Imports, productivity and firm heterogeneity: do origin markets and factor intensity matter?

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Abstract

Employing a rich panel data set of Dutch firms covering the years 2002 to 2008 we shed more light on the relationship between the characteristics of imports and firm-level productivity. We present evidence confirming a well-established *stylized fact* suggesting that importers do indeed outperform non-importers with the direction of causality running from productivity to import status. We show that the characteristics of imports in terms of origin country and factor intensity do affect the relationship between import status and firm-level productivity. The degree of concentration of imports in terms of geographic origin and factor intensity of Dutch importers is high. Sourcing imports nearby is associated with a firm-level productivity premium, which increases in the degree of import concentration. The productivity premia also increase in the degree of concentration of imports in terms of factor intensity. Importing technology intensive products and primary products is associated with the largest productivity premium, whereas importing unskilled-labor intensive products shows the least beneficial impact on productivity.

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1 Introduction

Since the mid-1990s a stream of papers has been published on the different nature of firms that are internationally competing and firms that solely serve domestic markets. The surge in research on this topic was spurred by the seminal work of Bernard, Jensen, and Lawrence (1995), Roberts and Tybout (1997) and Melitz (2003). An impressive body of literature has presented compelling evidence that firms engaging in international trade are larger, more productive, more capital intensive, pay higher wages, invest more in R&D and have a higher probability of survival than firms that focus primarily on domestic markets (see Greenaway and Kneller (2007), Wagner (2007) and Wagner (2012) for a survey of the empirical evidence). However, until recently most attention was directed towards the relationship between export status and firm performance, while the impact of importing on firm performance has been investigated considerably less frequently.

The aim of our paper is threefold. Firstly, we will establish whether importers indeed outperform non-importers as we hypothesize based on previous studies. Secondly, we investigate the direction of causality between import status and productivity by testing the self-selection and learning-by-doing hypotheses empirically, utilizing propensity score matching to test the latter. These first two steps mark the build up to our third and ultimate aim, investigating whether characteristics of imports in terms of country of origin and factor intensity affect the relationship between import status and firm performance. Do firms that mainly import unskilled labor intensive products from East-Asia perform differently from firms that focus on importing technology intensive products from the US? Do firms that engage in trade solely with neighboring countries perform differently from global traders? It makes sense to expect intuitively that these widely diverging import strategies impact differently upon firm performance, our aim is to investigate whether these intuitive expectations are confirmed by the data.

In recent years research on the impact of import status on firm performance has gained momentum, although much less consensus has been reached regarding the exact mechanics. Nonetheless, it is quite well established empirically that the beneficial characteristics attributed to exporters also apply to importers (Vogel and Wagner, 2010; Wagner, 2012). That is, importers are on average more productive than non-importers, but the direction of causality between productivity and import status is less well established. Do firms start importing when they reach a certain threshold level of productivity, analogous to the generally accepted self-selection hypothesis regarding export status? Or does the causality run in the opposite direction; firms become more productive because global sourcing enables them to utilize e.g.

higher quality or cheaper intermediate inputs than when they source inputs domestically? To get a better understanding of the mechanics at play we investigate the impact of differences in the characteristics and geographic origin of imported inputs on the performance of Dutch firms. In addition we investigate whether factor intensity of imports affect firm performance. In order to do so, we adopt the product classification developed by Van Marrewijk (2002), who classifies imports according to their factor intensity into five types; primary products, natural resource intensive, unskilled labor intensive, technology intensive and human capital intensive.

We add to the existing literature in two ways. We are to the best of our knowledge the first to replicate the analysis of firm heterogeneity regarding import status and firm performance employing Dutch firm-level data. Next to this, we analyze the impact of import status on firm performance accounting for country of origin and factor intensity simultaneously. Earlier research frequently used the country of origin as a proxy for factor intensity, assuming for example that imports from the US are high-tech by default. This seems to be a rather strong assumption, whereas the level of detail of our data allow us to unravel the dynamics at play more thoroughly.

The rest of this paper is organized as follows. Section 2 provides a brief discussion of the empirical literature with respect to the relationship between import status and firm performance and the relevance of country of origin and factor intensity as an explanatory factor. Section 3 introduces the data employed in the empirical analysis discussed in section 4, which evolves around three questions each dealt with in a separate subsection: do importers perform better than non-importers, in which direction does causality run, and how do origin and factor intensity of imports affect this relationship? Section 5 concludes and provides some discussion and directions for further research.

2 Firm heterogeneity and imports

The literature distinguishes several mechanisms through which importing and firm-level productivity could be causally related. Firms can raise productivity by importing R&D intensive intermediate inputs from the technological frontier. Coe and Helpman (1995) and Coe, Helpman, and Hoffmaister (1997) show empirically that productivity gains from R&D are indeed not only considerable in the source country, but that the benefits are also reaped by importing economies, both developed and less developed. Lööf and Andersson (2010) argue that global specialization plays a key role in enhancing firm productivity, since importing enables firms to utilize inputs from the technological frontier. Acharya and Keller (2009) present evidence on this matter

suggesting that importing is an important vehicle for technology transfers between countries. In a related paper, Acharya and Keller (2008) show that trade liberalization induces technological learning and thereby raises domestic productivity if it affects the imports of advanced technologies. This enables specialization and the focusing of resources on activities in which firms have a comparative advantage. Moreover, importing might offer firms the possibility to purchase intermediate inputs at lower cost. The wider variety of intermediate inputs that becomes available through importing, amongst which higher quality inputs, can increase firm-level productivity, that is, imported and domestic inputs are imperfect substitutes. Manova and Zhang (2012) show empirically in a recent paper that exporting firms use higher quality inputs to produce higher quality outputs, and that firms vary the quality of their products across destinations by using inputs of differing quality. In addition to this, importing firms may benefit from spill-over effects and increase productivity by learning from foreign suppliers (Coe, Helpman, and Hoffmaister, 1997). This combination of learning and variety effects is also referred to as the complementarity aspect of importing (Halpern, Koren, and Szeidl, 2009). Finally, importing final goods increases competition on domestic markets, which forces domestic producers, regardless of their trading status, to operate more efficiently and thus become more productive (Amiti and Konings, 2007).

Firm level evidence suggests that firms importing inputs are indeed more productive than firms that source inputs solely domestically. However, the direction of causality is less well understood. Bernard, Jensen, Redding, and Schott (2007) show that US importers are more productive than non-traders. In a follow-up paper Bernard, Jensen, and Schott (2009) present evidence suggesting that US importers have a higher probability of survival and show larger employment growth than non-traders. Vogel and Wagner (2010) employ a panel data set of German manufacturing firms and perform a propensity score matching procedure to investigate the direction of causality between productivity and imports. They do not find convincing evidence for the learning-by-importing hypothesis. The evidence does however point to self-selection into importing. These findings are largely congruent with related studies by e.g. Kurz (2006), Kasahara and Lapham (2008), Muûls and Pisu (2009), Eriksson, Smeets, and Warzynski (2009) and Altomonte and Békés (2008). Andersson, Lööf, and Johansson (2008) present evidence based on an eight year panel of Swedish firms, indicating that firm level productivity increases in the number of markets and products traded, both with respect to imports and exports. Their results show a productivity premium that is of similar magnitude for importers and exporters, but larger for firms doing both simultaneously. They argue that the export productiv-

ity premium can be attributed to self-selection, but suggest, without testing this hypothesis, that causality could very well be reversed when it comes to importing. Evidence supporting the learning-by-importing hypothesis is presented in a follow-up paper by Lööf and Andersson (2010). Hagemejer and Kolasa (2011) present firm-level evidence suggesting that Polish importers of capital goods perform better than non-traders and they show empirically that importing firms also show higher productivity growth than non-traders. Muendler (2004) however shows for Brazil that importing intermediate inputs has a negligible impact on firm-level productivity. He presents evidence suggesting that it is mainly increased competition on the output market and a redistribution of market shares away from the least productive firms that induces productivity growth. Kugler and Verhoogen (2009) show empirically that Colombian firms self-select into importing and that firms pay more for imported inputs than for domestic inputs. They argue that more productive firms tend to import and make use of inputs of higher quality. Halpern, Koren, and Szeidl (2009) present evidence on Hungarian manufacturing firms, suggesting that importing intermediate inputs has a large impact on productivity, mainly caused by imperfect substitution of inputs.

The empirical evidence regarding the impact of country of origin and factor intensity of imports on firm performance is much more scarce. Tucci (2005) presents evidence for Indian firms suggesting that importing from North America or Western Europe does not lead to higher firm-level productivity compared to firms with a different import profile. However, focusing on one specific region for both imports and exports simultaneously does yield a significant productivity advantage. A key result from the analysis by Lööf and Andersson (2010) discussed previously is that productivity increases in the share of imports from G7 countries. They conclude that imports are an important channel for technological learning and knowledge transfers, by assuming, rather crudely, that G7-imports are on average more R&D and knowledge intensive and of better quality than imports from other countries. Serti and Tomasi (2009) and Castellani, Serti, and Tomasi (2010), employing a panel data set of Italian firms, investigate empirically whether the effect of trading on firm performance is related to geographic patterns of trade. The evidence suggests that the productivity premium for importers is larger than for exporters, and the direction of causality points to self-selection into importing rather than learning-by-doing. Moreover, their findings indicate that imports from developed economies are associated with a higher productivity premium than imports from less developed economies. Their suggested explanation for this is that imports from high-income countries are presumably of higher quality and are more technology intensive than imports from lower income countries. These imports therefore require the presence of a certain

amount of absorptive capacity which they associate with the existence of a productivity premium.

A few general conclusions can be taken from the preceding discussion. A well-known stylized fact that is also confirmed by the literature discussed here is that importers tend to be more productive and perform better in general than non-traders, although the evidence concerning the magnitude of this effect compared to exporters is less conclusive. Furthermore, the evidence pointing to self-selection into importing is quite compelling, while the evidence concerning the learning-by-importing hypothesis is rather mixed. Finally, the empirical evidence regarding the impact of import characteristics in terms of geographical origin and factor intensity on firm performance is still rather scarce. However, the limited amount of evidence available on this matter indicates that imports from developed countries or technologically advanced imports are associated with larger productivity premia.

3 Data

For our empirical analysis we merge data from three main data sources, the General Business Register (GBR), the Baseline Database and the International Trade Database, all provided by Statistics Netherlands into a panel data set covering the years 2002 to 2008. The data from the three different sources are merged using an unique identification number which is assigned by Statistics Netherlands to each individual firm in the General Business Register. This results in an exhaustive database covering all Dutch firms including a set of basic firm characteristics such as the number of employees in fulltime equivalents, the sector in which the firm operates according to the internationally standardized ISIC Rev. 3.1 sector classification[1], the legal type of the firm and some general address information. The GBR forms the starting point for the accumulation of our panel. We take from a separate but related database information concerning the ultimate controlling institution of the firm, indicating whether the ultimate controlling owner of the Dutch firm is located abroad.

Data related to productivity measurement come from Baseline. This database contains a wealth of financial information collected from both corporate tax declarations and income tax declarations of entrepreneurs by the Dutch Tax Authority and modified by Statistics Netherlands for e.g. research purposes. However, corporate tax declarations are registered on Value Added Tax (VAT) numbers, which then need to be connected to the business identi-

[1]The ISIC Rev. 3.1 sector classification equals the SBI'93 2 digit classification employed by Statistics Netherlands

fication numbers used by Statistics Netherlands. This is only done when the connection is absolutely certain. Since firm structures tend to get more complex with increasing firm size, the success rate decreases accordingly. Moreover, the Baseline data cover income tax statements of entrepreneurs only since 2006, the years 2002-2005 contain data from corporate tax declarations solely. This implies that the number of observations in our panel increases from about 100,000 to roughly 500,000 annually and the average firm size in our panel drops considerably once income tax information is included. The fraction of firms with less than five employees increases from about 58%, a considerable underrepresentation, to over 85% from 2006 onwards (see table 16 in the appendix), while we know from the full GBR that between 80% and 90% of Dutch firms fall in that size category (see table 15. Moreover, tables 15 and 16 show that the fraction of firms in the largest size group is slightly underrepresented compared to the full GBR. The information taken from the Baseline database is modified to fit the widely used KLEMS-framework, and contains information about gross output, value added and the value of capital, labor and intermediate inputs. The data regarding input used and output produced are deflated using separate sector level price indices for gross output, value added, labor, capital and intermediate inputs.[2]

In the next step we merge the trade data to the GBR. Trade data were taken from the International Trade database and includes information on all imports and exports of goods by Dutch firms.[3] The total value of intra-EU imports and exports is recorded by the Dutch Tax Authority. For import and/or export values larger than a total of 900,000 euro (threshold in 2009) firms are also required to specify their trade transactions at the 8-digit level according to the Combined Nomenclature (CN) and specify the origin and destination of trade through an additional questionnaire from Statistics Netherlands. Extra-EU trade is recorded by the Customs Authority. These data always include product information at the 8-digit CN-level and specification of origin and destination country. The trade data available at the firm level cover more than 80% of annual aggregate trade in terms of value in the Netherlands.[4] However, since we only consider observations for which

[2]The sector level price indices are provided by the National Accounts department of Statistics Netherlands and are characterized by a slightly higher level of aggregation than the sector information derived from the General Business Register. Therefore mapping of the sector level price indices to our panel data set has been done manually.

[3]Note that apart from the import value we do not have information as to whether it regards imports of capital goods, intermediate inputs or final goods.

[4]The trade data are recorded on VAT-numbers. Connection to the firm identification key used by Statistics Netherlands leads to a merging loss of about 20% of annual trade values

productivity information is available the coverage of aggregate imports and exports drops considerably in our panel to roughly 20% to 25% of the value of Dutch imports and 15% to 20% of the value of exports. As we noted earlier, the loss of coverage is mostly on account of an underrepresentation of large firms. However, in this paper we focus on small and medium sized firms (SMEs), since large firms, representing large trade values, are more likely to be global traders, whereas our research question focuses particularly on trade-off decisions in import patterns, and trading patterns are likely to be more pronounced among small traders. Finally, we also include import and export values according to the factor intensity of the goods traded, following Van Marrewijk (2002) and distinguishing between primary products, natural resource intensive products, unskilled labor intensive products, high-tech products and human capital intensive products.

After a preliminary investigation of the data we eliminate micro firms (less than one fulltime equivalent), since these turn out to be difficult to measure consistently.[5] Moreover, we eliminate implausible observations with zero or negative output or exports exceeding gross output, thereby eliminating an additional 52,552 resp. 7,352 observations. In addition we eliminate two sectors with five observations or less. This procedure results in an unbalanced panel data set containing a total of 1,9 million observations spanning a period of seven years (2002-2008).

We employ information on trade values to construct a series of dummy variables, indicating whether the firm only exports, only imports, does both (two-way trade) or does neither (non-trader). Table 1 shows that over 70% of the firms in our panel does not trade internationally. Once the income tax information is included from 2006 onwards, this percentage increases to over 80%. This percentage is higher than studies for e.g. Germany (Vogel and Wagner, 2010) and Sweden (Andersson, Lööf, and Johansson, 2008), but comparable to Belgium (Muûls and Pisu, 2009). At least part of an explanation can be found in the composition of the data, since our data cover all firms including sole proprietorships, whereas most comparable studies only consider firms with at least one fulltime employee. This increases the fraction of small enterprizes in our data relative to other studies considerably. The fraction of firms only importing (around 10%) is in line with German data

[5]By doing so we eliminate 177,623 observations. A relatively large fraction of the firms in this group, more than 10%, reports larger exports than gross output and an additional 10% reports negative or zero output. Furthermore, a considerable number of these firms is either inactive or reportedly has zero employees, but positive and considerable turnover, labor cost, etc, which raises the suspicion that holding companies or other artificial legal structures form a substantial part of this group, thereby falling outside the scope of this research

and Belgian data, but considerably higher than in Sweden. The fraction of firms only exporting is relatively low in the Netherlands at 2% to 4%. These figures are considerably higher in Germany (10%), and Sweden (13%). However, Muûls and Pisu (2009) present comparable figures for Belgium with a percentage of sole exporters of about 4%. The share of two-way trading firms varies considerably over the years, due to the availability of income tax data from 2006 onwards, causing a drop from 15% to around 5%. This is relatively low compared to Belgium (11%), Sweden (22%) and Germany (25%).

Table 1: Trade status of Dutch firms by year (%)

	non-trading	only exports	only imports	two-way trading	total
2002	70.9	3.9	9.6	15.6	105,341
2003	70.2	3.8	10.2	15.8	106,389
2004	70.4	3.8	10.2	15.7	107,587
2005	70.7	3.6	10.3	15.4	111,257
2006	86.0	1.7	7.2	5.2	466,107
2007	84.3	1.9	8.2	5.6	486,965
2008	81.4	2.4	10.1	6.1	559,504
total	1,570,081	46,776	173,467	152,826	1,943,150

Note: The number of (larger) firms keeps gradually increasing over the years 2006-2008 mainly because of the improving quality of the connection between VAT-numbers and GBR-identification numbers

Table 2 shows the distribution of trade status over firm size categories. The picture emerging from the data is as expected. The fraction of non-traders decreases gradually with increasing firm size, although still 29% of the largest firms does not trade internationally. Especially two-way trading increases dramatically with firm size to over half of the largest firms engaging in both imports and exports. The fraction of firms only importing also increase with firm size, albeit to a lesser extent.

Table 2: Trade status of Dutch firms by firm size (%)

	non-trading	only exports	only imports	two-way trading	total
fte<5	85.5	2.1	7.9	4.5	1,545,683
5<=fte<10	67.3	3.6	13.4	15.7	191,142
10<=fte<20	61.9	3.9	12.6	21.6	113,513
20<=fte<50	54.4	3.7	13.1	28.8	64,573
50<=fte<100	47.8	3.3	13.7	35.2	15,382
100<=fte<250	39.8	2.0	14.0	44.1	6,863
fte>250	28.9	1.8	16.7	52.6	2,359
total	1,566,728	46,715	173,348	152,724	1,939,515

The distribution of trading firms by sectors is depicted in table 17 in the appendix. The number of observations per sector in our panel varies dramatically. Most striking is the large number of firms providing other business activities. As expected, the fraction of firms in this service sector trading manufactured goods is low. Two-way trading in obvious manufacturing sectors is much more common. Trading is, as expected, less common in sectors like construction and hospitality. Another intuitively straightforward observation is the relatively high fraction of importers in retail trading. Transport sectors show surprisingly little trade activity, except for air transport where importing is relatively important. Trading in manufactured goods, especially importing and two-way trading, is relatively common in research and development.

We employ the data from tax declarations to calculate several different measures of productivity. Labor productivity (LP) is computed in two ways, as value added and gross output per employee deflated using an sector specific price index. We estimate total factor productivity (TFP) by employing the procedure proposed by Levinsohn and Petrin (2003) and facilitated by Petrin, Poi, and Levinsohn (2004), which is an extension of the basic Cobb-Douglas framework. We assume production takes the form of the standard Cobb-Douglas production function:

$$Y_{it} = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l} M_{it}^{\beta_m} \tag{1}$$

With Y_{it} representing output produced by firm i in year t by using input factors capital (K), labor (L) and intermediate inputs (M). In this production function A_{it} represents the level of productive efficiency of firm i in year t with which input is converted into output. It is referred to as total factor productivity since it affects the marginal product of all input factors simultaneously. Ideally, Y_{it}, K_{it}, L_{it} and M_{it} would be observed in quantities, since factoring out input and output prices would enable the measurement of the

actual productive efficiency most accurately. However, just as in most cases, we do not observe input and output in quantities, but in value terms. That is, except for labor inputs which is measured in fulltime equivalents.[6]

Total factor productivity, A_{it} is inevitably unobserved and needs to be estimated. In order to do so, we start by taking the natural log of (1) (denoted by lower-case letters), yielding:

$$y_{it} = a_{it} + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} \tag{2}$$

This makes the production function to be estimated linear in its parameters, where total factor productivity consists of two elements (see e.g. Arnold (2005); Van Beveren (2010)):

$$a_{it} = ln(A_{it}) = \beta_0 + \omega_{it} + u_{it} \tag{3}$$

The mean level of productivity across firms and years is represented by β_0 , whereas the last two terms on the righthand side of equation 3 represent the deviation from that mean by a particular firm in a particular year. The observable part of firm-level productivity is represented by ω_{it} and u_{it} is the independently identically distributed error term due to e.g. unobservable productivity shocks or measurement error. Estimation of (2) is complicated by a few econometric issues. There is the well-established problem of endogeneity of inputs. In order for the estimation of (2) to yield unbiased estimators, the explanatory variables need to be uncorrelated with the error term. However, firms generally observe at least part of their productivity early enough to be able to adjust the choice of inputs used accordingly. This means that inputs are not exogenous, but correlated with unobserved productivity shocks, yielding biased results when estimating (2). Imperfect competition in input and output markets is another potential source of endogeneity. Since information regarding quantities of input and output are generally not available, as well as firm-specific price levels, sector-level prices are commonly used to deflate firm-level input and output measures. However, an endogeneity issue arises when the input choice of the firm is correlated with unobserved deviations from the sector-level price levels by the individual firm, either in input or in output markets.

Van Beveren (2010) provides an excellent review of the available estimation techniques to deal with endogeneity issues. He argues that the choice of the estimation technique will ultimately depend on the availability of data. We thus choose to adopt the Levinsohn-Petrin procedure, mainly motivated

[6]Note that an alternative measure for labor input would be the use of labor cost, but this would decrease the number of observations in our panel considerably since all firms without employees generally do not report positive labor costs.

by availability of data regarding intermediate inputs. Moreover, information regarding investments is not part of the panel data set at hand, ruling out the procedure proposed by Olley and Pakes (1996) as an alternative.

The Levinsohn-Petrin model uses intermediate inputs as a proxy for unobservable productivity shocks (Levinsohn and Petrin, 2003). This is done by expressing intermediate inputs in terms of capital and productivity: $m_{it} = m_{it}(k_{it}, \omega_{it})$. This function can be inverted, assuming that intermediate inputs are monotonically increasing in productivity given capital input: $\omega_{it} = \omega_{it}(k_{it}, m_{it})$. Rewriting 2 yields:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it}(k_{it}, m_{it}) + u_{it} \tag{4}$$

Equation 4 is estimated assuming productivity follows a first order Markov process, with $\omega_{it} = E[\omega_t \mid \omega_{t-1}] + \eta_t^*$. Estimation of equation 4 is done in two separate steps, the first being:

$$y_{it} = \beta_l l_{it} + \phi_{it}(k_{it}, m_{it}) + u_{it} \tag{5}$$

In the second step the coefficient on the proxy variable intermediate inputs is obtained by estimating ϕ_{it}:

$$\phi_{it} = \beta_0 + \beta_k k_{it} + \beta_m m_{it} + \omega_{it}(k_{it}, m_{it}) + u_{it} \tag{6}$$

We estimate total factor productivity with labor input in quantities (full-time equivalents) as our freely variable input. Capital input is the summation of costs of depreciation and interest. Intermediate inputs are only available at the aggregate level, which makes it impossible to test alternative proxies by disentangling intermediate inputs into e.g. materials, energy and service inputs. Labor productivity is calculated as discussed above. Tables 18 through 20 in the appendix present some descriptive statistics of the different productivity measures.[7] Labor productivity in terms of gross output per employee (table 18) shows average values comparable to the figures presented by Vogel and Wagner (2010) for Germany. Again, we observe a break in the data in 2006, when the coverage of smaller firms improves dramatically. Before 2006, the average labor productivity was considerably higher than Vogel and Wagner (2010) reported for Germany, but after the break, the average productivity is in line with the figures reported for Germany. The data also

[7]We present a number of descriptive statistics concerning labor productivity of gross output, to be able to benchmark our data against comparable studies. However, for our analysis we choose to work with value added as our output measure, mainly because of the different nature of the firms in our panel, ranging from manufacturing firms to wholesale traders and service providers.

show labor productivity increasing with firm size. Non-traders show the lowest productivity on average, and two-way traders the highest, which is also as expected. A comparable picture emerges when we look at labor productivity (table 19) and total factor productivity (table 20), both in terms of value added.[8] Nonetheless, labor productivity regarding value added shows a noteworthy picture, with firms with up to ten employees being among the most productive, together with firms with over 250 employees and firms with up to 100 employees being the least productive on average. However, total factor productivity shows average values increasing gradually with firm size.

A key condition underlying the estimation of total factor productivity employing the Levinsohn-Petrin procedure is monotonicity of productivity. If this condition holds, productivity should be increasing in the use of intermediate inputs, given the level of capital input. Levinsohn and Petrin (2003) suggest a visual test for examining the monotonicity condition. Figure 1 shows visually that this condition seems to be met in our panel. Fixing the amount of capital used, thus looking vertically along the y-axis, we generally see average productivity increasing in the use of intermediate inputs.

Figure 2 plots the TFP-estimations at the firm-level against labor productivity, both using value added as a measure for output. Obviously, there is strong correlation between labor productivity and total factor productivity, although total factor productivity is obviously the preferred productivity measure, since it captures the efficiency with which the firm translates all inputs into output instead of just labor. However, the fact that both productivity measures are closely correlated indicates that the data behave in a reassuringly consistent way.

[8]The estimations of total factor productivity are obtained by running a Levinsohn-Petrin estimation procedure excluding the top and bottom 1% of capital, intermediate inputs and value added per employee.

Figure 1: Productivity levels given capital and intermediate inputs

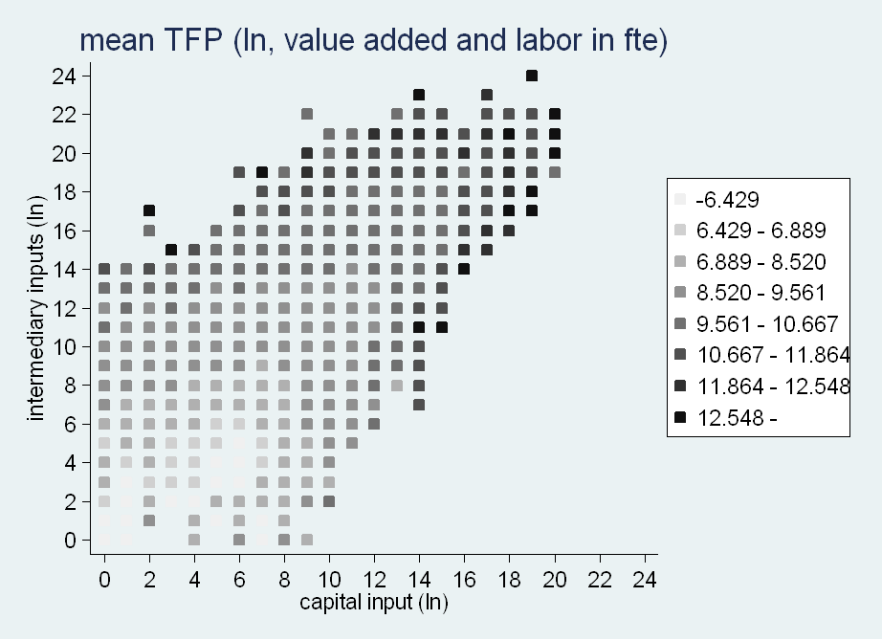
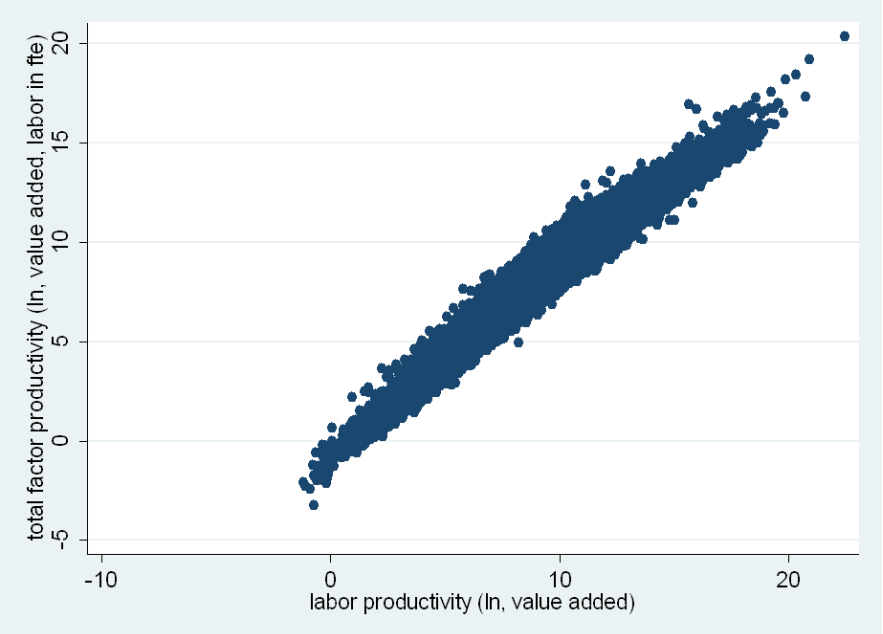


Figure 2: Labor productivity and total factor productivity



4 Empirical findings

4.1 Do importers perform better?

We start by establishing some stylized facts. Table 3 shows that, in line with the literature reviewed in section 2, firms that only serve domestic markets are on average the least productive, both in terms of labor productivity and total factor productivity.[9] The picture emerging from the data is remarkably homogeneous for both productivity measures; Dutch importers are on average less productive than exporters, and firms doing both simultaneously outperform both sole importers and exporters. The productivity difference between non-traders, exporting and importing firms is relatively small, whereas two-way traders are further ahead.Running a series of Wilcoxon rank-sum tests, which tests the hypothesis that two independent samples are drawn from the same distribution, shows that the mean differences presented in table 3 are all statistically significant in the hypothesized direction, for both productivity measures. In addition to this, Fischer's exact test indicates that the hypotheses of equality of the medians of the different groups are consistently and significantly rejected.[10]

Table 3: Mean productivity and firm size of Dutch firms by trade status

	total factor productivity	labor productivity	number of employees
all firms	12,684	52,414	5.5
by trade status			
non-trader	11,791	49,345	3.8
only importing	12,772	50,504	8.4
only exporting	13,457	53,769	6.5
two-way trader	20,711	85,643	18.3

Note: Mean calculations are based on pooled data in constant prices over the years 2002-2008.

However, analyzing differences in means or medians of different populations does not tell the complete story, since it only involves one moment of the productivity distribution for each group. One way to consider the full distribution is to perform a series of Kolmogorov-Smirnov tests comparing the productivity distributions of non-traders, sole exporters, sole importers

[9]From this point onwards, the productivity measures referred to are estimated using value added as the measure of output, unless explicitly stated otherwise

[10]The results of the statistical tests are not reported in detail for space considerations, detailed results are available from the author upon request.

and two-way traders with each other. The results of these tests for both total factor productivity and labor productivity are significant in all cases and indicate that the productivity distributions of the four groups divided by trade status do indeed differ.

The next step in the empirical analysis consists of estimating the trader premia, that is, the productivity difference between non-traders and traders that can be attributed to the differing trade status. In order to do so, one needs to control for other factors affecting firm-level productivity, such as firm size and sector, since these tend to correlate with trade status as well. For example, firms that both import and export simultaneously tend to be larger on average than non-traders, and larger firms are on average more productive than smaller firms. This raises the question whether part of the productivity difference between non-traders and two-way traders remains once controlling for firm size. To investigate this we estimate a regression model employing our panel data concerning Dutch firms over the years 2002 to 2008. The empirical model is thus specified as follows:

$$\begin{aligned} ln(Prod_{it}) = \alpha + \beta_1 importer_{it} + \beta_2 exporter_{it} + \beta_3 twowaytrader_{it} \\ + \beta_4 foreigncontrolled_{it} + \beta_5 firmsize_{it} \\ + \beta_6 year_t + \beta_7 sector_{it} + \beta_8 region_i + e_{it} \end{aligned} \quad (7)$$

In this model the subscript i identifies individual firms and t indexes the year. The dependent variable to be estimated ($lnProd_{it}$) is either total factor productivity, denoted by $lnTFP_{it}$, or labor productivity, denoted by $lnLP_{it}$. Dummies regarding trade status, with non-trading firms as the reference group, are defined by $importer_{it}$, $exporter_{it}$ and $twowaytrader_{it}$. We also include a series of control variables; firm size in terms of employment in full-time equivalents ($firmsize_{it}$), a dummy variable indicating whether the firm is controlled by a company located abroad $foreigncontrolled_{it}$) and a full set of year ($year_t$) and 2-digit sector ($sector_{it}$) and region ($region_i$) dummies. The region dummies identify the twelve Dutch provinces. Equation 7 is estimated in several ways.[11] The data set contains firms from every 2-digit sector, and are thus not limited to particular manufacturing sectors. However, our trade data only concern goods trade, and we have no information regarding trade in services, which could bias our estimations of trade premia of goods traders. To control for this, we run each regression in three steps, one including all firms in our sample and two for separate subsets, one excluding typical (financial and public) service sectors and one only including

[11] The top and bottom 1% of the observations along the relevant productivity distribution are excluded from each regression analysis

service sectors. We choose *financial intermediation* as our cut-off point for this division.[12].

Table 4 and 5 report the estimation results of our baseline model.[13] The results are largely as expected and confirm the productivity ordering previously established. The trade premia are of considerable magnitude and statistically significant. Only importing firms are for example an estimated 8.8% more productive in terms of TFP and 20.1% in terms of labor productivity.[14] The estimations of the labor productivity premia mirror the findings of Vogel and Wagner (2010) for German firms and Muûls and Pisu (2009) closely, who find importer premia of 22% for West-Germany respectively 18% for Belgium. Andersson, Lööf, and Johansson (2008) present considerably lower importer premia for Sweden, but these results are difficult to compare because of differing estimation procedures and sample compositions. For only exporting firms and two-way traders these premia are even larger. We find exporter premia of 13.3% (TFP) and 24.6% (LP) and two-way trader premia of 35.0% (TFP) and 55.6% (LP). For only exporting firms this is a somewhat higher labor productivity premium than the findings of Vogel and Wagner (2010) and Muûls and Pisu (2009) who report premia of about 18%. The estimated trade premia for two-way traders are comparable to the estimations for Germany (55.8%), but higher than those for Belgium (35%). The difference between the estimated coefficients of the different trade statuses are statistically significant as well for both total factor productivity and labor productivity. The coefficients of the control variables show the expected results. Firms controlled by a foreign owner consistently show a productivity premium and firm size significantly positively affects firm-level productivity in the OLS-models. The geographic location of firms within the Netherlands significantly impacts upon firm-level productivity. All province dummies (not reported) return significant coefficients with plausible magnitudes, indicating that economically peripheral regions seem to face a productivity penalty compared to the provinces forming the economic center of the country.

Splitting the panel into separate parts for typical manufacturing and service sectors does reveal some interesting patterns. Excluding typical service

[12]This corresponds to ISIC Rev. 3.1 section J, division 65

[13]In many empirical studies fixed effects models are estimated next to pooled OLS-models. However, the trade status of individual firms is generally relatively stable. This implies that the individual firm-specific intercept would capture the better part of the effect of trade status on firm-level productivity for those firms where the trade status does not change during the observed period. This implies that the estimated coefficient only reflects the effect of trade status on productivity for those firms where the trade status changed during the observed time period.

[14]Trade premia are calculated as $100(exp(\beta) - 1)$.

sectors leads to higher estimates of the trade premia for manufacturing sectors. The estimated trade premium for importing manufacturers is 11.5%, which is 2.7% higher than the estimated premium for the full panel. The estimated productivity premia of goods trade for service sectors are thus considerably smaller. These results hold for both TFP and LP estimates, although the effect is more pronounced for the TFP-estimations. The baseline TFP-model even returns a slightly negative, albeit insignificant, coefficient for goods importing service providers. The differences between the estimated trade premia across the models including all firms, only manufacturing firms and only service providers are all statistically significant. It is difficult to hypothesize about the direction of the difference between inclusion and exclusion of service sectors. Including service sectors implies that service traders not engaging in goods trade are considered being non-trader, thereby possibly reducing the estimated productivity premia of goods traders. However, engaging in both goods and service trading could imply incurring even higher fixed cost of trading and thereby increasing the estimated productivity premium of goods traders. From the results of split panel regression it seems that the first hypothesis is most plausible.

Table 4: Total factor productivity premia of Dutch firms (pooled OLS, 2002-2008)

	all firms	manufacturing sectors	service sectors
trade dummies			
non-trader	reference	reference	reference
only imports	0.085***	0.109***	-0.007
only exports	0.125***	0.166***	0.036***
two-way trader	0.300***	0.315***	0.147***
control variables			
domestically controlled	reference	reference	reference
foreign controlled	0.302***	0.242***	0.396***
firm size (fte, log)	0.254***	0.272***	0.224***
No. of observations	1,642,142	1,030,025	612,121
R^2	0.167	0.192	0.140

Notes: All regressions include a full set of year, sector and region dummies. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Labor productivity premia of Dutch firms (pooled OLS, 2002-2008)

	all firms	manufacturing sectors	service sectors
trade dummies			
non-trader	reference	reference	reference
only imports	0.183***	0.198***	0.121***
only exports	0.220***	0.261***	0.126***
two-way trader	0.442***	0.448***	0.323***
control variables			
domestically controlled	reference	reference	reference
foreign controlled	0.293***	0.220***	0.425***
firm size (FTE, log)	0.104***	0.128***	0.069***
No. of observations	1,746,625	1,074,406	672,214
R^2	0.112	0.106	0.113

Notes: All regressions include a full set of year, sector and region dummies. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Direction of causality I: self-selection or not?

In the previous section we presented empirical evidence that Dutch importers are more productive than non-traders. The next question to answer concerns the direction of causality: does the firm become an importer because it is more productive than its non-importing peer prior to the switching of trade status, or does it become more productive once it starts importing due to learning effects. In order words, do firms self-select into importing or learn by importing?

In order to investigate the self-selection hypothesis we take a closer look at persisting productivity differences between import starters and continuing non-importers three years before the import start.In order to do so we compare two groups of import starters with their continuing non-importing peers; firms that start importing in year t that did not trade in years *t-3* through *t-1* and firms that start importing in year t that exported at least once in in years *t-3* through *t-1*. The first group is compared to the group of firms that continued to be non-trader in year t, the latter is compared to firms that did not import, but exported at least once in in years *t-3* through *t-1* and that remained either exporter or non-trader in year t. The exact definitions of the cohorts and the corresponding number of firms satisfying the

conditions are presented in table 21 in the appendix. Our panel, covering the years 2002-2008 allows us to identify four cohorts of import starters, starting in 2005, 2006, 2007 and 2008. For each paired cohort we estimate a pooled OLS-regression model that is specified as follows:

$$ln(Prod_{it-3}) = \alpha + \beta_1 importer_{it} + \beta_2 foreigncontrolled_{it-3} + \beta_3 firmsize_{it-3} + \beta_4 year_t + \beta_5 sector_{it-3} + \beta_6 region_i + e_{it} \quad (8)$$

Each variable in this model is defined in the same way as in equation 7, all explanatory variables are also lagged three years, except for time-invariant variables and the dummy marking the import start. Table 6 shows the results for both total factor productivity and labor productivity.[15] All estimated coefficients on the importer dummy are positive. The results thus point in the direction of self-selection of more productive firms into importing, particularly for firms that did not trade altogether prior to the import start. However, this is not confirmed by all cohorts. Labor productivity of non-trading import starters is consistently higher three years prior to import start, but for TFP the results are less conclusive; two out of four cohorts return insignificant coefficients for the importer dummy. The magnitude of the labor productivity difference between non-traders and import starter at *t-3* is in line with the findings of Vogel and Wagner (2010) for Germany. Our estimations suggest that labor productivity of import starters is 5% to 16% higher three years prior to the import start than that of continuing non-traders. For TFP the estimated premia are lower; 2% to 9%. The results for the paired cohorts of exporting import starters are rather mixed. The 2005-cohort returns a large and significant productivity difference for both TFP and LP, but the estimated coefficients for the other cohorts insignificant although positive.

Table 6: Self-selection of Dutch firms into import markets

		total factor productivity				labor productivity			
		t=2005	t=2006	t=2007	t=2008	t=2005	t=2006	t=2007	t=2008
non-trader	coefficient	0.090	0.031	0.018	0.048	0.153	0.077	0.054	0.093
starting to import		(0.002)	(0.226)	(0.507)	(0.007)	(0.000)	(0.006)	(0.058)	(0.000)
in year t	no. of obs.	33,638	30,350	30,725	29,753	34,889	31,098	31,502	30,442
exporter	coefficient	0.158	0.123	0.078	0.042	0.199	0.002	0.097	0.068
starting to import		(0.002)	(0.822)	(0.133)	(0.286)	(0.001)	(0.973)	(0.085)	(0.110)
in year t	no. of obs.	2,925	2,586	2,434	2,312	2,976	2,627	2,479	2,337

Note: *p*-values in parentheses

[15] We only present the coefficient on the importer dummy for space considerations, the full estimation results are available from the author upon request.

4.3 Direction of causality II: learning by importing?

The next step is to establish whether import starters incur gains from learning by importing. Presenting evidence that firms starting to import from abroad show higher productivity growth than firms that keep sourcing domestically is not sufficient to conclude that firms learn from importing, simply because it is well possible that firms starting to import already perform better than continuing not-importers before the import start. There would be no valid reason to expect this difference to disappear after the import start. On the other hand, it is impossible to check whether import starters would have continuously performed better than non-importers if they also continued their non-importing status, since this scenario is simply unobserved.

A common way to deal with this issue is to adopt propensity score matching. The objective of this procedure is to construct the non-observed counterfactual by matching each treated firm to a firm from the control group based on similarity of firm characteristics before the treatment where in this particular application the treatment is the import start of the firm and analyze whether these matched pairs of firms show diverging productivity growth paths after the import start. We investigate this issue over two time frames, following Vogel and Wagner (2010). The import starting firm could immediately incur a productivity raise because it can benefit from e.g. higher quality or cheaper inputs or better technology in its production process. We investigate this static learning effect of importing by checking whether non-importers and import starters show diverging paths of productivity growth in the year of the import start en the year right after. Furthermore, the import starter could continuously learn from importing through e.g. knowledge spillovers from foreign trading partners or competitors and efficiency gains through international competitive pressure. We investigate this dynamic learning effect by checking whether non-importers and import starters face diverging productivity growth paths several years after the import start.

We employ propensity score matching to investigate the persistence of both the static and the dynamic learning effects of importing. Firms starting to import in year t are matched to a non-importer from the control group based on similarity of a set of firm characteristics at *t-1* (firm size, nationality of ownership, sector, region and productivity growth between years *t-2* and *t-1*). These characteristics are employed in a probit model to estimate the probability of an import start at time t, the so-called propensity score. Firms from the import-starting cohort are then matched to a peer from the continuingly non-importing control group by minimizing the difference in individual propensity scores; this procedure is referred to as nearest neighbor

propensity score matching.[16] In the final step the productivity growth paths of the matched pairs of import starters and continuing non-importers are compared. The static learning effect is evaluated by comparing productivity growth between *t-1* and *t* and between *t* and *t+1*. The dynamic learning effect is evaluated by comparing productivity growth paths from *t+1* to *t+2* and from *t+2* to *t+3*.[17]

Table 7: Static effect of learning by importing on Dutch importers

	year of import start	outcome measure	no. of matched treated firms	mean of matched treated	mean of matched control group	ATT	bootstrapped p-value
non-trader	2007	ΔTFP_{06-07}	830	20.6	22.6	-2.0	0.732
starting to import		ΔTFP_{07-08}	811	11.0	15.7	-4.7	0.678
	2007	ΔLP_{06-07}	842	24.5	32.9	-8.4	0.348
		ΔLP_{07-08}	842	17.1	34.8	-17.6	0.162
	2006	ΔTFP_{05-06}	761	71.8	31.9	39.9	0.204
		ΔTFP_{06-07}	753	64.1	54.9	9.2	0.812
	2006	ΔLP_{05-06}	772	83.7	86.9	-3.2	0.961
		ΔLP_{06-07}	772	76.3	21.9	54.5	0.150
	2005	ΔTFP_{04-05}	746	49.8	21.7	28.0	0.521
		ΔTFP_{05-06}	731	28.8	24.1	4.7	0.754
	2005	ΔLP_{04-05}	756	72.3	10.8	61.5	0.262
		ΔLP_{05-06}	756	43.1	44.1	-1.0	0.970
exporter	2007	ΔTFP_{06-07}	219	22.3	21.8	0.5	0.960
starting to import		ΔTFP_{07-08}	213	2.7	8.6	6.0	0.515
	2007	ΔLP_{06-07}	225	25.4	61.5	-36.1	0.133
		ΔLP_{07-08}	225	5.7	12.4	6.6	0.616
	2006	ΔTFP_{05-06}	190	89.4	48.7	40.7	0.474
		ΔTFP_{06-07}	188	34.5	30.1	4.4	0.789
	2006	ΔLP_{05-06}	194	95.6	46.4	49.3	0.270
		ΔLP_{06-07}	194	32.1	87.5	-55.4	0.246
	2005	ΔTFP_{04-05}	174	28.3	12.4	16.0	0.287
		ΔTFP_{05-06}	174	36.8	66.7	-29.8	0.258
	2005	ΔLP_{04-05}	171	28.3	9.2	19.1	0.317
		ΔLP_{05-06}	171	47.7	27.0	20.8	0.358

[16]Nearest neighbor propensity score matching was done using Stata 11 and the psmatch2 package developed by Leuven and Sianesi (2003). The common support condition is imposed on the matching procedure, implying that treated firms with a propensity score higher than the maximum of the non-treated control group and lower than the minimum of the control group are taken off support and are not matched to a peer.

[17]We choose to maximize the size of each cohort under investigation by defining the constraints for each cohort separately. The exact definitions of the cohorts and the corresponding number of firms satisfying the conditions are again presented in table 21 in the appendix.

Table 8: Dynamic effect of learning by importing on Dutch importers

	year of import start	outcome measure	no. of matched treated firms	mean of matched treated (%)	mean of matched control group (%)	ATT (%)	bootstrapped p-value
non-trader	2006	ΔTFP_{07-08}	313	16.0	12.3	3.7	0.836
starting to import	2006	ΔLP_{07-08}	336	17.7	2.7	15.0	0.892
	2005	ΔTFP_{06-07}	345	50.7	20.7	30.0	0.147
	2005	ΔTFP_{07-08}	296	12.3	6.6	5.7	0.587
	2005	ΔLP_{06-07}	364	40.5	-3.2	43.7	0.360
	2005	ΔLP_{07-08}	314	14.6	47.0	-32.4	0.510
exporter	2006	ΔTFP_{07-08}	97	0.2	14.4	-14.3	0.255
starting to import	2006	ΔLP_{07-08}	100	3.6	27.0	-23.5	0.251
	2005	ΔTFP_{06-07}	81	25.1	11.2	13.9	0.170
	2005	ΔTFP_{07-08}	76	20.6	14.7	5.9	0.775
	2005	ΔLP_{06-07}	82	29.5	66.5	-36.9	0.312
	2005	ΔLP_{07-08}	77	14.9	34.1	-19.2	0.573

The results of the propensity score matching procedure for the static and the dynamic learning effect of importing are presented in 7 and 8. We find no evidence pointing towards the existence of a static or dynamic learning effect. The average treatment effect on the treated (ATT), where the treatment is defined by the import start, is not consistently signed and never significantly different from zero in any of the cohorts. This is mainly due to the dispersion in productivity growth rates, inflating the standard error and the bootstrapped p-values.[18].

4.4 Does geographic origin of imports matter?

In the last part of this section we turn to the key part of our analysis; do the origin country and factor intensity of imports affect firm-level productivity? In order to tackle this issue we confine the analysis to the subset of observations for which the complete breakdown of imports in terms of geographic origin is available.[19] To keep the analysis manageable we aggregate the import data by origin country into twelve mutually exclusive and exhaustive regions; Belgium and Luxembourg (BeLux), the rest of North-Western Europe, Southern Europe, the rest of the EU, the rest of Europe, Middle East and North Africa, Sub-Saharan Africa, developed Asia, developing Asia, Oceania, North America and Latin America and the Caribbean.[20]

We include the geographical breakdown of imports in our baseline regression model in two separate ways, using import shares and regional import

[18]Bootstrapped p-values are generated by running 200 replications

[19]We also experimented with cluster analysis trying to identify persisting patterns in import profiles among Dutch importers. However, since a considerable part of the firms source inputs only from one foreign country cluster analysis does not yield useful and consistent clusters of importing firms.

[20]The geographic regions are described in detail in table 22 in the appendix.

concentration dummies. In the first approach, the import share of each region in the total imports of the firm is included in the baseline model, with BeLux serving as the reference group. In the second approach we define four separate sets of concentration dummies. If the import share of a region exceeds 50%, 60%, 75% or 95% of the total import value of the firm the dummy variable for that particular region is set to 1 and is 0 otherwise.

Table 9: Number of observations by regional origin and degree of import concentration (2002-2008)

	degree of concentration				% change		
					>50% ↓	>60% ↓	>75% ↓
	>50%	>60%	>75%	>95%	>60%	>75%	>95%
region of origin							
BeLux	3,287	2,734	2,079	1,253	-16.8%	-24.0%	-39.7%
rest of North-Western Europe	16,584	14,818	12,310	8,073	-10.6%	-16.9%	-34.4%
Southern Europe	3,165	2,577	1,874	973	-18.6%	-27.3%	-48.1%
rest of EU	2,087	1,928	1,698	1,433	-7.6%	-11.9%	-15.6%
rest of Europe	947	892	837	730	-5.8%	-6.2%	-12.8%
Middle East and North Africa	3,769	3,603	3,363	3,027	-4.4%	-6.7%	-10.0%
Sub-Sahara Africa	1,110	1,065	997	888	-4.1%	-6.4%	-10.9%
developed Asia	5,575	5,082	4,400	3,500	-8.8%	-13.4%	-20.5%
developing Asia	15,551	14,790	13,644	11,673	-4.9%	-7.7%	-14.4%
Oceania	824	788	720	629	-4.4%	-8.6%	-12.6%
North America	18,382	17,792	16,843	14,971	-3.2%	-5.3%	-11.1%
Latin-America and the Caribbean	1,517	1,424	1,291	1,110	-6.1%	-9.3%	-14.0%
total	72,798	67,493	60,056	48,260			
% of no. of obs	94.3%	87.4%	77.8%	62.5%			

The numbers of observations for which the dummy is set to 1 by region are presented in table 9. In terms of numbers North-Western Europe, North America and developing Asia are the most prominent source regions. The level of concentration of imports is generally high; 94% of the firms imports more than half its goods from only one region. This decreases to a still considerable 62% of the firms sourcing more than 95% of its imported goods from one region. Moreover, concentration of imports is more prominent for regions far away than for regions nearby. Table 9 shows that for regions close to the Netherlands the number of firms mainly importing from that region decreases relatively fast with increasing levels of concentration compared to regions further away. In other words, firms importing goods from nearby are

more likely to increase the number of regions it sources goods from than firms importing from region further away, indicating that distance is an important factor in the degree of concentration of imports. This observation fits the hypothesis that fixed costs of importing from regions at great distance are higher than those of sourcing imported goods nearby well.

The import shares of the region of origin and the types of goods with different factor intensities are included separately in our baseline regression model. In addition, each set of concentration dummies is included in a separate model. The results of these regressions are presented in tables 10 and 11. The impact of region of origin of imports on firm-level productivity could hypothetically go both ways; the importing firm can benefit from high quality imports from the technological frontier from developed regions nearby and thereby increase productivity. But the fixed costs of importing are higher for imports from regions far away or from regions which pose more difficulties for Dutch importers due to various barriers to trade. This would imply that a higher level of productivity is needed to overcome those costs.

The regression results point in the direction of the first mechanism, indicating that higher import shares from regions nearby impact positively upon firm-level productivity. The estimated premia for the rest of North-Western Europe and Southern Europe do not significantly differ from the reference region, which is BeLux. All other regions return a significantly negative estimated coefficient, indicating that firm-level TFP is negatively associated with the import share from these regions. Developing regions, Sub-Saharan Africa, developing Asia and the Middle East and North Africa, have the most negative impact on productivity. The control variables included in the regressions are all significant and have the hypothesized sign. The separate regressions for manufacturing and service sectors do not yield noteworthily different results. Increasing the degree of concentration of imports, or put differently, the focusing of imports, is positively associated with productivity (table 11), particularly for imported goods from nearby regions. The estimated premia increase steadily with increasing degrees of concentration, with the premia for the 95% concentration level being almost twice that of the 50% concentration level for the three regions closest to the Netherlands. The regressions including geographic concentration dummies also indicate that importing from regions nearby impacts positively upon firm-level productivity, with developing regions relatively far away again showing the least beneficial relationship with firm-level productivity.

Table 10: Impact of import origin on total factor productivity (pooled OLS, 2002-2008)

	all firms	manufacturing sectors	service sectors
import shares by geographic region			
BeLux	reference	reference	reference
rest of North-Western Europe	-0.013	-0.004	-0.274**
Southern Europe	-0.034	-0.026	-0.296*
rest of the EU	-0.262***	-0.255***	-0.409***
rest of Europe	-0.358***	-0.332***	-0.592***
Latin America and the Caribbean	-0.299***	-0.300***	-0.389***
North America	-0.282***	-0.299***	-0.370***
Sub-Saharan Africa	-0.404***	-0.399***	-0.552***
developed Asia	-0.297***	-0.260***	-0.501***
developing Asia	-0.448***	-0.438***	-0.572***
Middle East and North Africa	-0.474***	-0.463***	-0.576***
Oceania	-0.261***	-0.247***	-0.420***
control variables			
non-exporter	reference	reference	reference
exporter	0.196***	0.218***	0.109***
domestically controlled	reference	reference	reference
foreign controlled	0.185***	0.141***	0.313***
firm size (fte, log)	0.208***	0.201***	0.216***
No. of observations	65,625	51,506	13,419
R^2	0.247	0.264	0.179

Notes: All regressions include a full set of year, sector and region dummies.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Impact of import concentration by region on total factor productivity (pooled OLS, 2002-2008)

	degree of regional import concentration			
	>50%	>60%	>75%	>95%
concentration dummies by geographic region				
BeLux	0.102***	0.131***	0.152***	0.191***
rest of North-Western Europe	0.0814***	0.109***	0.128***	0.132***
Southern Europe	0.0738***	0.0864***	0.103***	0.136***
rest of EU	-0.133***	-0.130***	-0.152***	-0.183***
rest of Europe	-0.250***	-0.213***	-0.195***	-0.223***
Latin America and the Caribbean	-0.196***	-0.169***	-0.165***	-0.189***
North America	-0.163***	-0.139***	-0.124***	-0.129***
Sub-Saharan Africa	-0.283***	-0.257***	-0.267***	-0.284***
developed Asia	-0.183***	-0.163***	-0.145***	-0.151***
developing Asia	-0.318***	-0.299***	-0.290***	-0.304***
Middle East and North Africa	-0.352***	-0.335***	-0.326***	-0.343***
Oceania	-0.156***	-0.138***	-0.119**	-0.105*
control variables				
non-exporter	reference	reference	reference	reference
exporter	0.197***	0.199***	0.204***	0.205***
domestically controlled	reference	reference	reference	reference
foreign controlled	0.187***	0.186***	0.184***	0.183***
firm size (fte, log)	0.209***	0.210***	0.212***	0.215***
No. of observations	65,625	65,625	65,625	65,625
R^2	0.246	0.245	0.244	0.243

Notes: All regressions include a full set of year, sector and region dummies.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.5 Does the factor intensity of imports matter?

Next to the geographic origin of imports we have information regarding the factor intensity of the imported goods, following the product classification developed by Van Marrewijk (2002), who classifies imports according to their factor intensity into five types; primary products, natural-resource intensive, unskilled-labor intensive, technology intensive and human-capital intensive. We adopt the same strategy as with the regional classification of imports and include the import shares from each group and four sets of concentration dummies in our baseline model. The numbers of observations satisfying each of the degree of concentration conditions are presented in table 12. The level of concentration of imports is even higher for factor intensities compared to regions of origin, which is intuitively straightforward, since the core business of the firm mainly determines the factor intensity of imports.

Table 12: Number of observations by factor intensity and degree of import concentration (2002-2008)

	degree of concentration				% change		
					>50% ↓ >60%	>60% ↓ >75%	>75% ↓ >95%
	>50%	>60%	>75%	>95%			
factor intensity							
primary products	8,090	7,822	7,400	6,336	-3.3%	-5.4%	-14.4%
natural resource intensive	2,870	2,587	2,192	1,563	-9.9%	-15.3%	-28.7%
unskilled labor intensive	15,911	15,182	14,052	11,903	-4.6%	-7.4%	-15.3%
high-tech products	27,852	26,589	24,463	19,833	-4.5%	-8.0%	-18.9%
human capital intensive	21,035	19,834	17,959	14,621	-5.7%	-9.5%	-18.6%
total	75,758	72,014	66,066	54,256			
% of no. of obs	98.1%	93.3%	85.6%	70.3%			

The import shares of the types of goods with different factor intensities are included separately in our baseline regression model. In addition, each set of concentration dummies is included in a separate model. The results of these regressions are presented in tables 13 and 14. The regressions including the factor intensity of imported goods show a similar pattern as the regressions including the geographic origin of imports; focusing is associated with higher levels of productivity. This effect is most pronounced for primary products. Furthermore, importing high-tech products and primary products is most beneficiary to firm-level productivity. This makes sense intuitively especially with respect to technology intensive products with the discussion of mechanisms through which importing can raise productivity in section 2 in mind. In that same line of reasoning it is intuitively straightforward that

importing mainly unskilled-labor intensive products impacts negatively upon firm-level productivity. The remaining types of goods, natural-resource intensive goods and human-capital intensive goods return mixed and frequently insignificant results.

Table 13: Impact of factor intensity of imports on total factor productivity (pooled OLS, 2002-2008)

	all firms	manufacturing sectors	service sectors
import shares by factor intensity			
primary products	reference	reference	reference
natural resource intensive	-0.075**	-0.073**	-0.048
unskilled labor intensive	-0.181***	-0.187***	-0.064
high-tech products	0.009	0.026	0.042
human capital intensive	-0.046***	-0.062***	0.073
control variables			
non-exporter	reference	reference	reference
exporter	0.249***	0.275***	0.125***
domestically controlled	reference	reference	reference
foreign controlled	0.216***	0.170***	0.322***
firm size (FTE, log)	0.238***	0.239***	0.222***
No. of observations	65,584	51,476	13,408
R^2	0.230	0.246	0.171

Notes: All regressions include a full set of year, sector and region dummies.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Impact of import concentration by factor intensity on total factor productivity (pooled OLS, 2002-2008)

	degree of import concentration			
	>50%	>60%	>75%	>95%
primary products	0.034	0.051***	0.056***	0.059***
natural resource intensive	-0.033	-0.006	0.002	0.014
unskilled labor intensive	-0.125***	-0.106***	-0.108***	-0.107***
high-tech products	0.044*	0.061***	0.059***	0.055***
human capital intensive	-0.006	0.012	0.011	0.020
control variables				
non-exporter	reference	reference	reference	reference
exporter	0.250***	0.251***	0.251***	0.253***
domestically controlled	reference	reference	reference	reference
foreign controlled	0.215***	0.216***	0.217***	0.222***
firm size (fte, log)	0.238***	0.238***	0.239***	0.240***
No. of observations	65,625	65,625	65,625	65,625
R^2	0.230	0.229	0.229	0.229

Notes: All regressions include a full set of year, sector and region dummies.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

5 Conclusion and discussion

Employing three comprehensive data sets covering Dutch firms over the years 2002-2008 we are the first to investigate the relationship between import status and firm-level productivity in the Netherlands. Our analysis consists of two main parts. In the first part we focus on the question whether importers are more productive than non-traders and the direction of causality between import status and productivity. In the second part we investigate whether the geographic origin of imports and the factor intensity of imported goods affect firm-level productivity.

The empirical results indicate that firms that import and do not export are more productive than non-traders. Only exporting firms are more productive than only importers and two-way traders are the most productive

group. This productivity ordering by trade status of Dutch firms is in line with the findings of earlier research regarding other developed countries. This also holds for the question of the direction of causality. The results of our empirical analysis indicate that import starters are significantly more productive than continuing non-traders already three years before the import start. This suggests that firms self-select into importing. We do not find evidence supporting the hypothesis that firms become more productive after an import start because of learning effects; import starters do not show significantly different productivity growth paths in the years after the import start compared to continuing non-traders.

Descriptive statistics regarding the pattern of imports show that the degree of concentration of imports in geographical terms is large and increases with distance. In terms of factor intensity the degree of concentration is even larger. Furthermore, we present evidence suggesting that focusing imports geographically impacts positively upon firm-level productivity. This also holds for the factor intensity of imported goods, where the effect is most pronounced for primary products. Moreover, the premium in terms of increased firm-level productivity decreases with distance. Importing from developing regions relatively far away shows the least beneficial relationship with productivity. Regarding the factor intensity of imported goods, our analysis shows that importing technology intensive products and primary products is associated with the largest productivity premium. Unskilled-labor intensive imports show the least beneficial productivity premium.

This paper is work in progress. Future extensions of the analysis mainly regard sections 4.4 and 4.5. Among future extensions will be investigation of the two-dimensional characteristics of imports where we consider both the factor intensity and the geographical origin of imported goods simultaneously.

A Appendix

Table 15: Distribution of firms by size (General Business Register)

	1≥fte<5	5≤fte<10	10≤fte<20	20≤fte<50	50≤fte<100	100≤fte<250	fte>250	total
2002	81.9%	8.8%	4.3%	2.9%	1.0%	0.6%	0.4%	868,990
2003	81.9%	9.0%	4.3%	2.9%	1.0%	0.6%	0.4%	870,419
2004	82.2%	8.9%	4.2%	2.8%	0.9%	0.6%	0.4%	870,354
2005	82.8%	8.6%	4.2%	2.6%	0.9%	0.5%	0.4%	901,736
2006	84.3%	7.0%	4.0%	2.5%	0.9%	0.7%	0.6%	1,073,595
2007	85.7%	7.0%	3.6%	2.2%	0.7%	0.5%	0.3%	1,095,521
2008	86.7%	6.2%	3.5%	2.1%	0.7%	0.4%	0.3%	1,188,377

Table 16: Distribution of firms by size (panel data set)

	1≥fte<5	5≤fte<10	10≤fte<20	20≤fte<50	50≤fte<100	100≤fte<250	fte>250	total
2002	57.3%	18.1%	13.0%	8.5%	2.0%	0.9%	0.2%	104,202
2003	57.3%	18.4%	12.9%	8.3%	2.0%	0.9%	0.3%	105,414
2004	57.6%	18.2%	12.8%	8.2%	2.0%	0.9%	0.3%	106,738
2005	58.8%	17.8%	12.8%	7.6%	1.9%	0.8%	0.3%	110,585
2006	85.4%	7.8%	4.0%	2.0%	0.5%	0.2%	0.1%	466,107
2007	85.6%	7.8%	3.9%	2.0%	0.5%	0.2%	0.1%	486,965
2008	86.5%	7.0%	3.8%	1.9%	0.5%	0.2%	0.1%	559,504

Table 17: Trade status of Dutch firms by sector (%)

	non-trading	only exports	only imports	two-way trade	total
agriculture and hunting	78.1	5.6	4.7	11.7	1,376
forestry and logging	X	X	X	X	12
fishing and aquaculture	X	X	X	X	22
extr. of crude petr. and nat. gas	X	X	X	X	20
other mining and quarrying	X	X	X	X	18
man. of food products	67.5	2.9	9.4	20.3	13,054
man. of tobacco products	X	X	X	X	42
manufacture of textiles	56.4	3.5	13.1	26.9	4,397
man. of wearing apparel	70.7	2.2	12.9	14.1	4,002
tanning and dressing of leather	45.7	7.0	10.4	36.9	1,063
man. of products of wood	67.3	2.4	15.2	15.0	6,866
man. of paper products	26.9	5.1	7.5	60.5	1,416
publishing, printing and repro	72.2	9.0	6.6	12.2	23,329
man. of petr. and nucl. prod.	23.0	6.6	7.4	63.1	122
man. of chemical products	25.8	6.3	8.2	59.8	2,989
man. of rubber and plast. prod.	31.5	5.8	10.6	52.0	4,276
man. of non-metallic min. prods.	58.5	3.2	19.4	19.0	5,445
manufacture of basic metals	39.2	7.2	8.9	44.7	1,004
man. of fabricated metal prod.	65.1	5.1	9.7	20.2	28,882
man. of machinery and eq.	46.4	6.5	9.1	38.0	16,486
man. of office and comp. mach.	54.4	4.3	11.6	29.8	658
man. of electrical machinery	50.2	4.0	11.3	34.5	3,634
man. of radio, TV and comm. eq.	41.0	3.5	16.0	39.6	1,448
man. of med. and optical instr.	65.6	3.1	11.3	20.0	7,901
man. of motor vehicles	49.1	5.8	10.7	34.5	2,486
man. of other transport eq.	72.6	4.8	8.7	13.8	6,180
man. of furniture	71.6	2.6	14.5	11.4	24,153
recycling	45.9	8.5	9.5	36.1	706
electricity, gas, and hot water	X	X	X	X	50
construction	93.1	0.8	4.8	1.3	295,239
sale, maint., rep. of motor veh.	75.5	5.2	9.4	9.8	76,323
wholesale and comm. trade	45.3	5.7	14.6	34.4	219,402
retail trade	69.5	1.0	25.1	4.3	244,804
hotels and restaurants	94.2	0.1	5.4	0.3	103,631
land transport	90.7	3.5	3.3	2.5	44,371
water transport	95.5	1.3	2.4	0.8	11,538
air transport	71.2	2.9	17.6	8.3	615
supporting transport act.	80.0	4.8	7.9	7.3	21,032
post and telecommunication	90.2	2.4	4.7	2.7	11,798
financial intermediation	88.5	1.5	5.4	4.7	4,095
insurance and pension funding	X	X	X	X	65
act. aux. to fin. intermediation	86.7	2.8	5.5	5.1	1,224
real estate activities	88.2	2.4	4.9	4.5	1,704
rent of mach. without operator	83.7	2.3	8.4	5.7	15,636
computer and related act.	84.3	4.1	7.4	4.2	83,871
research and development	72.4	4.1	11.2	12.2	5,141
other business activities	92.8	1.9	3.4	2.0	535,638
public adm. and defense	X	X	X	X	25
education	90.5	1.5	6.1	1.8	655
health and social work	87.7	1.2	6.0	5.1	583
sewage and sanitation	83.1	3.8	3.3	9.8	183
act. of membership org.	X	X	X	X	194
recr., cult. and sporting act.	84.7	2.1	7.8	5.4	1,773
other service activities	95.0	0.2	4.6	0.3	101,303
total	1,569,834	46,772	173,455	152,819	1,942,880

Note: Due to confidentiality issues the trade status by sector is not displayed for each sector.
The cases at hand are marked with an "X", but have not been dropped from the analysis.

Table 18: Labor productivity (gross output)

	number of obs.	mean	median	st. dev.	5th perc.	95th perc.
all firms	1,939,515	186,158	66,436	8,694,565	4,336	459,617
by trade status						
non-trader	1,566,728	139,046	56,010	9,338,739	3,514	317,537
only exports	46,715	342,586	115,657	3,796,605	13,855	985,251
only imports	173,348	227,395	111,183	2,886,497	12,044	541,063
two-way trader	152,724	574,803	212,983	7,162,699	44,761	1,624,529
by year						
2002	104,202	304,197	98,104	5,943,221	3,049	768,433
2003	105,414	294,893	96,425	6,530,440	3,588	741,511
2004	106,738	284,570	98,038	3,888,822	3,686	764,221
2005	110,585	303,403	101,746	4,523,698	3,780	803,694
2006	466,107	168,050	58,673	16,005,348	4,617	364,665
2007	486,965	148,095	60,134	2,483,583	4,529	392,822
2008	559,504	149,955	58,630	4,660,352	4,370	381,286
by firm size						
fte<5	1,545,683	175,021	57,093	9,607,727	3,534	425,641
5<=fte<10	191,142	231,697	101,756	4,135,667	22,027	566,516
10<=fte<20	113,513	222,168	102,699	1,986,890	24,761	533,941
20<=fte<50	64,573	224,123	105,796	1,556,517	22,270	541,953
50<=fte<100	15,382	254,999	106,562	1,655,129	16,659	630,444
100<=fte<250	6,863	284,502	114,149	1,654,583	13,725	737,557
fte>250	2,359	286,504	131,916	1,182,431	13,731	795,298

Table 19: Labor productivity (value added)

	number of obs.	mean	median	st. dev.	5th perc.	95th perc.
all firms	1,939,515	52,414	27,811	1,937,184	-2,001	126,662
by trade status						
non-trader	1,566,728	49,345	25,588	1,968,656	-1,827	117,789
only exports	46,715	53,769	36,419	213,406	-2,203	147,053
only imports	173,348	50,504	30,945	806,327	-4,968	119,087
two-way trader	152,724	85,643	47,359	2,673,185	-695	206,284
by year						
2002	104,202	64,175	34,659	3,452,505	-7,305	181,776
2003	105,414	65,786	34,232	1,360,659	-5,639	177,798
2004	106,738	65,484	34,736	1,101,505	-5,442	181,127
2005	110,585	80,788	35,639	3,574,938	-5,255	191,564
2006	466,107	47,584	25,218	1,602,418	-1,208	104,088
2007	486,965	48,979	26,635	1,918,025	-1,223	115,124
2008	559,504	46,614	26,386	1,530,095	-1,599	114,450
by firm size						
fte<5	1,545,683	51,139	24,485	1,827,003	-2,968	132,804
5<=fte<10	191,142	59,431	35,641	3,231,942	4,607	109,915
10<=fte<20	113,513	55,543	37,371	889,663	7,121	103,642
20<=fte<50	64,573	56,714	38,134	704,373	6,749	102,581
50<=fte<100	15,382	49,803	39,086	137,216	3,742	110,715
100<=fte<250	6,863	55,198	40,087	152,924	2,691	122,592
fte>250	2,359	59,614	41,536	187,176	1,031	140,878

Table 20: Total factor productivity (value added)

	number of obs.	mean	median	st. dev.	5th perc.	95th perc.
all firms	1,677,506	12,684	8,065	215,386	833	31,200
by trade status						
non-trader	1,338,566	11,791	7,476	235,514	745	28,528
only exports	42,247	13,457	10,149	26,329	1,300	33,004
only imports	153,648	12,772	8,875	84,709	1,055	29,894
two-way trader	143,045	20,711	13,864	130,430	2,540	49,358
by year						
2002	90,076	16,178	10,998	89,162	1,141	39,050
2003	92,141	16,300	10,651	177,519	1,118	37,934
2004	93,411	16,296	10,843	83,626	1,099	39,522
2005	96,859	17,101	11,115	89,878	1,112	41,792
2006	405,435	10,949	7,062	177,001	755	26,345
2007	420,764	12,511	7,668	364,472	803	30,007
2008	478,820	11,353	7,456	93,241	790	28,728
by firm size						
fte<5	1,295,273	11,326	6,913	105,883	667	29,702
5<=fte<10	184,480	15,252	10,439	557,595	2,928	29,327
10<=fte<20	110,772	16,886	12,589	171,657	3,935	33,127
20<=fte<50	63,134	20,829	15,056	202,864	4,347	38,105
50<=fte<100	14,954	22,675	18,403	48,861	3,749	47,795
100<=fte<250	6,650	27,803	21,893	60,415	3,456	60,504
fte>250	2,243	37,430	28,982	56,437	3,062	84,051

Table 21: Definition of spells by trade status

	2002	2003	2004	2005	2006	2007	2008	$no.of firms^*$
Self-selection								
Non-trader	non-trader	non-trader	non-trader	non-trader				41,235
		non-trader	non-trader	non-trader	non-trader			32,976
			non-trader	non-trader	non-trader	non-trader		33,292
				non-trader	non-trader	non-trader	non-trader	31,439
Non-trader starting to import in t+3	non-trader	non-trader	non-trader	importer				1,092
		non-trader	non-trader	non-trader	importer			989
			non-trader	non-trader	non-trader	importer		1,145
				non-trader	non-trader	non-trader	importer	2,216
Exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter				3,171
(at least once exporting before t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter			2,608
			non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter		2,433
				non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	2,129
Exporter starting to import in t+3	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader				276
(at least once exporting before t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader			248
			non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader		268
				non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	452
Dynamic effect of learning-by-doing								
Non-trader	non-trader	non-trader	non-trader	non-trader	non-trader	non-trader	non-trader	19,209/4,229
		non-trader	non-trader	non-trader	non-trader	non-trader	non-trader	22,907
Non-trader starting to import in t+3	non-trader	non-trader	non-trader	importer	non-trader /importer	non-trader /importer	non-trader /importer	339/54
(at least once importing after t+3)		non-trader	non-trader	non-trader	importer	non-trader /importer	non-trader /importer	366
Exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	511/123
(at least once exporting before t+3 and at least once after t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	637
Exporter starting to import in t+3	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	any	any	any	90/5
(at least once exporting before t+3 and after t+3, and at least once importing after t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	any	any	113
Static effect of learning-by-doing								
Non-trader	non-trader	non-trader	non-trader	non-trader	non-trader			27,271
		non-trader	non-trader	non-trader	non-trader	non-trader		28,137
			non-trader	non-trader	non-trader	non-trader	non-trader	26,738
Non-trader starting to import in t+3	non-trader	non-trader	non-trader	importer	non-trader /importer			822
		non-trader	non-trader	non-trader	importer	non-trader /importer		838
			non-trader	non-trader	non-trader	importer	non-trader /importer	905
Exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter			2,129
(at least once exporting before t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter		2,133
			non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	1,814
Exporter starting to import in t+3	non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	any			201
(at least once exporting before t+3)		non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	any		221
			non-trader/ exporter	non-trader/ exporter	non-trader/ exporter	importer/two-way trader	any	245

*The cohorts of firms regarding the dynamic effect of learning-by-doing running from 2002 to 2008 comprise of two subgroups, presented separately in the table, where the former group satisfies the conditions over the full period and the latter satisfies the conditions until 2007 but not in 2008.

Table 22: Regional aggregation of origin countries

region	remarks
BeLux	Belgium and Luxembourg
rest of North-Western Europe	Germany, Great Britain, Ireland, Denmark, Finland, Sweden, Austria, Norway, Switzerland and Iceland,
Southern Europe	France, Greece, Italy, Portugal and Spain
rest of EU	EU27 except EU15
rest of Europe	includes Russia and non-EU Central and Eastern Europe
Middle East and North Africa	includes Turkey and Israel
Sub-Sahara Africa	includes South Africa
developed Asia	Japan, South Korea, Singapore, Hong Kong, Taiwan and Macao
developing Asia	Asia and Pacific except developing Asia
Oceania	Australia and New Zealand except Pacific
North America	includes United States and Canada
Latin-America and the Caribbean	includes Brazil and Mexico

References

Acharya, R., and W. Keller (2008): "Estimating the productivity selection and technology spillover effects of imports," NBER Working Paper Series Working Paper 14079, National Bureau of Economic Research.

Acharya, R., and W. Keller (2009): "Technology transfer through imports," *Canadian Journal of Economics*, 42(4), 1411–1448.

Altomonte, C., and G. Békés (2008): "Trading activities, firms and productivity," .

Amiti, M., and J. Konings (2007): "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia," *The American Economic Review*, 97(5), 1611–1638.

Andersson, M., H. Lööf, and S. Johansson (2008): "Productivity and international trade: Firm level evidence from a small open economy," *Review of world economics*, 144(4), 774–801.

Arnold, J. (2005): "Productivity estimation at the plant level: A practical guide," .

Bernard, A., J. Jensen, and R. Lawrence (1995): "Exporters, jobs, and wages in US manufacturing: 1976-1987," *Brookings Papers on Economic Activity. Microeconomics*, 1995, 67–119.

Bernard, A., J. Jensen, S. Redding, and P. Schott (2007): "Firms in international trade," *The Journal of Economic Perspectives*, 21(3), 105–130.

Bernard, A., J. Jensen, and P. Schott (2009): *Importers, Exporters and Multinationals: A Portrait of Firms in the U.S. that Trade Goods in: Producer dynamics: new evidence from micro data*chap. 14, pp. 513–557. University of Chicago Press.

Castellani, D., F. Serti, and C. Tomasi (2010): "Firms in International Trade: ImportersŠ and ExportersŠ Heterogeneity in Italian Manufacturing Industry," *The World Economy*, 33(3), 424–457.

Coe, D., and E. Helpman (1995): "International R&D spillovers," *European Economic Review*, 39(5), 859–887.

Coe, D., E. Helpman, and A. Hoffmaister (1997): "North-South R&D Spillovers," *The Economic Journal*, 107(440), pp. 134–149.

Eriksson, T., V. Smeets, and F. Warzynski (2009): "Small Open Economy Firms in International Trade: Evidence from Danish Transactions-Level Data," Aarhus University Department of Economics Working Paper Series Working Paper 09-7, Aarhus University School of Business.

Greenaway, D., and R. Kneller (2007): "Firm heterogeneity, exporting and foreign direct investment," *The Economic Journal*, 117(517), F134–F161.

Hagemejer, J., and M. Kolasa (2011): "Internationalisation and Economic Performance of Enterprises: Evidence from Polish Firm-level Data," *The World Economy*, 34(1), 74–100.

Halpern, L., M. Koren, and A. Szeidl (2009): "Imported inputs and productivity," Central European University Economics Working Paper Series Working Paper 3/2009, Central European University.

Kasahara, H., and B. Lapham (2008): "Productivity and the Decision to Import and Export: Theory and Evidence," CESifo Working Paper Series Working Paper No. 2240, CESifo.

Kugler, M., and E. Verhoogen (2009): "Plants and imported inputs: New facts and an interpretation," in *American Economic Review Papers and Proceedings*, vol. 99, pp. 501–507.

Kurz, C. (2006): "Outstanding outsourcers: A firm-and plant-level analysis of production sharing," Finance and Economics Discussion Series Working Paper 2006-04, Federal Reserve Board.

Leuven, E., and B. Sianesi (2003): "PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing," Statistical Software Components, Boston College Department of Economics.

Levinsohn, J., and A. Petrin (2003): "Estimating Production Functions Using Inputs to Control for Unobservables," *The Review of Economic Studies*, 70(2), pp. 317–341.

Lööf, H., and M. Andersson (2010): "Imports, Productivity and Origin Markets: The Role of Knowledge-intensive Economies," *The World Economy*, 33(3), 458–481.

Manova, K., and Z. Zhang (2012): "Export prices across firms and destinations," *The Quarterly Journal of Economics (forthcoming)*, forthcoming.

Melitz, M. (2003): "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, 71(6), 1695–1725.

Muendler, M. (2004): "Trade, Technology and Productivity: A Study of Brazilian Manufacturers 1986-1998," CESifo Working Paper Series Working Paper No. 1148, CESifo.

Muûls, M., and M. Pisu (2009): "Imports and Exports at the Level of the Firm: Evidence from Belgium," *The World Economy*, 32(5), 692–734.

Olley, G. S., and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64(6), pp. 1263–1297.

Petrin, A., B. Poi, and J. Levinsohn (2004): "Production function estimation in Stata using inputs to control for unobservables," *Stata Journal*, 4, 113–123.

Roberts, M., and J. Tybout (1997): "The decision to export in Colombia: an empirical model of entry with sunk costs," *The American Economic Review*, 87(4), 545–564.

Serti, F., and C. Tomasi (2009): "Self-selection along different export and import markets," LEM Papers Series LEM Papers Series No. 18, Laboratory of Economics and Management.

Tucci, A. (2005): "Trade, Foreign Networks and Performance: a firm-level analysis for india," Centro Studi Luca D'Agliano Development Studies Working Paper No. 199 Working Paper No. 199, Centro Studi Luca D'Agliano.

Van Beveren, I. (2010): "Total factor productivity estimation: A practical review," *Journal of Economic Surveys*.

Van Marrewijk, C. (2002): *International Trade & The World Economy*. Oxford University Press.

Vogel, A., and J. Wagner (2010): "Higher productivity in importing German manufacturing firms: self-selection, learning from importing, or both?," *Review of World Economics*, 145(4), 641–665.

Wagner, J. (2007): "Exports and productivity: A survey of the evidence from firm-level data," *World Economy*, 30(1), 60–82.

——— (2012): "International trade and firm performance: a survey of empirical studies since 2006," *Review of World Economics*, 148, 235–267, 10.1007/s10290-011-0116-8.