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Abstract

This study presents recently available data on the microstructure of Dutch exports and the relation between export participation and productivity at the firm and establishment-level. We test whether recent theories of international trade with heterogeneous firms can explain the patterns in the Dutch data. We find significant evidence that firms self-select into export participation, even after controlling for sector and firm-specific characteristics. In general, only the most productive Dutch firms participate in exports and foreign direct investment. In addition, we do not find evidence for the learning-by-exporting hypothesis, even when controlling for the firm's distance to the international productivity frontier.

Keywords: Exports, foreign direct investment, productivity, self selection by firms
JEL codes: D21, D24, F12, F23, L1

1 Introduction

The international trade literature used to pay no attention to individual firm characteristics. The assumed trading agent was modelled at best as a representative firm. This approach was radically changed by the empirical research of Bernard and Jensen (1995; 1999). These authors analyzed microeconomic firm-level data for the US and found significant economic performance differences between exporting and non-exporting firms. Firms that exported appeared to be more productive, larger, more capital intensive and they paid higher wages. The ensuing trade literature on heterogeneous firms expanded with empirical studies that confirmed these findings for other countries. Two hypotheses have been formulated to explain the productivity premium of exporters. In the learning-by-exporting hypothesis, firms that engage in international trade become more productive after they begin to export.[1] The second hypothesis is self-selection. Only the most productive firms can overcome trade costs (i.e. sunk and fixed foreign market entry costs) and become exporters.[2] Both hypotheses are not mutually exclusive, but most studies have found strong evidence to support the self-selection hypothesis, and weak evidence on learning-by-exporting.[3]

In this paper we use Dutch firm and establishment-level data to analyze whether exporting firms follow the international pattern drawn by this literature. Since this is the first study to test the predictions of the heterogenous firms theory for the Netherlands, we want to investigate whether Dutch exporting firms are indeed more productive than non-exporting firms, whether or not they self-select into the export market and whether or not they experience learning-by-exporting effects. Although we follow the general methodology employed by other empirical studies, we add new elements to the empirical analysis that so far have had limited attention. First, we diverge from the common way to measure export self-selection by a standard OLS test. Instead, we use a latent-variable model in combination with probit regressions so that stochastic elements in the export decision can better be taken into account. Second, we extend the analysis to the Dutch services sector, while the majority of available studies for other countries only focuses on the manufacturing industry. Third, we include market structure as a determinant of the internationalisation decisions by firms. Finally, we use distance to the technological frontier in testing the learning-by-exporting hypothesis.

We use microeconomic data provided by Statistics Netherlands at the firm-level (SFGO database) and also at the establishment-level (PS database).[4] The richness of the dataset implies that we do not have to impose or assume a particular distribution of firms. The data cover a wide range of the total firm

[1] This was the initial common assumption in the 1990s. See for example, World Bank (1993; 1997), Grossman and Helpman (1991) and Evenson and Westphal (1995).

[2] The most influential paper is by Melitz (2003), who introduced firm-heterogeneity in a Krugman-type trade model. In his framework only the most efficient firms can overcome fixed entry-costs in foreign markets and become exporters. When these entry-costs (which include non-tariff barriers and sunk operation costs) are reduced, exporting firms expand. Low-productivity domestic firms without exports exit the market, as the expanding export firms drive up domestic factor prices. The outcome is an aggregate increase in productivity. Other theoretical papers have followed and extended the results by Melitz (e.g. Bernard *et al.*, 2003; Helpman *et al.*, 2004; Baldwin, 2005; Yeaple, 2005; Bernard *et al.*, 2007; Melitz and Ottaviano, 2008; Chaney, 2008). For instance, Helpman *et al.* (2004) extend the analysis to MNEs and suggest that the sunk costs required to become a MNE are higher than to become and exporter. Thus, MNEs are even more productive than purely exporting firms.

[3] Literature surveys are presented by Bernard *et al.* (2007), Wagner (2007) and the International Study Group on Exports and Productivity (2008).

[4] The SFGO is complemented by the SFKO database, which is a sample of small firms. The SFKO, however, has less balance sheet information and no expansion factor variable to make the database representative of the whole population of small firms. Thus, our firm-level results refer to large *firms*, even though we do analyse small *establishments* using the PS database.

and establishment distribution so that we can test firm heterogeneity across several dimensions: productivity, fixed-capital intensity, sales, value added, average wages, received subsidies, multinational-firm affiliation, innovation inputs, and human capital. Our primary focus is on productivity heterogeneity, but we use some of the other dimensions of firm heterogeneity as control variables. Throughout our analysis we divide the sample between manufacturing and services firms. The comparison of both sectors reveals a number of interesting distinctions. In particular, both sectors present significant differences concerning export participation and export intensity.

The first set of econometric tests deals with the predicted presence of productivity premia for exporting and FDI-making firms. Our results using probit regressions confirm the by now standard findings of the literature. We find significant performance differences between purely domestic firms, exporting firms and firms with affiliation to a multinational enterprise (MNE) for the Netherlands. Moreover, the type of product competition in the firm's domestic market has an important impact on the export-productivity link. Establishments in industries with homogeneous products and strong cost-based competition are found to have significantly higher productivity premia compared to non-exporters than establishments in industries with more product differentiation and less cost-based competition.

The second set of tests is about the predicted dynamic implications (ex-ante or ex-post productivity differences for exporters) of the heterogeneous-firms trade models. First, we find robust evidence in support of the self-selection hypothesis. This result is in accordance with studies conducted for other countries.[5] We also investigated whether learning-by-exporting is an additional source of productivity gains after the start of exports, but no significant learning-by-exporting productivity gains were found. Finally, we also found that such export-learning effects not even existed after controlling for the learning potential of individual firms, proxied by the firm-level distance to the international productivity frontier at the industry level.

This paper is organised as follows. Section 2 describes the data and some stylised facts describing firm characteristics by their internationalisation type. The following section conducts the econometric testing of the productivity premia for exporters and MNEs using probit regressions. Section 4 presents the market structure indicator and how it affects the productivity premia. In section 5 we test the self-selection hypothesis and in section 6 the learning-by-exporting hypothesis –where we include distance to the international frontier as an explanatory variable. Section 7 concludes.

2 The firm-level structure of Dutch exports: stylised facts

The recent theory on trade with heterogeneous firms was triggered by a number of stylised facts that did not match with the then prevailing trade theory. We present the corresponding stylised facts for the Netherlands, showing data on the skewed distribution of exports and the differences between exporting and non-exporting firms, separately for manufacturing industry and services. We also depict the differences between purely domestic firms, exporting firms and firms affiliated with multinationals.

[5] In Kox *et al.* (2010) and Rojas-Romagosa (2010) we replicate the ISGEP methodology and find comparable results for the Netherlands with respect to the other 14 countries of the group.

2.1 Data sources

Our empirical research is based on data produced by Statistics Netherlands at two aggregation levels: individual establishments or plants (*bedrijfseenheid*) and firm level data. We use both types of data, because each allows to address different aspect of decision making. For firm-level data we use SFGO data (Statistiek Financiën Grote Ondernemingen) and for the establishment level we draw on the PS dataset (Productiestatistieken).

- Firm-level data: SFGO (*Statistiek Financiën Grote Ondernemingen*). The SFGO database only includes firms with a balance sheet total of more than €23 million. The firms in this category must file their annual reports each year. This database has a wealth of information, including data on capital stocks. Using data for the period 1997-2005 we have at maximum nine observations per firm. For about two-third of the firms we have 8 or 9 observations. For about 17% of all firms we have less than five annual observations due to entry and exit dynamics. In total, there are 2440 different firms in the database. The number of annual observations varies between 1245 and 1685.[6]

- Establishment data: PS (*Productiestatistieken*). The establishment-level or plant-level dataset is much larger than the firm-level dataset. Data is collected by Statistics Netherlands through annual surveys. Establishments with 50 or more employees are represented each year, while smaller firms are represented on the basis of a rotating annual sample. The probability that a small establishment (<50 employees) is in the sample during a number of consecutive years is therefore small.[7] Because of statistical breaks in the time series we use data for the period 1999-2005. On average we have 15000 annual observations, about equally distributed between manufacturing and services. The manufacturing data include all industrial sectors, while the services data include mainly construction, transport and business services.

- General business register: ABR (*Algemene Bedrijven Register*). Statistics Netherlands uses this database as the master file with it identifies changes in the total population of Dutch firms and production units. It also provides the basis for linking firm-level and establishment-level data. The ABR together with the SFGO allow us to identify whether an establishment has foreign direct investment or whether it is associated with a multinational firm.

We have constructed human capital indicators[8] and performance indicators from the raw data. For firm performance we use three indicators: (a) labour productivity defined as value added per full-time

[6] A detailed description of the SFGO database is presented in Rojas-Romagosa (2010).

[7] We have reduced the problem of a long under-represented tail in our data by putting the cut-off size for inclusion in the establishment-level dataset at ten employed persons. A further reason for this is that the export or FDI participation is of less importance for these very small establishments. We only use questionnaire-based establishment data; entries holding imputations by Statistics Netherlands were removed from our sample.

[8] Using the establishment-level data at the lowest level of detail, it was possible to construct an indicator for human-capital intensity per worker. For the indicator we used the following exploitation sheet items: expenditure on R&D, patents and licenses, internal education programs, costs of knowledge-intensive intermediary services (consultants, accountants), travel and communication costs, ICT expenditure, and also earnings on establishment-level from patents, licenses,and intra-company services charged to affiliated companies. The sum of these items is expressed per full-time employee. The resulting indicator correlated strongly with wages per worker, which was available for a much larger sample of establishments. We therefore used wages per worker as indicator of human capital use.

worker; (b) sales per worker; and (c) profitability, defined as gross value added minus wages and minus depreciation.[9]

2.2 Export participation

To deal with export participation (i.e. whether the firm exports or not) we use data at the level of individual establishments and data at the firm level. Both types of data show different aspects of firm behaviour. A firm is a business unit of higher hierarchical order than an establishment. The firm is considered as the actual economic agent in financial processes (financing, income generation). It may have one or more establishments. The firm data are therefore closer to strategic decision making. Decisions to engage in foreign direct investment are more likely to be taken at the firm level than at the establishment level. The firm level data are also generally closer to legal and fiscal entities, even though firms may be grouped by ownership ties into a firm group. Averaged over the period 1997-2005, 55% of the firms is actively engaged in exports. It implies that 45% of these large firms does not export at all. Table 1 shows that nine out of ten exporting firms have a multinational affiliation.[10] About two-thirds of MNEs also active in exports. If the latter firms are owned by a foreign multinational (17%), it may imply that the Dutch subsidiary firm only concentrates on the domestic market. Some non-exporting large firms are owned by a Dutch multinational, where substitution between direct investment and exporting may play a role.

Table 1: Export participation by internationalisation type, percentages by firms and establishments

	Without multinational affiliation	With multinational affiliation		Total
		Dutch MNE	Foreign MNE	
Firm-level data (average 1997-2005)				
Non-exporter	19	10 [a)]	17	45
Exporter	5	22	28	55
Total	24	32	45	100
Establishment-level data (average 1999-2005)				
Non-exporter	50	5	0.4 [b)]	56
Exporter	33	11	0.7	44
Total	83	16	1.1	100

Notes: a) 39% of the non-exporting Dutch MNEs did not register their country of ownership. Some may be registered abroad for tax reasons. b) The identification of ownership ties with multinational firms (especially for foreign multinationals) is less precise than it is at the firm level. Many establishments associated with foreign multinationals may be incorrectly classified as local establishments.

Source: Own calculations based on the SFGO and PS databases.

The establishment or plant is the lowest level of observation of economic units in the Dutch business demography. In the definition by Statistics Netherlands, an establishment is characterised by relative

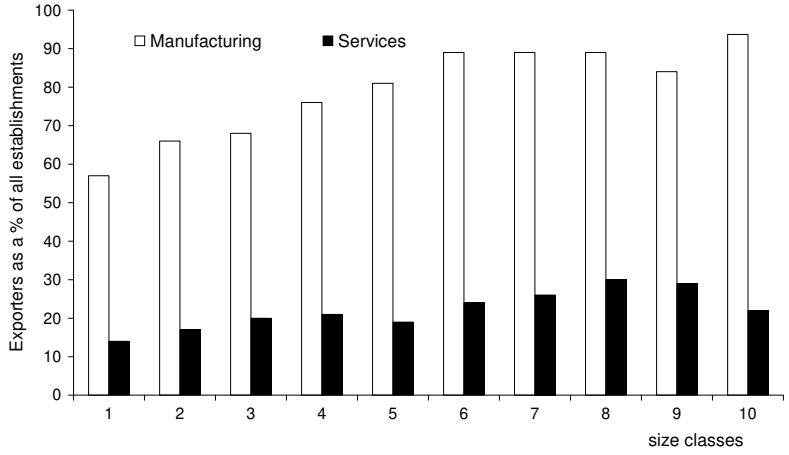
[9] At the firm level (SFGO) we have information on capital stocks and thus, we constructed a measure of TFP. The results using thi variable are very similar to those using the other performance variables (cf. Rojas-Romagosa, 2010). At the establishment level (PS) there was no information on capital that allowed us to construct a reliable TFP measure.

[10] The SFGO dataset includes an identifying variable for multinational firms. We refined the MNE identification by adding the criterions that the firm should have an FDI stock of at least 100,000 euros, and that it either should have foreign sales or intermediary inputs from foreign subsidiaries (cf. Rojas-Romagosa, 2010). In the establishment (PS) dataset it is possible to identify Dutch-affiliated MNEs, but it is not possible to identify foreign affiliated MNEs in a reliable way. This means that some local establishments may in reality be associated with very productive foreign MNEs. Thus, when using the PS dataset MNEs refer to Dutch affiliated, while in the SFGO dataset MNEs refer to both Dutch and foreign affiliated.

independence in production or distribution, and it offers its products to an external market. In economic sense, the establishment data are relatively close to the production process. From Table 1 we observe that there is a much larger proportion of establishments without multinational affiliation and of non-exporters, than for the data at the firm-level.

At the establishment level we also make a distinction between manufacturing and services. Figure 1 differentiates the export participation rate by size class. Export participation in manufacturing is much larger than in services and steadily increases by size class, reaching a maximum of almost 100% in the largest size class. The relation between establishment size and export participation is remarkably different in services.[11] First, the participation levels are much lower for services –on average around 20%. Secondly, export participation for services firms peaks at size class 8 (500 to 999 employees).

Figure 1: Export participation by size class: number of exporting establishments as % share of all establishments, 2005



Notes: All establishments with 10 or more employed persons. The size codes are based on the number of employed persons and cover the following intervals: 1: 10-19 employed persons; 2: 20-39; 3: 40-59; 4: 60-80; 5: 80-124; 6: 125-249; 7: 250-499; 8: 500-999; 9: 1000-1999; 10: >2000 employed persons.
Source: Own calculations based on the PS database.

As similar pattern can be found for export intensity: the share of export in total sales. Table 2 shows that export intensity in manufacturing steadily increases from 27% in the smallest firms to 60% in the largest. On the other hand, export intensity in services is much lower than in manufacturing and it remains between 10% and 30% for all size classes.

Figure 2 shows that across all size classes, manufacturing establishments are more likely to be associated with multinational firms than in services.[12] Beyond size class 8 (500 to 999 employees) multinational affiliation in services diminishes from 20 to 10% for the largest firms.

[11] For services we have data at the 4 digit industry level. The total number of observations by industry differs by year. Over the entire 1999-2005 period the industry breakdown of services observations was as follows: Construction 33%, Retail and wholesale trade 11%, Hotels, restaurants and catering 10%, Transport 18%, Post and telecom 1%, Equipment leasing services 2%, Computer and IT services 8%, and Business services 16%.

[12] Size classes for MNE are constructed using employment in The Netherlands (for which we have information) and not to the total worldwide employment of the MNE.

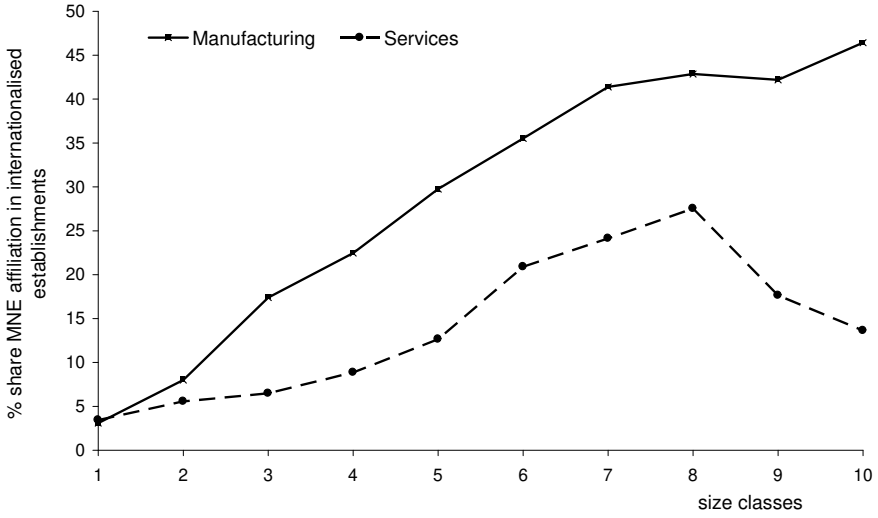
Table 2: Export intensity by size class: average share (%) of exports in total sales, establishments, 2005

	Size classes [a] 1	2	3	4	5	6	7	8	9	10
Manufacturing	28	27	37	38	44	49	48	49	56	60
Services	22	23	20	27	24	26	23	23	18	20

Notes: a) All establishments with 10 or more employed persons. The size codes are based on the number of employed persons and cover the following intervals: 1: 10-19 employed persons; 2: 20-39; 3: 40-59; 4: 60-80; 5: 80-124; 6: 125-249; 7: 250-499; 8: 500-999; 9: 1000-1999; 10: >2000 employed persons.

Source: Own calculations based on the PS database.

Figure 2: Establishments with MNE-affiliation as a percentage share of internationally active establishments, by size class, 2005



Notes: Internationally active establishments are defined as those establishments that have either exports or a multinational affiliation. Size classes are defined as in Figure 1.
Sources: Own calculations based on PS, ABR and SFGO data.

2.3 Export concentration

The total distribution of exports is much more skewed than is the case for export participation, with the largest exporters accounting for a disproportionately large share of total exports. Among our sample of large firms the mean export intensity is 19%, but the median is only 2%. It indicates that exports must be very much concentrated. This result also emerges at the establishment level.

The overwhelming majority of the largest exporters can be identified as being associated with multinational firms. Table 3 displays the export shares of the largest exporters. For instance, the top 5% of largest manufacturing exporters represent 73% of total exports. The corresponding figure for service exporters is 62%. The contribution of multinational-affiliated establishments is also reported. The table shows that the concentration of exports in the hands of MNE-affiliated establishments is considerably stronger in manufacturing than it is in services.

These stylised facts for the firm-level structure of Dutch exports confirm what has been found for many other countries by now. Exports are highly concentrated; this holds both at firm level and at establishment level. Compared to other countries the degree of concentration is not exceptional (cf.

Table 3: Export concentration rates by cumulative share (%) of largest exporters, establishments, 2005

	Share (%) of largest exporters in cumulative exports			
	Top 1%	Top 5%	Top 10%	Top 50%
Manufacturing establishments	50	73	83	99
of which: affiliated with Dutch MNE	42	60	68	74
Services establishments	37	62	78	98
of which: affiliated with Dutch MNE	16	26	31	34

Source: Own calculations based on the PS database.

Mayer and Ottaviano, 2007; International Study Group on Exports and Productivity, 2008). Multinational firms account for most of the Dutch exports; many domestic firms do not export. Exports by multinationals are much less important in services than they are in manufacturing.

The concentrated export structure has implications for the interpretation of short-term fluctuations in trade. The overwhelming role of the large all-time exporters means that a small fluctuation in their trade flow may outnumber the impact of entry and exit by many new (often small) export starters. For total manufacturing we calculated that over the period 2000-2005 a 10% fluctuation in the top-20% largest exporters on average had the same effect on Dutch manufacturing exports as the entry of 101 average export starters. This ratio differs by industrial sector, depending on capital intensity and the role of scale effects.

2.4 Descriptive performance data by internationalisation type

Table 4 compares labour productivity (using both valued added and sales per worker), wages and gross profitability. We distinguish between establishments in four internationalisation groups: (a) locals with only domestic sales, (b) exporters without multinational affiliation, (c) establishments with Dutch MNE affiliation but without exports, (d) exporting establishments with Dutch multinational affiliation.

A first comparison of productivity performance indicates that –when disregarding other firm characteristics– there is a strictly monotonic performance hierarchy between the internationalisation groups. Dutch affiliated multinational firms are substantially more productive than establishments that only export, both in services and in manufacturing. This is true for both definitions of labour productivity. In addition, value-added per worker of manufacturing exporters increases by internationalisation type. The productivity advantage of services exporters is also increasing by type of firm, but the differences are smaller than for manufacturing firms. When we use sales per worker as the labour productivity indicator, the previous results do not hold for the services sector, where non-exporting MNEs are more productive than exporting ones. Exporting firms (irrespective of MNE affiliation or not) are more productive than non-exporting firms. In the following section we look at these productivity differences when we use econometric tests. Table 4 also shows a number of differences in average wages and gross profits per worker. MNEs tend to pay higher wages than non-multinationals, while profit are distinctively higher for MNEs. Irrespective of MNE affiliation, exporters pay higher wages and earn bigger profits. For the firm-level data we find the same pattern that MNEs have higher values for both productivity measures, wages and profits than non-MNEs (not reported).

Table 4: Performance statistics by internationalisation group, establishments, pooled data, 1999-2005

Internationalisation group	Number of observations	Value added per worker in €1000	Sales per worker in €1000	Average wage per worker in €1000	Gross profit [a] in €1000
Manufacturing total [b]	51,340	68.7	133.6	21.3	47.4
of which:					
a. domestic-oriented	15,196	56.9	98.8	19.4	37.5
b. export only	23,644	67.6	132.1	21.1	46.5
c. non-exporter, Dutch MNE affiliated	2,253	77.6	158.2	22.8	54.8
d. exporter, Dutch MNE affiliated	9,482	90.0	202.8	24.3	65.7
Services total [b]	52,144	55.9	91.3	20.0	35.9
of which:					
a. domestic-oriented	36,789	52.2	87.1	19.0	33.3
b. export only	10,500	63.2	87.6	22.4	40.9
c. non-exporter, Dutch MNE affiliated	3,013	71.8	158.0	23.5	48.3
d. exporter, Dutch MNE affiliated	1,462	73.0	116.3	25.2	47.8
Total sample	103,484	62.3	112.3	20.6	41.6

Notes: a) The gross profit is calculated as valued added minus wages b) Manufacturing and services totals include firms (not shown) for which foreign MNE affiliation could not be identified in a reliable way.

Source: Own calculations based on PS; for MNE identification we used information from ABR and SFGO databases.

3 Testing the links between productivity and exports

The dominant way of empirical testing the predictions of the heterogeneous-firms trade models is to test through panel data regressions whether exporting firms have a significant productivity performance premium compared to non-exporters, when controlling for other export-invariant factors as well (cf. Wagner, 2007).[13] A positive exporter premium is indeed to be expected if positive self selection drives the choice behaviour on the extensive export margin. However, we want to focus primarily on the choice behaviour itself, rather than on the consequences of that behaviour. Thus, we use probit regressions as our main econometric test for export participation decisions, while the common panel data regressions that estimate the productivity premium are applied here as a robustness check.

3.1 The probability of becoming an exporter

The main prediction of the heterogeneous-firms trade model (cf. Melitz, 2003) is that firms opt for exporting if their productivity is sufficient to absorb the fixed entry costs in the export market. We assume that actual export behaviour can be adequately described by a latent variable model in which the preference of firm i in year t for exporting y_{it}^* precedes actual exporting. We reinterpret the heterogeneous-firms trade model in the following way. The decision to export y_{it}^* depends on a set of observable firm characteristics $\mathbf{x}_{it}$ and on an unobserved characteristic ε_{it} (e.g. the sunk entry costs firms expect to face in the export market). The main observable firm characteristics in $\mathbf{x}_{it}$ are per-

[13] Given that we do not have international transaction data, to test the predictions of the Melitz model for The Netherlands we need to impose the following assumptions: a) Firms in each sector (4-digit) have the same available information about market size, fixed and variable trade barriers, covering all relevant countries; b) All firms in a (4-digit) sector have the same country set as (potential) export markets and (giving assumption a) have an identical ranking within their set of preferred export countries; c) If firms in a (4-digit) sector decide to start exporting, they all enter the first country on their joint preference list, then all to the second country, etcetera.

formance characteristics (i.e. productivity, profitability). The assumed distribution of the unobserved characteristics ε_{it} determines the eventual export decision.

We assume that the firm's preference for exporting $y_{it} \in \{1, 0\}$ depends on a linear additive relationship between the vector of observed $\mathbf{x}_{it}$ characteristics and the unobserved ε_{it} characteristic that determine net export benefits:

$$y_{it}^{*} = \boldsymbol{\beta}\mathbf{x}_{it} + \varepsilon_{it} \tag{1}$$

If the latent decision variable y_{it}^{*} exceeds a certain threshold level, we assume that the firm exports.[14] Consequently, if $ES_{it} \in \{1, 0\}$ is firm i's export status in year t, we only observe $ES_{it} = 1$ if $y_{it}^{*} > 0$ and $ES_{it} = 0$ otherwise. We formulate the following probability of exporting:

$$P\{ES_{it} = 1\} = P\{y_{it}^{*} > 0\} = P\{\boldsymbol{\beta}\mathbf{x}_{it} + \varepsilon_{it} > 0\} = P\{-\varepsilon_{it} \leq \boldsymbol{\beta}\mathbf{x}_{it}\} = F(\boldsymbol{\beta}\mathbf{x}_{it}) \tag{2}$$

where F denotes the distribution function of $-\varepsilon_{it}$. Thus, we have obtained a binary choice model that depends on the distribution of ε_{it}. As the scale of the firm preference y_{it}^{*} is not identified, a normalisation on the distribution of ε_{it} is required.[15] Using a standard normal distribution, the binomial probit model for the export decision is given by:

$$\begin{aligned} y_{it}^{*} &= \boldsymbol{\beta}\mathbf{x}_{it} + \varepsilon_{it} \qquad \text{with } \varepsilon_{it} \sim NID(0,1) \\ \text{and} \quad : \quad & \begin{cases} y_{it} = 1 & \text{if } y_{it}^{*} > 0 \\ y_{it} = 0 & \text{if } y_{it}^{*} \leq 0 \end{cases} \end{aligned} \tag{3}$$

Based on the probit results we calculate impact elasticities. The (vector of) impact elasticities $\frac{\partial \ln(P\{ES_{it}=1|\mathbf{x}_{it}\})}{\partial \ln \mathbf{x}_{it}}$ gives the percentage change in the probability of a positive export preference after a 1% change in the log of firm characteristic $\mathbf{x}_{it}$.[16] We first analyze the most simple version of the probit model with only one performance variable x_{it} and all other possible impacts on the export decision unspecified. Table 5 shows the marginal effects of different performance variables. The general picture is that the performance variables always have a statistically significant impact on the export decision. In manufacturing we find a sensitivity for labour productivity and profitability that is, respectively, 30 to 50% larger than in services.

We extend the probit model by adding control variables that may also affect the export participation decisions of establishments: size of the establishment, industry-specific effects, lagged input characteristics, affiliation with a multinational firm, and time shocks. The probit model now becomes:

$$P\{ES_{it} = 1\} = F(\beta x_{it} + \gamma \mathbf{G}_{it-\theta} + \lambda \mathbf{R}_{i} + \eta \mathbf{T}_{t}) \tag{4}$$

[14] The threshold value can be set at zero without loss of generality.

[15] Usually this means that its variance is fixed at a given value (Verbeek, 2004). Since $F(\boldsymbol{\beta}\mathbf{x}_{it})$ is also bounded between 0 and 1, it is plausible to choose a standard normal distribution $\phi(\boldsymbol{\beta}\mathbf{x}_{it})$. There is no reason to expect that the standard normal distribution does not apply.

[16] We present impact elasticities instead of marginal effects $\frac{\partial P\{ES_{it}=1|\mathbf{x}_{it}\}}{\partial \mathbf{x}_{it}}$, because the intuitive interpretation of elasticities is easier. We evaluated point elasticities at the mean and median values of $\ln \mathbf{x}_{it}$. Since differences between mean and median appeared to be very small we only report point elasticities at the mean.

Table 5: Impact of performance on probability that an establishment exports: probit regressions, pooled data, 1999-2005

Performance indicator (in logs)	Sub-sample	Elasticity on export probability [a)]	Standard errors	z-value	Number of observations
Value added per worker	Manufacturing	1.2290	0.028	43.99 ***	53,000
	Services	2.323	0.067	34.82 ***	48,800
Profitability	Manufacturing	1.385	0.021	66.40 ***	52,600
	Services	1.895	0.046	40.95 ***	48,500

Notes: a) Post-estimation calculations of the point elasticities evaluated at the means of the independent variables, using the estimated probit model with clustered standard errors by 2-digit industry. Significance levels are coded as: *** significance at 1% level, ** at 5% level, and * at 10% level.

Source: Own calculations based on PS database.

where x_{it} is the performance indicator (e.g. value-added per worker, profitability), $\mathbf{G}_{it-\theta}$ is a vector of firm characteristics (lagged θ years to prevent multicollinearity problems with x_{it}), which includes a MNE dummy (the dummy has the value of one if the firm in year $t-1$ was affiliated to a multinational company and zero otherwise), and a lagged indicator of the firm's human capital (using the average wage per worker in year $t-3$ as a proxy). $\mathbf{R}_i$ is a vector of time-invariant environment variables of the firm, and $\mathbf{T}_t$ is a vector of year dummies. In the $\mathbf{R}_i$ vector we include 2-digit industry dummies and the firm's median size class over the entire interval that it is in our data panel.[17] In the estimation we account for the possibility of clustered standard errors by 2-digit industry.

The results for this extended probit model are presented in Table 6, covering pooled observations for the period 1999-2005. The performance indicators in all cases have a statistically significant marginal effect, even after controlling for a host of environment variables. We find that a one per cent growth in labour productivity would increase the probability of being an exporter by 0.82% in manufacturing and by 1.4% in services. Indirectly, these results are consistent with theory prediction that fixed or sunk entry costs in export markets are important and lead to productivity self selection. For profitability, the impact elasticity is around 0.95% in both manufacturing and services.

Regarding the other variables, Table 6 suggests that after control for industry differences the human capital intensity is not a major condition for becoming an exporter. Human capital is only significant in the profitability regression for services. The size of the establishment is a positive condition for becoming an exporter in manufacturing, which indicates that fixed costs and scale economies are important there. Being part of a multinational firm is a factor that positively predicts export participation in manufacturing, but not in services. Generally, the estimated probit model for manufacturing yields a better prediction of the actual export participation.

3.2 Testing productivity premia for exporters and MNEs

In this section we run as a robustness check the standard econometric tests to find export and MNE productivity premia. In particular, we use panel-data regressions where we construct dummy variables for the export status (ES) and the affiliation to a MNE of a firm, and include these dummies as

[17] The size class is measured on a 10-point Likert scale {1,..,10} that increases in employment size. We took the median size category for the firm over the full observation period. The result is expressed as a natural logarithm.

Table 6: Impact elasticities of performance on probability that an establishment exports: probit regressions including control variables, pooled data, 1999-2005

	Value added per worker		Profitability	
	Manufacturing	Services	Manufacturing	Services
Performance indicator (log)	0.819 ***	1.421 ***	0.955 ***	0.949 ***
Human capital indicator (log)	0.195	1.486	0.269	1.886 ***
Median size class (log)	0.243 ***	0.277 ***	0.051	0.053
MNE dummy	0.021 ***	0.007	0.017 ***	0.009
Industry dummies (2-digit)	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Number of observations	20,200	13,200	20,100	13,200
Predicted ES_{it} after probit [a)]	0.71	0.23	0.71	0.23

Notes: Post-estimation calculations of the point elasticities evaluated at the means of the independent variables, using the estimated probit model with clustered standard errors by 2-digit industry. Significance levels are coded as: *** significance at 1% level, ** at 5% level, and * at 10% level. a) This indicator gives the joint prediction power of the probit estimate, predicting the probability that ES_{it}=1.

Source: Own calculations based on PS database, combined with employment and MNE data from SFGO and ABR.

an explanatory variable for the firm's productivity levels. Productivity is the crucial performance variable in the heterogeneous-firms trade models (Melitz, 2003; Baldwin, 2005). Exporters need a higher productivity rate (than non-exporters) allowing them to absorb the fixed or sunk entry costs in the foreign market. Hence, exporters should have on average a positive performance premium compared to non-exporters, all other things equal. We test the productivity performance premia in a number of discrete steps, starting with the pooled data. We investigate whether the predicted productivity premia for exporting and multinational firms indeed exist. And if they exist, whether such effects can possibly be explained away by controlling for various firm-specific, industry-specific or market-specific factors. We check for all three of these control variables. To reduce possible endogeneity between export participation and firm size, we use a set of size class dummies based on the firm's median employment size over the entire time span that the firm is present in the data panel. The extended model reads:

$$\ln x_{it} = \alpha + \beta ES_{it} + \psi MNE_{it} + \gamma \mathbf{G}_{it} + \eta \mathbf{T}_t + \varepsilon_{it} \tag{5}$$

where x_{it} it the performance variable for firm i in period t, ES_{it} is the firm's exporter status, MNE_{it} is a dummy for affiliation with a multinational company, $\mathbf{G}_{it}$ is a vector of environment control variables (industry dummies, and dummies for period-median size class), $\mathbf{T}_t$ is a vector of year dummies to control for time shocks, and ε_{it} is the error term.

The resulting extended performance-premium regression has been applied to both the firm-level data and the establishment-level data, so as to allow further comparison. For the establishment-level data, we use a weighted least square (WLS) estimator with sample-to-population expansion factors as weights, so as to be able to account for non-response and under-representation of small firms with less than 50 employees. Table 7 reports the results regarding the performance premia for firms and establishments.

Exporters and MNE have significant and large positive productivity premia in terms of value-added per worker. The exporter labour productivity premia are all round 20% and significant at the highest confidence level. MNE premia are all highly statistically significant and between 14 and 23%. The latter

Table 7: Exporter and MNE labour productivity (value-added per worker) premia, firm and establishment-level, pooled data, 1999-2005

Internationalisation group	Firm-level pooled data (2000-2005) [a]	Establishment-level pooled data (1999-2005) [b] Manufacturing	Services
Exporters vs. non-exporters	23% ***	20% ***	18% ***
MNE versus local firms	14% ***	20% ***	24% ***
Number of observations	12,400	43,700	50,100

Notes: The performance variable is the log of value added per worker. WLS regressions using clustered standard errors by 2-digit industry. a) The G-vector contains 2-digit industry dummies interacted with dummies per period-median size class of the firm. The MNE identifier refers to Dutch-owned and foreign-owned MNE. b) The G-vector contains 4-digit industry dummies, and separate dummies for period-median size class of the establishment. The MNE identifier solely refers to Dutch-owned MNE.

Sources: Own calculations based on the SFGO and PS database.

result is in line with the predictions of Helpman *et al.* (2004). The gap between the MNE premium and exporter premium is particularly strong in services. In the reasoning of Helpman *et al.* (2004) it indicates that sunk entry costs for FDI in services are stronger than in manufacturing.

3.2.1 Controlling for size composition

The heterogeneous-firms trade model predicts that exporter premia are probably more important for small firms than for large firms, because fixed market-entry costs are relatively more important for smaller firms.[18] In Table 8 we test this hypothesis by calculating the labour productivity premia for four firm-size categories. The premium indeed appears to be largest for the two smallest size classes. This suggests that scale effects are important for exports and for setting up a foreign subsidiary.

Table 8: Exporter and MNE labour productivity (value-added per worker) premia, firm-level pooled data, differentiated by firm size, 2000-2005 [a]

Internationalisation group	Value-added per worker, all firms [b]	Value-added per worker by size class (employed persons) 1-49 empl.	50-249 empl.	250-499 empl.	>500 empl.
Exporters vs. non-exporters	26%***	107%***	28%***	16%***	20%***
MNE versus local firms	20%***	54%***	28%***	16%***	8%***
Number of observations	12,400	800	4,300	3,100	4,200

Notes: a) Panel regression over pooled SFGO dataset, using sample-to-population expansion factors as weights. All productivity variables measured in logs. Control variables: 2-digit sector, size class dummies, and year dummies. b) The " all firms" labour productivity premia differ somewhat from those in Table 7 because the exporter dummy and the MNE dummy are applied independently from each other rather than together in one regression equation.

Sources: Own calculations based on the SFGO database.

For the establishment data we did similar regressions by size-class with a more refined, 10-point size-class scale. The labour productivity premia of exporters in the two largest size classes (1000+ employees) generally were not statistically significant, possibly because of limited sample size. The performance premia are largest (30% or more) for the smallest size classes and that they decrease with establishment size. Beyond a threshold of 250 employed persons we found few significant export premia.

[18] For instance, Kneller and Pisu (2007) report for British firms that exports impact mostly on the size of the firm and only to a more limited extent on productivity.

3.2.2 Controlling for fixed effects

After checking whether exporter and MNE premia are caused by input-specific and market-specific factors, we test whether such premia are perhaps caused by special characteristics of individual firms and establishments, such as management capacity, innovativeness of the work force or geographic location. To control for such influences, we consider the data in a panel dimension and add firm-specific (or establishment-specific) fixed effects.[19] This means that one of the annual observation per firm (or establishment) is sacrificed as a constant reference over time.

The panel dimension of the large-firm data is much better than the establishment data, since the majority of firms is surveyed annually in the dataset. Tables 9 presents the firm-level fixed effects regression results. It shows that the exporter premium is significant and positive for value added per worker, but not for sales per worker. The MNE premium is significant and positive for both productivity criteria.

Table 9: Firm-level labour productivity premia when controlling for fixed effects: panel regressions, 1997-2005

Internationalisation group	Value-added per worker	Sales per worker
Exporters vs. non-exporters	6.2% ***	1.8%
MNE versus local firms	4.2% ***	4.4% *
Number of observations	12,400	12,400
Number of firms	2,400	2,400
R^2 adjusted	0.27	0.18

Notes: Panel regressions with firm-level fixed effects, dummies for years, size, and 2-digit industry. Productivity indicators are in logs. Significance levels: *** significance at 1% level, ** at 5% level, and * at 10% level. Premium calculated as 100*[exp(β) -1].
Sources: Own calculations based on the SFGO database.

Table 10 displays the results for the establishment-level data. The productivity premium of MNE-linked establishments evaporates. Apparently, the MNE premium is related to other characteristics of these establishments than to export participation decisions. Conversely, for exporters we still find significant and substantial positive performance premia for labour productivity. The results are statistically significant at the highest confidence level even though they explain just a small part of variance in the data (i.e. there is a low R^2).

It is interesting to note the difference between the establishment-level and firm-level results for the MNE performance premium. However, recall that the firm-level dataset allows a much better identification of links with foreign-owned firms, while the establishment data only allows for the identification of links with Dutch-owned multinationals.

To sum up, the most important conclusions from this section are that, throughout the total population of firms and establishments:

- Exporters are robustly more productive than non-exporting units. These results are not conditional on other factors such as industry, input choices, market characteristics, and fixed effects specific for the individual firm or establishment.

[19] We use fixed effects estimated as deviations from the time series mean.

Table 10: Establishment-level labour productivity premia when controlling for fixed effects: panel regressions, 1999-2005

	Value added per worker	
Internationalisation group	Manufacture	Services
Exporters vs. non-exporters	3.3% ***	2.2% ***
MNE versus local firms	0.1%	-2.6%
Number of observations	51,247	47,934
Number of firms	13,058	20,559
R^2 adjusted	0.001	0.001

Notes: Panel regressions with establishment-level fixed effects, dummies for years, size, and 2-digit industry. Productivity indicator is in logs. Significance levels: *** significance at 1% level, ** at 5% level, and * at 10% level. Premium calculated as 100*[exp(β) -1].
Sources: Own calculations based on the SFGO database.

- The exporter productivity premia are only found for establishments up to an employment size of 250 employees. This means that the exporter premia are scale-related, which is consistent with the presence of sunk entry costs in foreign markets.

- MNE performance premia at the establishment level disappear when we consider firm-specific characteristics. In manufacturing, the MNE performance premium is no longer statistically significant. This means that firm-specific characteristics like management capabilities, innovativeness of the work force, and geographic location are more decisive than the exporter status of the establishment. However, it should be kept in mind that in our large-firm sample, MNEs still have a higher productivity, even when firm-specific characteristics are taken into consideration. A possible explanation is that the manufacturing MNE-premium is based mainly in headquarter services that are less well captured at the establishment level.

4 The role of market structure in export performance

Chaney (2008) extends the heterogenous firms trade model of Melitz (2003) to include the role of market structure. It can be derived from the Chaney (2008) model that a firm in homogeneous markets (high substitution elasticity between products) needs a bigger performance premium to enter an export market. Conversely, exporter premia are predicted to be lower in markets with more product differentiation. We test this hypothesis by splitting the samples in two parts on the basis of competition characteristics. The heterogeneous products group is made up of industries with strong product differentiation and low substitution elasticity. The homogeneous products group is characterised by weak product differentiation and high substitution elasticity.

The distinctive criterion for product homogeneity is based on the idea that in an industry with homogeneous products, competition will have mainly the character of price and cost competition. Inefficient firms with low productivity will then either shrink or drop out and more efficient firms will survive and grow. As a result of these movements, the dispersion of productivities in such homogeneous-products industries will be lower than average for all industries. Conversely, in industries with more differentiated products the competitive process is driven less by price and cost competition, and we expect more than average dispersion of productivities. Using these insights we calculated the dispersion

of firm productivities in each 4-digit industry. The "homogeneous products" dummy was set to 1 if the variation coefficient of value added per worker over the entire observation period was less than 75% of the average for manufacturing and services, and set to 0 otherwise.

According to this criterion, about two-thirds of manufacturing and services establishments were found to operate in homogeneous products industries. With the split samples we estimated again the full probit regression model from equation (4). For brevity, we only give the estimated parameters and the number of observations in Table 11.

Table 11: Impact elasticities of performance on probability that an establishment exports: probit regressions including market structure indicator, pooled data, 1999-2005

	Manufacture		Services	
	Homogeneous Products	Heterogeneous Products	Homogeneous Products	Heterogeneous Products
Value added per worker (log)	0.827 ***	0.744 **	3.549 ***	1.051 ***
Human capital indicator (log)	0.024	0.398 ***	1.851	0.781
Median size class (log)	0.264 ***	0.195 ***	0.293 ***	0.202 ***
MNE dummy	0.011	0.049 ***	0.030	-0.011
Industry dummies (2-digit)	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
Number of observations	14,678	5,522	7,161	6,057
Predicted ES_{it} after probit [a)]	0.07	0.73	0.20	0.20
Pseudo R^2	0.05	0.11	0.09	0.02

Notes: Post-estimation calculations of the point elasticities evaluated at the means of the independent variables, using the estimated probit model with clustered standard errors by 2-digit industry. Significance levels are coded as: *** significance at 1% level, ** at 5% level, and * at 10% level. a) This indicator gives the joint prediction power of the probit estimate, predicting the probability that ESit=1.
Source: Own calculations based on PS database, combined with employment and MNE data from SFGO and ABR.

The results are consistent with the predictions of the Chaney (2008) model: both for manufacturing and for services we find that exporters in homogeneous-product industries have higher productivity elasticities than those in heterogeneous-products industries. This suggests that self selection in industries with strong cost and price competition is based on productivity as major selection parameter. The strongest difference is found in services. For heterogeneous services, the elasticity of labour productivity on the probability of being an exporter is less than one-third compared to the homogeneous services. After splitting the sample, we now find that establishment size is important at the highest confidence level in all regressions, suggesting that fixed entry costs affect scale economies. Multinational affiliation and human capital intensity are only a positive predictors of export starting for heterogenous-products industries in manufacturing. Overall, these results suggests that the type of sunk entry costs in foreign markets may differ by industry.

5 Self-selection into foreign markets

So far we tested for static productivity premia in the pooled datasets, which include all-time exporters, new exporters and non-exporters. However, these estimations do not deal with time-dependent behaviour that is crucial to test the self-selection hypothesis. This hypothesis can be tested by assessing the pre-export performance differences of export starters and non-exporters. According to the heteroge-

neous firms theory, a firm self-selects into export participation on the basis of its relative performance in the domestic market. This implies that even before export starts we should find a positive performance premium.

This can be tested by using a modified version of the probit analysis of equation (4) where we use the past performance of firms $x_{t-\theta}$ (instead of the present performance) and where we drop the all-time exporters from our dataset and focus on the new exporters. Thus, the equation being regressed is:

$$P\{ES_{it} = 1\} = F\left(\beta x_{it-\theta} + \gamma \mathbf{G}_{it-\theta} + \lambda \mathbf{R}_i + \eta \mathbf{T}_t\right) \tag{6}$$

New exporters are identified as firms that started exporting during our data period (1999-2006) and that did not have exports in the θ years before export start in year t. The latter condition excludes the incidental or "on-off" exporters.[20] We compare the set of new exporters with non-exporting firms that neither had exports in the year t nor in period $t-\theta$. This sample selection implies that we lose many observations and are left with only small samples of export starters each year. The number of observations decreases with the length of the lead period θ. We experimented with lead periods of one, two and three years. Table 12 gives the results for the ex-ante probit self-selection model.

Table 12: Impact elasticities of ex-ante performance on probability that an establishment exports in period t-q: probit regressions, pooled data, 1999-2006

	Value added per worker		Profitability	
	Manufacture	Services	Manufacture	Services
Performance indicator, 3 years before	2.804 ***	0.452	2.771 ***	-0.612
Number of observations	3,783	4,607	3,753	4,590
Number of export starters	387	297	387	297
Predicted ES_{it} after probit [a)]	0.08	0.05	0.08	0.05
Performance indicator, 2 years before	1.929 ***	0.705	1.628 **	0.281
Number of observations	6,376	8,611	6,337	8,572
Number of export starters	797	724	797	724
Predicted ES_{it} after probit [a)]	0.10	0.06	0.10	0.06
Performance indicator, 1 year before	0.084 ***	1.692 **	0.056 ***	1.288 ***
Number of observations	6,991	9,718	6,949	9,675
Number of export starters	1,332	627	1,332	627
Predicted ES_{it} after probit [a)]	0.15	0.05	0.15	0.05

Notes: Post-estimation calculations of the marginal effects at the means of the independent variables, using the estimated probit model with clustered standard errors by 2-digit industry. Significance levels are coded as: *** significance at 1% level, ** at 5% level, and * at 10% level. Includes control variables: human capital indicator, size class, and industry (2-digit) and year dummies. a) This indicator gives the joint prediction power of the probit estimate, predicting the probability that ESit=1.

Source: Own calculations using the PS database.

A clear result is that the probability of exporting depends positively on the ex-ante labour productivity and profitability performance, confirming the prediction of the self-selection model. The evidence for dynamic self selection is strongest in manufacturing. The labour productivity and profitability of manufacturing in year $t-3$ is a good predictor for export start in year t. A 1% higher labour productivity in the year $t-3$ yields a 2.8% higher probability of a positive export decision in year t, and for the year $t-1$ the elasticity is only 0.08%. The ex-ante productivity 3 years before is therefore a better

[20] To prevent the inclusion of 'on-off' exporters in the case of theta=1, we added the additional restriction that the exporter starters remain active in exporting in t+1, even though this diminished the size of the sample.

predictor than productivity in later years. In services, only productivity and profitability in year $t-1$ can significantly predict export start. The pattern for profitability as performance indicator is likewise.

We also did robustness test for ex-ante performance premia using the more common panel regression formulation:

$$\ln x_{it-\theta} = \alpha + \beta XS_{it} + \gamma \mathbf{G}_{it} + \eta \mathbf{T}_t + \varepsilon_{it} \tag{7}$$

where the productivity indicator is taken θ years before the firms begins to export (XS) and the pre-export performance premium for exporters can be derived from β. In Table 13 we report the results of the panel regression with our large-firms dataset, which is limited by the relatively small sample size that only allows using a 2-year pre-start observation window. In spite of the small number of export starters we find a significant and positive productivity advantage of firms two years before they start exporting.[21]

Table 13: Dynamic panel regressions for productivity premium 2 years before export start, firm-level SFGO sample, 1997-2005

	Value-added per worker	Sales per worker
Exporter starter premium	12.2% *	8.9% *
Number of observations	2,100	12,400
R^2 adjusted	0.30	0.34

Notes:Includes dummy control variables for years, size class, and 2-digit industry. Productivity indicators are in logs. Significance levels: *** significance at 1% level, ** at 5% level, and * at 10% level. Exporter starter premium calculated as 100*(exp(β) -1).
Sources: Own calculations based on the SFGO database.

Summarizing these results, our estimations clearly support the self-selection hypothesis that export starters have a significant productivity advantage –with respect to non-exporters– before they begin to export.

6 Learning-by-exporting and distance to the technological frontier

Empirical studies in the 1980s and 1990s used to explain the fact that exporters were more productive than non-exporters due to the learning experiences of exporters.[22] Although we find strong evidence in favour of the self-selection hypothesis, we cannot exclude that ex-post learning-by-exporting is a supplementary explanation for productivity premia by exporting firms, certainly when dynamic learning effects are taken into account.

We tested empirically for the general existence of learning-by-exporting effects. For this we considered a sample of establishments from which the all-time exporters have been removed. We focus on the establishments that started exporting during the observation period (1999-2005) and we compare their productivity performance with that of similar establishments that did not export. Export starters are

[21] We find similar results at the establishment-level, which are not reported here.
[22] E.g. World Bank (1993; 1997) Grossman and Helpman (1991) and Evenson and Westphal (1995).

those establishments that start exports in year t and did not export during the two years before export start. We evaluate their labour productivity growth during 1, 2 and 3 years after export starts.

We found, however, no empirical support for the learning-by-exporting hypothesis. This result holds for every time lag, for both firm and establishment-level databases, and for the manufacturing and services sub-samples.[23]

Although we find no general export-learning effect on productivity, it can be that the learning-by-exporting effects are conditional on the export destination market. In particular, the destination country's distance to the international productivity frontier. The inclusion of this variable would give support to the insight that learning-by-exporting is conditional on export destination (De Loecker, 2007; Pisu, 2008). A neglect of considering the learning potential by export destination might explain why most country studies fail to find significant learning-by-exporting effects. To correct for learning potential we constructed an international productivity frontier, based on value added per worked hour for the 2-digit industry level. We use labour productivity (value-added per worker) as the key variable based on data from the EUKLEMS productivity database. It contains internationally harmonised data for 60 industries for a group of 17 major developed countries, most of them in the OECD. We construct the industry-level international frontier over this 17-country horizon. Secondly, after converting the national data into PPP dollars it is possible to identify –by year and industry– the frontier country with the highest value added per worked hour. Finally, after identifying the frontier country, we calculated for the rest of the countries the relative gap compared to the frontier country. Both the frontier and the frontier gaps move over the years.

As an illustration Figure (3) in the Appendix provides the percentage distance of Dutch industries to the international labour productivity frontier and the shifts in this gap between 1995 and 2003. The only services industry for which The Netherlands held an international frontier position in 1995 was the insurance and pension fund sector (NACE 66). In that year the frontier gap was therefore zero, but in 2003 this industry had become less competitive in productivity and at a distance of ten per cent from the new frontier country. For manufacturing industry, five Dutch industries held international frontier positions in 2003.

We then re-run the panel data regressions with a control variable that quantifies an establishment's distance to the international productivity frontier. The results are negative: even when controlling for the learning potential we find no significant learning-by-exporting productivity gain for firms. Even though some studies report learning effects for relatively backward export starters Besedes and Prusa (2006) and Albornoz *et al.* (2009) we cannot confirm this for the Netherlands.

7 Conclusions

This paper has been guided by two research targets. Firstly, to produce a descriptive analysis of the firm-level structure of Dutch exports and the distinctive characteristics of exporting firms and multinational firms active in the Dutch markets. Such data have recently come available for a range of countries and we sketched the corresponding picture of stylised facts for The Netherlands. We find that Dutch exporting firms follow the now standard results of the heterogeneous-firm literature: exporting firms are more productive, larger and pay higher wages than non-exporting firms. Moreover, exports are highly

[23] These results are reported in Kox *et al.* (2010).

concentrated in a few large exporting firms. The concentrated export structure has implications for the interpretation of short-term fluctuations in trade. The overwhelming role of the large all-time exporters means that a small fluctuation in their trade flow may outnumber the impact of entry and exit by many new (often small) export starters.

Secondly, we want to establish what is behind these stylised facts. We investigate econometrically whether the self-selection hypothesis and other predictions from the heterogeneous-firms trade models can explain the patterns we find in Dutch exports. Our results find strong support for the self-selection hypothesis, where initial higher productivity levels allow firms to cover the initial sunk trade costs and self-select into becoming an exporter. We also test whether the learning-by-exporting hypothesis offers a complementary explanation for the export-productivity link. We find no empirical support for the learning-by-exporting hypothesis, not even after controlling for the firm's distance to a constructed international productivity frontier. This latter result may be important for the motivation of future export promotion policies.

Throughout our empirical estimates, we use probit regressions as an alternative way to test whether productivity levels increase the probability of becoming an exporter. These probit regressions are complemented by the standard OLS panel regression estimates.

Finally, we test wether the productivity-export link is altered if we consider an indicator for sectoral market structure. We find that services sectors with high competition, and thus, lower product differentiation have a significantly higher export productivity premia than firm's in less competitive sectors. Such differences are not found in the manufacturing sector.

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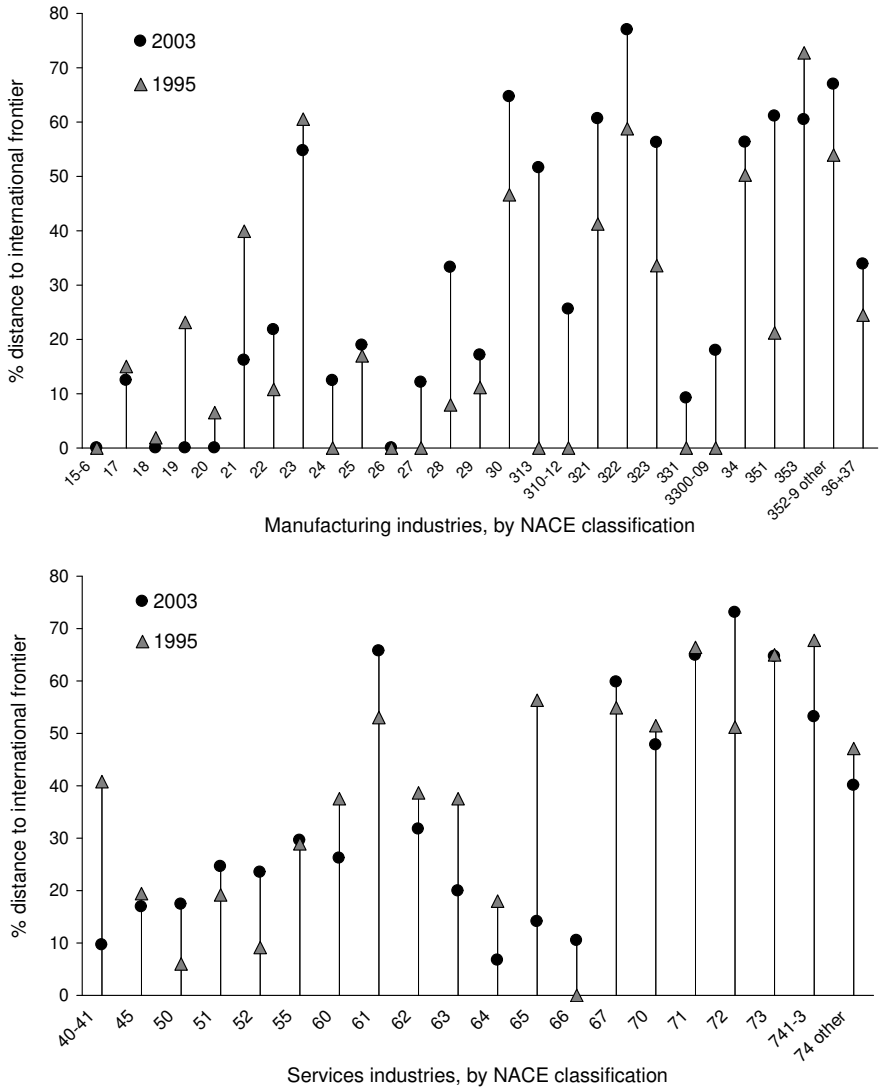
A Appendix

Figure 3: Percentage distance of Dutch industries to the international labour productivity frontier (specified by industry and by year based on average value added per hour worked, PPP constant), 1995 and 2003



Notes: Industry codes services. 40-41: electricity, gas and water supply; 45: construction; 50: sale, maintenance and repair of motor vehicles, fuel sales; 51: wholesale trade; 52: retail trade; repair of household goods; 60-63: transport and storage services; 64: post and telecom; 65-67: banking, insurance and financial services; 70: real estate; 71: renting of equipment; 72: computer and IT services; 73: contract research; 740-748: other business services.
Industry codes manufacturing: 15-16: food, drink and tobacco; 17: textiles; 18: clothing; 20: leather and footwear; 21: wooden products; 22: pulp & paper products; 23: printing & publishing; 24: min. oil refining, coke & nuclear fuel; 24: chemicals; 25: rubber & plastics; 26: non-metallic mineral products; 27: basic metals; 28: fabricated metal products; 29: mechanical engineering; 30: office machinery; 310-312: other electrical machinery and apparatus nes; 313: insulated wire; 321: electronic valves and tubes; 322: telecom equipment; 323: radio and television receivers; 331: scientific instruments; 3300-09: other instruments; 34: motor vehicles; 351: shipbuilding; 353: aircraft and spacecraft; 352-9: other transport equipment; 36+37: Furniture, miscellaneous manufacturing; recycling.
Sources: Own calculations based on EUKLEMS data (GGDC).