exporting activity. MCLAREN focuses on the possibility of using informal links *in lieu* of more formalised contracts. SCHMITZ, whose analysis is of more relevance to our particular research question, shows how links reduce the hold-up problem through fostering trust and repeated transactions. Through repeated transactions via longer term collaboration, both partners have an incentive to reduce costs. This is because by introducing trade into the model, the number of potential buyers for the offshored component increases. This, in turn, induces an overseas customer to cut his own costs in order to retain the supplier's custom by paying a competitive price for the input.

3 ROBERTS and TYBOUT (1997) develop a test for the presence and magnitude of sunk costs using a sample of Colombian firms, while BERNARD and JENSEN (2004) construct a dynamic panel data model from the US Annual Survey of Manufactures.

So far links have been regarded as homogeneous. However, links can be subdivided into supplier-buyer (vertical links) as well as horizontal links (typified by distributive networks). FEENSTRA, YANG and HAMILTON (1999) explore both types of links in their two-country study of South Korea and Taiwan. Vertical links in South Korea with overseas buyers permit the realisation of scale and scope economies, leading to South Korea being a net exporter of relatively narrow range of high volume, low cost goods. Taiwan is dissimilar to South Korea in that Taiwanese firms produce and export a wider range of differentiated products. Overseas vertical links play a lesser role in Taiwan. More recently KNELLER and PISU (2007) conduct a study which uses sectoral aggregate data to derive measures of inter-industry (vertical) and intra-industry (horizontal) links. They find that the decision of a firm to participate in export markets is greatly increased by the presence of vertical and/or horizontal FDI links in the industry. Although the study by KNELLER and PISU is not a study of overseas links per se, one could argue that FDI might have similar effects to those predicted by overseas links.

Hypothesis 1:
Overseas links are associated with higher export intensities.

2.3 Can larger firms derive more value from overseas firm links?

This is where the interactive effect exercised by enterprise size and links on export intensity comes in. We can accept that it is a stylised fact that larger firms are more likely to export. However, the issue of whether larger firms have higher absorptive capacity than small firms is still the source of conflict in the literature.

CASSIMAN and VEUGELERS (1999) report that large firms incur lower unit transaction costs in overseas links, at least when the overseas link involves the exchange of an intermediate (got example a knowledge input) where there is the potential for *ex-post* opportunism by the overseas partner:

> "... technology outsourcing may create considerable transaction costs, *ex ante* in terms of search and negotiation costs and *ex post* to execute and enforce the contract".

We have indirect evidence of the superior ability of large firms to exploit links in CASSIMAN and VEUGELERS (2002).[4] They argue that firms need to be of a certain critical size in order to optimally benefit from R&D cooperation. Specifically, if there are economies of scale in basic research, larger firms are better equipped to understand and exploit R&D, which would lead to innovation and consequently exports.

There are other transaction cost arguments that can be advanced to show how larger firms can especially gain from membership of overseas links. We expect that overseas firms doing business with larger, known domestic firms incur reduced average monitoring costs. For example their finances are audited and transparent, and more officially published information is available. Purchasing economies also arise when transacting with larger domestic exporters (for example the purchasing of materials and service intermediates in a vertical relationship).

Despite evidence that there are transaction costs in contracting with overseas parties which favor large firms, there is also evidence that smaller firms can profit from overseas links. HSING (1999) finds that overseas links can be sustainable for small firms when these overseas links are well organised. He finds that networks of small firms are able to realise economies of scale and scope through the coordination of intermediaries called 'traders'. These latter intermediaries help maintain and support inter-firm links. Similarly, RAUCH and WATSON (2004) hypothesise that although sufficient incentive may be missing for firms to share networks with rival firms, governments can step in to correct this market failure by encouraging large scale trading companies.

To sum up, the ability of a domestic firm to benefit from an overseas link across different categories of firm size may well depend on the nature of the overseas link: vertical or horizontal. As KNELLER and PISU (2007) point out, vertical links are more likely to result in the transfer in information flows. Positive information flows should give rise to higher exports. The lack of consensus in literature on the role of firm size implies that it is debatable whether larger firms have the edge in profiting from information exchanged in a vertical overseas link. Accordingly one cannot predict whether the benefits to overseas links with increasing firm size are convex, concave or linear.

4 Using a 2-stage structural equation approach, the researchers allow for a nonlinear effect of firm size on the probability of R&D cooperation (research link). They find that larger firms are more likely to enter research links. However, the probability of entering a link, although positively related with firm size, shows a falling off with successive increases in firm size.

KNELLER and PISU also point out that horizontal links not only facilitate information transfer. Horizontal links have the additional feature of directly impacting sales and hence exports of a product (competition effects). Therefore one would expect overseas horizontal links to have a greater impact in increasing export intensity, irrespective of a firm's size.

The overall message from the literature is that firm size plays an important role in moderating the influence of overseas links on export intensity.

> **Hypothesis 2:**
> Enterprise size modifies how firms generate exports from overseas links. The nature of this relationship is indeterminate.

2.4 Product differentiation enhances exports

There have been a number of studies showing how innovation fosters exports although few studies showing how exporting helps a firm's knowledge base (supporting learning effects). Specifically in the case of the UK, studies show the positive impact of innovation on exporting (BLEANEY and WAKELIN 2002; WAKELIN 1998; LOVE and ROPER 2001).[5]

BLEANEY and WAKELIN (2002) find that firms are more likely to export if they are in a sector with a high R&D intensity (R&D to sales ratio). They also find that in the case of the innovators, their ability to innovate was a key determinant of export performance. They conclude that these firms compete in an environment where product differentiation is a prerequisite. WAKELIN (1998) uncovers a statistically significant positive correlation between innovation (measured in terms of number of innovations) and exporting. She interprets the positive relationship between innovation and exporting as suggestive of the role of innovation in supporting export growth. LOVE and ROPER (2001) find that plants with in-house R&D capability are more likely to export.

5 Work for other countries includes LACHENMAIER and WÖSSMANN (2006) for Germany using an instrumental variables approach controlling for endogeneity of exports to R&D. They find that increases in innovation induce German manufacturing exports to rise by 7 per cent. BARRIOS, GÖRG and STROBL (2003) using Spanish data find that R&D intensity is one of the biggest determinants of a firm's exporting decision.

BARRIOS, GÖRG and STROBL (2003) describe a model which explains how exporting (and spillovers from export activity) strengthens the firm's competitive position both locally as well as overseas through improved product quality and raised efficiency. They find strong evidence that a firm's R&D intensity is an important determinant of its export capacity. Moreover, LEFEBVRE and LEFEBVRE (2001) find that higher technology enhances export performance in an analysis of over 3,000 Canadian SMEs.[6] Finally, BERNARD and JENSEN (2004), claim to present the first microeconomic evidence that product differentiation induces higher export capacity. When they include a dummy denoting whether the firm switched industries in two consecutive years, they find a positive effect on export capacity.

Hypothesis 3:
Higher innovation rates raise export intensity.

3 Model and Econometric Specification

Let us first recall the research questions before moving on to describe how these questions are framed empirically.

H_1: Overseas links are associated with higher export intensities.
H_2: Enterprise size modifies how firms generate exports from overseas links. The nature of this relationship is indeterminate.
H_3: Higher innovation rates raise export intensity.

The hypotheses can be included in a simple model of export intensity as

$$EX = X_i^{'}\alpha + \beta_1 (LINK)_i + \beta_2 (LINK \times SIZE)_i + \beta_3 (INNOV)_i + \mu_i \tag{1}$$

where EX denotes exports as a percentage of total sales, X is a vector of controlling covariates including sector and a skills measure. $LINK$ denotes some measure of inter-firm collaboration, a size/link interaction term captures differentials in benefits across links across the size categories and, finally, $INNOV$ represents some measure of firm innovation, while μ represents a random disturbance term for each firm i and the vector X contains

6 They apply some interesting measures of firm's technological know-how including the level of automation and the degree to which the equipment used is up to date.

standard covariates including a measure of skill, sectoral dummies and corporate governance characteristics of the firms.

The dependent variable *EX* is by definition bounded between 0 and 1. Researchers have tackled the estimation of export intensities in different ways. The methods used in each case depend on the assumptions made: is the decision to export independent of export intensity or are the two possible outcomes inextricably linked? Researchers opting for a 2-stage framework based on the assumption that the decisions are separate, have in turn viewed the determinants of both outcomes as very different (advocates of the Heckman approach with instrumentation (see BARRIOS, GÖRG and STROBL 2003)) or essentially similar (advocates of the modified Tobit approach using Cragg's specification (See WAKELIN 1998; BASILE 2001; WAGNER 1996).

The approach used here is informed by some new thinking on the inseparability of the two outcomes and is based on PAPKE and WOOLRIDGE'S (1996) seminal analysis using a quasi-likelihood estimation method for fractional response variables bounded between 0 and 1. The reason for this revisionism in how export intensity is viewed, comes from the *ex ante* nature of the export decision, where an exporter cannot ascertain whether costs are sunk, and hence unrecoverable, or not. An enterprise will only export if the price that can be charged covers average total costs. Total costs are made up of variable and fixed costs, the latter being sunk. Once the firm commits itself to export, these costs are *ex post* sunk costs (*ex ante* they are not) and according to WAGNER (2001) the decision to export and the magnitude of exports are not mutually exclusive, on account of the *ex post* rather than *ex ante* nature of costs. WAGNER (2001) with respect to costs argues that:

> "...[costs] enter the firm's calculation whether it is profitable to enter this market by selling the profit maximising quantity at the given price or not. It follows that there is no such thing as a two-step decision – to export or not, and then how much to export".

He goes on to observe that the degree of interconnectedness of the two outcomes provides one explanation why it is so difficult to find separate instrumental variables to define the two mutually exclusive equations, as is customary in a 2-step approach.

Accordingly, following PAPKE, LESLIE and WOOLRIDGE (1996) the quasi-likelihood is estimation method is applied to the data because export intensity is a fractional response variable. Rather than applying OLS, where the predicted values are not constrained to lie on the interval between 0 and 1, or even reformulating our response variable as the log odds ratio with the standard adjustments for extreme values of 0 and 1, a General Least Squares (GLS) model is used here. Using GLS has the advantage of reducing potential distortion in our predicted responses because firstly, one does not need to adjust for 0 when taking logs as is customary when using the log odds ratio for the response variable; secondly, the export intensity variable is a fraction rather than a proportion from a discrete group size (unlike the assumption made in standard Tobit analysis), and thirdly, this technique represents the distribution of responses when many outcomes lie at the extremes. In PAPKE, LESLIE and WOOLDRIDGE, 40 per cent of their response values took the value of unity, in our analysis although only a minority of firms export all their products (less than 1 per cent), nonetheless a large proportion (ca. 50 per cent), do not export at all. Accordingly, because a high percentage of our cases lie at this extreme, the GLS estimator is opted for, applying a logistic function and assuming a binomial distribution for our response variable, export intensity.

To help interpretation of the impact of the coefficients on export intensities, marginal effects in terms of probabilities are also reported. Because firm size plays a central role in our analysis and in order to make the analysis of marginal effects more meaningful (sometimes rather problematic in probit analyses with binary outcome variables), size is decomposed into separate size quartiles. This latter measure can easily be applied to marginal effects questions such as: what is the predicted export intensity for firms in the smallest size quartile?

4 The Data and Descriptive Statistics

Data from the third wave of the Community Innovation Survey (CIS3) are used in an analysis, represents the first application of the UK CIS to explore export intensity, although the Belgian CIS data has been formerly used to explore R&D cooperation (See CASSIMAN and VEUGELERS 2002). Coverage is for the years 1998 to 2000. A full listing of the variables used in this analysis and the correlations between them is available in Appendix 1 and 2 respectively.

The CIS takes place every 4 years. Its aim is to investigate levels of innovation in business. Results are gathered via a postal questionnaire asking questions on innovation related topics. The survey goes out to a sample of enterprises in each participating country, including the UK. The sample is designed to be representative of all regions, all industrial sectors (both services and manufacturing) and all enterprise sizes. In the UK, the survey is voluntary with a response rate of 42 per cent (for CIS3) which is considered high for a voluntary survey (DTI 2004).

The survey noted the following responses which are used to represent sometimes with modification, our research questions. In turn, these are:

Exports:
In the questionnaire, firms were asked to note what proportion of their total sales was exported overseas.

Innovation:
Responding firms were asked to document whether or not they had introduced products or processes which were new to their industry in the period 1998 to 2000.

Overseas links:
These are captured from the firms' responses to Q12 on the 3rd CIS survey. Respondents were asked to categorise on a 4-point ordinal scale, the importance of overseas collaboration with partner firms from "not used" to "high". Where overseas links exist, firms were asked to rate the importance of these links (See Appendices 1 and 2 for a listing of these variables and their nter-relationships).

Table 1: Breakdown of Summary Statistics for SIC 2-digit sectors

	Mining and Quarrying (SIC10-14)			Mfr Food, Clothing, etc. (SIC15-22)			Mfr Fuels, Chem., Plast. etc (SIC23-29)		
	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)
mean	0.2	173	7	0.2	195	2	0.3	159	6
p10	0.0	10	0	0.0	10	0	0.0	11	0
p50	0.1	28	1	0.1	40	0	0.2	34	2
p90	0.7	276	12	0.6	469	5	0.7	397	15
range	1.0	7,247	80	1.0	13,002	100	1.0	6,846	100
N	29	123	92	396	984	795	599	1098	941

	Mfr Electrical & Opt. Equip (SIC30-33)			Mfr Transport Equip. (SIC34-35)			Other Mfr. (SIC36-37)		
mean	0.4	192	10	0.3	200	6	0.2	117	1
p10	0.0	12	0	0.0	14	0	0.0	11	0
p50	0.3	65	5	0.2	60.5	3	0.1	53.5	0
p90	0.8	456	30	0.8	492	13	0.6	301	5
range	1.0	7,849	100	1.0	5,805	100	1.0	1,476	20
N	384	521	461	205	338	268	225	440	346

	Electricity, Gas etc. (SIC40-41)			Construction (SIC45)			Wholesale & Commission Trade (SIC51)		
mean	0.3	1208	13	0.1	146	4	0.2	121	5
p10	0.0	14.5	0	0.0	8	0	0.0	10	0
p50	0.1	144	10	0.0	25	0	0.1	27	0
p90	1.0	3913	29	0.5	310	10	0.6	260	15
range	1.0	16,141	54	0.9	7,729	100	1.0	8,160	100
N	7	50	41	49	915	758	386	1022	885

Table 1: Breakdown of Summary Statistics for SIC 2-digit sectors (Ctd.)

	Transport, Storage & Comm. (SIC60-64)			Financial Intermed. (SIC65-67)			Real Estate, etc. (70-74)		
	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)
mean	0.3	326	2	0.3	316	4	0.3	173	17
p10	0.0	9	0	0.0	9	0	0.0	7	0
p50	0.2	45	0	0.2	43	0	0.1	23	0
p90	1.0	687	5	1.0	424	10	0.9	299	60
range	1.0	18,273	89	1.0	23,790	66	1.0	42,900	100
N	69	756	577	33	400	335	279	1350	1179

	Total		
	export int (exp_int).	employment (employ00)	% employees: science degree (propsci)
mean	0.10	191	6
p10	0	9	0
p50	0	35	0
p90	0.42	390	20
range	1	42,900	100
N	6672	7,997	6,678

Table 1 documents summary statistics, the main non-discrete variables of interest broken down by 2-digit sector codes. It is worth noting that the Electrical and Optical Equipment Manufacturing sector (SIC 30-33) reports the highest average export intensity, at 40 per cent of output being exported from the UK. It also exhibits the highest median export intensity, where 30 per cent of goods manufactured in this sector leaving the country. Not surprisingly, the Construction sector displays the lowest average export intensity. This result fits well with the view that activities in this sector are neither easily tradable nor transported abroad.

Table 2 decomposes our data by the type of overseas link. There are 4 main categories of overseas link; horizontal, *org_horiz_abroad*, vertical, *org_vert_abroad*, knowledge based, *org_rd_abroad* and FDI based, *org_vi_abroad*. The final type of overseas link represents one measure of FDI.[7] Finally, our measure of differentiation where sales are generated from products which have been altered or tailored in some way, *prod_change* is also included in the table.

The main thing we should note is that overseas links are a far less rare phenomenon than FDI. Recall that FDI proxies are denoted by the presence of fully integrated overseas affiliates (118 firms in all) and group consolidation (1,887 firms are members of a consolidated group). This compares with only 26 and 53 firms who have horizontal and vertical links respectively. Therefore overseas links are not a common way of organising business activity. However product differentiation is a common phenomenon. Approximately 32 per cent (843 firms) of firms in our sample derived sales from altered or modified products.

7 Our other measure is group consolidation, which although not captured in Q12 in the survey which deals specifically with overseas links, means precisely this: the firm is part of a wider conglomerate and as such is likely to have fully integrated overseas affiliates.

Table 2: Breakdown of overseas links and other descriptors of firm

	Overseas link with partner in same industry (org_horiz_abroad)			Overseas research link (org_rd_abroad)			Overseas link with upstream/downstram partner firm (org_vert_abroad)		
	0	1	Total	0	1	Total	0	1	Total
N	2,634	26	2,660	2,633	27	2,660	2,607	53	2,660
%	99	1	100	99	1	100	98	2	100
	Consolidation with firm abroad (org_vi_abroad)			Firm is a member of a larger consolidated group (group)			Some sales generated from changed products (prod_change)		
	0	1	Total	no	yes	Total	0	1	Total
N	2,542	118	2,660	773	1,887	2,660	1,817	843	2,660
%	96	4	100	29	71	100	68	32	100

5 Analysis

Having examined the univariate breakdown of the data in the above section, we now move on to the regressions themselves. The results for the GLS estimation, assuming a binomially distributed response variable and applying the logistic function are reported in Table 3. Given the potential for heteroscedasticity, particularly when using cross-section data, the Huber-White-Sandwich variance adjustment is applied in order to derive consistent standard errors. In all our models, the full vector of sectoral dummies is included at the 2-digit SIC level.

Estimation (1) reports the association between export intensity and the other covariates. It has also been checked whether exports are higher for firms that changed their products (Hypothesis 3). Now we look at each variable in turn.

Comparing all size categories to the base category (firms with less than 15 employees), we see that all firms in the largest 3 size categories have lower exports than the base category. Positive relationship between size and export intensity had been expected on the basis of existing literature. The fact that the highest export intensities are registered by the smallest firms in our sample comes therefore as a surprise, and necessitates some further exploration.[8]

Overseas links, both vertical *org_vert_abroad* and horizontal, *org_horiz_abroad* do matter for exports, where they are associated with significantly higher export intensities (see marginal effects for these later). Group consolidation, 'group' (one proxy for FDI) was not significantly associated with export intensity, and was not included in the subsequent estimation. The other proxy for FDI, *org_vi_abroad* was also insignificant and was subsequently dropped in my estimations. Purely knowledge based links, *org_rd_ abroad* were also insignificantly related with exports and subsequently dropped.

The final two variables, namely innovation and scientific skills, are both significant. Enterprises reporting that at least some of their sales are generated from products that have been tailored or changed in some way, *prod_ change*, record higher export intensities. The fact that firms that modified or tailored their products in some way have higher exports than firms that did not, provides some support for Hypothesis 3.

8 See Bleaney and Wakelin (2002); Barrios, Görg and Strobl (2003); Bernard and Jensen (2004).

Table 3: Export Intensity Regression with Censored Data

	(1)	(2)	(3)
	export intensity: (exp_int)	export intensity: (exp_int)	export intensity: (exp_int)
Size categories:			
‡ 15 < Employment <= 35 (size_2)	-0.6394***		-0.6344***
	(5.64)		(5.61)
35 < Employment <= 110 (size_3)	-0.2942***		-0.2920***
	(4.59)		(4.55)
Employment > 110 (size_4)	-0.4602**		-0.4506**
	(2.46)		(2.40)
Employment size (employ00)		0.0002	
		(1.61)*	
Overseas Link dummies:			
Vertical link (org_vert_abroad)	0.6100**	0.5954*	0.6699***
	(2.39)	(1.91)	(2.76)
Horizontal link (org_horiz_abroad)	1.1818***	1.1542***	1.2099***
	(3.75)	(3.21)	(3.95)
Partner part of firm (org_vi_abroad)	0.1681		
	(0.71)		
R&D overseas link (org_rd_abroad)	0.2782		
	(0.69)		
Overseas Link x size interactions:			
		0.0003	
		(1.48)	
		-0.0001	
		(1.39)	
Controlling covariates:			
Enterprise is part of wider group (group)	0.2242	-0.0461	0.2350
	(1.32)	(0.39)	(1.39)
Product innovation proxy (prod_change)	0.2019*	0.0422	0.2132*
	(1.67)	(0.35)	(1.77)
Skill proxy (prop_sci)	0.0237***	0.0211***	0.0240***
	(5.35)	(4.84)	(5.41)
Sector dummies	yes	yes	yes
Observations	1043	1043	1044
Pseudo r^2 (1 – SSR/SST)	0.04	0.03	0.04
AIC	.68	0.69	.67
Initial Pseudo Log Likelihood	345.92	-354.26	-346.29
Log Pseudo Likelihood	332.25	-343.78	-332.54

Notes: ‡ Base category: First Employment Size Quartile
coefficient and z-value reported
*significant at 10%; ** significant at 5%; *** significant at 1%
Standard Errors adjusted using Huber/White/sandwich robust variance estimates.

This result is to some extent analogous to the recent result obtained by BERNARD and JENSEN (2004) who report from their regressions that firms making radical changes to their product mix (registered as an industry switch) increase the probability of exporting. My more direct measure of changed product mix (product changed or tailored), is positively and significantly related to export intensity. Furthermore, firms possessing higher endowments of science graduates, *prop_sci*, report higher export intensities.

One possible reason for the seemingly anomalous result that exports are highest for the smallest firms in the sample may be due to the different formulation of the size variable in the study. Other studies have employed a continuous variable. Accordingly, in estimation (2) as a robustness check, size is formulated as a continuous variable. Now the size variable behaves as it has in existing studies. It shows that larger firms have higher export intensities. The message to take from this robustness check is that formulating size as a continuous variable may mask potential non-linearities that will be explored later in the section on marginal effects.

Estimation (2) also investigates the hypothesis that there are differential effects to overseas links for large and small firms respectively (Hypothesis 2). There were no positive interactions of enterprise size with the overseas link dummies, for either horizontal or vertical links.[9]

Estimation (3) shows the final equation that will be used to derive the marginal effects for the model. From this it will be attempted to quantify to what extent overseas links help the firms in my sample through higher export volumes.

Although we can observe from Table 3 the relative importance (rank) and significance (p-value) of the covariates, it is useful to check the marginal effects for overseas links on export intensities. Accordingly, Tables 4 and 5 report the effects of vertical and horizontal links on predicted export intensities respectively. The marginal effect of an independent variable is the derivative (that is, the slope) of the prediction function, which by default is the probability of success, for example 60 per cent. We follow the convention of calculating the derivative at a point which is at the means of the covariates for the continuous variables such as *'prod_change'* but also the sec-

9 Another difference between estimation (2) and estimation (1) is that the innovation variable for which I test Hypothesis 3 is now insignificant. This difference is most likely due to collinearity.

toral variables. Moreover, the at() option is used in Stata to set the point to 0 for horizontal overseas links when looking to calculate the effect of vertical overseas links. In other words, when looking at the marginal effects for vertical overseas links, the model assumes that no horizontal links exist because we need to observe the pure marginal effect due only to vertical links. Likewise, vertical overseas links are set to 0 when looking to calculate the marginal effect due to horizontal overseas links.

Table 4: Predicted export intensities with Vertical Links and Marginal Effects

Size category	Enterprise has vertical link	Enterprise has no vertical link	% to exports from link
Up to 15 employees	28	17	65%
Between 15 and 35 employees	17	10	70%
Between 35 and 110 employees	23	13	77%
Greater than 110 employees	20	11	82%

Notes: Marginal effects derived from GLS estimations in Table 3
Covariates set at mean values

Table 5: Predicted export intensities with Horizontal Links and Marginal Effects

Size category	Enterprise has horizontal link	Enterprise has no horizontal link	% to exports from link
Up to 15 employees	40	17	135%
Between 15 and 35 employees	26	10	160%
Between 35 and 110 employees	33	13	154%
Greater than 110 employees	30	11	173%

Notes: Marginal effects derived from GLS estimations in Table 3
Covariates set at mean values

From Table 4 we see that regardless of size category, vertical links are associated with an average increase in exports of about 74 per cent. There is little variation within size categories in the magnitude of the change, the smallest increase of 65 per cent registered by firms with up to 15 employees and the largest increase of 82 per cent by firms with over 110 employees. Consistent with our examination of the coefficients in the earlier table (Table 2), the smallest firms in our sample with up to 15 employees have the highest exports. However, even though the interaction terms (Estimation

2) showed no significance for size/overseas link interactions, there is some tentative evidence here that the largest firms benefit most from vertical links with an increase in exports of 82 per cent.

Interestingly, when we look at the marginal effects for horizontal links in Table 5, firms with these links exhibit even higher export intensities than we saw earlier for firms with vertical links. Firms who belong to horizontal overseas links experience an increase in exports of on average 156 per cent. Once again, it is the very largest firms in our sample that benefit most from overseas links where firms with at least 110 employees increase their exports by approximately 173 per cent.[10]

6 Conclusions

The analysis of association between overseas links, innovation and exports shows a number of statistical regularities. Specifically, it was found that overseas vertical links are associated with an increase in export intensity of about 74 per cent, while vertical links are associated with an average increase in export intensity of approximately 156 per cent. Because my analysis is associative rather than causative, this result shows that firms with overseas links are associated with higher exports than firms without such links.

No evidence was found of any significant size/overseas link interactions. This suggests that firm size does not play a role in leveraging exports from overseas links. The marginal effects however, suggest however that the largest firms in the sample gain the highest export gains from overseas links, both vertical and horizontal.

Additionally some evidence was found that innovators report higher export intensities. This is consistent with evidence from BERNARD and JENSEN (2004), who conclude that more innovative firms (those who differentiate their products by changing the product mix) are more likely to export.

The findings of this study overall suggest that overseas links are effective conduits of export activity. This conclusion stands despite the comparatively few firms in our sample using overseas links relative to firms using more integrated overseas relationships.

10 However, the low numbers of observations in the data relating to horizontal links suggests caution in interpreting this result as no significant size/ link interactions were observed.

Result that overseas links represent important conduits for exports, underpins the role of government institutions such as the UK Trade & Investment body in the UK, which facilitates contacts with overseas firms by supporting small businesses, businesses entering markets of strategic interest (for example Gulf Co-operation Council States or China) and recently firms from the high technology sector.[11] It is clear that fostering overseas links at such venues can offer businesses a viable way of increasing exports, in some circumstances replacing the need for FDI.

11 The UK Tradeshow Access Programme is geared towards subsidising firms wishing to make contact with overseas intermediaries and customers.

References

AW, BEE YAN, MARK ROBERTS and TOR WINSTON (2007), Export Market Participation, Investments in R&D and Worker training, and the Evolution of Firm Productivity, *The World Economy* 30 (1), pp. 83–104.

BARRIOS, SALVADOR, HOLGER GÖRG and ERIC STROBL (2003), Explaining Firms Export Behaviour: R&D, Spillovers and the Destination Market, *Oxford Bulletin of Economics and Statistics* 65 (4), pp. 475–496.

Basile, Roberto (2001), Export Behaviour of Italian Manufacturing Firms over the Nineties: The Role of Innovation, *Research Policy* 30 (9), pp. 1185–1201.

BERNARD, ANDREW and J. BRADFORD JENSEN (2004), Why Some Firms Export, *The Review of Economics and Statistics* 86 (2), pp. 561–569.

BERNARD, ANDREW and JOACHIM WAGNER (2001), Export Entry and Exit by German Firms, *Weltwirtschaftliches Archiv/Review of World Economics* 137 (1), pp. 105–23.

BERNARD, ANDREW, JONATHAN EATON, J. BRADFORD JENSEN and SAMUEL KORTUM (2003), Plants and Productivity in International Trade, *American Economic Review* 93 (4), pp.1268–1290.

BLEANEY, MICHAEL and KATHERINE WAKELIN (2002), Efficiency, Innovation and Exports, *Oxford Bulletin of Economics and Statistics* 64 (3), pp. 3–15.

CASSIMAN, BRUNO and REINHILDE VEUGELERS (2002), R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium, *American Economic Review* 92 (4), pp. 1169–84.

DEPARTMENT OF TRADE AND INDUSTRY (2004), *International Comparisons of the Third Community Innovation Survey* (CIS3), Internet: http://www.berr.gov.uk/files/file9657.pdf (as of February 23, 2009).

FEENSTRA, ROBERT, TZU-HAN YANG and GARY HAMILTON (1999), Business Groups and Product Variety in Trade: Evidence from South Korea, Taiwan and Japan, *Journal of International Economics,* 48 (1), pp. 71–100.

GHIRONI, FABIO and MARC MELITZ (2004), International Trade and Macroeconomic Dynamics with Heterogenous Firms, *Boston College Working Papers in Economics* No. 599.

HARRIS, RICHARD and QIAN CHER LI (2005), *Review of the Literature: the Role of International Trade and Investment in Business Growth and Development,* Report for UKTI.

HELPMAN, ELHANAN, MARC MELITZ and STEPHEN YEAPLE (2004), Export Versus FDI with Heterogeneous Firms, *American Economic Review* 94 (1), pp 300–316.

HSING, YOU-TIEN (1999), Trading Companies in Taiwan's Fashion Shoe Networks, *Journal of International Economics* 48 (1), pp. 101–20.

KNELLER, RICHARD and MAURO PISU (2007), Industrial Linkages and Export Spillovers from FDI, *The World Economy* 30 (1), pp.105–134.

LACHENMAIER, STEFAN and LUDGER WÖSSMANN (2006), Does Innovation cause Exports? Evidence from Exogenous Innovation Impulses and Obstacles using German Micro Data, *Oxford Economic Papers* 58 (2), pp. 317–350.

LEFEBVRE, ELISABETH, LOUIS LEFEBVRE and MARIO BOURGAULT (1998), R&D Related Capabilities as Determinants of Export Performance, *Small Business Economics* 10 (5), pp. 365–377.

LEFEBVRE, ELISABETH and LOUIS LEFEBVRE (2001), *Innovative Capabilities as Determinants of Export Behaviour and Performance: A Longitudinal Study of Manufacturing SMEs,* in: KLEINKNECHT, ALFRED and PIERRE MOHNEN (eds.), *Innovation and Firm Performance. Econometric Exploration of Survey Data.* London: Palgrave.

LOVE, JAMES and STEPHEN ROPER (2001), The Determinants of Export Performance: Panel Data Evidence for Irish Manufacturing Plants, *NIERC Working Paper Series* No. 69.

MACGARVIE, MEGAN (2005), The Determinants of International Knowledge Diffusion as measured by Patent Citations, *Economics Letters* 87 (1), pp. 121–126.

MCLAREN, JOHN (1999), Supplier Relations and the Market Context: A Theory of Handshakes, *Journal of International Economics* 48 (1), pp. 121–38.

MELITZ, MARC (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica* 71 (6), pp. 1695–1725.

PAPKE, LESLIE and JEFFREY WOOLRIDGE (1996), Econometric Methods for Fractional Response Variables with an Application to 401(K) Plan Participation Rates, *Journal of Applied Econometrics* (11) 2, pp. 619–632.

RAUCH, JAMES (2001), Business and Social Networks in International Trade, *Journal of Economic Literature* 39 (4), pp. 1177–1203.

RAUCH, JAMES (1999), Networks versus Markets in International Trade, *Journal of International Economics* 48 (1), pp. 7–35.

RAUCH, JAMES and JOEL WATSON (2004), Network Intermediaries in International Trade, *Journal of Economics and Management Strategy* 13 (1), pp. 69–93.

RUANE, FRANCES and JULIE SUTHERLAND (2005), Export Performance and Destination Characteristics of Irish Manufacturing Industry, *Review of World Economics/Weltwirtschaftliches Archiv* 141 (3), pp. 442–59.

ROBERTS, MARK and JAMES TYBOUT (1997), An Empirical Model of Sunk Costs and the Decision to Export, *American Economic Review* 87 (4), pp. 545–564.

SCHMITZ, HUBERT (1999), From Ascribed to Earned Trust in Exporting Clusters, *Journal of International Economics* 48 (1), pp.139–50.

STERLACCHINI, ALESSANDRO (2001), The Determinants of Export Performance: A Firm-Level Study of Italian Manufacturing, *Weltwirtschaftliches Archiv/Review of World Economics* 137 (3), pp. 450–72.

VEUGELERS, REINHILDE and BRUNO CASSIMA (1999), Make and Buy in Innovation Strategies: Evidence from Belgian Manufacturing Firms, *Research Policy* 28 (1), pp. 63–80.

WAGNER, JOACHIM (1996), Export Performance, Human Capital and Product Innovation in Germany: A Micro View, *Jahrbuch für Wirtschaftswissenschaften* 47 (1), pp. 40–45.

WAGNER, JOACHIM (2001), A Note on the Firm Size – Export Relationship, *Small Business Economics*, 17 (4), pp. 229–237.

WAKELIN, KATHERINE (1998), Innovation and Export Behaviour at the Firm Level, *Research Policy* 26 (7-8), pp. 829–841.

Appendix 1: List of Variables

Variable name	**Variable label**
employ00	Number of employees in 2000
employ98	Number of employees in 1998
exp_int	Export intensity: exports /turnover
export00	Total exports in 2000
export98	Total exports in 1998
group	Enterprise part of a wider business conglomerate
org_vert_abroad	Upstream or downstream overseas partner
org_horiz_abroad	Overseas partner in same SIC area
org_vi_abroad	Overseas partner integrated within the firm
org_rd_abroad	Overseas collaboration for R&D
prod_change	Innovation generates portion of Sales
produnch	percentage of turnover from unchanged products
propoth	percentage of employees educated to degree level or above - other
propsci	percentage of employees educated to degree level or above - science and engineer
sic2digi	2 digit SIC code
turn00	total turnover in 2000
turn98	total turnover in 1998

Appendix 2: Correlation Matrix

	exp_int	employ00	group	org_horiz_abroad	org_vert_abroad	org_rd_abroad	org_vi_abroad	propsci
exp_int	1							
employ00	0.0402*	1						
group	0.1643*	0.1606*	1					
org_horiz_abroad	0.1221*	0.1215*	0.0385*	1				
org_vert_abroad	0.1703*	0.0237	0.0430*	0.1333*	1			
org_rd_abroad	0.0762*	0.0202	0.0349*	0.0835*	0.1183*	1		
org_vi_abroad	0.1338*	0.0326*	0.0853*	0.1113*	0.1994*	0.1659*	1	
propsci	0.2283*	0.0248	0.0693*	0.0427*	0.1077*	0.0752*	0.0834*	1

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