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Abstract:
The paper tests the role of agglomeration effects on the export decision of services firms. Recent theories on trade with heterogeneous firms predict that export participation goes along with sunk market-entry costs. Only the more productive firms will be able to overcome these sunk costs. This leads to a process of - ex ante - self selection. These predictions are tested for the services industry, with due account for the possible role of agglomeration effects in large-city areas.

Standard empirical tests of the new trade models consistently find productivity-based *ex ante* self selection by exporters, and this effect is mostly explained by unobserved sunk entry costs that exporters have to absorb in new foreign markets. Recent research by urban economists (e.g. Combes et al., 2012) suggests, however, that operating in large-city areas also goes along with positive productivity sorting. Ignoring this leads to upwardly biased estimates of the effect of foreign market entry costs. A large set of micro-data for establishments in Dutch services is used to investigate this hypothesis.

I find evidence that positive productivity self-selection is based on the combined effects of agglomeration and anticipated market-entry cost for export starters. This effect is strongest in markets with more or less homogeneous products. I also find evidence that the productivity self-selection effect (of exporters compared to non-traders) is stronger in non-urban areas and smaller agglomerations.

JEL codes: R12, D4, F12, L8

Key words: services, export, heterogeneous firms, agglomeration effects, productivity

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1. INTRODUCTION

Last decade has seen a fast expansion of theoretical and empirical studies on international trade with firms that are heterogeneous with respect to some productivity performance parameter. The growth of this literature is partly generated by the recent availability of international transaction data at the firm level. These data have enabled researchers to test a host of predictions made by the new trade models with heterogeneous firms. New in these models and studies is that they explain why not all firms participate in exports, and why exporters differ from non-exporters. Basically, the models assume that exporters face sunk entry costs in foreign markets and that only firms with superior productivity are profitable enough to absorb these sunk costs. The self-selection by firms into exports explains why exporters are systematically more productive than non-exporters and why many firms refrain from exporting. The predictions by now have been corroborated by firm-level studies for many countries.[1]

More recently, scientists in the regional economics specialisation have drawn attention to the fact that the heterogeneous-firms trade economists perhaps jump to conclusions too easily: they should consider the impact of agglomeration effects. Regional economists have, in the footsteps of Adam Smith and Alfred Marshall, firmly established that firms and workers in large cities are on average more productive than comparable firms and workers in non-urban areas. If high-productivity exporters are predominantly located in urban areas, the trade researchers may in fact have (re)discovered agglomeration effects. The main problem with the estimation of agglomeration effects is that it is difficult to distinguish between two competing explanations for the positive correlation between agglomeration and productivity. First, productivity is high because of agglomeration effects: local spatial externalities (e.g. thick labour markets, shared suppliers, concentration of high-skilled workers, learning potential). Second, agglomeration is an endogenous consequence (rather than a cause) of high productivity, if workers and firms are drawn to regions where successful high-productivity firms are established. Econometric research of the latter causality chain typically requires long time series, because the geographical shift of firms and workers is a process that materialises in the long term.

Combes et al. (2008, 2012) using French data find that agglomeration effects contribute positively to above-average productivity of firms in larger cities. They claim that the process is generated by the fact that Darwinian competitive selection among firms is tougher in large cities than elsewhere in a country.[2] If we assume that the results by Combes et al. (2012) are correct, this must have consequences for the export decision of firms. We may infer the prediction that for large-city firms the step towards exports will be smaller than for firms elsewhere in a country where both the local Darwinian selection among firms and the agglomeration advantages are weaker. The present paper will investigate this implication.

The paper contributes in three ways to the self-selection versus agglomeration discussion. Firstly, it establishes the role of productivity based self-selection for export decisions of services firms. Secondly, the paper investigates whether productivity-based self selection of exporters is stronger in non-urban areas than in large-city areas. A third contribution to the literature is the finding that productivity self selection for exporters also depends on the market structure, more in particular the degree of product homogeneity.

[1] Comprehensive surveys of the results have been provided by Wagner (2007, 2012), Greenaway and Kneller (2007), Ottaviano (2007) , and ISGEP (2008).

[2] Allowing only the most productive ones to survive and thus generating higher average productivity compared to rural areas (like in Melitz and Ottaviano, 2008).

The findings of the paper can be summarised as follows. The export decision of services firms goes along with positive, performance-based self selection, even after controlling for a range of other factors that may affect performance. This self-selection is strongest in markets with more or less homogeneous products. The magnitude of productivity-based self selection by exporters (in response to sunk foreign market-entry costs) tends to be over-estimated if one does not control for productivity sorting in large-city areas. Taking account of agglomeration effects should become standard procedure in empirical tests of heterogeneous-firms trade models. Finally, the strength of performance-based self selection (exporters versus non-exporters) tends to be under-rated in rural areas, because the future exporters cannot benefit from agglomeration-related benefits.

The structure of the paper is as follows. Section 2 positions the research questions in the context of the international literature from which researchable hypotheses will be developed. Section 3 describes the data and the empirical strategy. Section 4 first presents some descriptive results from the data. Section 5 investigates the static aspects of productivity-based self selection and agglomeration for exporting firms. I distinguish between markets with relatively homogeneous and markets with relatively differentiated products. Section 6 concentrates on dynamic, time-dependent aspects of the self-selection process and the way this is affected by agglomeration factors. Section 7 discusses the main results and concludes.

2. AGGLOMERATION, PRODUCTIVITY SORTING AND EXPORTING

Bernard and Jensen (1995) were the first authors to question the causality direction between productivity differences and export participation. Until then, received theory had it that firm productivity increased by the export experience itself, through the contact with competitors in international markets. The 'self-selection school' came into being with almost simultaneous papers by Bernard, Eaton, Jensen and Kortum (2003) and Melitz (2003). Both assume that firms are heterogeneous in terms of productivity. Melitz (2003) so far has turned out to be the most fruitful approach. It assumes monopolist competition and one-off sunk entry costs for firms entering export markets.[3] Only firms with productivity above a certain threshold level expect to overcome the sunk market-entry costs and decide to start exporting. Lowering of sunk market barriers creates market opportunities for exporters that have lower productivity than the firms that were exporting before the sunk market barriers decreased. Nonetheless, the increased import penetration drives out the least-productive domestic firms. The resulting market reallocation causes average productivity in the importing country to go up. The Melitz model has been followed by several papers offering variants and elaborations of the original model.[4] Helpman, Melitz & Yeaple (2004) extend the analysis to foreign market entry through direct investment, i.e. local production by multinational enterprises (MNE). They claim that the sunk costs required to become a MNE are even higher than those for an exporter. Based on this, their model predicts that productivity self-selection for firms that start multinational activities will even be stronger than for export starters.

The heterogeneous-firms trade model by Melitz (2003) is intrinsically complex. In technical terms, it requires a joint solution of the trade equilibrium and the entry conditions for all firms to identify the marginal domestic and the marginal exporting firms. Some of the later papers try to simplify the

[3] Examples of such costs are language barriers, complying with foreign regulations, adapting the product to the foreign market, the fixed costs of reaching foreign customers. Early trade models with sunk costs are Dixit (1989), Baldwin (1988) and Baldwin and Krugman (1989).

[4] See Redding (2010) for a review. Prominent theoretical papers are Yeaple (2007); Eaton, Kortum and Kramarz (2011); Melitz and Ottaviani (2008); Chaney (2008).

model without loss of generality and to make it more easily testable (e.g. Baldwin, 2005; Lawless, 2009). Both Balistreri, Hillberry and Rutherford (2008) and Chaney (2008) achieve a simplification by decomposing the model into a general equilibrium module and a partial-equilibrium module. The general-equilibrium part evaluates the relative prices, expenditure structures, comparative advantage and the terms of trade. The partial equilibrium module determines the industrial-organisation aspects: market entry, production and employment and export decisions. An attractive property of the Chaney model is that it predicts that firms in homogeneous markets (high substitution elasticity between products) need a bigger performance premium to enter an export market. Conversely, exporter premia are predicted to be lower in markets with more product differentiation. I will test this prediction later in the paper.

The literature on the impact of agglomeration on the productivity distribution of firms and workers is vast. It is by now well-established that this impact is statistically significant and positive (e.g. Ciccone and Hall, 1996: Ciccone, 2002; Duranton and Puga, 2004; Rosenthal and Strange, 2004; Melo et al., 2009; Andersson and Lööf, 2009). A positive 'urban productivity premium' has been widely researched and it could be registered in many countries. Agglomeration impacts may work along different lines. Three main micro-foundations for urban agglomeration effects are: (i) sharing of resources and suppliers, (ii) local matching of quality-based search for specific inputs and labour skills and (iii) local learning spill-overs (e.g. Duranton and Puga, 2004; Morettti, 2004). Larger regions may be able to sustain a larger variety of input suppliers and a deeper division of labour that makes workers more productive. Urban agglomerations offer opportunities for the generation, the diffusion, and the accumulation of knowledge (Marshallian externalities). Furthermore, the increasing-returns-to-scale effects of a larger market when many firms and workers crowd together, come on top of this (Krugman, 1991).

The interaction of agglomeration and productivity self selection of exporters is an aspect in the trade literature that so far has received only limited attention. Early papers on trade and agglomeration are Krugman (1991) and Ottaviano, Tabuchi and Thisse (2002), but at that time the seminal papers on trade with heterogeneous firms still had to appear. The first papers to link productivity self selection and agglomeration are Baldwin and Okuba (2006), Melitz and Ottaviani (2008) and the papers by Combes, Duranton et al. (2008, 2012). Baldwin and Okuba (2006) focus on the fact that firms in large markets benefit more from forward and backward linkages. Melitz and Ottaviani (2008) analyse the relation between toughness of competitive selection and country size, which subsequently feeds back into impacts on the selection of exporters in the large-country markets.

Combes et al. (2012) concentrate on firm selection in large cities, with selection defined as "*the inability of weak firms to survive when faced with tougher competition in large markets*". Their model is a generalisation of Melitz and Ottaviano (2008). It predicts that: (1) stronger selection in large cities left-truncates the productivity distribution; (2) stronger agglomeration right-shifts the productivity distribution and dilates/widens it. An important innovation in their paper is that the authors propose a number of solutions to overcome the econometric difficulty of identifying agglomeration economies and to separate the questions whether average productivity is higher in denser cities, because:

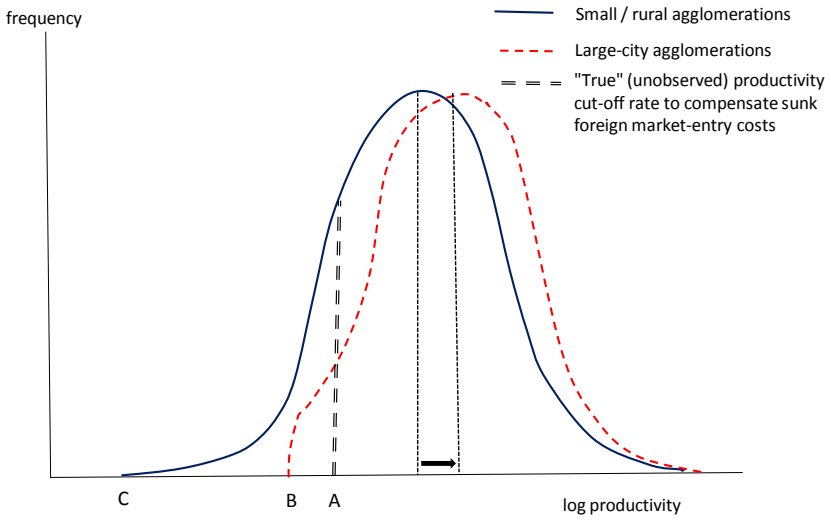
- shared resources in large agglomerations generate productivity benefits to all local firms;
- there is greater selection that eliminates the least productive firms.

Earlier papers like Melitz and Ottaviani (2008) or Syverson (2004) predict that in larger and more dense markets a tougher competition causes left truncations of the productivity distribution and therefore a raised average productivity. Combes et al. (2012) argue that it is insufficient to only use summary statistics about the productivity distribution (variance, median, bottom decile), because both

self selection and agglomeration can be the cause of an increase in median productivity or in the performance of the bottom productivity decile. So an identification problem remains. They propose that a proper test should look at all quantiles of the productivity distribution without imposing particular distributional assumptions or restrictions. Using French data they found that self selection alone cannot fully explain the left truncation of the distribution and the right-shift of median productivity, hence agglomeration must play an additional role. Moreover, the agglomeration advantages of large cities accrue to all local firms and therefore show up in the form of changes over the *entire* productivity distribution.

Combes *et al.* (2012) is by now a well-travelled paper that has been around for some time (e.g. Combes *et al.*, 2008), so we probably may quite safely assume that their findings stood the test of all types of professional critique. Hence, it is time to think about its consequences. It means that the standard empirical tests of the heterogeneous-firms trade models are probably flawed for two reasons. Firstly, because agglomeration effects generally are not taken into consideration in this empirical literature. Secondly, because the standard procedure of testing these models has often been a test on summary statistics about the productivity differences between exporters and non-exporters. A typical test like the existence of a "productivity premium" for exporters (cf. Wagner 2007, 2012) is unable to distinguish between agglomeration and self selection effects. This leads to biased measurement as is illustrated in Figure 1. The national population of firms in a particular services industry is split up in two part: firms in large-city agglomerations (dashed, red line) and firms in small and rural agglomerations (solid, blue line). The productivity distribution of the large-city firms has a right-shift due to positive agglomeration benefits that accrue to all large-city firms. Moreover, due to a more fierce competitive selection in the large cities, we also see a left-truncation of the productivity distribution. As a consequence, the least-productive large-city firms (B) are more productive than the

Figure 1 Agglomeration-caused measurement bias of productivity premium for exporters



least-productive firms (C) in the rest of the country. Now assume that all exporters in the country face the same sunk foreign market-entry costs and face the same price for their products. The minimal productivity required to compensate for the sunk foreign entry costs is depicted by A, the cut-off productivity for all exporters. Because the distribution area dominated by AB is smaller than the area

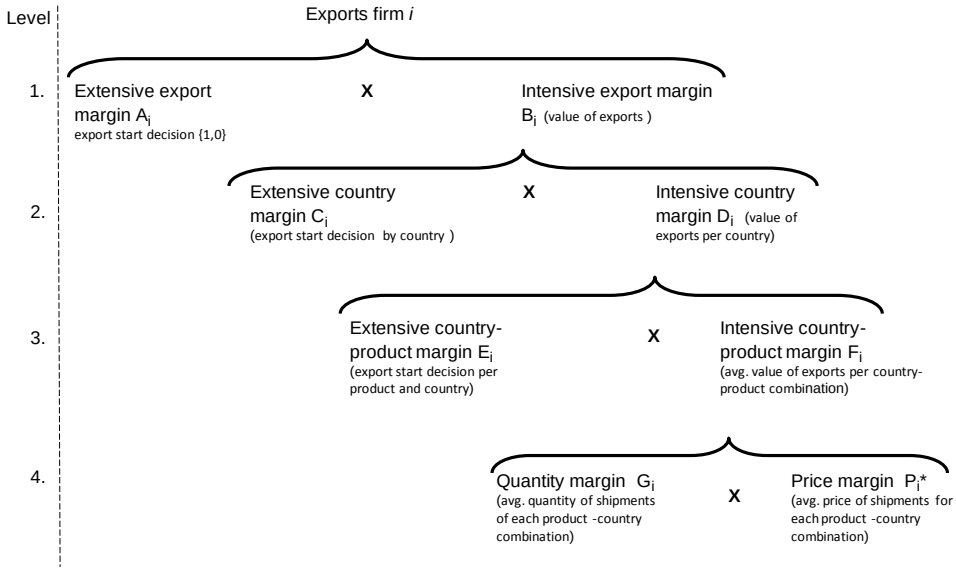
dominated by AC, the productivity premium in large cities is considerably smaller than that in the rural areas. The standard procedure is, however, to measure with national data with neglect of agglomeration differences. If the two sub-sample distributions of Figure 1 are added up to one national distribution, the distribution tail AC will become 'fatter' due to the fact that the AB firms of the large-cities are added. The result is that the average productivity premium for large-city exporters will be *over*-estimated, while the average productivity premium for rural exporters is *under*-estimated. It depends on the relative size of both sub-sample how large the overall bias is.

In this paper I address these measurement challenges for Dutch services exporters when testing performance-based sorting into export by explicitly dealing with agglomeration differences. Moreover, instead of estimating productivity premia (a potentially misleading summary statistic) I use a probit estimation procedure that evaluates the entire productivity distribution.[5]

3. DATA AND EMPIRICAL STRATEGY

The exports of firm *i* can be decomposed into a decision on export participation, a decision on country choice, a decision on export products, a decision on export quantities and a decision on the export price. Some of these decisions may be taken simultaneously, but for analytic reasons it is useful to dissect the export decision in a number of sub-decisions. Figure 2 shows that the decision structure has four levels. At each level we may distinguish a participation decision (extensive margin) and a decision on the quantity and volume (intensive margin). Using the symbols of the figure, the export of firm *i* decomposes into three extensive margin decisions (A_i , C_i , E_i) and the price and volume decision (G_i , P_i). Sunk, fixed and variable trade barriers may affect firm export behaviour at each of these levels. This paper concentrates on the level-1 decision: the role of productivity self selection and agglomeration on the export participation level of individual firms.

Figure 2 The structure of export decisions (export margins)



When testing the impacts of self selection and agglomeration on export decisions on has to deal with endogeneity and causality issues. Agglomeration effects in large-city areas may have a positive impact on services firms, but at the same time the awareness of such impacts works like a magnet on

[5] Although productivity premiums will be shown as a form of robustness test.

high-productivity services firms to relocate to these agglomerations. Several endogeneity loops may play a role in this process:

- Mobile workers consume where they work, generating a large local demand pool and thus activating the increasing-returns-to-scale effects on productivity of firms that produce consumption items for workers (Krugman, 1991). Since services are often produced and consumed locally, this endogeneity bias is can be very strong when we want to assess agglomeration impact on services productivity.
- High-educated workers are often endogenously drawn to regions or cities where successful high-productivity firms are already established. This creates a relatively thick local labour market for high-educated workers, with positive productivity spill-overs for firms in this region.
- Firms may require the outputs of their sector as intermediate inputs (Krugman and Venables, 1995). This generates another endogeneity loop between local demand and increasing-returns-to-scale effects on productivity of local firms. Input-output studies show that business services and other intermediary services have high within-industry input intensities (Kox, 2002). Hence, the endogeneity bias could be particularly strong in services.

The endogeneity biases are probably strongest for the headquarters and top hierarchical layers of services firms. The latter typically have a strong demand for high-skilled workers, and also more demand for inputs of articulated producer services. If one wishes to assess the specific impact of agglomeration on productivity, it is probably better to choose a plant-level or establishment-level approach. For instance, Moretti (2004) and Henderson (2003) estimate *plant-level* production functions that are extended with variables reflecting the local environment.[6] If one would choose the location of headquarters as reference, the measured productivity effects of agglomeration could more easily be 'polluted' and over-rated by the endogenous sorting into cities where other successful high-productivity firms are already established. I will therefore study agglomeration effects using establishment data, the lowest level of observation of economic units in the business demography.

Our main data set with establishment-level data for Dutch services is produced and provided by Statistics Netherlands. These data called Productiestatistieken (PS) are collected through annual surveys. In the definition by Statistics Netherlands, an establishment is characterised by relative independence in production or distribution, and it offers its products to an external market. Because also export data are available at the level of establishments, this seems an excellent basis for assessing how agglomeration effects and productivity-based self selection affect the export-participation decision. Establishments with 50 or more employees are represented each year, while smaller firms are represented on the basis of a rotating and stratified annual sample.[7] The probability that a small establishment (with less than 50 employees) is in the sample during a number of consecutive years is therefore small.[8] Due to statistical breaks in the time series we only use data for the period 1999–2005. On average we have 7,500 annual observations for services establishments. The services data include mainly construction, transport and business services. We have enriched the establishment data

[6] Moretti (2004) focuses on the education-level of the employees in the region, whereas Henderson (2003) focuses on the number of other firms in the same industry in the region as a source of spill-over effects.

[7] The sampling data are provided in the form of an expansion factor that says for each sampled establishment how much other establishments it represents in its stratum. This expansion factor is used as a weight in regressions.

[8] The problem of a long under-represented tail has been reduced by adopting a cut-off size of at least ten employed workers for services establishments. Export participation and association with multinational firm are less important for these small establishments. Data entries holding imputations by Statistics Netherlands were removed from our sample, keeping only questionnaire-based establishment data.

with characteristics of the associated firms using the General Business Register (ABR) and the Financial Statistics for Firms (SFO). The ABR data allow linking firm-level and establishment-level data, providing inter alia data on location, municipality and ownership by multinational firms.

To capture the productivity effects of external economies associated with the agglomeration characteristics of a region I do not inquire into the specific type of external economy. Rather, I refer to agglomeration economies as a comprehensive term for urban increasing returns (cf. Fujita and Thisse 2002). To capture the potential impact of urban increasing returns on the productivity of establishments I use a set of three variables: (a) the population size of the municipality; (b) a rural area dummy; and (c) the agglomeration density measure for the postal code at which the establishment is registered. The agglomeration density measure is used to derive five urbanisation classes.[9] The 'rural area dummy' has been set to 1 if the number of addresses per postal code amounted to less than 1501 per square kilometre, and zero otherwise. I conclude that agglomeration has a positive effect on productivity and export participation decisions of establishment if the 'rural area dummy' has a negative sign, and when the municipal population size and/or the agglomeration density measure has a positive sign. Agglomeration-relevant variables about the location of establishments have been added from the Basic Geographic Register (GBR).

We have constructed human capital indicators and productivity indicators from the raw data. Using the establishment-level data at the lowest level of detail, it was possible to construct an indicator for human-capital intensity per worker, using 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 establishment-level earnings 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 appeared to be correlated strongly with wages per worker, which was available for a much larger sample of establishments. For pragmatic reasons, I therefore used wages per worker as indicator of human capital use. For firm performance we use three indicators: (a) labour productivity defined as value added per full-time worker; (b) sales per worker; and (c) profitability, defined as gross value added minus wages and minus depreciation.

As suggested by Vogel and Wagner (2011), I have removed extreme outliers from the sample to achieve robust results. Compared to many other studies that apply firm- or establishment-level data, this paper controls for a rich set of attributes that are likely to influence productivity. In addition to capital intensity, human-capital intensity, we control for affiliation with (domestic) multinational corporation, its median size class during the observation period, its 4-digit industry affiliation.

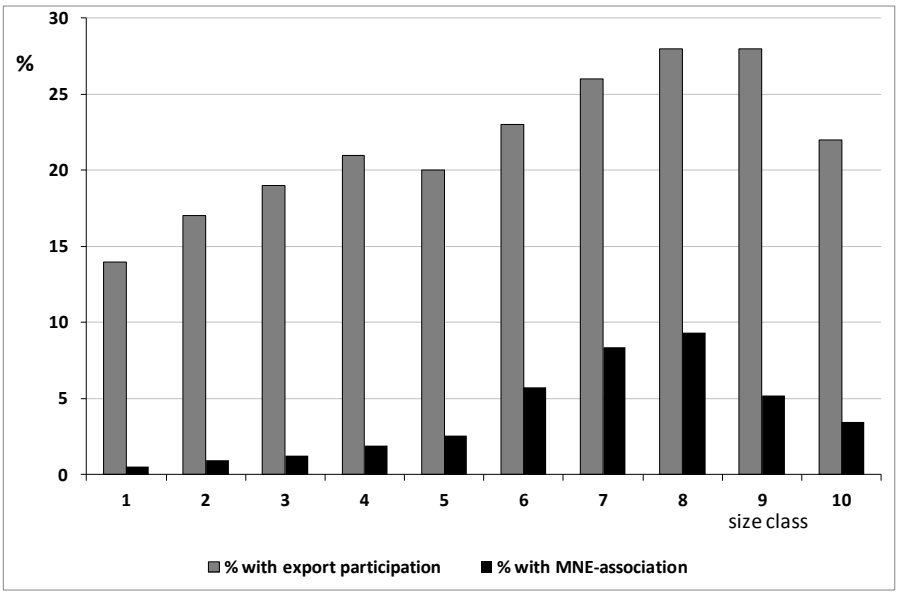
4. SOME DESCRIPTIVE RESULTS

This section shows some descriptives on the extensive and intensive export margin, productivity characteristics of establishments with international activities, the relation of productivity with agglomeration characteristics. Figure 3 differentiates the export participation rate by size class.[10]

[9] The agglomeration density variable measures the average number of addresses per square kilometre within a circle of a one-kilometre ray, measured at the beginning of each year. The five urbanisation classes are: 1. very strong urbanisation (>= 2500 addresses per km²); 2. strong urbanisation (1500-2500 addresses per km²); 3. moderate urbanisation (1000-1500 addresses per km²); 4. weak urbanisation (500-1000 addresses per km²); 5. non-urban area (<500 addresses per km²). In the regressions we have taken the log of the urbanisation-class indicator.

[10] The size classes are based on the number of employed persons and cover the following intervals: 1: 10–19 employed persons; 2: 20–39 employed persons; 3: 40–59 employed persons; 4: 60–80 employed persons; 5: 80–124 employed persons;

Figure 3 Services establishments with exports and multinational affiliations by size class, 2005



Export participation amount to around 20% on average, peaking at 28% participation in size class 8 (500–999 employees). This class also has the highest incidence of establishments that are associated with Dutch multinational firms.[11] The graph shows that some of the largest services providers are more oriented to the domestic market than the intermediate-sized establishments in size classes 7 and 8 (those that employ between 250 and 999 employees).

Table 1 shows that services establishments with international activities on differ significantly from establishments that are only active in the national market. I 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

Table 1 Performance statistics by internationalisation group, establishments, pooled data, 1999-2005

Internationalisation group	No. of observations	Value added per worker in 1000 euro	Sales per worker in 1000 euro	Average wage per worker in 1000 euro	Gross profit a) in 1000 euro
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

Notes: [a)] The gross profit is calculated as valued added minus wages. [b)] Services total includes firms (not shown) for which foreign MNE affiliation could not be identified in a reliable way. Source: own calculations based on PS, ABR and SFO databases.

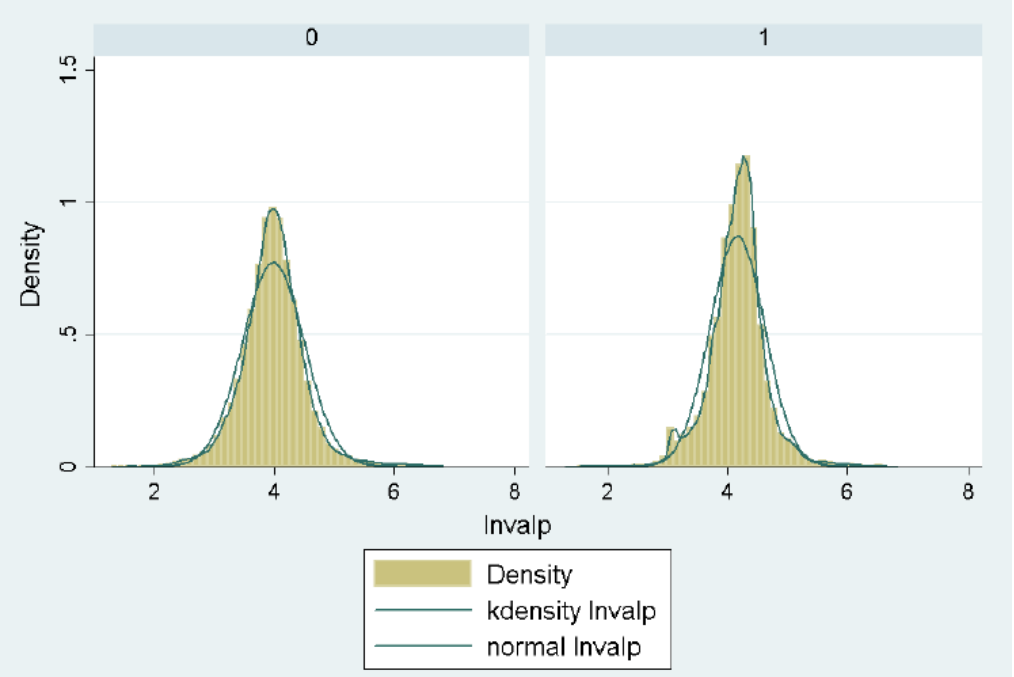
6: 125–249 employed persons; 7: 250–499 employed persons; 8: 500–999 employed persons; 9: 1,000–1,999 employed persons; 10: >2,000 employed persons. This size class definition is consistently applied in the remainder of the paper.

[11] The data do not allow a reliable identification of establishments that are associated with foreign multinational firms.

are substantially more productive than establishments that only export. The productivity advantage of services exporters increases by type of firm. However, this hierarchy does not hold for sales per worker as the labour productivity indicator: non-exporting MNEs are more productive than exporting ones. Exporting firms (irrespective of MNE affiliation or not) are more productive than non-exporting firms. Table 1 also shows that the internationalisation groups differ by average wages and gross profits per worker. MNEs tend to pay higher wages than non-multinationals, while profits are distinctively higher for MNEs. Irrespective of MNE affiliation, exporters pay higher wages and earn bigger profits.

Figure 4 shows the labour productivity (lnvalp) distribution for exporting (right panel) and non-exporting establishments (left panel). The distributions for both sub-samples differ in two important ways. Firstly, for exporters we see a clear left truncation of the distribution, which can be regarded as evidence that some cut-off productivity threshold plays a role. Secondly, there is a right-shift of the mean and the median productivity of exporters compared to non-exporters.

Figure 4 Distribution characteristics of labour productivity for exporting (right) and non-exporting (left) services establishments, 2005

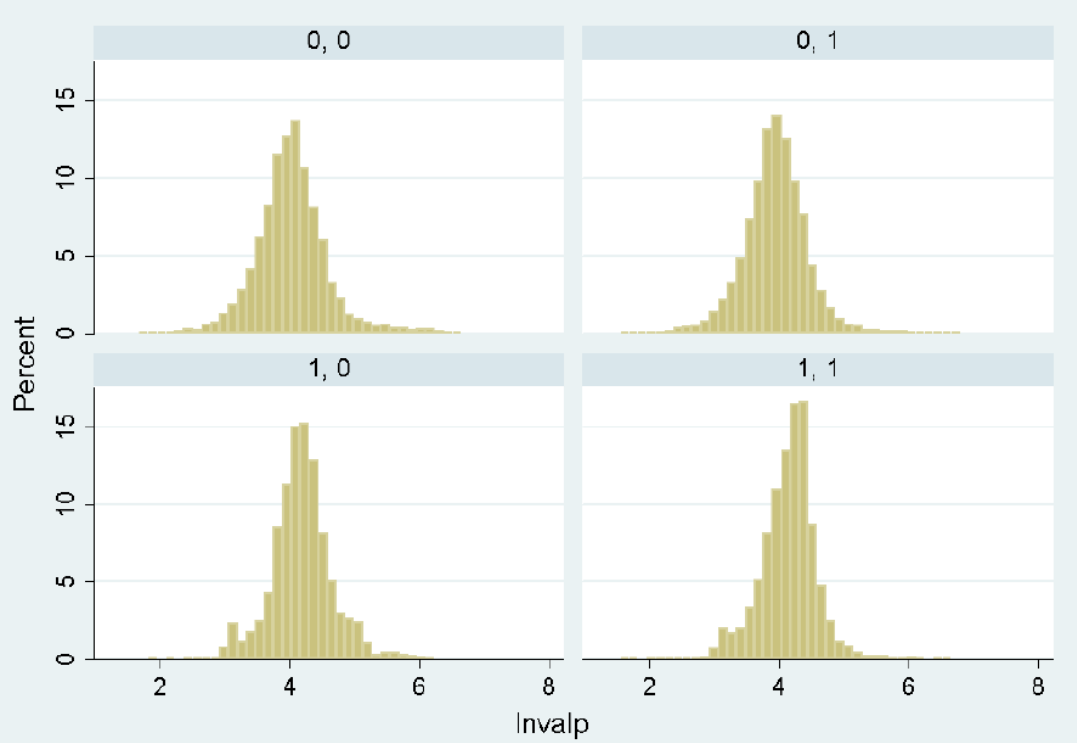


The discussion that I want to address is how the agglomeration factors fit into this picture. For this reason I have split up both samples in rural versus non-rural (large cities) establishments. Figure 5 shows the distributions for the four sub-samples. The figure suggests that - in line with our hypothesis - the productivity self selection of exporters in the rural areas (panel 1,1) is stronger than for exporters in urban areas (panel 1,0), both in terms of the degree of left truncation and in terms of right-shift of the median, compared to the corresponding non-exporters.[12] For urban exporters, we also see a dilation of the distribution compared to rural exporters; following Combes et al. (2012), this can be interpreted as an impact of agglomeration. Also the median shift is much stronger in rural areas than

[12] The distinction between rural and non-rural areas is made on the basis of the rural area dummy. The 'rural area dummy' has been set to 1 if the number of addresses per postal code amounted to less than 2000 per square kilometre, and zero otherwise.

in urban areas. This also can be interpreted as an effect of agglomeration, according to Combes et al. (2012).

Figure 5 Distribution characteristics of labour productivity for exporting rural (1,1), non-exporting rural (0,1), exporting urban (1,0) and non-exporting urban (0,0) services establishments, 2005



The descriptives so far indicate that both performance-based self selection and agglomeration effects play a role. The next two sections investigate whether these indications hold when we add further control variables that may affect the productivity performance of firms.

5. PRODUCTIVITY BASED SELF-SELECTION FOR SERVICES EXPORTERS

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, 2012).[13] A positive exporter premium is indeed to be expected if positive

[13] Given that for this regression international transaction data were not available, the following assumptions are imposed to test the predictions of the heterogeneous-firms trade model: (a) establishments in each sector (4-digit) have the same information about market size, variable and sunk trade barriers, covering all relevant countries; (b) establishments share a common country set as potential export markets and (giving assumption a) have an identical ranking within their set of preferred export countries; (c) establishments in a (4-digit) sector enter potential export countries according to an identical country sequence based on market size, distance and sunk market-entry costs. In other research (Smeets et al. 2010) we have estimated the country-specific sunk market entry costs for Dutch manufacturing firms.

self selection drives the choice behaviour on the extensive export margin. However, the productivity premium may also be the result from exporters being mainly located in urban areas (agglomeration). In this paper I use probit regressions as the main econometric test for factors that affect export participation decisions. The standard panel data regressions that estimate the productivity premium are applied here as a robustness check.

TESTING THE PROBABILITY OF BECOMING AN EXPORTER

The main prediction of the heterogeneous-firms trade model 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. The heterogeneous-firms trade model can then be reinterpreted in the following way. The decision to export y_{it}* depends on a set of observable firm characteristics 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 x_{it} are performance characteristics (i.e. productivity, profitability). The assumed distribution of the unobserved characteristics ε_{it} determines the eventual export decision. I assume that the firm's preference for exporting $y_{it} \in \{1, 0\}$ depends on a linear additive relationship between the vector of observed x_{it} characteristics and the unobserved ε_{it} characteristic that determine net export benefits:

$$y_{it}^* = \beta x_{it} + \varepsilon_{it} \qquad (5.1)$$

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*, $ES_{it} = 1$ is only observed if $y_{it}^* > 0$ and $ES_{it} = 0$ otherwise. The probability of exporting can be expressed as:

$$P\{E_{it} = 1\} = P\{y_{it}^* > 0\} = P\{\beta x_{it} + \varepsilon_{it} > 0\} = P\{-\varepsilon_{it} \leq \beta x_{it}\} = F(\beta x_{it}) \qquad (5.2)$$

where $F(.)$ denotes the distribution function of $-\varepsilon_{it}$. This yields 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:

$$y_{it} = \beta x_{it} + \varepsilon_{it} \qquad (5.3)$$

where $\varepsilon_{it} \sim NID(0,1)$ and $y_{it} = 1$ if $y_{it}^* > 0$; and $y_{it} = 0$ if $y_{it}^* \leq 0$. The probit estimation results allow calculating the vector of impact elasticities $\frac{\partial \ln P\{ES_{it}=1 \mid \mathbf{x}_{it}\}}{\partial \ln \mathbf{x}_{it}}$ (the percentage change in the probability of a positive export preference after a 1% change in the log of firm characteristic x_{it}).[16]

To start with I test the most simple version of the probit model, concentrating on the impact of single performance variables x_{it} on the probability that an establishment engages in exports; all other possible impacts on the export decision are for the moment left unspecified. Table 2 shows the

[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 $\mathrm{F}(\beta \mathrm{x\_it})$ is also bounded between 0 and 1, it is plausible to choose a standard normal distribution $\varphi(\beta \mathrm{x\_it})$. There is no reason to expect that the standard normal distribution does not apply.

[16] Impact elasticities instead of marginal effects are presented, because the intuitive interpretation of elasticities is easier. I evaluated point elasticities at the mean and at the median values of $\ln \beta \mathrm{x\_it}$. Since differences between both were very small, I only report point elasticities at the mean.

marginal effects of two performance variables. Both have a statistically significant and positive impact on the export participation. The same regression has been done for two sub-samples, one for rural establishments and one for urban establishments. The split is made on the basis of the 'rural area' dummy. It turns out that in the urban areas a 1% higher labour productivity yields a 2.74% increase in the probability that the establishment exports, while this is only 1.69% in rural areas.

Table 2 Impact of establishment performance on export probability: probit regressions, pooled data, 1999–2005

Performance indicator (log)	Elasticity on export probability [a)]	Standard errors	z-value	no. of observations
Value added per worker	2.39	0.783	3.06***	37,717
* urban sub-sample	2.74	0.932	2.94***	28,132
* rural sub-sample	1.69	0.499	3.38***	11,585
Profitability	2.97	0.836	3.55***	39,562
* urban sub-sample	0.0023	0.001	1.94**	28,132
* rural sub-sample	−0.005	0.006	−0.81	11,585

Notes a) Post-estimation calculations of point elasticities evaluated at the means of the independent variables, using the estimated probit model with clustered standard errors by 2-digit industry. The 'rural area' dummy has been used to split the total sample into two sub-samples. *** indicates significance at 1% confidence level.
Source: own calculations based on PS database.

In a next step I 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, input characteristics, affiliation with a multinational firm, and time shocks. To prevent multicollinearity between input characteristics and x_{it} the input characteristics of the establishment are lagged θ years. The probit model now becomes:

$$P\{ES_{it} = 1\} = F(\beta x_{it} + \gamma \mathbf{G}_{\mathbf{it-\theta}} + \lambda \mathbf{R}_{\mathbf{i}} + \ + \eta \mathbf{T}_{\mathbf{t}}) \qquad (5.4)$$

where x_{it} is the performance indicator (e.g. value-added per worker, profitability), $\mathbf{G}_{\mathbf{it-\theta}}$ is a vector of firm characteristics lagged θ years. $\mathbf{R}_{\mathbf{i}}$ is a vector of time-invariant environment variables of the firm, and $\mathbf{T}_{\mathbf{t}}$ is a vector of year dummies to control for time shocks. The $\mathbf{G}_{\mathbf{it-\theta}}$ vector includes a dummy for affiliation with a multinational company (in year $t-1$), a lagged indicator of the firm's human capital (using the average wage per worker in year $t-3$ as a proxy), and the establishment's median size class over the entire interval that it is in our data panel.[17] The $\mathbf{R}_{\mathbf{i}}$ vector includes 2-digit industry dummies and the agglomeration variables (rural area dummy, agglomeration density measure for the postal code at which the establishment is registered).[18] The estimation accounts corrects for clustered standard errors by 2-digit industry.

Table 3 presents the results for this extended probit model, covering pooled observations for the period 1999–2005. Table 3 shows the results for two x_{it} performance variables, with and without the agglomeration variables included in the $\mathbf{R}_{\mathbf{i}}$ vector. The performance indicators in all cases have a statistically significant marginal effect, even after controlling for a host of environment variables.

[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.
[18] The population size and the agglomeration density scale are expressed in logs.

Without agglomerations variables, a 1% higher labour productivity would increase the probability of being an exporter by 1.4% in services; a 1% higher profitability would raise this same probability by

Table 3 Impact elasticities of performance self-selection and agglomeration variables on probability of export participation, based on probit regression [a], pooled data, 1999–2005

Explanatory variables	Performance variable: value added per worker		Performance variable: profitability	
	without agglom. variables	with agglom. variables	without agglom. variables	with agglom. variables
Performance indicator (log)	1.421***	1.324**	0.949***	0.880*
Agglom. density measure (log)		0.479**		0.481**
Rural dummy		-0.187***		-0.190***
Control variables				
Human capital indicator (log)	1.486	1.645	1.886***	2.028*
Median size class (log)	0.277***	0.307***	0.053	0.307***
MNE dummy	0.007	0.009	0.009	0.011
Industry dummies (2-digit)	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
No. of observations	13,200	9,141	13,200	9,130
Predicted ES_{it} after probit [b]	0.23	0.22	0.23	0.22
log pseudo likelihood	-7024	-4751	-7036	-4760

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% confidence level, ** at 5% level, and * at 10% level. [b] This indicator gives the joint prediction power of the probit estimate, predicting the probability that ES_{it} = 1 (actual probabilities are shown in Figure 1). Source: own calculations based on PS database, combined with data from SFO and ABR.

0.95%. These results are consistent with the performance self selection predicted by the heterogeneous-firms trade models. However, inclusion of the local agglomeration variables lowers these effects to 1.3% and 0.88%, while at the same time the statistical significance of the self-selection variables diminishes. The confidence level for labour productivity self selection drops from the 1% level to the 5% level, and for profitability self selection from the 1% level to the 10% level. We may conclude from this that measured exporter self selection is in fact partly driven by agglomeration effects.[19]

TESTING PRODUCTIVITY PREMIA FOR EXPORTERS AND MNES

As a robustness check on the previous result I run a standard econometric test to find positive export and MNE productivity premia. This is done by running panel data regressions where we construct dummy variables for the export status (ES_{it}) and the MNE-affiliation, and include these dummies as explanatory variables for the establishment's performance levels, in particular labour productivity. Productivity is the crucial performance variable in heterogeneous-firms trade models (e.g. Melitz 2003; Baldwin 2005; Chaney, 2008) and also in models that explain agglomeration economies (e.g. Baldwin and Okubo, 2006; Melitz and Ottaviano, 2008). Export starters need a higher productivity rate allowing them to absorb the fixed or sunk entry costs in the foreign market, i.e. they should have a significant positive performance premium compared to non-exporters, all other things equal. This holds a fortiori for firms that engage in multinational activities (Helpman et al., 2004). I test whether

[19] Anderson and Lööf (2009) conclude that firms located in larger regions are more productive, even when controlling for size, human capital, physical capital, ownership structure, import and export, industry classification and time trend. Second, they find that results from dynamic panel estimations suggest a learning effect in that agglomeration enhances firms' productivity. Third, the role of agglomeration phenomena does not seem to have a clear coupling to firm size.

there is robust evidence for the existence of such productivity performance premia after correction for agglomeration and control variables and fixed effects at the establishment level. The tested model reads:

$$ln\ xt_{it} = \alpha + \beta\ ES_{it} + \psi\ MNE_{it} + \gamma\ \mathbf{G}_{it} + \eta\mathbf{T}_t + \varphi\ \mathbf{Z}_i + \varepsilon_{it} \qquad (5.5)$$

where xt_{it} is the performance variable for firm *i* in period *t*, ES_{it} is a {0,1} dummy for the firm's exporter status, MNE_{it} is a {0,1} dummy for the establishment's affiliation with a multinational company, $\mathbf{G}_{it}$ is a vector of environment control variables (industry dummies, median size class during entire observation period, agglomeration variables), $\mathbf{T}_t$ is a vector of year dummies to control for time shocks, $\mathbf{Z}_i$ is a vector holding establishment-level fixed effects, and ε_{it} is the error term. Regression equation (5.5) is tested with a weighted least squares (WLS) estimator, applying sample-to-population expansion factors as weights. The WLS estimator accounts for non-response and for under-representation of small firms with less than 50 employees. Table 4 reports the results, before and after including control variables for local agglomeration effects.

Table 4 Labour productivity premia for exporters and MNE-affiliated establishments, with and without agglomeration variables, using establishment-level fixed effects, pooled data, 1999–2005

Internationalisation group	Without agglomeration variables	With agglomeration variables
Exporters versus non-exporters	2.2%***	1.9%***
MNE versus local firms	−2.6%	−3.0%
No. of observations	47,934	35,448
No. of establishments	20,559	15,300

Note: Panel regressions with establishment-level fixed effects, dummies for years, size, and 2-digit industry. Productivity indicator is in logs. Significance levels are coded as: *** significance at 1% confidence level, ** at 5% level, and * at 10% level. Premia calculated as: 100*[exp(ß)−1], where ß is the estimated coefficient. The MNE identifier solely refers to Dutch-owned MNE. Sources: Own calculations based on the SFO and PS database.

After accounting for fixed effects at the establishment level, exporters have 2.2% exporter premium without agglomeration variables, and 1.9% when agglomeration is taken into account. This suggests that about one-seventh of the productivity premium is caused by agglomeration effects.[20] The MNE premium completely evaporates when fixed effects (unobserved heterogeneity at the establishment level, like management capacity) are taken into account.

TESTING THE IMPACT OF MARKET STRUCTURE

Chaney (2008) extends the heterogeneous firms trade model of Melitz (2003) to include the role of market structure. It can be derived from the Chaney 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.

[20] The caveat raised at the end of section 2 about the unreliability of summary statistics for measuring self selection (in the presence of agglomeration factors) remains valid.

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 Dutch 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 again estimated the full probit regression model from equation (5.4). The main results are presented in Table 5.

Table 5 Impact elasticities of performance self-selection and agglomeration variables on probability of export participation after including market structure, post-probit elasticities[a], pooled data, 1999–2005

Explanatory variables	Markets with homogeneous products		Markets with heterogeneous products	
	without agglom. variables	with agglom. variables	without agglom. variables	with agglom. variables
Labour productivity (log)	3.549***	3.854***	1.051***	1.010***
Agglom. density measure (log)		0.581***		0.054
Rural area dummy		-0.092***		-0.185
Control variables				
Human capital indicator (log)	1.851	1.890	0.781	0.796*
Median size class (log)	0.293***	0.358***	0.202***	0.158**
MNE dummy	0.030	0.036	−0011	−0.013
Industry dummies (2-digit)	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes
No. of observations	7,161	5,971	6,057	4,937
Predicted ES_{it} after probit [b]	0.20	0.25	0.20	0.19
log pseudo likelihood	-3860	-3142	-2975	-2363

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% confidence level, ** at 5% level, and * at 10% level. [b] This indicator gives the joint prediction power of the probit estimate, predicting the probability that ES_{it} = 1 (actual probabilities are shown in Figure 1). Source: own calculations based on PS database, combined with data from SFO and ABR.

The findings are consistent with the predictions of the Chaney (2008) model. Table 5 tells us that self selection based on productivity is stronger in markets with homogeneous products than in markets with differentiated, heterogeneous products. This suggests that self selection matters most for services where cost and price competition can be expected to be relatively strong. For heterogeneous services, the elasticity of the export decision with respect to labour productivity is less than one-third compared to the homogeneous services. That effect does not change after inclusion of agglomeration variables. 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 appear to be mostly insignificant as predictors of export starting. Alternatively, these results imply that the sunk

entry costs in foreign markets weigh heavier for exporters of homogeneous products than for exporters of heterogeneous, differentiated products. Agglomeration variables only have a significant impact on the selection process in markets with homogeneous products.

6. DYNAMIC SELF-SELECTION INTO FOREIGN MARKETS

So far, I calculated static productivity premia for the pooled dataset. This means that the data included all-time exporters, new exporters and non-exporters. Such regressions can only yield a rough approximation of the self-selection process and how it is affected by agglomeration effects. In order to understand dynamic self selection it is necessary to deal with time-dependent anticipation behaviour. According to the heterogeneous-firms theory, a firm self-selects into export participation on the basis of its relative performance in the domestic market *before* export starts. If export starts in year *t* we should find a positive *ex ante* performance premium in year *t-θ.* I test this using a modified version of the probit analysis of equation (5.4). The all-time exporters are removed from the dataset and the focus is now exclusively on how future new exporters compare with domestic establishments that do not export. The equation array being regressed is:

$$P\{ES_{it} = 1\} = F(\beta x_{it-\theta} + \gamma \mathbf{G}_{it-\theta} + \lambda \mathbf{R}_i + \ + \eta \mathbf{T}_t) \qquad (5.6)$$

New exporters are identified as establishments that started exporting during our data period (1999–2006) and that did not have exports in the θ years before year *t* when it starts exporting. It is known from other trade literature that export decisions are at least partly governed by trial-and-error behaviour.[21] In order to keep the trial-and-error exporters out of the export starter samples, I add the restriction that the export starters remain active as exporter at least two years (t, t+1) even though this diminishes the size of the sample.

The characteristics of the new exporters are compared 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, leaving 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. The small numbers of export starters make it harder to establish statistically significant effects.

Table 6 gives the results for the ex-ante probit self-selection model. For $\theta=3$ and $\theta=2$ no significant *ex ante* self selection behaviour could be established for Dutch services firms. There was, however, significant *ex ante* self selection with respect to labour productivity and profitability in *t-1* as predicted by the heterogeneous-firms trade model. This differs from positive selection for $\theta=3$ and $\theta=2$ in Dutch manufacturing (Kox and Rojas-Romagosa, 2010). A possible explanation for the difference between manufacturing and services may be that fixed-equipment investments for export capacity are smaller in services, and that the lead times for starting exports are shorter in services. The *ex ante* effect did not disappear after inclusion of agglomeration variables, on the contrary: if anything, the self-selection effect became stronger after accounting for agglomeration factors, even

[21] Cf. Békés and Muraközy (2008) for Hungary. Besedes and Prusa (2006) established for the USA that trade relationships typically start small and that almost half of the 'small relationships' end within a year, while larger initial purchases result in longer, stable relationships. From this they advance a matching model of international trade in which uncertainty and the costs of searching reliable trade partners play important roles. The search cost idea can be reconciled with the Melitz model, because search costs are in fact country-specific sunk entry costs. Albornoz et *al.* (2009) go one step further in evaluating the role of uncertainty and learning. In their view a strategy of sequential exporting to different country markets is a rational firm strategy to discover their own competitive advantage.

though the statistical significance dropped. The *ex ante* self selection was corroborated by a robustness test for ex ante productivity premia (not shown). Summarizing, the results support the self-selection hypothesis that export starters have a significant productivity advantage – with respect to non-exporters – before they begin to export.

Table 6 Impact elasticities [a] of ex-ante performance on probability that an establishment exports in period t-θ: probit regressions, new exporters , 1999–2006

Explanatory variables	Value added per worker		Profitability	
	without agglom. variables	with agglom. variables	without agglom. variables	with agglom. variables
Performance indicator, t −3 years	0.452	0.564	-0.612	-0.506
Number of observations	4,607	3,034	4,590	3,204
Number of export starters	297	297	297	297
Predicted ES_{it} after probit b)	0.05	0.01	0.05	0.04
Performance indicator, t −2 years	0.705	0.639	0.281	0.370
Number of observations	8,611	5,470	8,572	5,640
Number of export starters	724	724	724	724
Predicted ES_{it} after probit b)	0.06	0.02	0.06	0.06
Performance indicator, t −1 year	1.692**	1.758*	1.288***	1.308*
Number of observations	9,718	6,267	9,675	6,247
Number of export starters	627	624	627	627
Predicted ES_{it} after probit b)	0.05	0.053	0.05	0.02

[a] 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. [b] This indicator gives the joint prediction power of the probit estimate, predicting the probability that ES_{it}=1.
Source: own calculations using the PS database.

7. DISCUSSION AND CONCLUSION

This paper assessed the role of agglomeration effects on the export decision of services firms. Our findings support the predictions done by heterogeneous-firms trade models about positive productivity sorting among new exporters, in anticipation of sunk market-entry costs in foreign markets. We found significant *ex ante* productivity-based self selection by future exporters one year before actual exports started. The productivity self selection is three times stronger in services markets that are characterised by relatively homogeneous products, compared to services industries where products tend to be more differentiated. A possible explanation for this difference is that price- and cost competition is stronger in markets with homogeneous services products, whereas in markets with differentiated products each supplier is in a sense a monopolist in his own product niche and thus has more leeway for passing on higher costs to foreign consumers.

The empirical findings do not corroborate the correctness of the claim by Helpman *et al.* (2004) that firms with multinational affiliations will have a stronger productivity self selection than firms that only export. The 'MNE productivity premium' disappeared entirely when we corrected for fixed unobserved effects at the establishment level. As a caveat in this regard it should be repeated that the data only allowed identifying links with Dutch multinational enterprises, but not with foreign-owned multinationals.

Agglomeration effects in large-city areas were found to contribute to above-average productivity for exporting firms. Without the explicit check on agglomeration effects the above-average productivity bonus for exporters would incorrectly have been attributed to productivity selection for anticipated sunk foreign market-entry costs. Or stated alternatively, the impact of sunk foreign market-entry costs would have been over-rated. Based on our results it is fair to conclude that many earlier empirical evaluations of the heterogeneous-firms trade models have probably upwardly biased estimates of the effects of sunk foreign market-entry costs.

Time seems ripe for theoretical effort to unify the models of productivity sorting in large agglomerations and productivity sorting in trade models. In both cases this sorting behaviour is driven by fixed/sunk costs and increasing returns to scale. The Melitz-based trade models have structured the productivity sorting as a lottery result: upon accepting sunk entry costs the firm's true productivity is revealed to itself as a draw from a known productivity distribution.[22] If the drawn productivity is sufficiently high the firm stays, otherwise it exits immediately. The same mechanism is used to model the productivity hierarchy between non-exporters and exporters: if the productivity draw allows it, the firm exports, otherwise it stays only active in the domestic market. From this it is only a small step to also integrate the productivity selection that goes along with agglomeration. In order to be allowed to operate in large cities (with their cultural amenities, with large local supply of consumption varieties, thick labour markets for high-educated workers, intricate division of labour, and the local supply of advanced intermediary deliveries and services), firms must annually accept to absorb a given amount of sunk urban costs.[23] Their own productivity draw determines whether the firm stays in the large-city area, moves to areas without the sunk urban costs, or completely exits. The firm's own productivity sorting then yields the left-truncation of the urban productivity distribution. In this way a unified model of trade and agglomeration is achieved.

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[22] The mechanism is taken from Jovanovic (1984) and Hopenhayn (1992).

[23] Think of taxes that are linked to urban land and property prices, such taxes embody the agglomeration mark-up linked with being in an attractive business and living agglomeration.

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