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External Trade and Internal Geography: Local Export Spillovers by Industry Characteristics and Firm Size

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ABSTRACT *Exporting firms in a region may reduce export entry costs for other local firms either through market or non-market interactions. This paper tests this proposition by analyzing whether the probability of exporting among Swedish firms is positively associated with the local presence of exporters in their region and industry. Our results support this conjecture, while also providing some support for such export spillovers being more important in contract-intensive industries and small firms. The results for different industries and size-classes of firms are also sensitive to whether we focus on firms' export status or restrict the sample to export starters.*

Commerce extérieur et géographie interne—diffusion des exportations locales par caractéistiques des secteurs industriels et envergue des entreprises

RÉSUMÉ *Les firmes exportatrices dans une certaine région pourront réduire les coûts d'entrée à l'exportation pour d'autres entreprises locales, par le biais d'interactions commerciales ou non commerciales. La présente communication soumet cette proposition à des tests en analysant si la probabilité d'exportation parmi des sociétés suédoises est en rapport positif avec la présence locale d'exportateurs dans leur région et dans l'industrie. Nos résultats soutiennent cette conjecture, tout en apportant un certain soutien pour l'importance majeure de cette diffusion des exportations dans des secteurs intensifs sur le plan des contrats et des petites entreprises. Les résultats pour différents secteurs ou entreprises classées sur le plan de leur envergure sont néanmoins sensibles au plan sur lequel nous plaçons notre recherche, à savoir le statut export des entreprises ou la limitation de l'échantillon aux nouvelles entreprises exportatrices.*

Comercio externo y geografía interna—spillovers de exportación local por características de industria y tamaño de empresa

EXTRACTO *Las empresas exportadoras de una región pueden reducir los costes de entrada de exportaciones para otras empresas locales, a través de interacciones de mercado o que no sean de mercado. El estudio pone a prueba esta proposición analizando si la probabilidad de exportación entre empresas suecas se asocia positivamente con la presencia local de exportadores en su región e industria. Nuestros*

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resultados apoyan esta conjetura, mientras que también proporcionan cierto apoyo para la idea de que dichos spillovers de exportación son más importantes en industrias de contratos intensivos y empresas pequeñas. Los resultados para diferentes empresas y clases de tamaños de empresas son, no obstante, sensibles a si nos centramos en el estado de exportación de las empresas o si restringimos la muestra a empresas nuevas en exportación.

外部贸易和内部地理—行业性质和公司规模对本地出口的影响

摘要：一个地区的出口公司可能会通过市场或非市场途径降低其他本地公司的出口报关成本。本文通过分析瑞典公司的出口概率是否与其所在地域和行业的出口商正相关来验证这一假设。结果证实了这一假设，同时也证明，这种出口影响对合同密集型产业和小公司更为重要。但是，行业不同，公司规模不同，其结果会受到对公司出口状况关注与否以及对出口商样本数目的限制的影响。

KEYWORDS: *Agglomeration; export; local export spillovers; transaction costs; relationship-specific investment; small firms; international trade; spillovers*

JEL CLASSIFICATION: F10; F14; M21; L25; R12

1. Introduction

What are the determinants of a firm's participation in international trade? An established finding is that firm characteristics matter: exporting involves significant fixed (sunk) entry costs which imply productivity thresholds that only more productive firms can overcome (Bernard & Jensen, 1999, 2004; Greenaway & Kneller, 2007; Wagner, 2007). At the same time, it seems that entry costs cannot be equated with a one-time sunk investment to overcome export market barriers, but need to be incurred on a recurring basis (Roberts & Tybout, 1997).

The present paper emphasizes regional characteristics and builds on the idea that spatial proximity to already established exporters may reduce export entry costs for domestic firms. This conjecture is known as the 'local export spillover' hypothesis (Aitken *et al.*, 1997), and suggests that the local presence of established exporters is an important determinant of a firm's export status.

A significant part of the costs associated with exporting can be interpreted as informational transaction costs, which comprise, e.g. gathering as well as updating information on export opportunities and potential markets, identifying trustworthy trading partners at home (e.g. an export agent) and overseas (e.g. a local distributor), engaging in contract negotiations and learning about contract enforcement issues abroad, etc. (North & Thomas, 1973; Williamson, 1979; Trefler, 1995; Anderson, 2000). Spatial proximity to exporters may reduce such costs in two main ways. The first is non-market interactions such as spatially bounded flows of information about the practice of exporting and characteristics of foreign markets. The second is market interactions where the local presence of exporters may attract ancillary export services sectors and trade intermediaries to a region. Both mechanisms suggest that the individual firm should enjoy better access to export information—and thus lower export entry costs—if there is a high local concentration of exporters.

Previous literature provides mixed results as regards the empirical relevance of the local export spillover hypothesis. For instance, Aitken *et al.* (1997) use data on

Mexican manufacturing plants and find the probability of Mexican plants exporting to be uncorrelated with the local concentration of exporters in the plants' industry. Likewise Bernard & Jensen (2004) find no evidence that geographic spillovers may increase the probability of entry into exporting. By contrast, Greenaway & Kneller (2008), analyzing the exporting behaviour of manufacturing firms in the United Kingdom, show that spillovers associated with regional and industry agglomeration seem to be relevant to successful entry of new exporters. Evidence of local export spillovers is also provided by Koenig *et al.* (2010), who investigate the impact of local exporters on the export decision of French manufacturers and consider destination-specific spillovers.

The current paper makes use of Swedish firm-level data with information of firms' aggregate export status. The nature of these data does not allow for an assessment of destination-specific spillovers as in Koenig *et al.* (2010). The main contribution of the paper is instead its analyses of how the importance of local export spillovers varies across different types of industries and small and large firms. It distinguishes itself from previous studies of export spillovers in two main respects. First, the paper argues that the importance of local export spillovers may vary across industries—an issue that has received little attention in previous studies. We hypothesize that an industry's contract intensity influences the extent to which firms in that industry benefit from local export spillovers. The underlying logic is that the more contract-intensive an industry is, the higher the upfront transaction costs of exporting since the exporting firm has to bear a larger relationship-specific investment compared with a firm belonging to a less contract-intensive industry (cf. Nunn, 2007). Transaction costs associated with exporting, such as gathering information and knowledge of trading partners, contract negotiations and contract-enforcement practices, are hence expected to be higher in contract-intensive industries. This reinforces the function that local export spillover in the industry may play in lowering export costs. In the empirical analysis, we split our sample into firms belonging to contract-intensive and less contract-intensive industries, using an index of contract intensity by industry developed by Nunn (2007).

A second element of the analysis is that we test whether local export spillovers are more important for smaller firms. Small firms have been shown to be endowed with limited internal resources (Hessels & Terjesen, 2010), and may therefore face comparably large costs of accumulating export knowledge. Throughout the paper we conduct separate estimations for small and large firms.

Our results provide empirical support for the general relevance of local export spillovers. While controlling for several determinants of a firm's export status, we find that firms are more likely to export if they are located in regions with a local presence of many exporters in the same industry. Local export spillovers appear more important for contract-intensive industries. When splitting the sample between firms in high and low contract-intensive industries, we find that the local presence of exporters only matters for both small and large firms in industries with high contract intensity. In less contract-intensive industries, only small firms appear to benefit from spillovers. The results for different industries and size-classes of firms are sensitive to whether we focus on firms' export status or isolate the export starters.

The remainder of the paper is structured as follows: Section 2 provides a theoretical framework for local export spillovers, which includes a discussion of the nature of export entry costs and the specific mechanisms by which local export spillovers reduce these costs. In Section 3, we present the econometric model, the

export spillover variable and discuss the estimation issues. Section 4 presents results and Section 5 concludes.

2. Local Export Spillovers and Entry Costs

2.1. The Nature of Entry Costs into Export Markets

Export costs appear to a large extent to be determined by 'informal' barriers to trade—as opposed to classical trade barriers such as transportation costs and tariffs (Trefler, 1995; Rauch & Watson, 2004).[1] These barriers normally encompass incomplete information about international trading opportunities, uncertainty about contract enforcement and unfamiliarity with market characteristics abroad (Anderson, 2000; Rodrik, 2000; Anderson & Marcouiller, 2002; Anderson & van Wincoop, 2004).

A useful way to conceptualize informal trade barriers is the transaction cost economics (TCE) framework (Williamson, 1979). North & Thomas (1973) identify different types of transaction costs: (i) costs of search and information; (ii) negotiation costs; and (iii) enforcement costs. Information and negotiation costs constitute *ex ante* costs of contracting, whereas enforcement costs can be categorized as *ex post* costs of contracting. Under the reasonable assumption of far-sightedness and a limited tolerance for risk (Mahoney, 1992; Williamson, 1998), *ex post* costs of monitoring and enforcement should also play a major role in firms' *ex ante* decision-making on whether it will be profitable to incur a given transaction. From a firm and export perspective, *ex ante* transaction costs can be thought of as market and agent information costs (Zacharakis, 1997). They arise, for example, when it comes to identifying local business partners (e.g. a distributor) or customers—who, moreover, may be geographically distant, operate under political instability and weak legal systems, behave according to different cultural norms and speak a different language. Lack of knowledge about markets and behaviour of agents—in particular with respect to such non-familiar market environments—conceivably adds to a firm's perception of uncertainty and risk, and represents export costs.

At the same time, previous research shows that the costs that firms incur when entering export markets are not single sunk investments. Roberts & Tybout (1997), for example, find that by the time a plant has been out of the export market for two years, its probability of exporting differs little from that of a plant that has never exported. They suggest that this pattern is consistent with the need to update export-specific information on a recurring basis. Moreover, it might well be possible that a firm decides to enter different export markets or changes its export supply pattern in consecutive years—which would also entail recurrent entry costs. In this way, informational entry costs arguably act as a recurrent 'tax on trade'.

2.2. Spatial Proximity to Exporters, Entry Costs and Firms

Most firm-level analyses take the magnitude of entry costs as given and focus on which types of firms are able to incur them. Entry costs are interpreted as productivity thresholds that only more productive firms (often with sizable internal economies of scale) can overcome. Therefore, it is argued that more productive firms self-select into an export status (Roberts & Tybout, 1997; Bernard & Wagner, 1997; Bernard & Jensen, 1999, 2004; Greenaway & Kneller, 2007; Wagner, 2007).

The literature on local export spillovers, however, focuses on how a firm's local environment may influence the magnitude of export market entry costs. The basic argument is that proximity to exporters improves a firm's access to export information and knowledge, thus reducing entry costs (see e.g. Aitken *et al.*, 1997; Bechetti & Rossi, 2000; Requena Silvente & Castillo Giménez, 2007; Greenaway & Kneller, 2008; Koenig *et al.*, 2010). A non-exporting firm located in a region with density of exporters may thus, because of better access to information, face lower entry costs than a similar firm located elsewhere.

There are two main ways in which proximity to exporters may reduce informational export costs faced by local firms: (i) market interactions and (ii) non-market interactions. Market interactions refer to improved access to export service industries (e.g. export agents and trade middlemen) that can be expected to cluster in regions with a high concentration of exporting firms.[2] They also refer to the sharing of costs and risks of exporting (Anspacher, 2002). Non-market interactions involve more informal diffusion and spillovers of information and knowledge about the practice of exporting and export markets (Aitken *et al.*, 1997; Sjöholm, 2003; Koenig, 2009). Implying learning processes—which often have a 'face-to-face' nature (Duranton & Puga, 2003)—these non-market export information spillovers can be transmitted, among others, via mobility of personnel between firms, social gatherings, friendship, local industry associations, etc.[3] Both mechanisms are means by which information transaction costs associated with exporting may be reduced. This conjecture is known as the 'local export spillover' hypothesis, which will be tested in the present paper.

2.3. The Role of Industry Characteristics and Firm Size

While in principle any type of firm could benefit from local export spillovers, there are theoretical arguments suggesting that the impact of such spillovers may depend on the characteristics of the industry that a firm belongs to as well as firm size.

A basic hypothesis is that local export spillovers are more relevant to industries with high contract intensity. In such industries, contracts matter and transaction costs are thus expected to be more significant. Knowledge and information about negotiation practices, contract-enforcement procedures as well as informal and formal institutions in foreign markets is expected to be of greater importance. The underlying argument is built around three important attributes of transactions and their associated costs (see e.g. Williamson, 1979, 1998; Joskow, 1985): (i) contracts are inherently incomplete; (ii) transactions feature complexity and uncertainty; and (iii) transactions may require one or both parties to make relation-specific (idiosyncratic) investments. Limited knowledge and information about foreign markets enhance expected transaction costs, especially for firms in contract-intensive industries where contractual issues are important. A firm may choose to withdraw from a planned transaction given the high costs, uncertainties and risk of facing holdup on defaulted contracts (cf. Mahoney, 1992; Anderson, 2000).[4] Local export spillovers are expected to play an important role in contract-intensive industries, by increasing a firm's knowledge and information about foreign markets and thereby reducing transaction costs.

As regards firm size, there are arguments that local export spillovers may be more important for smaller firms. This argument draws on the resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney & Arikan, 2001). The RBV defines

the firm as a collection of firm-specific and slowly changing resources that are difficult to imitate, emphasizing capabilities and competencies that are internal to the firm (Link & Siegel, 2007). On that basis, one can conjecture that small firms—due to their limited internal resources, such as stock of accumulated knowledge and human capital (Johanson & Vahlne, 1977; Zacharakis, 1997; van Beers & van der Panne, 2009)—may have more difficulty in incurring entry costs associated with exporting than large firms. Small firms' sales on international markets may be particularly dependent upon information and knowledge flows from the local environment.[5] When internal resources are weak, external resources are likely to be of greater importance (Sherer & Lee, 2002; Hessels & Terjesen, 2010), and local export spillovers are indeed such an external resource.[6] Spatially bounded externality phenomena may substitute for weak internal resources (cf. Acs *et al.*, 1994).

In the empirical analysis we test these conjectures by conducting separate estimations for firms in industries with high and low contract intensity, and for small and large firms.

3. Data and Empirical Strategy

3.1. Data

The empirical analysis presented in this study builds on a panel dataset containing observations on manufacturing firms in Sweden (NACE 15–37) with 10 or more employees. Covering the period 1997–2004, this dataset is the product of four data sources that have been matched based on a unique identification number of each firm. In all data sources a firm is defined as a legal entity. The data have been gathered by the Swedish Customs Office and Statistics Sweden. The first dataset provides information on firms' import and export activities on a yearly basis. The second data source contains balance-sheet information on the firms, such as employment, value-added, sales, gross investments, short- and long-run debts, etc. The Swedish employment database (RAMS) constitutes the third dataset, giving information on the education structure of each firm's employees. The fourth dataset provides insight into the firms' ownership structure, indicating whether a firm is non-affiliated or whether it is owned by a domestic corporation, a domestic multinational or a foreign multinational.

Each firm is assigned to one of 81 functional regions in Sweden through a spatial identifier.[7] A drawback of the data is that they do not contain information on whether a given firm is a multi-plant firm or not. However, multi-plant phenomena are mostly a feature of corporations, and the empirical model includes control variables for affiliation to corporations.

In order to test the importance of an industry's contract intensity, we merge our basic data with a novel industry classification developed by Nunn (2007) who classifies industries based on the importance of relationship-specific investments within an industry, i.e. investments whose value within a seller–buyer relationship is much higher than outside (see Nunn (2007) for details). In particular, he develops an index of contract intensity for different manufacturing industries based on the fraction of products that are not sold on organized exchange and not referenced priced, following Rauch's (1999) classification of differentiated products. We use this index value to distinguish between industries with high (above-median) and low (below-median) contract intensity.

3.2. Empirical Model and Variables

3.2.1. Model. The empirical model is designed to test whether regional variables, assumed to reflect local export spillovers, influence the probability that a firm i is exporting in period t. Our main model is given by:

$$\Pr(X_{irt} = 1) = \Phi(\lambda' \mathrm{F}_{irt-1}, \beta' \mathrm{R}_{irt-1}, \gamma' \mathrm{Z}_{irt-1}) \quad (1)$$

Firm attributes *Regional characteristics* *Other control variables*

where X_{irt} is a binary indicator taking the value 1 if firm i in region r is exporting in period t and 0 otherwise. There are three groups of variables assumed to influence the probability that a firm i is exporting in any year t ($X_{irt} = 1$); (i) firm attributes (**F**); (ii) regional characteristics (**R**); and (iii) other control variables (**Z**). The $t-1$ subscript indicates that all explanatory variables are lagged one period to reduce potential endogeneity and simultaneity issues (cf. Koenig *et al.*, 2010). Our focus on local export spillovers implies that the main interest is on the influence of regional characteristics (**R**). If the estimated parameters in β associated with the variables in **R**, which are assumed to reflect local export spillovers, are positive and significant, it provides support for the hypotheses in the paper. Ottaviano & Martincus (2011) present an analysis of exporting firms using a similar empirical set-up.

Note that the estimated effects will be conditional on both firm attributes and other controls. The model in Equation (1) is the baseline model which will be estimated for small and large firms and for firms in industries with different contract intensity. Following the arguments in the previous section, the hypothesis is that the effect of the local export spillover variables will be stronger for small firms and for firms in contract-intensive industries.

As a robustness test we also consider two additional dependent variables which isolate export starts. The first is a dummy for multiple starts which is 1 for a firm in year t if the export status of that firm equals 1 in that year and if the export status in $t-1$ equals 0 (i.e. no exports in the previous year). The second is a dummy variable for first-time exporters, which is 1 for the point in time when the firm starts to export for the first time during the sample period, where changes in the firm's export status beyond this start are ignored. For both these variables, firms that export persistently during the sample period are deleted from the sample, such that export starters are compared with non-exporters.

These types of indicators of export starts have been applied in recent analyses by, e.g. Koenig *et al.* (2010), who make use of firm-level export data tabulated over products and destination countries and consider export starts of products to different destinations. In our empirical context where the observational unit is firms and their aggregate export status these indicators of export starts should yet be interpreted with care. Persistent exporters may, for example, start to export novel export products and enter new export markets over time despite their overall export status remaining unchanged. Although characteristics of the firms' location may matter for such dynamics, persistent exporters will simply be deleted from the analysis by construction of the indicators of export starts. In the subsequent analyses, export starts will just refer to whether the firm exports or not since we cannot account for the composition or destination of the firms' export flows. We will, however, consider specifications of export starts as a test of robustness and sensitivity of the results.

3.2.2. Variables. How do we empirically measure the potential of export spillovers in a region? The main spillover variable in this study is based on the number of exporters in each given functional region and two-digit industry. The basic idea is that in regions with several other export firms in the same industry, there is richer information and knowledge about export markets and the practice of exporting. In line with previous studies, we assume that local export spillovers are primarily of intra-industry nature (cf. Chevassus-Lozza & Galliano, 2003; Greenaway & Kneller, 2008).[8] Empirically, we construct our spillover variable by counting the number of exporters in each two-digit NACE sector and region on a yearly basis, thus considering export spillovers that are internal to the two-digit industry and region.[9]

In order to isolate the effect of the described spillover variable on the probability of exporting, the empirical model includes several control variables, at the firm, region and industry level. Table 1 presents and defines all variables in the analysis. Descriptive statistics are presented in Table 2. Starting with firm-level

Table 1. Variables in the empirical analysis

Variable	Definition	Exp. sign	Aimed to measure
Spillover variable (local export spillovers)			
Exporters in region	Number of exporters in the two-digit industry and region the firm is located in year t	+	Potential of local export spillovers for a firm in the same two-digit industry
Firm-level control variables			
Previous export status	Dummy variable which is 1 if the firm exported in $t-1$, 0 otherwise	+	Export experience (sunk costs)
Imports	Dummy variable which is 1 if the firm has imports, 0 otherwise	+	Import networks to foreign markets // advantages of global specialization
Human capital	Fraction of employees with a university education of at least three years	+	Absorptive capacity, knowledge resources
Labour productivity	Value-added per employee	+	Productivity
Physical capital	Accounting value of machinery and buildings per employee	+	Technology, scale economies
Size	Number of employees	+	Scale economies, general internal resources
MNE	Dummy variable which is 1 if the firm belongs to MNE, 0 otherwise	+	Foreign networks, corporate resources
Corporation	Dummy variable which is 1 if the firm belongs to domestic corporation, 0 otherwise	+	Networks, corporate resources
Regional control variables			
Regional size	Total number of employees in the region the firm is located in	+/−	General agglomeration phenomena // congestion
Metropolitan region	Dummy variable which is 1 if the region the firm is located in is Stockholm, Göteborg or Malmö, 0 otherwise	+/−	General agglomeration phenomena // congestion
Other controls			
Time-invariant industry effects	Dummies for each two-digit industry	//	Unobserved industry heterogeneity
Time effects	Year dummies	//	Business cycle effects

Notes: +denotes that we expect a positive influence, − a negative. // implies no firm expectation. All firm-level and regional control variables except *Previous export status* and *Metropolitan region* are lagged by one year to avoid reverse causality issues.

Table 2. Descriptive statistics on the variables in the empirical analysis

Variable	Mean	Std Dev.
Previous export status	0.72	0.44
Imports	0.65	0.47
Human capital	0.04	0.07
ln (Labor productivity)	3.84	0.40
ln (Physical capital)	6.19	1.87
ln (Employment)	3.47	1.08
MNE	0.31	0.46
Corporation	0.32	0.47
ln (Local exporters in industry)	2.58	1.29
ln (Regional size)	10.94	1.47
Metropolitan region	0.26	0.44

Notes: The variables are explanatory variables. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of exporters in each region in a given two-digit NACE industry during the sample period. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms in contract-intensive and non-contract-intensive industries with at least 10 employees over the period 1997–2004.

controls, the modern theoretical literature on entry costs associated with export market entry emphasizes that firms are heterogeneous and that the more efficient ones self-select into an exporting status (Melitz, 2003). Heterogeneity in firm characteristics may therefore play an important role in explaining a firm's export status. Our empirical model includes six firm-level control variables, assumed to capture heterogeneity across firms that may influence export behaviour. The first is firm *size* measured by the number of employees. Size is a standard control often assumed to reflect scale economies and general internal resources. *Human capital* is defined as the fraction of firms' employees with a university education of at least three years. This reflects knowledge resources embodied in the firms' employees and their absorptive capacity, i.e. firms' capacity to absorb external knowledge from, e.g. the local milieu (Bartel & Lichtenberg, 1987; Cohen & Levinthal, 1990). The model also includes *physical capital* measured as the value of machinery and buildings and *labor productivity* measured as value-added per employee, both of which are expected to positively influence the probability of exporting. Physical capital is a proxy for production technology and scale economies, and labor productivity is a common productivity measure.

There are several arguments in the literature suggesting that entry costs may be sunk, which implies that a firm's previous export status is relevant for current export decisions.[10] Therefore, we include *lagged export status* (1 if positive exports in $t-1$; 0 otherwise). We also include an indicator of each firm's *import status* (1 if the firm has imports, 0 otherwise). Established import networks to foreign countries may matter for exports for two reasons. The first is that contacts with suppliers abroad may bring about information and knowledge about export opportunities in foreign markets (Sjöholm, 2003). The second is that imports may increase firms' efficiency by taking advantage of global specialization, where the quality and variety of inputs may differ across origin countries (cf. Amiti & Konings, 2007; Lööf & Andersson, 2010). We further control for whether a firm is affiliated to a multinational enterprise (MNE) or a domestic corporation. Firms that are part of

corporations can be assumed to have better established foreign networks and knowledge capabilities (Sjöholm, 2003), and are as such likely to acquire knowledge and information about export markets from their 'parent firm'. In particular, affiliation to a MNE often implies access to the company group's established foreign networks and proprietary knowledge and information inside the MNE (cf. Pfaffermayr & Bellak, 2002).

Regional control variables include *regional size* measured in terms of employees. This variable is intended to capture general agglomeration phenomena. We also add a *metropolitan* dummy variable which is 1 if the region is Stockholm, Göteborg or Malmö.

The empirical model further includes two-digit industry dummies and year dummies. Whereas the industry dummies are intended to capture industry-specific characteristics that may influence the probability to export, year dummies are supposed to account for business cycle effects. Pair-wise correlations between all variables are presented in the Appendix (Table A1).

4. Estimation and Results

4.1. Estimation Strategy

We wish to estimate the influence of the variables in Table 1 on the probability that a firm is exporting using the model specified in Equation (1). The analysis is based on panel data where firms are observed over the period 1997–2004, and we employ a panel Probit model with random firm-specific effects. A general argument for firm-specific effects is that there are more often than not relevant unobserved firm-specific characteristics, such as managerial skills and capabilities.

The panel Probit model is given by:

$$\Pr(X_{irt} = 1) = \Phi(\alpha + \lambda' \mathrm{F}_{irt-1}, \beta' \mathrm{R}_{irt-1}, \gamma' \mathrm{Z}_{irt-1} + \mathrm{c}_i + \mu_{irt-1}) \qquad (2)$$

where c_i is a time-invariant firm-specific component and μ_{irt-1} is a remainder disturbance (Wooldridge, 2002). The c_i component of the error term is assumed to be a random variable with a mean-zero normal distribution.[11] As we regress individual variables on aggregated variables, we cluster standard errors at the industry and region level in all estimations (Moulton, 1990).

The empirical strategy is to estimate model (2) for small and large firms, as well as for firms in industries with high and low contract intensity. We will also report results with and without lagged export status, to test if results are sensitive to its inclusion.[12]

4.2. Results

We start by presenting results for the whole manufacturing industry and then go on to the results obtained when doing separate estimations for firms in industries with high and low contract intensity, respectively. Table 3 presents the results for the whole sample, i.e. all firms with at least 10 employees in all manufacturing industries (NACE 15–36). The results are overall in line with our expectations, and a first observation is that the coefficient estimates for all variables drop when we include lagged export status. This illustrates the important role of export experience

Table 3. The probability of exporting explained by firm attributes and regional characteristics: estimates for all firms with and without lagged export status

	(1) Excluding lagged export status	(2) Including lagged export status
Previous export status		1.80***
		(0.0872)
Imports	0.782***	0.595***
	(0.0481)	(0.0342)
Human capital	0.866	−0.023
	(1.120)	(0.4765)
ln (Labor productivity)	0.357***	0.141***
	(0.0524)	(0.0357)
ln (Physical capital)	0.152***	0.079***
	(0.0214)	(0.0118)
ln (Employment)	0.765***	0.195***
	(0.0507)	(0.0292)
MNE	0.688***	0.339***
	(0.0823)	(0.0498)
Corporation	0.220***	0.088***
	(0.0591)	(0.0282)
ln (Number of local exporters in industry)	0.309***	0.081***
	(0.0501)	(0.0261)
ln (Regional size)	−0.155***	−0.036**
	(0.0411)	(0.0165)
Metropolitan region	−0.272**	−0.050
	(0.132)	(0.0534)
Number of observations	32,825	32,825

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the industry and region level. Year and industry dummies are included. The variables in Table 3 are explanatory variables and have a one-year lag. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable displaying 1 if firm i is exporting in year t, and 0 otherwise. Cluster-robust standard errors are in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

for a firm's current export status. The main variable of interest, i.e. the spillover variable, is significant and positive, lending support for the hypothesis that firms located in regions with the local presence of many exporters benefit from local export spillovers. Conditional on several control variables, firms in regions with many other exporters are more likely to export. Second, the control variables have the expected signs: firms who import are more likely to export, and large firms with more physical capital and high labour productivity are also more likely to be exporters.

A high fraction of employees with a long university education also increases the likelihood of exporting, but the variable is insignificant.[13] Consistent with our expectations, firms that are affiliated to MNEs and corporations are more likely to export as compared to firms with no affiliation to a company group. Regional size and the dummy variable for metropolitan regions (Stockholm, Göteborg and Malmö) are negative, which may be interpreted as congestion effects where exporting manufacturing firms may prefer locations outside metropolitan regions

Table 4. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms with and without lagged export status

	(1)	(2)	(3)	(4)
	Firm size class (employment)			
	10–25	>25	10–25	>25
Previous export status			1.904***	1.900***
			(0.0760)	(0.1212)
Imports	0.886***	0.774***	0.562***	0.543***
	(0.0591)	(0.0897)	(0.0375)	(0.0556)
Human capital	0.897	0.962	0.012	0.124
	(1.1184)	(1.5712)	(0.4644)	(0.5263)
ln (Labor productivity)	0.320***	0.327***	0.111***	0.137***
	(0.0646)	(0.0884)	(0.0379)	(0.0518)
ln (Physical capital)	0.140***	0.227***	0.058***	0.092***
	(0.0261)	(0.0381)	(0.0125)	(0.0215)
ln (Employment)	0.628***	0.461***	0.127***	0.101**
	(0.0905)	(0.0866)	(0.0471)	(0.0444)
MNE	0.523***	0.814***	0.187***	0.379***
	(0.1052)	(0.1375)	(0.0549)	(0.0750)
Corporation	0.255***	0.179*	0.091***	0.049
	(0.0804)	(0.1044)	(0.0329)	(0.0526)
ln (Number of local exporters in industry)	0.298***	0.252***	0.055**	0.064*
	(0.0642)	(0.0733)	(0.0277)	(0.0344)
ln (Regional size)	−0.224***	0.021	−0.048***	0.030
	(0.0488)	(0.0598)	(0.0176)	(0.0271)
Metropolitan region	−0.228	−0.164	−0.035	−0.041
	(0.1468)	(0.2022)	(0.0532)	(0.0818)
Number of observations	16,689	16,136	16,689	16,136

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the industry and region level. Year and industry dummies are included. The variables in Table 4 are explanatory variables and have a one-year lag. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

with lower land prices. An alternative explanation could be that small firms focus on the home market when the local market is large.

To assess whether local spillovers matter more for small than large firms, Table 4 presents the results for small (10–25 employees) and large (>25 employees) firms, respectively.

As argued in previous sections, the basic hypothesis is that local export spillovers are more important for small firms, since they often have limited internal resources. We find some evidence that is consistent with this conjecture in that the spillover variables for large firms have a weaker influence on large than small firms in the specification with lagged export status. Other than this, we also find that an affiliation to a domestic corporation does not appear to matter for larger firms (>25 employees) whereas it does for small firms. This may be interpreted as meaning that belonging to a domestic corporation does not add much to larger firms, which could be assumed to possess more substantial internal resources than smaller firms.

Table 5. The probability of exporting explained by firm attributes and regional characteristics: estimates for firms in contract-intensive and non-contract-intensive industries with and without lagged export status

	(1)	(2)	(3)	(4)
		Contract intensity in industries		
	High	High	Low	Low
Previous export status		1.362***		1.992***
		(0.2204)		(0.0855)
Imports	0.921***	0.808***	0.783***	0.530***
	(0.1412)	(0.1031)	(0.0934)	(0.0528)
Human capital	2.017	1.042	2.819**	1.128**
	(1.3251)	(0.6761)	(1.1674)	(0.5177)
ln (Labor productivity)	0.181	0.044	0.285**	0.074
	(0.1302)	(0.0869)	(0.1117)	(0.0655)
ln (Physical capital)	0.109**	0.067*	0.287***	0.101***
	(0.0549)	(0.0379)	(0.0525)	(0.0199)
ln (Employment)	0.680***	0.301***	0.921***	0.223***
	(0.1288)	(0.0872)	(0.1170)	(0.0512)
MNE	1.126***	0.697***	0.601***	0.198**
	(0.2258)	(0.1662)	(0.2067)	(0.0907)
Corporation	0.300*	0.153*	0.478***	0.113**
	(0.1542)	(0.0910)	(0.1218)	(0.0441)
ln (Number of local exporters in industry)	0.323***	0.175**	0.164*	0.013
	(0.1098)	(0.0705)	(0.0862)	(0.0347)
ln (Regional size)	−0.117	−0.068	−0.275***	−0.064***
	(0.1190)	(0.0566)	(0.0653)	(0.0239)
Metropolitan region	−0.354	−0.157	0.358	0.176**
	(0.3711)	(0.2042)	(0.2296)	(0.0848)
Number of observations	4,515	4,515	7,340	7,340

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the industry and region level. Year and industry dummies are included. The variables in Table 5 are explanatory variables and have a one-year lag. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms in contract-intensive and non-contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Moreover, congestion effects associated with regional size appear to primarily pertain to small firms.

4.2.1. Industries by contract intensity. We now turn to an assessment of differences between firms in industries with high and low contract intensity, respectively, employing an industry classification developed by Nunn (2007). Low contract-intensive industries are defined as two-digit NACE industries with an index value of contract intensity below the median, and high contract-intensive industries as two-digit NACE industries with an index value of contract intensity above the median.[14]

Table 5 presents the results for all firms for manufacturing industries with high and low contract intensity, respectively. For each type of industry we perform regressions with and without lagged export status. As in the previous tables, the

Table 6. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms in contract-intensive industries with and without lagged export status

	(1)	(2)	(3)	(4)
	Firm size class (employment)			
	10–25	>25	10–25	>25
Previous export status			1.745***	1.052**
			(0.1238)	(0.4172)
Imports	0.970***	1.197***	0.729***	0.957***
	(0.1857)	(0.3188)	(0.1041)	(0.2373)
Human capital	1.164	7.423***	0.077	4.488**
	(1.3757)	(2.4796)	(0.6961)	(1.8683)
ln (Labor productivity)	0.170	−0.005	0.002	0.013
	(0.1497)	(0.3273)	(0.0834)	(0.2397)
ln (Physical capital)	0.078	0.169	0.0686**	0.082
	(0.0659)	(0.1033)	(0.0319)	(0.0746)
ln (Employment)	0.475**	0.762**	0.002	0.468**
	(0.2258)	(0.3177)	(0.1228)	(0.2255)
MNE	0.818***	1.403***	0.317*	0.995***
	(0.3020)	(0.3351)	(0.1786)	(0.2914)
Corporation	0.308	0.418	0.086	0.294
	(0.2037)	(0.2704)	(0.0864)	(0.1908)
ln (Number of local exporters in industry)	0.397***	0.247	0.123*	0.153
	(0.1412)	(0.1716)	(0.0713)	(0.1158)
ln (Regional size)	−0.232*	0.073	−0.086	0.016
	(0.1180)	(0.2049)	(0.0576)	(0.1133)
Metropolitan region	−0.347	−0.282	−0.080	−0.107
	(0.4519)	(0.5291)	(0.1991)	(0.3643)
Number of observations	1,898	2,617	1,898	2,617

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the industry and region level. Year and industry dummies are included. The variables in Table 7 are explanatory variables and have a one-year lag. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in non-contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

estimator is a panel Probit model with firm-specific random effects and clustered standard errors at the industry-region level. Our basic hypothesis is that local export spillovers are more important in industries with high contract intensity.

We find support for the hypothesis: in industries with high contract intensity, the spillover variable is positive and significant in both specifications, i.e. with and without lagged export status. For industries with low contract intensity, the spillover coefficient is only significant at the 0.1 level in the specification without lagged export status. This lends support for the hypothesis that local export spillovers are more important in industries with high contract intensity.

The control variables have the expected signs, and there are no major differences as regards their influence on the probability of exporting between the different types of industries. The only exceptions are that human capital is

insignificant in industries with high contract intensity, and that regional size is negative and significant for the industries with low contract intensity. The insignificance of the human capital variable for industries with high contract intensity may be interpreted as meaning that these industries in general comprise more advanced manufacturing industries (such as aircraft, electronics and computers) where many firms have a relatively high fraction of human capital, such that the marginal effect of more human capital is low. The negative coefficient estimate for regional size in industries with low contract intensity may be explained by that interaction and face-to-face contacts are less important in these industries, implying lesser advantages of a location in dense regions and higher sensitivity to congestion effects.

Table 7. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms in non-contract-intensive industries with and without lagged export status

	(1)	(2)	(3)	(4)
	Firm size class (employment)			
	10–25	>25	10–25	>25
Export status$_{t-1}$			1.946***	2.022***
			(0.0935)	(0.1677)
Imports	1.027***	0.634***	0.621***	0.420***
	(0.1253)	(0.1603)	(0.0639)	(0.0976)
Human capital	3.187**	4.287	1.109**	2.608*
	(1.3425)	(2.6382)	(0.5145)	(1.4236)
ln (Labor productivity)	0.179	0.322*	0.075	0.012
	(0.1558)	(0.1843)	(0.0749)	(0.1097)
ln (Physical capital)	0.297***	0.383***	0.095***	0.105**
	(0.0699)	(0.1124)	(0.0235)	(0.0435)
ln (Employment)	0.466**	0.744***	0.060	0.206**
	(0.2185)	(0.2058)	(0.1028)	(0.0882)
MNE	0.663**	0.599**	0.175	0.237*
	(0.2825)	(0.3029)	(0.1315)	(0.1470)
Corporation	0.455***	0.540**	0.119**	0.099
	(0.1396)	(0.2209)	(0.0546)	(0.0931)
ln (Number of local exporters in industry)	0.262***	−0.058	0.057	−0.060
	(0.0956)	(0.1392)	(0.0380)	(0.0543)
ln (Regional size)	−0.369**	−0.031	−0.100***	−0.009
	(0.0803)	(0.1147)	(0.0278)	(0.0589)
Metropolitan region	0.359	0.475	0.143***	0.260
	(0.2775)	(0.3929)	(0.0971)	(0.1751)
Number of observations	3,849	3,491	3,849	3,491

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the industry and region level. Year and industry dummies are included. The variables in Table 7 are explanatory variables and have a one-year lag. The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in non-contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Tables 6 and 7 test for differences between small and large firms within industries with high and low contract intensity, respectively. Table 6 shows the results for small and large firms in industries with high contract intensity, and Table 7 presents results for small and large firms in industries with low contract intensity. The purpose of these tables is to test if local export spillovers matter more for small firms in the different industries. The model remains the same, and the estimator is a panel Probit model with firm-specific random effects and clustered standard errors at the industry-region level.

The results from Tables 6 and 7 are in line with the previous ones, where the impact of employment size, imports and affiliation to a MNE are robust across specifications. We again find that an affiliation to a corporation is only significant for smaller firms (10–25 employees). With regard to the variable of main interest, i.e. the spillover variable, we find that it is significant and positive only for small firms for industries with high contract intensity, but it is only weakly significant for small firms when we include lagged export status (Table 6). For large firms, the estimated parameter is positive but statistically insignificant. A similar pattern is obtained for industries with low contract intensity. The spillover is significant for small firms without lagged export status, but is insignificant when lagged export status is included. We interpret this as an indication that local export spillovers matter more for small firms in both types of industries.

As a robustness and sensitivity check of the findings in Tables 3–7, we also estimate the same models with two different dependent variables, i.e. multiple export starts and first-time exporters (see Section 3.2). The results of these estimations are presented in the Appendix in Tables A2–A6, and the overall conclusion from these is that the empirical support for local export spillovers is reduced when we split the data by industries and size-classes of firms. The spillover variable is statistically significant for both multiple starts and first-time exporters in the specification which includes all firms in all industries (Table A2). In all other specifications it is, however, insignificant. One explanation for this is that the estimations for different industries and size-classes are based on very few firm-year observations, where firms that export persistently are dropped from the sample.[15] As argued previously, analyses of export starts are better suited for analyses with detailed data comprising both products and destinations, as in Koenig *et al.* (2010), which may include export dynamics by persistent exporters as well. Local export spillover may matter for established exporters' decision to export new products and/or enter new markets, but we cannot capture this with data in this analysis.

5. Conclusions

The present paper focused on testing the empirical relevance of the local export spillover hypothesis. This hypothesis suggests a link between internal geography and external trade in that the local presence of export firms is assumed to reduce entry cost for local firms, increasing the probability that they export. Using a firm-level dataset and controlling for an extensive set of firm attributes and other characteristics that may influence export behaviour, we find support for the export spillover conjecture; firms located in regions with a stronger presence of exporters in the same industry are more likely to be exporters. We also find that local export spillovers are more important in contract-intensive industries. These are industries in which knowledge of foreign markets in terms of negotiation practices, contract

enforcement and informal as well as formal institutions are likely to be more important, and it is such knowledge that is likely to spillover to local firms. Moreover, we find some support for the view that small firms are particular beneficiaries of local export spillovers.

In summary, we conclude that the results are consistent with the hypothesis that the local presence of exporters reduces entry costs for other local firms, and that such spillovers appear to be more important for contract-intensive industries and small firms. Characteristics of the local environment in which firms operate influence export behaviour, but this influence is not uniform across industries and firms. Also, our results for different industries and size-classes of firms turned out to be sensitive to our alternative export indicators measures, multiple and first-time export starts. As argued in more detail in the paper, export starts are difficult to interpret in our empirical context with information available about firms' aggregate export status. Further analyses of local export spillovers would certainly benefit from more detailed export data able to better capture the export dynamics of persistent exporters.

The analysis in this paper may be extended in several ways. For instance, the paper did not attempt to distinguish between market and non-market interactions. Another avenue would be to use more detailed data regarding firms' decision to start to export new products and novel markets. Such data provide opportunities to conduct finer analyses of the scope of spillovers, for instance assessing whether they are product- and destination-specific.

Notes

1. Informal trade barriers have, for example, emerged to an increasing extent on the international trade research agenda to explain the 'mystery of the missing trade' (Trefler, 1995) or the fact that nations would rather trade with themselves than with each other (McCallum, 1995; Helliwell, 1998).
2. Usually acting as brokers of goods, middlemen perform certain functions that are important from a transaction-cost perspective (Biglaiser & Friedman, 1993; Biglaiser, 1993; Rubinstein & Wolinsky, 1987; Rauch, 2001).
3. Anecdotal evidence of local export spillovers via non-market interactions is provided by Schmitz (1995, p. 21). Discussing the Sines Valley region of Brazil, the origin of over 80 percent of the country's footwear exports, he notes that 'non-economic ties between actors do seem to play a major role. Some are to do with ethnicity (being of German descent); others with geography (being local); or kinship'. Schmitz (1995, p. 12) also states that 'the diffusion of information and ideas between the firms occurs not only in business transactions, but also at social gatherings of friends, family, sports club, neighborhood or church'.
4. The TCE framework assumes indeed that organizations are far-sighted in the sense that they look ahead, try to perceive hazards and incorporate these into the contractual calculus (Williamson, 1998).
5. This may be further fostered by the fact that SMEs tend to have many business linkages and are more susceptible to knowledge spillovers from external actors than larger firms (Acs *et al.*, 1994).
6. There is scattered empirical evidence that local export spillovers may be particularly beneficial for small and medium-sized enterprises (SMEs), significantly enhancing their probability of becoming exporters (Bechetti & Rossi, 2000; Chevassus-Lozza & Galliano, 2003; Requena Silvente & Castillo Giménez, 2007).
7. The spatial identifier is the municipality a given firm is located in. A functional region consists of several municipalities that form an integrated local labor market. Within such a region, time distances between places are small enough to allow for frequent face-to-face contacts. Functional regions are delineated based on the intensity of commuting flows. We use the definition of functional regions given by the Swedish Agency for Economic and Regional Growth.
8. A large set of studies indeed finds that export spillovers are strongest within industries. Greenaway & Kneller (2008), for instance, find that the number of firms within the same region *and* industry has the largest impact on likelihood of exporting, while the number of export firms in a different region and different industry has no statistically significant impact.

9. An issue is that firms exporting in a year t may explain why its neighbours export in subsequent periods, which implies that the spillover variable could be endogenous. For this reason, we have estimated all the subsequent models using longer lags of the spillover variable (two and three years). All the results that we present are robust to using longer time lags of the spillover variable. The results with longer time lags of the spillover variable are available from the authors upon request.
10. Baldwin (1989), Baldwin & Krugman (1989) and Dixit (1989) have developed models that show how sunk costs associated with exports interact with expectations formed in an uncertain environment. They predict that, due to sunk costs, current foreign market participation is affected by previous export experience.
11. In the fixed effects model such a distributional assumption is not made, but the fixed effects model cannot be estimated in a Probit setting due to the incidental parameters problem (Wooldridge, 2002).
12. Including a lagged dependent variable in a discrete choice setting brings about initial conditions, problems and issues with correlation between firm-specific effects c_i and other regressors, specifically the lagged dependent variable (see e.g. Wooldridge, 2002). There are no well-developed techniques to solve these issues in a panel Probit setting. Instead, we here need to interpret the results of the model with lagged export status with care and we test whether results are sensitive to its inclusion. A similar strategy is applied by Ottaviano & Martincus (2011).
13. That the sign is negative (yet insignificant) in the specification where the lagged export status is included may be interpreted as meaning that those firms who exported in the previous year are firms with a high fraction of employees with a long university education.
14. Nunn's (2007) index of contract intensity is based on the importance of relationship-specific investments, measured as the fraction of products that are not sold on organized exchange and not referenced priced, following Rauch's (1999) classification of differentiated products. There are two alternative indexes, rs1 and rs2, where the second employs a weaker definition of relation-specific investments. The results presented in the sequel are based on the rs1 index, but we get the same results with the rs2 index as well. These robustness results are available from the authors upon request. The original industry classification developed by Nunn (2007) is available at: http://www.economics.harvard.edu/faculty/nunn/data_nunn.
15. For instance, Table A5 is based on just a couple of hundred firm-year observations.

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Appendix

Table A1. Pair-wise correlations between variables

	Export status	Previous export status	Imports	Human capital	Labour productivity	Physical capital	Employment	MNE	Corporation	Local exporters in industry	Regional size	Metropolitan region
Export status	1											
Previous export status	0.7677	1										
Imports	0.5251	0.5487	1									
Human capital	0.1216	0.1265	0.1840	1								
Labour productivity	0.1793	0.1791	0.1902	0.2166	1							
Physical capital	0.3149	0.3174	0.3230	0.1025	0.3578	1						
Employment	0.3273	0.3331	0.3947	0.2009	0.1913	0.7367	1					
MNE	0.2897	0.2939	0.3443	0.2512	0.2399	0.4046	0.5333	1				
Corporation	−0.0344	−0.0362	−0.0654	−0.0909	−0.0400	−0.0955	−0.1117	−0.4476	1			
Local exporters in industry	−0.0172	−0.0163	−0.0611	0.1301	0.0620	−0.1179	−0.0824	−0.0233	−0.0003	1		
Regional size	−0.0373	−0.0393	−0.0048	0.2349	0.0647	−0.1186	−0.0177	0.0123	−0.0245	0.6004	1	
Metropolitan region	−0.0283	−0.0300	0.0056	0.2448	0.0534	−0.1468	−0.0308	0.0092	−0.0308	0.5680	0.7341	1

Notes: The explanatory variables have a one-year lag and are logged if applicable (see Table 1). The spillover variable (Persistent exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of persistent exporters in each region in a given two-digit NACE sector. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms in contract-intensive and non-contract-intensive industries with at least 10 employees over the period 1997–2004.

Table A2. The probability of exporting explained by firm attributes and regional characteristics: estimates for all firms using the robustness measures (I) and (II) as dependent variable

	(1)	(2)
	Dependent variable robustness measure	
	(I) Multiple export starts	(II) First-time export start only
Imports	0.472***	0.574***
	(0.0491)	(0.0685)
Human capital	−0.561	−0.492
	(0.7699)	(1.1688)
ln (Labor productivity)	0.157**	0.199**
	(0.0644)	(0.0946)
ln (Physical capital)	0.094***	0.117***
	(0.0183)	(0.0270)
ln (Employment)	0.131***	0.330***
	(0.0484)	(0.0809)
MNE	0.204**	0.234*
	(0.0939)	(0.1378)
Corporation	0.064	0.078
	(0.0517)	(0.0730)
ln (Number of local exporters in industry)	0.067**	0.114**
	(0.0290)	(0.0470)
ln (Regional size)	−0.032	−0.021
	(0.0257)	(0.0419)
Metropolitan region	−0.019	−0.115
	(0.0873)	(0.1483)
Number of observations	8,638	7,269

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the sector and region level. The variables in Table 3 are explanatory variables and have a one-year lag. The lagged export status-variable is omitted due to the way the robustness measures for the dependent variable are constructed (see above). The spillover variable (number of exporters in region *i*) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable displaying 1 if firm i is exporting in year t, and 0 otherwise. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table A3. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms using the robustness measures (I) and (II) as dependent variable

	(1)	(2)	(3)	(4)
	Dependent variable robustness measure			
	(I) Multiple export starts		(II) First-time export start only	
	Firm size class (employment)			
	10–25	>25	10–25	>25
Imports	0.543***	0.334***	0.645***	0.379***
	(0.0573)	(0.0828)	(0.0772)	(0.1217)
Human capital	−0.387	−0.911	−0.340	−0.747
	(0.9138)	(0.9626)	(1.2288)	(1.2444)
ln (Labor productivity)	0.165**	0.218	0.180*	0.311
	(0.0727)	(0.1684)	(0.0952)	(0.2743)
ln (Physical capital)	0.078***	0.134***	0.090***	0.182***
	(0.0227)	(0.0404)	(0.0305)	(0.0574)
ln (Employment)	0.156**	0.224**	0.272**	0.468***
	(0.0784)	(0.0969)	(0.1083)	(0.1540)
MNE	0.255**	0.044	0.291**	0.011
	(0.1117)	(0.1501)	(0.1469)	(0.2348)
Corporation	0.068	0.004	0.077	0.004
	(0.0645)	(0.1017)	(0.0804)	(0.1444)
ln (Number of local exporters in industry)	0.033	0.059	0.047	0.121
	(0.0371)	(0.0654)	(0.0488)	(0.1196)
ln (Regional size)	−0.036	0.036	−0.009	0.004
	(0.0344)	(0.0646)	(0.0455)	(0.0990)
Metropolitan region	−0.015	−0.099	−0.089	−0.102
	(0.0993)	(0.1893)	(0.1452)	(0.3085)
Number of observations	6,712	1,926	5,718	1,551

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the sector and region level. The variables in Table 4 are explanatory variables and have a one-year lag. The lagged export status-variable is omitted due to the way the robustness measures for the dependent variable are constructed (see above). The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table A4. The probability of exporting explained by firm attributes and regional characteristics: estimates for firms in contract-intensive and non-contract-intensive industries using the robustness measures (I) and (II) as dependent variable

	(1)	(2)	(3)	(4)
	Dependent variable robustness measure			
	(I) Multiple export starts		(II) First-time export start only	
	Contract intensity in industries			
	High	Low	High	Low
Imports	0.641***	0.495***	0.683***	0.660***
	(0.1682)	(0.0993)	(0.2473)	(0.1360)
Human capital	0.387	1.553**	0.265	3.678***
	(1.3491)	(0.6641)	(1.6110)	(1.3360)
ln (Labor productivity)	0.538***	0.198	0.672**	0.199
	(0.2030)	(0.1226)	(0.3382)	(0.1608)
ln (Physical capital)	0.013	0.142***	0.026	0.185***
	(0.0603)	(0.0403)	(0.0770)	(0.0617)
ln (Employment)	0.135	0.263***	0.320	0.429***
	(0.1478)	(0.0945)	(0.3310)	(0.1391)
MNE	0.789**	0.230	0.790	0.343
	(0.3471)	(0.1712)	(0.5156)	(0.2563)
Corporation	0.075	0.096	0.099	0.199
	(0.1806)	(0.0942)	(0.2479)	(0.1465)
ln (Number of local exporters in industry)	−0.075	0.033	−0.296	0.127
	(0.1463)	(0.0616)	(0.2461)	(0.1126)
ln (Regional size)	0.0194	−0.080	0.169	−0.128
	(0.0893)	(0.0598)	(0.1488)	(0.0898)
Metropolitan region	0.097	0.070	0.409	0.009
	(0.2986)	(0.1976)	(0.5823)	(0.2830)
Number of observations	721	2,699	557	2,361

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the sector and region level. The variables in Table 5 are explanatory variables and have a one-year lag. The lagged export status-variable is omitted due to the way the robustness measures for the dependent variable are constructed (see above). The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of firms in contract-intensive and non-contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table A5. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms in contract-intensive industries using the robustness measures (I) and (II) as dependent variable

	(1)	(2)	(3)	(4)
	Dependent variable robustness measure			
	(I) Multiple export starts		(II) First-time export start only	
	Firm size class (employment)			
	10–25	>25	10–25	>25
Imports	0.569***	1.145**	0.572**	4.690
	(0.1928)	(0.5259)	(0.2320)	(5.7436)
Human capital	−0.036	3.094	−0.004	16.699
	(1.5559)	(3.2034)	(1.5337)	(45.1046)
ln (Labor productivity)	0.523***	0.423	0.442*	3.461
	(0.1911)	(0.8350)	(0.2461)	(4.5964)
ln (Physical capital)	0.025	0.010	0.073	0.053
	(0.0691)	(0.1451)	(0.0883)	(0.7406)
ln (Employment)	−0.144	0.637	−0.087	1.960
	(0.2572)	(1.2212)	(0.2953)	(6.4360)
MNE	0.632	1.541*	0.366	5.3165
	(0.5505)	(0.8704)	(0.6971)	(5.9973)
Corporation	−0.113	0.497	−0.035	1.192
	(0.2101)	(0.5366)	(0.2318)	(2.3495)
ln (Number of local exporters in industry)	−0.125	0.018	−0.310	−1.323
	(0.1440)	(0.4934)	(0.1946)	(2.9743)
ln (Regional size)	0.094	−0.350	0.180	0.741
	(0.0968)	(0.4503)	(0.1513)	(2.2709)
Metropolitan region	−0.064	1.060	0.284	1.429
	(0.3177)	(1.6266)	(0.5001)	(7.2615)
Number of observations	538	183	427	130

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the sector and region level. The variables in Table 6 are explanatory variables and have a one-year lag. The lagged export status-variable is omitted due to the way the robustness measures for the dependent variable are constructed (see above). The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.

Table A6. The probability of exporting explained by firm attributes and regional characteristics: estimates for two size-classes of firms in non-contract-intensive industries using the robustness measures (I) and (II) as dependent variable

	(1)	(2)	(3)	(4)
	Dependent variable robustness measure			
	(I) Multiple export starts		(II) First-time export start only	
	Firm size class (employment)			
	10–25	>25	10–25	>25
Imports	0.568***	0.430***	0.768***	0.435**
	(0.1363)	(0.1550)	(0.2071)	(0.1901)
Human capital	1.605**	1.796	3.866**	3.714
	(0.7107)	(2.8649)	(1.7444)	(3.5319)
ln (Labor productivity)	0.158	0.2775	0.305	0.068
	(0.1447)	(0.2710)	(0.2293)	(0.3326)
ln (Physical capital)	0.145***	0.0693	0.170**	0.177
	(0.0454)	(0.0948)	(0.0800)	(0.1208)
ln (Employment)	0.040	0.494*	0.098	0.568**
	(0.1813)	(0.2581)	(0.2338)	(0.2768)
MNE	0.439**	−0.010	0.688**	−0.194
	(0.2153)	(0.2682)	(0.3164)	(0.3122)
Corporation	0.160	−0.161	0.282	−0.209
	(0.1181)	(0.1954)	(0.1773)	(0.2374)
ln (Number of local exporters in industry)	0.085	−0.035	0.155	0.069
	(0.0770)	(0.1752)	(0.1265)	(0.2293)
ln (Regional size)	−0.124*	0.031	−0.131	−0.104
	(0.0704)	(0.1739)	(0.1027)	(0.1952)
Metropolitan region	0.0588	−0.195	−0.060	0.010
	(0.2254)	(0.4260)	(0.3154)	(0.5145)
Number of observations	2,128	571	1,888	473

Notes: The table presents panel Probit estimates—Equation (2)—with random firm-specific effects and cluster-robust standard errors at the sector and region level. The variables in Table 7 are explanatory variables and have a one-year lag. The lagged export status-variable is omitted due to the way the robustness measures for the dependent variable are constructed (see above). The spillover variable (number of exporters in region) is calculated according to the formula $\ln(1+n)$, with n indicating the number of local exporters within the same industry as firm i in year t. The MNE-variable comprises both Swedish and foreign-owned MNEs. The corporation variable contains firms that are part of a Swedish corporation without foreign subsidiaries. The underlying data are a panel dataset of small and large firms in non-contract-intensive industries with at least 10 employees over the period 1997–2004. The dependent variable is a dummy variable which is 1 if a firm i is exporting in period t, and 0 otherwise; 10–25 refers to small firms with 10–25 employees, and >25 to large firms with more than 25 employees. Cluster-robust standard errors in parentheses. ***Significant at 1% level, **significant at 5% level, *significant at 10% level.