Geography, knowledge spillovers and small firms' exports: an empirical examination for The Netherlands

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Abstract This study examines the impact of external and internal scale economies on the decision to start exporting and the level of exports of innovating firms. Based on new trade theory, increasing returns to scale—both internal and external scale economies—are considered an important source of comparative and competitive advantage. The empirical analysis of (small) innovating firms in The Netherlands leads to two main findings. First, firms that are located in technical Marshallian clusters seem less inclined to become exporters. Availability of technical knowledge alone does not help to reduce entry costs that come with the decision to export and/or marketing and sales costs in order to achieve a higher export performance. Second, firms that experience difficulties in appropriating innovation rents due to labour poaching also seem to be less inclined to become exporters. The explanation for this second finding is the importance of outgoing knowledge spillovers, which is particularly relevant for small, product innovating firms. This reduces their probability to export. However, if firms export, the knowledge leaking argument is not valid for the export performance of the firm.

Keywords Exports · Innovation · Scale economies · Small firms

JEL Classifications L26 · R12 · Q31

1 Introduction

Academic interest in the relationship between trade and geography has increased substantially since Krugman (1991). The central concept in international trade theory is comparative advantage, which is determined by differences in underlying country characteristics such as factor endowments and technology differences. Increasing returns to scale and imperfect competition explain trade between countries that are similar and have no comparative advantage with regard to each other (Helpman and Krugman 1985). Increasing returns to scale can arise at the firm and the industry level. Internal economies of scale are relevant at the firm level and mean that firms that produce at a larger scale experience lower average cost. External economies of scale arise at the industry level and point to increasing benefits accruing to a firm because of its favoured location in an industrial district or urban area. Large firms can experience the benefits of both internal and external economies of scale and therefore have more opportunities to achieve a competitive advantage than smaller firms. Small firms can benefit less from

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internal economies of scale; hence, external scale economies and therefore their location decision become more important than for large firms. In other words, large firms are more likely to export than small firms.

This paper investigates whether the geographical location of firms affects their decision to export and their export intensity. More specifically, do firms that are located in the vicinity of other firms in the same industry have a higher probability to export and—if so—a higher export intensity than firms that are located in areas with no such concentration? Marshall (1920) argued that external scale economies would arise through three mechanisms, i.e. the availability of (1) special suppliers, (2) specialized workers and (3) knowledge spillovers. These lead to a decline in average production costs and hence a means to overcome entry costs of entering foreign markets. In addition, also Jacobian externalities or diversification, i.e. the vicinity of other firms in different industries, are studied.

Although most empirical studies investigate the impact of internal economies of scale on exports (e.g. Bernard and Jensen 1999), a limited number deal with the impact of external economies of scale (Bechetti and Rossi 2000; Belso-Martinez 2006; Mittelstaedt et al. 2006) and found that these were particularly relevant for small firms.

Another strand of literature investigates the relationship between innovations and exports (Bleaney and Wakelin 2002; Cassiman and Ros 2007; Roper and Love 2002; Wakelin 1998), reporting mixed evidence. For instance, Wakelin (1998) finds for the UK that non-innovating firms have a higher probability to export than innovating firms. Roper and Love (2002) show that, for both Germany and the UK, product innovations do affect both the probability to export and export intensity positively. Cassiman and Ros (2007) find a positive relationship between product innovations and the probability to export for Spain.

This paper focusses on the impact of external scale economies on the export behaviour of product-innovation-announcing small firms in The Netherlands. The motivation for the focus on this selected group of product innovators is twofold. First, innovating firms need technical knowhow that often is exchanged informally and personally. These are unintentional knowledge spillovers that are more

effective when firms are concentrated in a relatively small area with other innovating firms in the same industrial sector. These knowledge spillovers provide a firm located in such an area with a competitive advantage over firms located in an area with less concentration, and hence a higher probability to export. Second, our interest in small firms leads to the problem that many small firms do not export at all. As previous research has shown that being a product innovator increases the likelihood of being an exporting firm, restricting the sample to product innovators provides us with small firms of which a substantial number will export (Cassiman and Ros 2007).

The main conclusions are twofold. First, concentration or specialization in a Marshallian cluster affects the probability to export significantly but negatively. This can be explained by a lack of non-technical knowledge (e.g. marketing and distribution skills) that is relevant for the decision of whether or not to sell in foreign markets and to achieve an increasing export performance. Second, a firm experiencing increasing difficulties in appropriating innovation rents due to labour poaching is less inclined to start exporting, but if it exports, labour poaching does not affect its export performance. Our sample consists of many small product innovators that develop innovations mainly themselves, in contrast to firms that import their innovations from other firms. For these product innovators the costs of outgoing knowledge spillovers become more relevant than for non-innovating firms or firms that import their innovations from other firms, as these product innovators have their own technical knowledge that can leak away through knowledge spillovers to other firms. Hence location in a Marshallian cluster for these firms can be much less beneficial than for others. When the focus is on small innovative firms that innovate themselves, as in the present study, these outgoing knowledge spillovers become even more important as small firms are often dependent for their survival on one or a limited number of innovations. Knowledge leaks to other firms might threaten their existence.

The next section deals with the theoretical background and literature. Section 3 presents the model and discusses the data. The empirical analysis is reported in Sect. 4, and the fifth section presents the conclusions.

2 Theoretical background and literature

2.1 Theoretical analysis

The increasing returns assumption in the new trade theory led to the recognition of a new economic geography (Krugman 1991). Increasing returns to scale lead to trade between countries that initially do not have comparative advantage in specific goods. Increasing returns to scale consist of internal and external scale economies. Internal economies of scale allow a firm to reduce its average production costs as it moves along the downward sloping average cost curve when increasing its sales and production. External economies of scale deal with benefits that accrue from the geographical environment to the firm. Agglomeration of firms is the result.

The relationship between agglomeration of economic activities and international trade can be studied from two perspectives (Ottoviano and Puga 1998). On the one hand, agglomeration can result from new trade opportunities as a market-enlarging factor. On the other hand, agglomeration or concentration of economic activities can cause comparative advantage and lead to new trade opportunities. In the theoretical literature the main focus is on the first perspective, i.e. it deals with the impact of trade liberalization on concentration of economic activities. The practical object of study is the increasing economic integration of the European Union countries, which would boost trade flows between the member states and consequently shift domestic and regional production patterns. Fujita et al. (2000) show that trade liberalization leads to two counteracting forces on agglomeration. The spatial concentration of specific industrial activities in countries increases as more openness to the world market means more specialization along the lines of comparative advantage. Centrifugal forces arise too, as both consumers and producers can buy and sell goods abroad, which reduces the geographical concentration of industry as a whole.

The impact of agglomeration on international trade is much less analysed in theoretical models. When firms are located in urban areas or industrial clusters they benefit from external economies of scale, which reduce their average production costs and hence increase the probability to export.

Marshall (1920) indicated three main explanations for the benefits of firms located close to each other.

First, a concentrated location of firms in a certain sector provides a sufficiently large market for specialized suppliers to remain in business. Second, firms that cluster can create a pooled market for specialized workers, which reduces the chance of labour shortages. The third reason consists of knowledge spillovers and is particularly relevant for innovative firms. Especially tacit knowledge is diffused much more easily when firms are concentrated in a small area. Belso-Martinez (2006) argues that the importance of concentration of industries for achieving international competitiveness contains more than only the existence of business networks in the same industry. A firm's international competitive advantage is also determined by the location of specific capabilities such as transport, consulting, specialized advanced services related to communication, etc., in the vicinity of the firm (Maskell and Malmberg 1999). This is associated with the notion attributed to Jane Jacobs (1969) that externalities arise between firms in different sectors that are spatially concentrated due to complementarities necessary in the chain from production to sales. Feldman (1994) also argues that proximity to specialized business services reduces the risks of commercial failure. Van der Panne and van Beers (2006) suggest that innovating firms in The Netherlands in Marshallian districts performed better in terms of production of innovative output or technological success. However, innovating firms in diversified regions seem to perform better in terms of commercial success.

2.2 Empirical studies

In the last 10 years an increasing number of empirical studies have tried to deal with the predictions of the new trade theory by using datasets at the firm level. Bernard and Jensen (1999) analysed the decision of a firm—instead of a country—to export and found that characteristics of US-firms explain systematically—though not completely—the decision to export. A small fraction of firms do export, and firms that are large and productive show a higher probability to export than small and non-productive firms. Entry costs due to learning and gathering information on foreign markets are an important barrier to becoming an exporter. These costs are particularly impeding for small firms due to scarce financial and human capital/knowledge resources. Other authors found similar

results (Eaton et al. 2004; Bernard et al. 2003; Greenaway and Yu 2004; Hansson and Lundin 2004). The focus of these studies is on internal economies of scale as a means to overcome entry costs. No attention is paid to external location economies of scale, which also can be a relevant source to overcome entry costs.

A limited number of empirical studies attempted to estimate the impact of the firm's external or geographical environment on the decision to export (Maskell 2001). This is commonly labelled export spillovers. Aitken et al. (1997) investigated for Mexico whether firm location in the vicinity of exporting multinational corporations affects the decision to export. Their findings show that the probability of a Mexican firm to export is positively related with proximity to multinational firms. No correlation was found between Mexican firms' export decisions and the local concentration of all exporters. Bernard and Jensen (2004) found that spillovers from neighbouring exporters do not lead to positive effects on the decision to export of US firms. Both studies use data that consist of larger firms, which already benefit from internal economies of scale due to their size and for which external scale economies or spillovers are less relevant than for small firms. De Clercq et al. (2008) investigated how a country's international trade and foreign direct investment (FDI) are sources of export spillovers to new ventures' export orientation. The authors found that the export orientation of new ventures is indeed affected by their country's levels of FDI and foreign trade, but to a different degree when distinguishing higher- and lower-income countries. Other studies on export spillovers are those by Greenaway et al. (2004) and Kneller and Pisu (2007). Greenaway and Kneller (2007) provide a synthesis and overview of the literature on why some firms export and others do not.

Bechetti and Rossi (2000) investigated the impact of the location of small and medium-sized Italian firms in Marshallian industrial districts on their decision to export and on their export intensity and found a positive effect. They emphasize the importance for small firms to be in an industrial cluster, as the formal and informal—face-to-face—exchange of complementary information can substitute for the lack of internal knowledge on exporting. These external spillovers can be expected to reduce the entry costs of becoming an exporter. They also show

empirically that the positive effect is decreasing in size, i.e. small firms benefit more from geographical agglomeration than do larger firms.

Belso-Martinez (2006) also focussed on small and medium-sized firms in the community of Valencia and found that industrial districts affect the export decision and export intensity positively.

Mittelstaedt et al. (2006) examined the impact of firm size, urbanisation and industrial concentration on the decision to export for manufacturing firms in the southeastern USA. Both external economies of scale (measured by urbanisation) and clustering (measured by industrial concentration) positively affect the decision to export. These effects are strong and significant for small firms, but weak and insignificant for medium-sized and large firms. The impact of urbanization on large firms' export decisions appears to be negative and significant, which suggests that in the southeastern part of the USA large firms' scale of operations is such that external scale economies have been internalized. They do not need an urban environment for their cost efficiency and hence decision to export.

Poppe (2002) found that small firms export for two main reasons, namely because of uniqueness of product and because of having a technological advantage over competitors. When smaller firms' size grows, internal economies of scale start to become a relevant explaining factor as well. Uniqueness of product can be achieved by developing own product innovations. Cassiman and Ros (2007) found that product innovations are a very important driver for small firms to start exporting.

3 Model, model operationalization and data

3.1 Model

The model presented in this study deals with the factors that affect both the decision to export and the export intensity or export performance. In contrast to many other studies that investigate the determinants of either the decision of whether or not to export or the export intensity, this study differs in two respects.¹ First, it models both export decision and

¹ Exceptions are Lefebvre and Lefebvre (2002), Kleinknecht and Oostendorp (2002), and Roper and Love (2002).

export intensity, and second, we focus on innovative firms. The main reason for focussing exclusively on innovating firms is that external scale economies such as knowledge and labour market spillovers can be expected to be more dominant than in non-innovating firms (see, among others, Glaeser et al. 1992; Feldman and Audretsch 1999; Van der Panne and van Beers 2006).

In Eq. 1 we model the determinants of a firm's export intensity.

$$\frac{\text{Export}}{\text{Sales}} = \beta_0 + \beta_1 \ln(\text{Size}) + \beta_2 \ln(\text{Salesnewproducts}) + \beta_3 \text{Age} + \beta_4 \text{MNE} + \beta_5 \text{Manufacturing} + \beta_6 \text{Specialization} + \beta_7 \text{Diversification} + \beta_8 \text{Competition} \quad (1)$$

Equation 1 models the determinants of export intensity provided that firms do export. From a theoretical point of view it is determined by internal economies of scale (Krugman 1980). These allow an individual firm to lower its average production costs and hence gain competitive advantage compared with its domestic and foreign competitors that do not or experience less internal scale economies (Krugman 1991). $\ln(\text{Size})$ is a measure of the size of the firm as a proxy for high fixed investment costs that can be earned back by producing and selling large quantities in foreign markets as the domestic market is small (see, among others, Calof 1994; Chetty and Hamilton 1993). A positive sign is expected for coefficient β_1 . *Salesnewproduct* is the innovation intensity. The more innovative a firm is, the more competitive it is, and hence a higher export intensity can be expected (Hummels and Klenow 2005). In other words, $\beta_2 > 0$ is expected a priori. *Age* is the age of the firm in years. The older a firm is, the more it can be expected to sell a larger part of its turnover abroad ($\beta_3 > 0$). Older firms have had more time to investigate opportunities in foreign markets than younger ones. *MNE* measures whether a firm is part of a multinational enterprise. If the firm is a part of a foreign firm, it is likely that it can use the existing exporting infrastructure of that firm. Therefore β_4 is expected to be positive. *Manufacturing* measures whether a firm belongs to the manufacturing sector. Manufacturing firms produce tangible goods, which are much easier to export than non-tangible goods produced in, for instance,

the service sector. Therefore a positive sign for coefficient β_5 is expected.

Although, from a theoretical perspective, export success is mainly dominated by internal scale economies (Krugman 1991), we follow other empirical studies by incorporating external scale economies in Eq. 1 as well (Bechetti and Rossi 2000; Belso-Martinez 2006; Mittelstaedt et al. 2006). These are specified by the variables *Specialization*, *Diversification* and *Competition*. The variable *Specialization* refers to externalities as defined by Marshall (1920). The location of the innovating firm in a Marshallian specialized area reduces its average production costs and therefore increases the export possibilities and performance (Krugman 1991; Krugman and Obstfeld 2006). We expect a priori a positive sign of β_6 . *Diversification* measures whether diversity of economic activities in the vicinity of the firm increases the export performance (Jacobs 1969; Maskell and Malmberg 1999). To be a successful exporter requires non-technical knowledge on foreign marketing and distribution channels. Diversity of economic activities in the vicinity of the firm implies a higher chance that the firm will obtain this knowledge. The parameter β_7 is assumed to be positive. The variable *Competition* originates from Jacobs (1969) and has been added in order to deal with the impact of the efforts that firms have to make to attract skilled workers. The more effort that innovating firms have to make, the less they can appropriate the benefits of innovations. As a result the impact of knowledge spillovers as a force reducing production costs becomes less dominant. A negative sign for β_8 is expected.

The decision of whether or not to export is presented in Eq. 2 and depends on both internal and external economies of scale as well.

$$P(\text{Export}) = \gamma_0 + \gamma_1 \ln(\text{Size}) + \gamma_2 \ln(\text{Salesnewproducts}) + \gamma_3 \text{Age} + \gamma_4 \text{MNE} + \gamma_5 \text{Manufacturing} + \gamma_6 \text{Specialization} + \gamma_7 \text{Diversification} + \gamma_8 \text{Competition}. \quad (2)$$

Equation 2 is specified identical to Eq. 1. Now external economies of scale are important to overcome the entry costs barrier. A favourable location in a Marshallian cluster means that external economies of scale accrue to all firms in that cluster. Their average production costs are lowered as compared with

domestic firms that are not located in the Marshallian area, which increases the probability to overcome the entry costs of starting to export to foreign markets.

It should be observed that we assume a causal relationship between economies of scale and the export variables in both Eqs. 1 and 2 based on modern trade theory. This causality might also be reversed as far as internal economies of scale are concerned. Exporting means increasing sales and hence achieving internal economies of scale. This leads to overestimation of the impact of internal scale economies on the probability to export. We accept this disadvantage, as the main focus of this paper is on the impact of external scale economies on the probability to export and there is no a priori reason to assume that becoming an exporter affects location in a cluster with innovators. The reversed causality cannot be assumed to be present in case of external economies of scale.²

3.2 Model operationalization

In Eq. 1 the dependent variable is exports as a percentage of sales. Firms were asked to indicate this percentage in a range from >0% to 10%, 10% to 25%, 25% to 50%, 50% to 75%, and 75% to 100%. The scores for these intervals were 1–5. In Eq. 2 the dependent variable $P(\text{export})$ is a zero-one variable, with value 1 if the firm is exporting and value 0 if it is not exporting.

External economies of scale are presented by the variables *Specialization* and *Diversification*. *Specialization* refers to Marshallian externalities and is measured by a PS_{ij} index calculated from employment data.³ It measures the extent to which region j is specialized towards industry i :

$$PS_{ij} = \frac{E_{ij} / \sum_{i=1}^{58} E_{ij}}{\sum_{j=1}^{98} E_{ij} / \sum_{i=1}^{58} \sum_{j=1}^{98} E_{ij}}, \quad (3)$$

where i is 1...58 industries; j is 1...98 postal code regions; and E_{ij} is employment in industry i in region j .

² A certain reversed causal impact would be present if the dependent variable would be innovativeness or being an innovator. This is not relevant here, as our sample consists of innovators only.

³ Provided by Marktselect Plc. (2002). De DM-CD. Amsterdam, Applidata BV. This CD ROM documents information on postal code and main activity of every single firm registered at the Dutch Chamber of Commerce.

The PS_{ij} variable is a location coefficient, measuring the share of employment accounted for by industry i in region j , relative to this industry's share in national employment (Feldman and Audretsch 1999; Glaeser et al. 1992; Van der Panne and van Beers 2006). High PS_{ij} values imply regional specialization externalities in industry i .

Diversification is described by a Gini coefficient:

$$GINI_j = \frac{1}{2n^2\bar{s}_j} \sum_{k=1}^n \sum_{i=1}^n |s_{ij} - s_{kj}|, \quad (4)$$

where s_{ij} is the share of industry i 's employment in region j , and s_{kj} is the share of industry k 's employment in region j ; n is the number of industries, and $\bar{s}_j$ is the mean of the shares. The Gini coefficient measures, for each postal region j , the area between a 45° line and a Lorenz curve. Ranking s_{ij} in ascending order and plotting its cumulative values against the cumulative values of employment derives this curve. An index with a value of 1 implies that employment in a region is strongly concentrated in one industry. If a region is characterized by an equal distribution of industries' employment, the Gini coefficient equals zero. For ease of interpretation, we proceed with the complement of the Gini coefficient, $GINIC_j$, defined as $(1 - GINI_j)$. $GINIC_j$ varies between 0 and 1 and associates larger values with diversified local production structures, indicating Jacobian externalities. The original Gini coefficient decreases with diversification; the complement $GINIC$ is positively related to diversification.

The degree of local competition (*Competition*) is measured by the competition coefficient $COMP_{ij}$:

$$COMP_{ij} = \left[(FIRMS_{ij} / E_{ij}) / \left(\sum_j FIRMS_{ij} / \sum_j E_{ij} \right) \right], \quad (5)$$

where i, j and E_{ij} are defined as in 3, and $FIRMS_{ij}$ is the total number of firms, whether innovative or not. This relates the number of firms per worker per industry i in region j to its national equivalent and refers to Jacobs' (1969) notion of labour market competition. High values are associated with fierce competition between local firms for labour; low values indicate less fierce local labour market competition (Glaeser et al. 1992; Feldman and Audretsch 1999). Alternatively, the values for $COMP_{ij}$ can be read in terms of average firm size. Values smaller

than 1 relate to large average firm size relative to the industry's national equivalent and suggest less fierce competition at the regional level. Following the Marshall-Arrow-Romer (MAR) model, small values for $COMP_{ij}$ suggest local market power enabling the innovator to appropriate innovation rents (Glaeser et al. 1992; Feldman and Audretsch 1999).

The first firm characteristic is *Size* and is measured by the number of employees in the firm. *Salesnew-product* measures the percentage of total sales that is achieved with improved and strongly improved products. The variable *Age* is defined as the number of years in 2002 since the establishment of the firm. The variable *Foreign* is a dummy variable and indicates whether a firm is part of a firm with its headquarters abroad, i.e. a foreign firm (value 1) or not (value 0). *Manufacturing* is a dummy variable that takes value 1 if a firm belongs to the manufacturing sector (Standard Industrial Classification 11-37) and 0 otherwise.

3.3 Data

The data concern innovating firms in The Netherlands and have been collected by the literature-based innovation output (LBIO) method by screening trade journals for new product announcements. The LBIO method has been used by several authors such as Edwards and Gordon (1984) and Acs and Audretsch (1988) for the USA, Kleinknecht et al. (1993) for The Netherlands, Cogan (1993) for Ireland, Coombs et al. (1996) for the UK, Santarelli and Piergiovanni (1996) for Italy and Flor and Oltra (2004) for Spain. For the present study three advantages of these data exist. First, the LBIO method allows for selecting many young and small firms, in contrast to official production and innovation statistics of Statistics Netherlands in which firms with fewer than ten employees are underrepresented or not present at all. This guarantees a substantial number of small (exporting) firms in our sample. Second, in the Dutch situation LBIO data provide information on the location of the firms, which—for privacy reasons—is not available in regular Dutch statistics of firms. Third, we select innovating firms. The few other empirical studies investigating the impact of location factors on firms' export behaviour deal with both innovative and non-innovative firms (Sect. 2.2). Our aim is to focus on export behaviour of innovating firms for two reasons. First, we are mainly interested in whether knowledge

and labour market spillovers as sources of external economies of scale affect the competitive advantage of firms and hence their export behaviour. These spillovers are much more important for innovating firms due to the existence of absorptive capacity (Cohen and Levinthal 1990). Second, as our focus is on small firms, we are confronted with the problem that many small firms do not export at all. As empirical research shows that innovating firms are more likely to export than non-innovating firms (e.g. Bleaney and Wakelin 2002), restricting the sample to firms with product innovations provides us with (small) firms of which a substantial part will export (Cassiman and Ros 2007).

During the period September 2000–August 2002 we screened two volumes of 43 trade journals for new-product announcements. These 43 trade journals were selected in order to cover all major branches of industry in The Netherlands equally. The screening method excluded advertisements. In order to reduce the risk of counting mere product differentiations, we took only announcements in the editorial sections of the journals into account. Based on the trade journal editor's expertise these products embody extra value over previous versions or substitutes. Further reduction of the product differentiation risk was achieved by the requirement to report at least one characteristic feature of superiority over previous versions or substitutes with regard to functionality, versatility or efficiency. We counted 1,585 new-product-announcing firms in The Netherlands, which received a questionnaire for further information on the firms and their innovating and exporting activities. The response was 1,056, of which 658 reported that they imported the innovation. As we are interested in active innovative activities inside the announcing firms and not in adoptive practices, these 658 cases were omitted and the remaining 398 cases were left for further analysis.

A disadvantage of our data-gathering method is representativeness with regard to innovators and exporters. In order to investigate representativeness of innovators, our sample data were compared with the distribution of the Dutch Community Innovation Survey (CIS), which is considered a representative sample of innovating firms. The results show that the CIS and the LBIO data of the present study—after correcting for the overrepresentation of small firms—do not significantly differ from each other with regard to research and development (R&D) intensity, R&D output or patents. The difference between these two

datasets is the strong dominance of small firms in the LBIO dataset. Nearly 31% are firms with fewer than 10 employees, and this percentage becomes 66% in the case of firms with fewer than 50 employees.

In order to obtain greater insight into the representativeness of our sample with regard to export behaviour we compared the distribution of export intensity in our sample of innovating firms with that in a sample of innovating and non-innovating firms.⁴ Figure 1 provides the distribution over the relevant classes. Each bar indicates the number of firms that export a percentage of their sales in the range shown on the horizontal axis. The vertical axis shows the percentage of all firms in each class. More than 40% of the innovating firms export less than 10% of their sales. The rest is distributed relatively equally over the other four categories. In the broader sample of innovating and non-innovating firms the same pattern can be found (Table 1).

Table 2 presents descriptive statistics of the relevant variables for two samples, i.e. all firms and firms with fewer than 50 employees (small firms). The mean value of *Exports* shows that nearly 84% of the firms in our sample export. Reducing the sample to the small firms reveals that a large fraction (79%) of the small firms also export. These percentages are high and imply that the analysis in this study can only be considered relevant for product innovators that developed the innovating product(s) themselves and report them in trade journals.⁵

The average size of the firms is some 65 employees, but the relatively high standard deviation shows that the spread is high. As can be expected, the average size of small firms is substantially lower, nearly 14 employees, also with a relatively high standard deviation. The innovating firms' innovation intensity, as measured by the share of sales achieved with new products, is more than 50% in both samples. The standard deviation in both samples suggests that sufficient spread exists around the mean value. This

Fig. 1 Distribution of exporting innovating and non-innovating firms: percentage of total number of firms (vertical axis) versus export intensity (horizontal axis). Source: “Innovators and non-innovators” from *Production Statistics Netherlands 2000*; “innovators”: *LBIO sample 2002*

Table 1 Comparison between Dutch Community Innovation Survey and literature-based innovation output data

Variable	CIS	LBIO
R&D intensity		
Mean	7	8.9
Median	2.2	5
Standard deviation	66.7	12.9
R&D output		
Improved		
Mean	20.8	23.3
Median	15	20
Standard deviation	20.7	16.1
New		
Mean	11.3	24.1
Median	8	20
Standard deviation	14.6	20.51
Patents		
Yes	28.3%	51.3%
No	71.7%	48.7%
R&D activities		
Permanently	72.0%	82.2%
Occasionally	28.0%	17.8%

variable's minimum value is 0, which corresponds to a firm that announced a new product in a trade journal but that was not (yet) able to achieve turnover with it.

⁴ This sample is based on 8,000 innovating and non-innovating firms from the Dutch Production Statistics 2002.

⁵ In order to check whether the high proportion of exporting firms can be attributed to firms in border regions, we tested whether a higher share of firms were exporters in border regions as compared with non-border areas. The difference was tested with an *F*-statistic and was found to be insignificant. We are grateful to an anonymous referee who drew our attention to this issue.

Table 2 Descriptives of LBIO data

Variable	Sample	Mean	Standard deviation	Minimum	Maximum	Observations
Firm level						
<i>Exports (yes/no)</i>	All firms	0.836	0.371	0	1	384
	Small firms	0.791	0.407	0	1	244
<i>Size</i>	All firms	65.75	131.23	0	1250	382
	Small firms	13.89	12.09	0	46	251
<i>Salesnewproducts</i>	All firms	50.41	29.39	0	100	306
	Small firms	52.16	30.98	0	100	189
<i>Age</i>	All firms	25.274	29.144	0	298	398
	Small firms	16.71	19.160	0	141	251
<i>Foreign</i>	All firms	0.138	0.345	0	1	377
	Small firms	0.062	0.242	0	1	241
<i>Manufacturing</i>	All firms	0.460	0.499	0	1	398
	Small firms	0.367	0.483	0	1	251
Geographical level						
<i>Specialization</i>	All firms	1.460	1.689	0.011	20.174	398
<i>Diversification</i>	All firms	0.273	0.024	0.218	0.337	398
<i>Competition</i>	All firms	1.325	1.314	0.11	14.2	398

Small firms are defined as firms with fewer than 50 employees

The average age of the firm ranges between 0 and 298 years, with a mean of 17 (small firms) and 25 years (all firms). The high spread is shown by the relatively high standard deviation. Nearly 14% of the firms are part of a foreign firm. This number reduces to 6% when only small firms are taken into account. Forty-six percent of the firms are in the manufacturing sector, and this fraction is 37% in the small firms' sample.

The mean of *Specialization* is larger than 1, which suggests Marshallian externalities. The mean value of the *Diversification* variable is relatively low, which implies that Jacobian externalities are not very dominantly present. The mean value of the *Competition* coefficient is larger than 1, which suggests competition between innovating firms for attracting workers, although not very fierce. Firms do experience a certain difficulty in appropriating innovation rents, as it requires efforts to reduce knowledge leakage through worker movements.

4 Empirical results

In Tables 3 and 4 the estimates of Eqs. 1 and 2 are shown.

In regressions 1 and 2 in Table 3 the ordered probit estimates of the determinants of export intensity as formulated in Eq. 1 are reported. In regressions 3 and 4 the ordered probit estimates corrected for selection bias are reported. As we leave out the non-exporting firms in Eq. 1, this might lead to selection bias. In order to obtain unbiased estimates of Eq. 1 we use Heckman sample bias-corrected ordered probit estimates, using Eq. 2 as the select equation. This model assumes that exporting firms take two decisions: (1) whether or not to export, which is governed by entry costs in foreign markets, and (2) if they export, how much to export. It is recommended to specify the select equation (probability to export) as the target equation (export intensity) plus at least one identifying variable that affects the probability to export but not the export intensity (Heckman 1979). The external scale economies variables—*Specialization*, *Diversification* and *Competition*—fulfil this function and are hence removed from Eq. 3. This assumes that external economies of scale are more important in order to overcome the entry costs of becoming an exporter than they are as a contributor to export performance after a firm has taken the decision to sell in foreign markets. Evidence for the statement that traditional

Table 3 Determinants of export intensity: ordered probit estimates

Equation	1	1	1	1
Regression	1	2	3	4
Sample	All firms	Small firms	All firms	Small firms
Constant	2.171*** (0.934)	2.054*** (1.442)	0.919 (0.818)	1.430 (1.303)
Ln(<i>Size</i>)	0.143** (0.058)	0.109 (0.101)	0.116 (0.095)	0.148 (0.181)
Ln(<i>Salesnewproducts</i>)	0.248*** (0.095)	0.323*** (0.119)	0.232** (0.110)	0.282** (0.131)
<i>Age</i>	0.005* (0.003)	0.003 (0.005)	0.004 (0.003)	0.002 (0.004)
<i>Foreign</i>	0.157 (0.214)	0.204 (0.362)	0.169 (0.232)	0.157 (0.346)
<i>Manufacturing</i>	0.255* (0.153)	0.357* (0.209)	0.213 (0.224)	0.433 (0.401)
<i>Specialization</i>	−0.133* (0.075)	−0.447** (0.168)		
<i>Diversification</i>	4.140 (3.111)	4.715 (4.647)		
<i>Competition</i>	0.066 (0.071)	−0.059 (0.087)		
Inverse Mill's ratio			−0.112 (0.878)	0.350 (1.535)
Pseudo R^2	0.045	0.047	0.034	0.029
Observations	232	143	232	143
Significance of regression	0.0000	0.0470	0.0002	0.0322

*** Significant at 1%;

** Significant at 5%;

* Significant at 10%

Standard errors in parentheses

(internal) scale economies have a more dominant influence on export performance than external scale economies has been provided by Malmberg et al. (2000).

Regression (1) in Table 3 shows that the size of the firm affects the export intensity positively and significantly. Internal scale economies do increase the export intensity of all firms. In the case of small firms (regression 2) the effect remains positive but becomes insignificant, which is as expected. The marginal effect of the size variable on the export intensity is 0.023 in regression (1) and 0.010 in regression (2).⁶ This means that an increase of the natural logarithm of the firm's size by 10% increases the chance to export more than three-quarters of total sales by 0.23% for large firms and by 0.10% for small

firms.⁷ In regressions (3) and (4) the ordered probit estimates of the target equation are reported after selecting firms through regressions (5) and (6) in the select Eq. 2 (Table 4). These estimates are also positive, though not significant. The relevant marginal effects in regressions (3) and (4) become 0.020 and 0.015.

The innovativeness (*Salesnewproducts*) of the firm also affects the export intensity significantly positive. Firms with a higher share of their total sales being innovative are more competitive and hence make a higher share of their sales abroad. The marginal effects in regressions (1) and (2) are 0.040 and 0.029. In other words, an increase in the natural logarithm of the sales with new products by 10% increases the chance to export more than three-quarters of total

⁶ The marginal effects have been calculated but not reported in Table 3. These are discussed in the main text for the continuous independent variables.

⁷ The chance to export more than 75% of total sales is 0.0896 and increases to 0.0898 due to a 10% increase in the natural logarithm of the size variable in regression (1).

Table 4 Determinants of probability to export: select equation for Heckman selection bias-corrected estimates of Table 3

Equation	2	2
Regression	5	6
Sample	All firms	Small firms
Constant	−1.768 (1.390)	0.402 (1.608)
Ln(<i>Size</i>)	0.280** (0.081)	0.289** (0.128)
Ln(<i>Salesnewproducts</i>)	0.161 (0.120)	0.072 (0.127)
<i>Age</i>	−0.0006 (0.0036)	0.001 (0.008)
<i>Foreign</i>	−0.509 (0.310)	−0.240 (0.539)
<i>Manufacturing</i>	0.898*** (0.249)	0.884*** (0.292)
<i>Specialization</i>	−0.146** (0.075)	−0.225** (0.091)
<i>Diversification</i>	6.071 (4.688)	−0.635 (5.259)
<i>Competition</i>	−0.206*** (0.077)	−0.187** (0.089)
Pseudo R^2	0.159	0.119
Observations	273	177
Significance regression	0.0000	0.0023

*** Significant at 1%; ** Significant at 5%; * Significant at 10%

Standard errors in parentheses

sales by 0.40% for all firms and by 0.29% for small firms. These effects hardly change in regressions (3) and (4), being 0.039 and 0.028, respectively.

The age of the firm (*Age*) affects the export intensity positively, but this effect is very small and mostly not significant. The effects of *Foreign* and *Manufacturing* are positive but not strongly significant in explaining export intensity.

With respect to the external scale economies we find a negative significant effect for *Specialization*. An increase of concentration of firms in an industry by 10% leads to a significant decrease of the chance to export more than three-quarters of total sales by 0.4%.⁶ This deviates from the a priori expected positive impact and is in contrast to the empirical findings reported by other authors who investigated both innovative and non-innovative firms (Bechetti and

Rossi 2000; Belso-Martinez 2006; Mittelstaedt et al. 2006). Two explanations are valid. First, as stated in Sect. 2, Marshall (1920) suggested three main explanations for why the average costs of firms in a specialized cluster should decline, namely the presence of (1) specialized suppliers, (2) a pooled market for specialized workers and (3) knowledge spillovers. The latter is particularly relevant for innovating firms as they benefit from the technical knowledge spillovers of other innovating firms in the specialized or Marshallian cluster. However, improvement of export performance is possibly more dependent on non-technical knowledge such as marketing, distribution and costs of product adaption to foreign regulations and tastes. This knowledge cannot be found in technologically specialized areas. The positive though not significant impact of the *Diversification* measure seems to corroborate this explanation. A second explanation is labour poaching. Innovating firms can not only benefit from incoming technical spillovers but also lose from outgoing technical spillovers due to a high turnover of skilled labour. The insignificant small impact of the *Competition* variable suggests that this explanation is not valid as far as the export intensity of innovating exporters is concerned.

The Heckman correction is empirically not very strong, as shown by the insignificant selection bias corrections of the inverse Mill's ratio in both regressions (3) and (4).

Regressions (5) and (6) in Table 4 report the probit model as specified in Eq. 2 and are also the selection equations for the selection bias-corrected estimates of regressions (3) and (4). The relevant sample consists of innovating exporters and innovating non-exporters. Some observations are in order.

The size of the firms as a proxy for internal economies of scale shows a significantly positive impact on the probability to export.⁸ Innovativeness [*Ln(Salesnewproducts)*] affects the probability to export positively, but the impact is not significant. In comparison with Table 3 we conclude that size as a proxy for internal scale economies is important for the decision to export but less so for the level of

⁸ This is a cautious conclusion as the impact might be overestimated by reversed causality. We do not consider this as problematic as our focus is mainly on external scale economies that are not or are less affected by reversed causality (Sect. 3.1).

exports. This is in line with other studies such as those by Bernard and Jensen (1999), Mittelstaedt et al. (2006) and Poppe (2002). For innovativeness it is the other way around, i.e. firms with a higher share of their sales categorized as innovative do not have a significantly higher chance of exporting but, if they do export, their innovativeness is a dominant positive factor in explaining the export level as a share of total sales [see regressions (3) and (4) in Table 3]. The variable *Age* does not exert a positive influence on the decision to export. Just as in the target equation the effect is very small. The emergence of so-called born globals, i.e. firms that start exporting at an early age, can explain this (Madsen and Servais 1997; Knight and Cavusgil 2004).⁹ Belonging to a foreign firm also has an insignificant impact on the probability to export. Innovating firms that are in the manufacturing sector have a strong likelihood to export.

With regard to external scale economies, the probability to export is affected in a significantly negative way by Marshallian specialization. This implies that concentration of firms in the same industry reduces the chance of being an exporter. Just as in the case of export intensity as reported in Table 3, the lack of non-technical knowledge in Marshallian clusters seems to be a barrier to overcome the entry costs of selling abroad. Also, when firms are located in areas characterized by diversification, they show a higher (albeit insignificantly so) probability to export.

Further comparison with regressions (1) and (2) in Table 3 reveals that, when the decision to export is the dependent variable, the impact of the *Competition* variable is significantly negative. This shows that, when firms have to compete harder to attract—often highly skilled—workers, the likelihood of starting to export is less. This result is expected a priori and shows that a reduction in power to appropriate innovation rents due to scarce (skilled) workers who can move easily from one firm to another reduces the probability to export. Alsleben (2005) emphasizes the phenomenon of information leakage through labour poaching in a theoretical model. High turnover of a firm's skilled workforce points to information leakages that lessen the cost-reducing impact of knowledge spillovers in a Marshallian

cluster. This is particularly relevant for small innovating firms that develop their product innovations mainly themselves. These firms have and use their own knowledge that can easily leak away, particularly to innovating firms that import their innovations. If technical knowledge leaks away, even their existence can be at stake. The stronger negative estimation of the *Competitiveness* variable that is found when restricting the sample to small firms indicates this direction.

Comparing the decision to export and the export performance of exporting firms, we have to conclude that knowledge leakage through labour poaching makes non-exporting firms reluctant to start selling in foreign markets. However, the export success of firms that do export is not affected by loss of knowledge due to high turnover of workers.

5 Conclusions, limitations and further research

Based on new trade theory, increasing returns to scale are an important source of comparative and competitive advantage. Increasing returns to scale consist of internal and external economies of scale. This paper reports the empirical results of the impact of external and internal scale economies on the decision of innovating firms to start exporting and the export intensity of innovating and exporting firms. The decision to export is considered to be dependent on both internal and external economies of scale, particularly for small firms. Although theoretically export intensity can be expected to be mainly determined by internal scale economies, also external scale economies are taken into account. Internal scale economies lead to cost reduction and increased efficiency due to large production volumes. External scale economies arise when a firm is located in a cluster with firms in the same industry. Due to the existence of specialized suppliers, a market for specialized workers and unintentional (tacit) knowledge spillovers from other firms, innovating firms located in such a cluster experience an improved competitive position, which facilitates their decision to export. We also included a *Diversification* variable in order to check whether firms located in areas with diversification, i.e. with firms from other not directly related industries, have a higher probability to export and/or higher export intensity.

⁹ We are grateful to one of the referees who pointed out this explanation.

The empirical analysis shows that, if firms are located in clusters with innovating firms in the same industry, the decision to export is affected negatively. Also, high turnover of scarce skilled workers exhibited a negative impact on the probability of a firm to export. The main explanation is twofold.

The first explanation is that, in order to overcome entry costs in foreign markets such as costs of product adaption to foreign regulations and tastes or gathering information on foreign markets, non-technical knowledge is more important than the technical knowledge that is dominantly present in a Marshallian cluster. Indeed, this study also finds (weak) evidence of a positive impact on the probability to export for firms located in a diversified area where non-technical knowledge is more dominant.

The second explanation relates to the costs of knowledge leakage to other firms or outgoing knowledge spillovers, which is more dominant in innovating than non-innovating firms or firms that import their innovations from other firms. Costs of knowledge leakage reduces firms' ability to overcome entry costs in foreign markets and hence their probability to export.

If the sample is restricted to firms that already export, the impact of location in a specialized or Marshallian cluster on export success is negative as well. Also here, lack of non-technical knowledge can be considered as a relevant explanation. However, if innovating firms decide to step into foreign markets, costs of knowledge leakage due to high turnover of workers are not important for their export success.

In contrast to the negative impact of external economies of scale on the probability to export, internal scale economies have a significant and positive effect on this probability. However, if firms export, the level of exports as a share of total sales is affected positively as well, but not always significantly.

The innovation intensity of the firm shows an insignificant impact on the decision of whether or not to export, but a significantly positive effect on export intensity. Only after firms decide to export does innovativeness become important to conquer foreign markets.

The counterintuitive result that location in a Marshallian cluster does not seem to increase the probability to export deserves more attention in order to deal with the scarce empirical, theoretical and policy attention to this issue. From a policy perspective this

is relevant as regional policies focussed on encouraging clustering of firms in the same industry with the aim of improving technical innovativeness might affect export performance negatively unless policies that support the supply of non-technical knowledge for selling in foreign markets can be framed.

Future research should also deal with some limitations of the research reported in this study. These are threefold. First, a study on the (costs of) outgoing knowledge spillovers as a cause of not gaining competitive advantage in foreign markets should pay attention to the question of where these outgoing knowledge spillovers go. Are these going to non-innovating firms or to firms that use innovations imported from others? As this paper focusses on data of product-innovating firms only, it was not able to address this issue. A second important issue is the time element. Although we argue that a theoretical case exists for causal relations running from scale economies to exports it is still possible that the exports may affect the internal scale economies after a time lag. It might be worthwhile to address this reversed causality issue by taking into account time lags in models as specified in this paper. Finally, as our sample is restricted to product innovators that produced and developed the technical innovation mainly themselves, it is of importance to investigate whether the conclusions still hold for other kind of (e.g. process) innovators as long as these innovators develop the technical knowledge themselves.

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