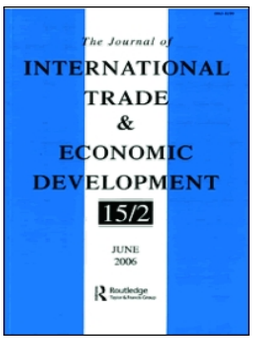

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Imports and productivity: the impact of geography and factor intensity

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ABSTRACT

Usingmicro-data for Dutch firms, we argue that both the geographic component (what country is the import from) and the intensity component (what type of good is imported) is crucial for measuring and understanding productivity premia associated with importing. For example, our results indicate that the productivity premium associated with importing technology-intensive products from Taiwan differs from importing unskilled-labor-intensive products from Switzerland. We show that increasing distance and decreasing levels of development of the origin economy are negatively associated with the productivity premia of importing. Similarly, these premia are larger for technology- intensive goods and smaller for unskilled-labor-intensive goods. This implies that the geographic-intensity markets are unique and cannot be lumped together. In addition, a more dispersed import portfolio (the extensive dimension) is always positively associated with firm-level productivity.

KEYWORDS Firm heterogeneity; imports; productivity; geography; factor intensity

JEL CLASSIFICATION D22, F14, F23

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1. Introduction

The link between imports and productivity has been widely studied. However, the distinction between geographic origin and goods characteristics in the firm-level relationship between imports and productivity is generally ignored. For example, several studies assume all imports from advanced countries to be synonymous for high-technology imports (by implication all other imports are low-technology imports), see for example Lööf and Andersson (2010), Castellani, Serti, and Tomasi (2010). We illustrate below (see Figure 1) that an additional layer of firm heterogeneity exists and that distinguishing between geographic origin and goods characteristics is empirically important. We thus investigate to what extent the characteristics of imported goods, in terms of their origin and factor intensity, are associated with firm-level productivity. As a case in point we will eventually be able to answer, from a Dutch firm's point of view, the question what

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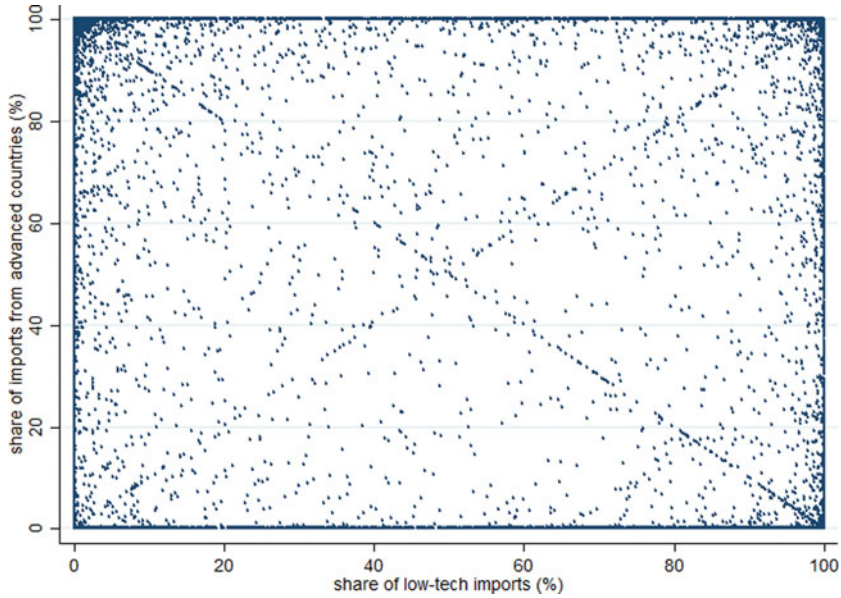

Figure 1. Relationship between low-tech imports and advanced country imports at the firm level (the Netherlands, 2002–2008, $n = 35{,}966$).
Notes: The share of imports from advanced economies is calculated as the share of imports from neighboring countries, Northern EU-15, Southern EU-15, non-EU Northwestern Europe, advanced Asia, Australia and New Zealand, and North America (see Figure 5) in total imports. The share of low-tech imports is calculated as the share of imported primary products, natural-resource-intensive products and unskilled-labor-intensive products in total imports. Only observations of firms for which the full decomposition of imports in terms of country of origin and factor intensity is known are depicted, totalling 35,966 observations. The clustering of observations along the diagonals reflects the empirical observation that only a small fraction of the firms reports imports from more than two product groups or regions, limiting the number of observed combinations of import shares. Clustering of observations in the corners is as follows: 3643 observations at (0,0), 9548 at (0,100), 5697 at (100,0), and 3326 at (100,100). In addition, 2320 observations are on the *x*-axis, 2747 are on the *y*-axis, 2790 observations are at $y = 100$-line, and 1437 are at $x = 100$-line. Finally, 246 observations are on the downward sloping diagonal, 2010 observations are located off the axes and to the left of the diagonal, and 2202 are located off the axes and to the right of the diagonal.

is associated with higher firm-level productivity? Importing (a) textiles (unskilled-labor-intensive products) from Germany (a neighboring country), (b) cutlery (human-capital-intensive products) from Italy (a Southern EU-15 country), or (c) tools (technology-intensive products) from Tanzania (a developing country)?

The initial focus of the firm heterogeneity literature was on the relationship between firm productivity and export status. Later on the analysis also included the relationship between firm productivity and import status. In both cases 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 domestic firms (see Wagner 2012 for a recent survey). Arguably, the channels through which import activities affect firm productivity are more direct than those for export activity. Importing may raise productivity through learning, variety, and quality effects, for example for imported inputs. Three dimensions play a role, namely the geographic dimension (which country is the import from), the character of the good (what type of good is imported), and the extensive dimension (from how many countries and product markets is being imported). In the first two cases there are two sub-dimensions to consider. The geographic dimension

may distinguish between advanced and developing countries or between proximate and remote countries. The character of the good may distinguish between intermediate and final goods or between types of goods based on (factor) intensity during the production process, such as technology-intensive goods.

Regarding the characteristics of imported goods we will focus attention on an intensity classification (see Section 3) that identifies five different types of goods, namely primary (e.g. dairy, copper ore, oil), natural-resource-intensive (e.g. leather, copper, aluminum), unskilled-labor-intensive (e.g. clothing, furniture, footwear), technology-intensive (e.g. chemicals, engines, aircrafts), and human-capital-intensive products (e.g. cosmetics, cars, televisions). Our data does not enable us to additionally distinguish between intermediate and final goods. The extensive dimension of imports is relevant to consider, since the fixed cost of foreign (import) market entry may be market-specific, which would imply that productivity needs to increase in the degree of dispersion of the import portfolio.

To illustrate that geography and factor intensity are really two different dimensions at the firm level, the scatter plot in Figure 1 depicts low-tech imports on the one hand and imports from advanced countries on the other hand for individual firms. If imports from advanced countries are synonymous for high-tech imports, as some of the literature assumes, then observations to the right of the downward sloping diagonal should be scarce. However, 27% of the observations is located in that area, implying that a lower boundary of almost one-third of the importers reports low-tech imports from advanced countries. This illustrates that distinguishing between geographic origin and goods characteristics of imports is empirically relevant.

The objective of the paper, and our contribution to the literature, is therefore fourfold, namely to study the relationship between firm productivity and (i) the geographic dimension of imported goods (both advanced-developing and proximate-remote), (ii) the intensity dimension of imported goods, (iii) the geographic-intensity interaction, and (iv) the degree of dispersion of the import portfolio. Our results regarding the geographic-intensity interaction will determine, in particular, the implications of not distinguishing clearly between these two dimensions. An indication of this was already provided at the macroeconomic level by Coe, Helpman, and Hoffmaister (1997) when they argued that developing countries can benefit from knowledge spillovers by importing from advanced countries through the interaction with machinery and equipment imports.

The remainder of the paper is organized as follows. Section 2 gives a brief overview of the empirical literature on the relationship between import status and firm performance regarding country of origin and factor intensity as explanatory factors. Section 3 discusses the Dutch data from the period 2002–2008 used in the empirical analysis. Section 4 gives an overview of the productivity characteristics of importers versus non-traders, exporters, and two-way traders. Section 5 analyzes firm productivity and the geographic dimensions of imports. Section 6 does the same regarding factor intensity. Section 7 analyzes firm productivity and geographic-intensity interaction. Section 8 concludes.

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 advanced and developing (see also Chang and Van Marrewijk 2013). 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. 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. 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. 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).

A considerable amount of firm-level evidence suggests that firms importing inputs in general are more productive than firms that source inputs solely domestically.[1] However, the empirical evidence regarding the differential impact of country of origin and factor intensity of imports on firm performance is much more scarce. Lööf and Andersson (2010) present evidence indicating 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 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. Their findings indicate that imports from advanced economies are associated with a higher productivity premium than imports from developing 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. The empirical evidence presented by Bas and Strauss-Kahn (2010) regarding French firms also suggest that the positive association between productivity and imports is stronger for imports from advanced economies. Silva, Afonso, and Africano (2012) present empirical evidence regarding Portuguese firms, showing that geographic and sectoral diversification, for both imports and exports, is positively correlated with productivity. Furthermore, their findings indicate that trading with nearby and familiar economies is associated with a smaller productivity premium than trading in more 'difficult' markets.

A few general conclusions can be taken from the preceding discussion. A well-known stylized fact is that importers tend to be more productive and perform better in general than non-traders. The empirical evidence regarding the impact of import characteristics in terms of geographic 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 advanced countries or technologically advanced imports are associated with larger productivity premia.

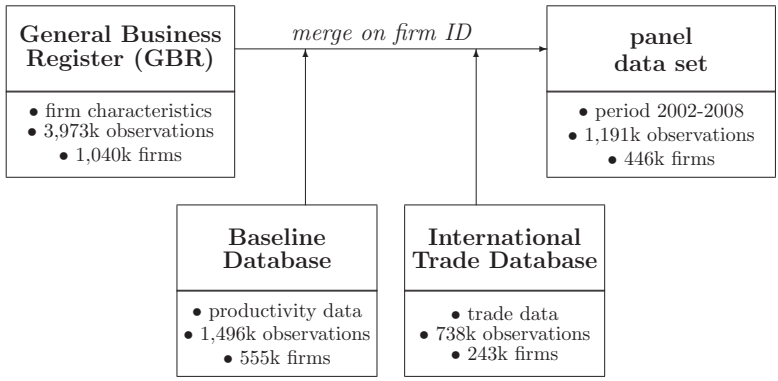

Figure 2. Graphical representation of the merging steps towards a panel data-set.

3. Data

For the empirical analysis we merge data from three main Dutch data sources: (i) the General Business Register (GBR), (ii) the Baseline Database, and (iii) the International Trade Database, all provided by Statistics Netherlands into a panel data-set covering the years 2002–2008.[2] The data from the three different sources are merged using a unique identification number which is assigned by Statistics Netherlands to each individual firm in the General Business Register. The merging procedure is graphically depicted in Figure 2. We focus the analysis in this paper on firms in manufacturing sectors and wholesale and retail trading sectors. This implies that typical service sectors are excluded.[3]

The GBR is, in principle, exhaustive in the sense that it contains information about every firm in the Netherlands, including a set of basic firm characteristics such as the number of employees in full-time equivalents, the sector in which the firm operates according to the internationally standardized ISIC Rev. 3.1 sector classification[4] and some general address information. 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. Corporate tax declarations are registered on Value Added Tax (VAT) numbers, which need to be connected to the business identification numbers used by Statistics Netherlands. This match is only allowed when the connection is absolutely certain. Since firm structures tend to get more complex with increasing firm size, the success rate of the matching procedure decreases accordingly. Moreover, the Baseline data cover income tax statements of entrepreneurs only since 2006, the years 2002–2005 contain only data from corporate tax declarations. This implies that the annual number of observations in the panel increases considerably from 2006 onwards and the average firm size in the panel drops once income tax information is included.[5] The information taken from the Baseline database 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.

We employ the data from tax declarations to calculate several different measures of productivity. Labor productivity (LP) is computed as value added per employee deflated using a sector-specific price index. We estimate total factor productivity (TFP) by employing the procedure proposed by Levinsohn and Petrin (2003), which is an extension of the basic Cobb-Douglas production function.[6] 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 employing 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, as in most cases, we observe input and output in value terms, except for labor input which is measured in full-time equivalents. Labor is preferably measured in quantities since firms without employees generally do not report positive labor costs. This implies that alternatively a remuneration to working owners would need to be imputed. Total factor productivity, A_{it}, is inevitably unobserved and needs to be estimated. In order to do so, we take the natural log of (1), which makes the production function to be estimated linear in its parameters.[7]

Trade data were taken from the International Trade database and includes information on all imports and exports of goods by Dutch firms.[8] Extra-EU trade is recorded by the Customs Authority. These data always include product information at the 8-digit Combined Nomenclature (CN) level and specification of origin and destination country. Intra-EU imports and exports are recorded by the Dutch Tax Authority. Firms with intra-EU import and/or export values larger than a total of 900,000 euro (threshold in 2009) are required to specify their trade transactions at the 8-digit level according to the CN and specify the origin and destination of trade through an additional questionnaire from Statistics Netherlands. Below this threshold firms only need to report the total import and export value of intra-EU trade. The trade data available at the firm level cover more than 80% of annual aggregate trade in terms of value in the Netherlands.[9] Finally, we also include import and export values according to the factor intensity of the goods traded, following Van Marrewijk (2002) and distinguishing between (i) primary products, (ii) natural-resource-intensive products, (iii) unskilled labor-intensive products, (iv) high-tech products, and (v) human capital- intensive products. The merging procedure results in an unbalanced panel data-set containing a total of 1.2 million observations of 446,000 manufacturing and wholesale and retail trading firms spanning a period of seven years (2002–2008).[10]

4. Main productivity characteristics

Before we turn to the main research question of this paper, investigating how the characteristics of imports in terms of geographic origin and factor intensity affect firm-level productivity, we start by establishing whether importers outperform non-traders in terms of productivity. After replicating this stylized fact we focus the rest of our empirical analysis solely on importers, taking as given that the average importer is more productive than the average non-trader.

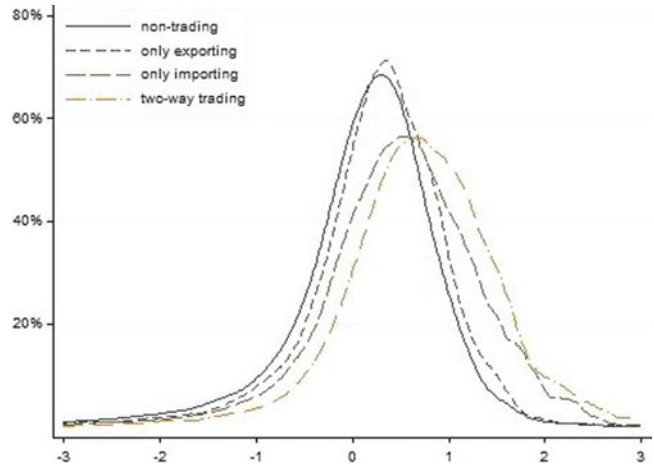

Figure 3. Firm-level productivity distribution by trade status (the Netherlands, 2002–2008).
Notes: Following Melitz and Trefler (2012), the horizontal axis represents firm-level log of total factor productivity (TFP) scaled by subtracting the annual median productivity of the firm's 2-digit sector. The vertical axis represents the density of firms at that particular productivity level, weighted by firm size in terms of employment.

The complete distribution of firm-level total factor productivity by trade status, for manufacturing firms and wholesale and retail trading firms pooled, is depicted in Figure 3.[11] The figure illustrates that the productivity distribution of non-traders is located left of the distributions of trading firms, followed by the productivity distributions of exporters, importers, and two-way traders in that order from left to right. 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, and two-way traders with each other.[12] The results of the two-sided tests for both total factor productivity and labor productivity are significant in all cases, indicating that the productivity distributions of the four groups of firms do indeed differ. This holds for both manufacturing sectors and wholesale and retail trading sectors.

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, we estimate the following empirical model:

$$\begin{aligned} ln(prod_{it}) = \alpha &+ \beta_1 importer_{it} + \beta_2 exporter_{it} + \beta_3 twowaytrader_{it} \\ &+ \beta_4 firmsize_{it} + \beta_5 foreigncontrolled_{it} \\ &+ \beta_6 year_t \times \beta_7 sector_{it} + \beta_8 region_{it} + e_{it} \end{aligned} \tag{2}$$

We estimate a pooled OLS-regression model with standard errors clustered at the firm-level employing the panel data concerning Dutch firms over the years 2002–2008.[13] In this model the subscript i identifies individual firms and t indexes the year. The dependent variable to be estimated ($ln(prod_{it})$) is either the natural log of total factor productivity, denoted by $lnTFP_{it}$, or the natural log of labor productivity, denoted by $lnLP_{it}$. Dummy variables regarding trade status, with non-trading firms as the reference group, are defined by $importer_{it}$, $exporter_{it}$, and $twowaytrader_{it}$.[14] We also include a series of control variables based on the preceding discussion; firm size in terms of employment

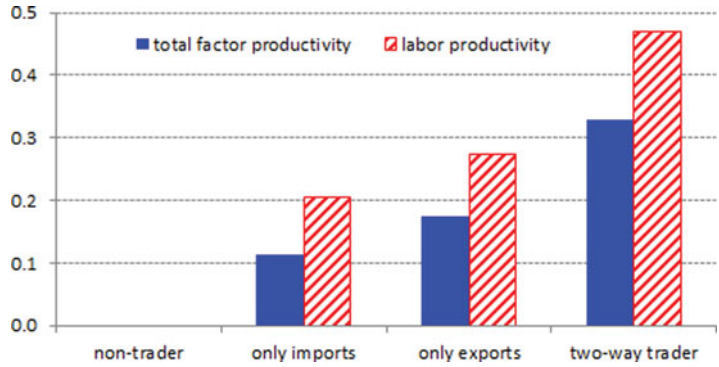

Figure 4. Firm trade type and productivity, estimated coefficients (the Netherlands, 2002–2008).
Note: All estimated trade premia are significant at the 0.1% level.

in fulltime equivalents ($firmsize_{it}$), a dummy variable indicating whether the firm is controlled by a company located abroad $foreigncontrolled_{it}$), and a full set of region ($region_{it}$) and interacted year ($year_t$) and 2-digit sector ($sector_{it}$) dummy variables.[15] The region dummies identify the 12 Dutch provinces.[16]

Figure 4 shows the estimation results of the baseline model using TFP and LP as productivity measures. The ranking of sole exporters and sole importers is reversed compared to the productivity distributions depicted in Figure 3, after controlling for additional firm characteristics. The trade premia are of considerable magnitude and statistically significant. In addition, the difference between the estimated coefficients of the distinguished trade statuses is statistically significant in the models including all firms and the two separate subsets by main sector. Only importing firms are an estimated 12% more productive in terms of TFP and 22.8% in terms of labor productivity.[17] Splitting the panel in typical manufacturing and wholesale and retail trading sectors (see Table A1 in the appendix) shows that the differences between both main sectors in terms of trade premia are limited, although the estimated premia are consistently lower in manufacturing sectors. In addition, we find a consistent productivity ordering for each subset, with non-traders being the least productive, followed by sole importers, sole exporters and two-way traders, in that order. The difference between the estimated coefficients of the distinguished trade statuses is statistically significant in the models including all firms and the separate subsets by main sector. This holds for for both total factor productivity and labor productivity. The coefficients of the control variables show the expected results.

5. Does geographic origin of imports matter?

Now we turn to the key part of the analysis; do the characteristics of imports relate to firm-level productivity? We confine the analysis in this and the next sections to the subset of observations for which the complete breakdown of imports along the relevant dimensions is available.[18] That is, we established in Section 4 that importers are on average more productive than non-traders. In the following sections we take this productivity premium of importers relative to non-traders as given and focus on productivity differences among importers.[19]

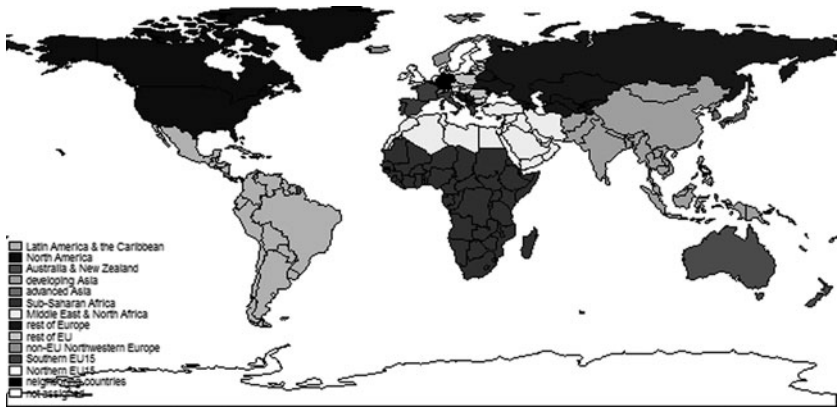

Figure 5. Regional aggregation of origin countries.

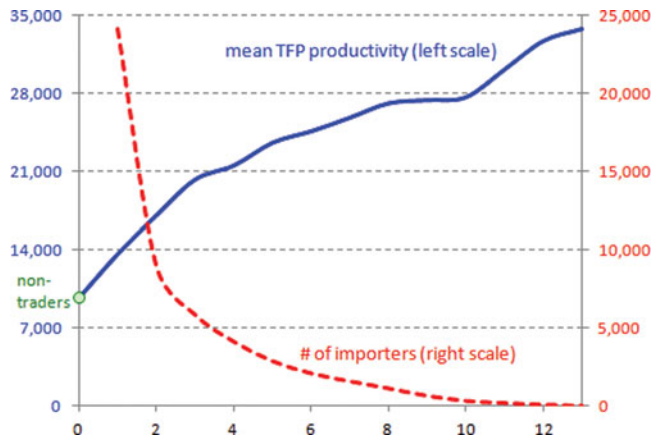

Figure 6. TFP and # of importers by # of geographic import markets.

To keep the analysis manageable we aggregate the import data by origin country into 13 mutually exclusive and exhaustive regions which are inspired by the geographic aggregation of countries by the World Bank; (1) neighboring countries to the Netherlands, (2) Northern EU-15, (3) Southern EU-15, (4) non-EU Northwestern Europe, (5) the rest of the EU, (6) the rest of Europe, (7) Middle East and North Africa, (8) sub-Sahara Africa, (9) developing Asia, (10) advanced Asia, (11) Australia and New Zealand, (12) North America, and (13) Latin America and the Caribbean (see Figure 5).[20]

Figure 6 shows that more than half of the firms (observations) for which the complete geographic composition of imports is available sources inputs internationally from more than one region. The number of observations monotonically decreases in the number of geographic import markets from 17% of the firms importing goods from two regions to 0.1% of the firms sourcing inputs from all (13) international regions. Figure 6 also shows that productivity increases in the number of geographic markets the firm imports from. The productivity pattern emerging points in the direction of the existence of fixed costs associated with importing from an additional geographic market. That is, not only import starters incur a fixed cost associated with the import start, but firms incur a fixed

cost for each additional geographic market as well, although generally at a decreasing rate. However, the fixed cost of an import start still seems to be higher than the fixed cost of adding a geographic market to the import portfolio, considering the fact that mean productivity of non-traders is well below that of single market importers.

The level of concentration of imports is generally high; 93% of the firms imports more than half of their goods exclusively from one region. This decreases to a still considerable 59% of the firms sourcing more than 95% of their imported goods from a single region. Moreover, concentration of imports is more persistent for regions far away than for regions nearby. In other words, firms importing goods from nearby are more likely to increase the number of regions they source goods from than firms importing from regions further away. This could be tied to the underlying product dimension of imports. In addition, it could indicate that distance is an important factor in the degree of concentration of imports. This suggests the existence of a stepping stone strategy regarding imports, where the firm starts importing from a country nearby and gradually expands its import activities to more distant markets in terms of both physical and cultural distance. This strategy regarding export market entry is well-documented, particularly regarding SMEs (see Creusen and Lejour 2011). This observation is consistent with the hypothesis that fixed costs of importing from regions at great distance are higher than those of sourcing imported goods nearby.

We include the import shares of each of the regions of origin separately in the baseline regression model. Along with the import shares we include a measure of geographic dispersion of imports, namely the log of the number of regions from which a firm imports, as an explanatory variable. This brings us to the following model to be estimated:

$$\begin{aligned} ln(prod_{it}) = \alpha + \sum_{g=1}^{13} \beta_g importshare_{git} + \beta_{14} dispersion_{it} \\ + \beta_{15} twowaytrader_{it} + \beta_{16} firmsize_{it} + \beta_{17} foreigncontrolled_{it} \\ + \beta_{18} year_t \times \beta_{19} sector_{it} + \beta_{20} region_{it} + e_{it} \end{aligned} \tag{3}$$

Each variable is defined in the same way as in equation (2).[21] In addition to subscripts i and t identifying firms, resp., years, subscript g identifies geographic regions running from 1 to 13. We choose North America, accounting for the most observations in terms of firms importing from a single geographic import market, to serve as the reference group consistently throughout the analysis. The variable $dispersion_{it}$ is the log of the number of regional markets the firm imports from.

The results of these regressions are presented in Figure 7 and Table 1. The impact of the 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 advanced regions, located relatively nearby for Dutch firms, and thereby increase productivity. But the fixed and variable 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. Note that cost advantages stemming from importing from low-wage countries do not necessarily translate into a productivity premium for the importing firm. Indeed, our productivity measure is expressed in value-added terms; a

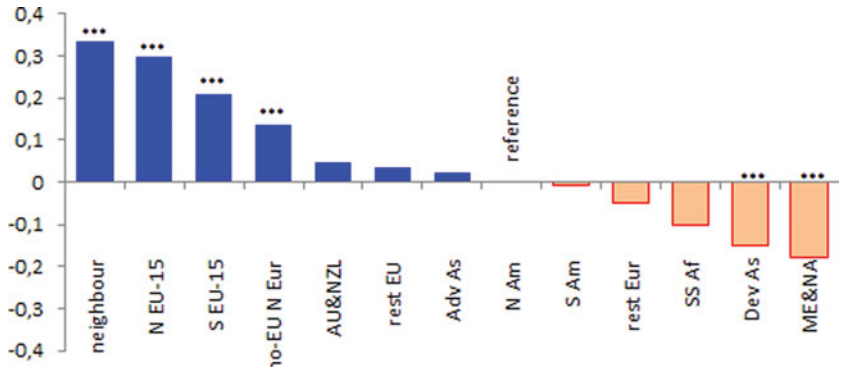

Figure 7. Estimated coefficients by geographic import market (Table 1, column 2).
Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

cost advantage on imports does not evidently translate into higher value added generated by the importing firm. In addition, low-cost imports might also be of lower quality translated into lower quality of the output of the importing firm.

The regression results point in the direction of both mechanisms playing a role. The results indicate that higher import shares from regions nearby are associated with higher firm-level productivity (Table 1, column 1). The estimated premia for imports from advanced regions nearby, neighboring countries, Northern and Southern EU-15, and non-EU Northwestern Europe are significantly positively correlated with firm-level productivity, relative to the reference region, which is North America. The differences between the premia estimated are considerable, with the premium of imports from Northern EU-15 being a good two times larger than the premium on imports from non-EU Northwestern Europe. In terms of distance, geographically, economically, culturally, and linguistically, these regions contain the group of countries closest to the Netherlands. The import share from advanced regions further away (Australia and New Zealand, the rest of the EU, and advanced Asia) returns relatively small or insignificant productivity premia relative to North America, as does the import share from the rest of Europe and Latin America & the Caribbean. The import share from typical developing regions, such as sub-Saharan Africa, developing Asia, and the Middle East and North Africa, is negatively and generally significantly tied to productivity relative to the baseline North America.

Furthermore, a consistent picture emerges regarding the relationship between the degree of dispersion of imports and firm-level productivity; productivity increases in the number of regional import markets on which the firm sources its inputs (column 2).[22] This finding seems in accordance with the theoretical argument stating that fixed costs of importing are market-specific, and each additional market added to the import portfolio implies incurring these fixed cost again. Controlling for the degree of geographic dispersion does not impact heavily upon the estimated premia for the separate regions.

The control variables included in the regressions are all significant and consistently show the hypothesized sign. The separate regressions for manufacturing and wholesale and retail trading sectors show that the estimated coefficients for import shares within the EU and Northwestern Europe are larger for wholesale and retail traders. Analogously, the productivity premium associated with a dispersed import portfolio in geographic

Table 1. Import origin, degree of dispersion, and total factor productivity (pooled OLS, 2002–2008).

	All firms		Manufacturing sectors		Wholesale and retail trading	
	(1)	(2)	(3)	(4)	(5)	(6)
Import shares by geographic region						
Neighboring countries	0.360***	0.336***	0.276***	0.254***	0.372***	0.346***
	(19.51)	(18.04)	(9.20)	(8.38)	(16.15)	(14.93)
Northern EU15	0.387***	0.297***	0.265***	0.204***	0.404***	0.297***
	(14.37)	(10.77)	(5.28)	(3.97)	(12.55)	(9.03)
Southern EU15	0.282***	0.208***	0.165**	0.0970	0.294***	0.212***
	(10.53)	(7.48)	(3.00)	(1.68)	(9.43)	(6.59)
Non-EU Northwestern Europe	0.128***	0.135***	0.0854**	0.0908**	0.148***	0.154***
	(5.42)	(5.74)	(2.77)	(2.96)	(4.44)	(4.61)
Australia and New Zealand	0.0524	0.0450	0.0717	0.0635	0.0369	0.0315
	(0.95)	(0.81)	(1.01)	(0.89)	(0.48)	(0.41)
Rest of EU	0.0517	0.0337	−0.0460	−0.0598	0.101*	0.0805
	(1.56)	(1.02)	(−0.89)	(−1.16)	(2.40)	(1.93)
Advanced Asia	0.0466	0.0236	0.0387	0.0275	0.0527	0.0222
	(1.86)	(0.94)	(1.08)	(0.76)	(1.60)	(0.67)
North America	reference	reference	reference	reference	reference	reference
Latin America and the Caribbean	0.00641	−0.00635	0.0858	0.0693	−0.0105	−0.0203
	(0.15)	(−0.15)	(1.45)	(1.17)	(−0.20)	(−0.38)
Rest of Europe	−0.0388	−0.0470	0.0374	0.0299	−0.0906	−0.0992
	(−0.85)	(−1.03)	(0.63)	(0.51)	(−1.40)	(−1.54)
Sub-Sahara Africa	−0.0946	−0.102	0.110	0.100	−0.170*	−0.174*
	(−1.77)	(−1.92)	(1.81)	(1.63)	(−2.43)	(−2.51)
Developing Asia	−0.140***	−0.149***	−0.0813**	−0.0896**	−0.151***	−0.159***
	(−7.51)	(−7.99)	(−2.85)	(−3.14)	(−6.39)	(−6.75)
Middle East and North Africa	−0.174***	−0.176***	−0.0870*	−0.0885*	−0.202***	−0.204***
	(−6.28)	(−6.34)	(−1.99)	(−2.02)	(−5.81)	(−5.86)
Degree of geographic dispersion of imports						
Number of regional markets (log)		0.102***		0.0668***		0.123***
Control variables						
Non-exporter	reference	reference	reference	reference	reference	reference
Exporter	0.208***	0.171***	0.162***	0.137***	0.230***	0.185***
	(18.25)	(14.51)	(8.47)	(6.91)	(16.60)	(12.98)
Domestically controlled	reference	reference	reference	reference	reference	reference
Foreign controlled	0.166***	0.162***	0.0710**	0.0549*	0.230***	0.240***
	(10.48)	(10.18)	(2.89)	(2.22)	(11.48)	(11.96)
Firm size (FTE, log)	0.195***	0.179***	0.182***	0.173***	0.206***	0.184***
	(47.56)	(41.39)	(27.59)	(24.84)	(39.32)	(33.61)
No. of observations	52,397	52,397	15,519	15,519	36,878	36,878
adj. R^2	0.265	0.269	0.278	0.280	0.262	0.266

Notes: All regressions include a full set of year-sector and region dummies.
Standard errors are clustered at the firm level. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

terms is higher for wholesale and retail trading than for manufacturing firms. This taken together it seems that the pattern of productivity premia by geographic origin is more pronounced for firms in wholesale and retail trading than for manufacturing firms.

Summing up, the empirical results presented in this section show that a geographically dispersed import portfolio is positively associated with firm-level productivity. Furthermore, productivity premia associated with imports by geographic origin decrease in

distance and increase in the level of development of the origin economy. It seems plausible that these findings are related to the theoretical argument stating that fixed cost of importing are market specific, and each additional market added to the import portfolio implies incurring these fixed costs again. However, productivity hinges positively on concentration of imports within the EU-15. A possible explanation for this phenomenon could be that firms highly focused on imports from nearby countries are an integrated element of a value chain, enabling them to incur efficiency gains particularly by being focused in terms of their import portfolio. Furthermore, a partial explanation for the lack of empirical support for the hypothesis that the fixed and variable costs of importing are higher for imports from regions far away or from 'difficult' regions could be provided by the nature of the products being imported from those regions. Imports from developing countries contain a relatively high fraction of final goods on average (possibly predestined for re-exporting), compared to imports from advanced countries (nearby) which contain a larger fraction of intermediate inputs.[23] This is in line with Miroudot, Lanz, and Ragoussis (2009) showing that the bulk of intermediate goods trade takes place between advanced countries. In addition, Miroudot, Lanz, and Ragoussis (2009) show that trade between advanced and developing regions is characterized to a larger extent by final goods trade. It makes sense intuitively to expect that the potential for incurring productivity and efficiency gains is larger for intermediate goods imports than for imports of final goods or goods predestined for re-exporting. Unfortunately, it is neither possible at this point to separate between intermediate and final goods imports nor to identify the fraction of imports predestined for re-exporting. However, decomposing imports in terms of the factor intensity embodied in the goods being imported might shed further light on this issue.

6. 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 the International Trade Center into five types of product, see Van Marrewijk (2002).

(i) Primary products, such as meat, dairy, cereals, fruit, coffee, sand, minerals, oil, natural gas, iron ore, and copper ore.
(ii) Natural-resource-intensive products, such as leather, cork, wood, lime, precious stones, pig iron, copper, aluminum, and lead.
(iii) Unskilled-labor-intensive products, such as various textiles, clothing, glass, pottery, ships, furniture, footwear, and office supplies.
(iv) Technology-intensive products, such as various chemicals, medicaments, plastics, engines, generators, machines, tools, pumps, telecommunications and photo equipment, optical equipment, and aircraft.
(v) Human-capital-intensive products, such as synthetic colors, pigments, perfumes, cosmetics, rubber and tires, tubes, various types of steel and iron, cutlery, televisions, radios, cars, watches, and jewelry.

The import shares of the types of goods with different factor intensities are included separately in the baseline regression model along with a measure of the degree of dispersion of imports, which is defined as the log of the number of product markets on

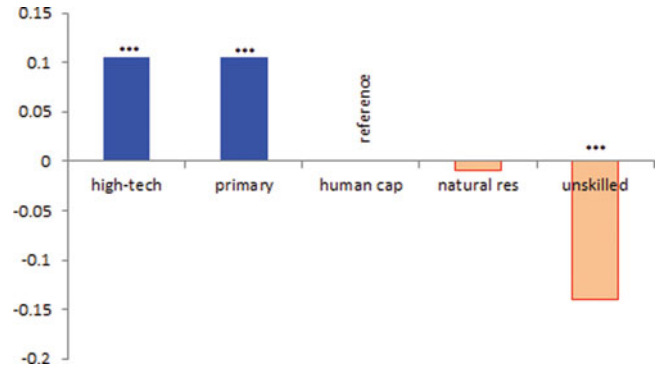

Figure 8. Estimated coefficients by intensity import market (Table 2, column 2).
Note: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

which the firm sources its inputs. Analogous to the procedure presented in Section 5 we estimate the following model with import shares of each of the product groups by factor intensity as the explanatory variables of interest:

$$\begin{aligned} ln(prod_{it}) = \alpha + \sum_{f=1}^{5} \beta_f importshare_{fit} + \beta_6 dispersion_{it} \\ + \beta_7 twowaytrader_{it} + \beta_8 firmsize_{it} + \beta_9 foreigncontrolled_{it} \\ + \beta_{10} year_t \times \beta_{11} sector_{it} + \beta_{12} region_{it} + e_{it} \end{aligned} \quad (4)$$

where subscript f identifies each of the five product classes, distinguished by their factor intensity and running from 1 to 5.

In terms of import shares, importing high-tech products and primary products shows to be most positively associated with firm-level productivity (Figure 8). With respect to technology-intensive products this makes sense intuitively, with the discussion of the mechanisms through which importing can raise productivity in mind (see Section 2). Following that same line of reasoning it is intuitively straightforward that importing mainly unskilled-labor-intensive products is negatively associated with firm-level productivity, which holds for both manufacturing and trading sectors. The significantly positive productivity premia for primary products relative to human-capital- intensive products is a more puzzling finding.

Note that the significantly positive association between productivity and primary and high-tech products is mainly on account of wholesale and retail trading sectors, for which the pattern of estimated premia is more pronounced again (Table 2). Natural-resource-intensive goods return an insignificant coefficient relative to the reference group, which contains human- capital-intensive imports. Manufacturing sectors show a considerable number of insignificant coefficients, which is due to the relatively low number of observations, particularly for specific product groups. Furthermore, firm-level productivity is positively associated with the number of international product markets on which the firm is active. Again, all control variables included are significant and return the expected sign.

Table 2. Factor intensity of imports and total factor productivity (pooled OLS, 2002–2008).

	All firms		Manufacturing sectors		Wholesale and retail trading	
	(1)	(2)	(3)	(4)	(5)	(6)
Import shares by factor intensity						
High-tech products	0.104***	0.105***	0.00330	0.00427	0.139***	0.140***
	(6.10)	(6.15)	(0.13)	(0.17)	(6.31)	(6.35)
Primary products	0.0978***	0.105***	0.0501	0.0481	0.111***	0.123***
	(4.10)	(4.40)	(1.21)	(1.16)	(3.95)	(4.35)
Natural-resource-intensive	0.000839	−0.00953	0.0725	0.0657	−0.0235	−0.0364
	(0.03)	(-0.28)	(1.53)	(1.38)	(-0.55)	(-0.84)
Human-capital-intensive	reference	reference	reference	reference	reference	reference
Unskilled-labor-intensive	−0.140***	−0.140***	−0.0995**	−0.102**	−0.136***	−0.135***
	(-7.14)	(-7.16)	(-2.95)	(-3.02)	(-5.80)	(-5.76)
Degree of dispersion of imports by factor intensity						
Number of product markets (log)		0.0538***		0.0351		0.0663***
		(4.45)		(1.78)		(4.51)
Control variables						
Non-exporter	reference	reference	reference	reference	reference	reference
Exporter	0.297***	0.288***	0.221***	0.213***	0.322***	0.313***
	(22.17)	(21.18)	(10.35)	(9.80)	(19.54)	(18.73)
Domestically controlled	reference	reference	reference	reference	reference	reference
Foreign controlled	0.255***	0.246***	0.125***	0.116***	0.319***	0.309***
	(12.14)	(11.63)	(3.93)	(3.63)	(11.95)	(11.59)
Firm size (FTE, log)	0.268***	0.264***	0.218***	0.216***	0.297***	0.292***
	(54.87)	(53.12)	(29.41)	(28.33)	(46.83)	(45.37)
No. of observations	31,814	31,814	9,430	9,430	22,384	22,384
adj. R^2	0.255	0.256	0.281	0.281	0.250	0.251

Notes: All regressions include a full set of year sector and region dummies.
Standard errors are clustered at the firm level. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

7. Interacting the geography and factor intensity of imports

The analysis in the previous sections marks the build up to our ultimate goal; interacting the geographic origin and factor intensity of imports and investigate how the two-dimensional characteristics of imports associate with firm-level productivity. The analysis in the previous sections has shown that both dimensions of imports separately relate to firm-level productivity, the question remaining is whether considering both dimensions simultaneously reveals additional heterogeneity in the relationship between importing and productivity.

In order to keep the analysis manageable, we further aggregate the trade data by geographic origin and factor intensity into 18 two-dimensional product-region combinations, which we will denote *geographic intensity markets*. The decisions regarding aggregation are based on the level of significance of the difference between coefficient estimates of the regressions including import shares by region and product type. The bilateral *p*-values, resulting from a series of *t*-tests on the equality of estimated coefficients obtained from the regressions presented in the second column of Tables 1 and 2, are depicted in Tables A2 and A3 in the appendix. The results indicate that importing primary products and high-tech products does not significantly differ in terms of its association with firm-level productivity. These product groups are thus aggregated into one group for the next step. The same holds for importing natural-resource-intensive products and

human-capital-intensive products. Regarding the geographic dimension of imports we reduce the number of regions by aggregation from 13 to 6. We pool together imports from neighboring countries and Northern EU-15. In addition, we also pool together other advanced countries (comprising of North America, advanced Asia and Australia & New Zealand) and developing countries (pooled over developing Asia, Middle East and North Africa, and sub-Sahara Africa). Finally, imports from the rest of the EU (outside the EU-15), the rest of Europe and Latin America and the Caribbean are taken together, forming a group we denote transition countries and South America. This procedure leaves us with $6 \times 3 = 18$ mutually exclusive and exhaustive geographic intensity markets, comprising of six regions and three product groups.

None of the firms in the panel sources inputs from all 18 geographic intensity markets; the largest number of markets on which a firm is active is 17. Productivity increases monotonously in the number of markets on which the firm sources its inputs. Comparable to the picture emerging from Figure 6 it seems that adding a second, third, and fourth geographic intensity market to the import portfolio is particularly associated with a productivity threshold, which points in the direction of the existence of fixed costs associated with importing from an additional geographic intensity market. The degree of concentration of imports in geographic intensity markets is high with 96% of the firms sourcing the majority of its imports on a single market. This decreases to a still considerable 63% of the firms importing more than 95% of its total import value exclusively from a single two-dimensional market.

Analogous to the proceedings in the previous sections we include the import shares of each of the 18 geographic intensity markets in the baseline regression model, in addition to the log of the number of two-dimensional import markets on which the firm is active, as a measure of import dispersion. This leads to the following regression model to be estimated:

$$\begin{aligned} ln(prod_{it}) = &+ \sum_{h=1}^{18} \beta_h importshare_{hit} + \beta_{19} dispersion_{it} \\ &+ \beta_{20} twowaytrader_{it} + \beta_{21} firmsize_{it} + \beta_{22} foreigncontrolled_{it} \\ &+ \beta_{23} year_t \times \beta_{24} sector_{it} + \beta_{25} region_{it} + e_{it} \end{aligned} \tag{5}$$

Subscript h identifies each of the geographic intensity markets running from 1 to 18. Each variable is defined in the same way as in equation (3). We choose to exclude the most prominent geographic intensity market to serve as the reference group, which is primary and high-tech imports from advanced countries outside Europe.

The result of these regressions is presented in Table 3, the significance of the bilateral differences between estimated productivity premia is presented in Table 4. In order to gain an understanding of the importance of including the interaction between geographic origin and factor intensity of imports we also present the regressions with both dimensions separately without interaction term. Comparing the results from the three separate regressions we see that controlling for both dimensions simultaneously is important, since the estimated premia for both dimensions separately show to be additive nor multiplicative. The geographic-intensity markets are largely unique and cannot be lumped together: no less than 114 out of 144 possible combinations (or 79% of all combinations) are statistically significantly different at the 10% level, while 107 (or 74%) are statistically significantly different at the 5% level.

Table 3. Import origin, factor intensity, degree of dispersion, and total factor productivity (pooled OLS, 2002–2008).

	(1)	(2)	(3)	(4)	(5)	(6)
Import shares by geographic import market						
Northern EU-15 (incl. neighboring countries)	0.422***			0.399***		
Southern EU-15	0.351***			0.290***		
Non-EU Northwestern Europe	0.128***			0.129***		
Transition countries & South America	0.0204			0.00771		
Other advanced countries	Reference			Reference		
Developing countries	−0.143***			−0.143***		
Import shares by intensity market						
High-tech and primary products		0.104***			0.107***	
Human-capital- and natural-resource-intensive		Reference			Reference	
Unskilled-labor-intensive		−0.129***			−0.130***	
Import shares by geographic intensity market						
Northern EU15 incl. neighboring countries						
High-tech & primary products			0.513***			0.493***
Human-capital- & natural-resource-intensive			0.474***			0.461***
Unskilled-labor-intensive			0.404***			0.382***
Southern EU15						
High-tech and primary products			0.448***			0.411***
Human-capital- and natural-resource-intensive			0.450***			0.402***
Unskilled-labor-intensive			0.297***			0.266***
Non-EU Northwestern Europe						
High-tech and primary products			0.233***			0.240***
Human-capital- and natural-resource-intensive			0.136**			0.141***
Unskilled-labor-intensive			0.118			0.123
Transition countries and South America						
High-tech and primary products			0.118*			0.111*
Human-capital- and natural-resource-intensive			0.117*			0.112*
Unskilled-labor-intensive			−0.0628			−0.0694
Other advanced countries						
High-tech and primary products			0.150***			0.150***
Human-capital- and natural-resource-intensive			Reference			Reference
Unskilled-labor-intensive			−0.145***			−0.152***
Developing countries						
High-tech and primary products			0.0147			0.0118
Human-capital- and natural-resource-intensive			−0.131***			−0.139***
Unskilled-labor-intensive			−0.153***			−0.155***
Degree of dispersion of imports						
Number of geographic markets (log)				0.101***		
Number of intensity markets (log)					0.0628***	
Number of geographic intensity markets (log)						0.0680***
Control variables						
Non-exporter	Reference	Reference	Reference	Reference	Reference	Reference
Exporter	0.204***	0.288***	0.193***	0.183***	0.280***	0.176***
Domestically controlled	Reference	Reference	Reference	Reference	Reference	Reference
Foreign controlled	0.223***	0.285***	0.218***	0.217***	0.276***	0.207***
Firm size (FTE, log)	0.225***	0.273***	0.223***	0.217***	0.269***	0.216***
No. of observations	29,878	29,878	29,878	29,878	29,878	29,878
adj. R^2	0.267	0.244	0.272	0.269	0.245	0.273

Notes: All regressions include a full set of year-sector and region dummies.
Standard errors are clustered at the firm-level. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Table 4. Overview of bilateral significance of geographic-intensity productivity premia (Table 3, column 6).

		A 1	A 2	A 3	B 1	B 2	B 3	C 1	C 2	C 3	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3
A	1	–																	
A	2	0.27	–																
A	3	0.01	0.06	–															
B	1	0.09	0.31	0.60	–														
B	2	0.10	0.33	0.75	0.90	–													
B	3	0.00	0.00	0.12	0.06	0.10	–												
C	1	0.00	0.00	0.00	0.00	0.01	0.72	–											
C	2	0.00	0.00	0.00	0.00	0.00	0.09	0.04	–										
C	3	0.00	0.00	0.00	0.00	0.00	0.11	0.09	0.81	–									
D	1	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.60	0.88	–								
D	2	0.00	0.00	0.00	0.00	0.00	0.05	0.02	0.61	0.88	0.99	–							
D	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	–						
E	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.04	0.04	0.15	–					
E	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	–				
E	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.62	–			
F	1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.82	0.67	0.39	0.42	0.00	0.00	0.00	0.00	–		
F	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.02	0.02	0.21	0.69	0.00	0.00	0.00	–	
F	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.74	0.96	0.00	0.00	–

Geography

A Northern EU-15
B Southern EU-15
C Non-EU Northwestern Europe
D Transition countries and South America
E Other advanced countries
F Developing countries

Intensity

1 High-technology-intensive and primary products
2 Human-capital-intensive and natural-resource-intensive products
3 Unskilled-labor-intensive products

Note: Values represent bilateral *p*-values obtained from regressions of firm-level productivity on import shares by geographic intensity market with varying baseline regions. Dark (light) shading indicates significantly different at 5% (10%).

Importing from the EU-15 in general is most positively associated with productivity at the firm level, with Northern EU-15 returning consistently larger coefficients than Southern EU-15. Relative to the reference group the coefficient for all three product groups are significantly positive, with the impact of primary and high-tech products being the largest, before, in that order, natural-resource-intensive and human-capital-intensive imports and unskilled labor-intensive imports. Compared to the reference group, imports from non-EU Northwestern Europe show a small, significant and positive productivity premium, except for unskilled labor-intensive products. The same holds for imports from transition countries and South America. The dispersion within imports from other advanced countries is considerable. With human capital and natural-resource-intensive imports representing the reference group we find high-tech and primary products returning a significant positive productivity premium and unskilled labor-intensive imports a significant negative premium. The estimated coefficients are negative and significant for human capital and natural-resource-intensive and unskilled labor-intensive imports from developing regions. In addition, the measure of dispersion of imports shows that productivity increases in the number of geographic-intensity markets on which the firm is active. Finally, the control variables perform well in the sense that they are all significant and show the expected sign.

The results thus indicate that the productivity premium of importing generally increases in the import share of nearby and advanced regions. Within regions, productivity decreases in the share of unskilled labor-intensive imports, although in relative terms, importing goods from this group from the nearby regions still correlates relatively positively with productivity. Intuitively, it seems plausible to expect that particular regions are specialized in producing particular product types. The general perception is that firms

importing unskilled-labor-intensive products would likely be better off importing these for example from China than from Germany. Yet, our results seem to imply that Germany is the best possible source country, even for unskilled-labor-intensive products. Although this might seem surprising at first, this relationship is of course endogenous; the only supply relationships between the Germany and the Netherlands that survived intensified supply by low-wage countries are the very best ones. Or, put differently, the only Dutch firms that can still afford to source unskilled-labor-intensive inputs from an advanced country like Germany are the very best.[24]

The separate regressions for manufacturing and wholesale and retail trading sectors (Table A4 in the appendix) show that the results regarding the full sample are mainly driven by wholesale and retail trading sectors, which we thus do not discuss separately. The separate regressions for manufacturing sectors yield relatively many insignificant coefficients, which is due to the small numbers of observations underlying some of the distinguished geographic intensity markets. Relative to the reference group, importing from Northern EU-15 shows significant productivity premia for all three product groups. In addition, importing primary and high-tech product from non-EU Northwestern Europe and human-capital and natural-resource- intensive products from Southern EU-15 are associated with a productivity premium. Unskilled-labor-intensive imports from developing countries yield a negative productivity premium.

The empirical evidence presented in this section shows that the use of the country of origin of imports as a proxy for the factor intensity of the imported goods is too general, since both the origin of imports, in terms of proximity and the level of development, and the factor intensity turn out to be associated with firm-level productivity, but not necessarily follow the same patterns. This shows that the relationship between importing and productivity is shaped simultaneously by all the dimensions of imports identified in Section 1, that is, distance, the level of development of the source country, and the type of product imported. As Keller (2004) argues, there is no such thing as a global pool of technology, since geography still turns out to play an important role in the diffusion of technologies, for which importing is proven to be a relevant vehicle. The empirical findings align with this argument. Illustrative for this is that high-tech imports from nearby EU-15 have a significantly more beneficial effect on productivity than do high-tech imports from advanced countries outside Europe like the US or Japan. Miroudot, Lanz, and Ragoussis (2009) present empirical evidence showing that trade flows of intermediate inputs are more sensitive to trade costs associated with, e.g. distance than is trade in final goods, while about half of world exports are intermediate goods (Brakman and van Marrewijk forthcoming(a), forthcoming(b)). This aligns with our findings showing that the productivity premium of importing is negatively correlated with distance, and provides preliminary evidence for the hypothesis that unskilled-labor-intensive imports and imports from developing regions contain a relatively large fraction of final goods, as opposed to imports from nearby economies which contain a larger fraction of intermediate inputs providing a more generous source for productivity gains.

8. Conclusion and discussion

Combining three comprehensive data-sets covering Dutch firms over the years 2002–2008 we investigate the relationship between imports and firm-level productivity. We start by confirming that the productivity ranking by trade status of Dutch firms in increasing order of productivity is: non-traders, importers, exporters, and two-way

traders, which is in line with the findings of earlier research regarding other advanced countries. Our analysis subsequently clearly distinguishes between the geographic dimension of the imports (where are the imports from), the goods dimension of the imports (what is imported), and the extensive dimension of the imports (from how many countries and product markets is being imported).

First, our empirical evidence shows that the use of the country of origin of imports as a proxy for the factor intensity, as is frequently done in the literature, is too general, since both the origin of imports and the factor intensity of imported goods turn out to be associated with firm-level productivity. The analysis shows that distance and the level of development of the origin economy are factors affecting the productivity premia associated with importing, indicating that geography still plays an important role in this process. Illustrative for this finding is that technology-intensive imports from nearby EU-15 countries are significantly more positively associated with firm-level productivity than are technology-intensive imports from advanced countries outside Europe, like the US or Japan. The observed premia patterns are comparable for manufacturing and wholesale and retail trading sectors, but are generally more pronounced in trading sectors.

Second, our findings show that productivity generally decreases in the share of unskilled-labor-intensive imports and rises in the share of technology-intensive and primary products. We also show that the geographic-intensity markets are largely unique and cannot be lumped together. We are now able to answer the question raised in the introduction to this paper whether, from a productivity point of view, it is better to import (a) textiles (unskilled-labor-intensive products) from Germany, (b) cutlery (human-capital-intensive products) from Italy, or (c) tools (technology-intensive products) from Tanzania? The point estimates in Table 3, column 6, provide the following order in terms of rising productivity: c – a – b, but note that the difference between a and b is not statistically significant (see Table 4).

Third, we show that dispersion, that is a diversified import portfolio in terms of the number of geographic intensity markets on which the firm is active, is positively associated with firm-level productivity. Our findings provide support for the theoretical argument that the fixed cost of importing are market-specific. Adding a new market, either in geographic terms or in terms of product type, to the import portfolio implies incurring this fixed cost again. Note that productivity depends positively on imports within the EU-15, irrespective of the type of product being imported. A possible explanation for this phenomenon is that firms highly focused on imports from nearby countries are an integrated element of a value chain, enabling them to incur efficiency gains. In addition, endogeneity of supply relationships might play a role in the sense that only the very best firms can afford to import, e.g. unskilled-labor-intensive product from advanced countries nearby.

The empirical evidence presented in this paper thus does not favor the hypothesis that the fixed and variable costs of importing are higher for imports from regions far away or from 'difficult' regions. The nature of the products being imported from these regions could provide an explanation for this, namely that imports from developing countries tend to contain a larger fraction of final goods, compared to imports from advanced countries which contain a larger fraction of intermediate inputs. The potential for incurring productivity and efficiency gains is thought to be larger for intermediate goods imports than for imports of final goods or goods predestined for re-exporting. This suggests that unskilled labor intensive imports contain a relatively large fraction of final goods. In addition, existing empirical evidence, suggesting that trade flows of

intermediate inputs are more sensitive to trade costs associated with e.g. distance than is trade in final goods, could explain the pattern of productivity premia observed in our analysis.

Some suggested avenues for further research follow naturally from the preceding discussion and mainly include deeper investigation of the impact of the characteristics of imports on firm-level productivity by accounting for additional dimensions of imports along the lines of capital goods, intermediate goods and final goods. The product classification in terms of broad economic categories (BEC) provided by the United Nations could provide a useful starting point to this purpose. In addition, the role of goods imports destined for re-exporting in the relationship between imports and productivity is not yet well understood. Finally, the direction of causality between importing and productivity also needs to be analyzed more closely along the different dimensions (geography, intensity, and dispersion). That is, self-selection into importing and potential productivity gains emanating from learning-by-importing could crucially hinge on the underlying characteristics of the imported goods.

Notes

1. Among others see Bernard et al. (2007), Muûls and Pisu (2009), Vogel and Wagner (2010), Hagemejer and Kolasa (2011).
2. For details regarding the merging procedure, see chapter 2 in Van den Berg (2014).
3. We choose *financial intermediation* as the cut-off point for service sectors, which corresponds to ISIC Rev. 3.1 section J, division 65. Manufacturing sectors correspond in the analysis to ISIC Rev. 3.1 sections A through I, excluding G. Wholesale and retail traders correspond to ISIC Rev. 3.1 section G and service sectors, defined as sections J to Q, are excluded from the analysis. The OECD and Eurostat recommend to define manufacturing as sections A through F and to include section G to Q in services. However, in terms of goods trade this division is less sensible, since a considerable part of goods trade takes place in trade and transport sectors it is therefore more appropriate to separate these sections from typical (financial and public) service sectors.
4. The ISIC Rev. 3.1 sector classification equals the SBI'93 2 digit classification employed by Statistics Netherlands.
5. This is reflected in an overrepresentation prior to 2006 and a small under-representation of large firms from 2006 onwards. The percentage of firms from the GRB in our full, merged panel, including service sectors, increases from about 12% to about 45% once information from income tax statements becomes available.
6. Van Beveren (2010) provides an excellent review of the available techniques for estimating TFP, the merits of each method and the econometric pitfalls associated with each method.
7. See chapter 2 in Van den Berg (2014) for further details regarding the estimation procedure.
8. The trade data also include intra-firm trade, which cannot be distinguished from inter-firm trade. Note also that apart from the import value we do not have information as to whether it concerns imports of capital goods, intermediate inputs, or final goods.
9. 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. In addition, since we only consider observations for which productivity information is available, the coverage of aggregate imports in our panel is roughly 20%–25%.
10. This is after eliminating micro firms (less than one full-time equivalent) and implausible observations with zero or negative output or exports exceeding gross output. See Van den Berg (2014) for details.
11. From this point onwards, the top and bottom 1% of the observations along the relevant productivity distribution are excluded, in order to eliminate implausible observations due to measurement errors, which we are unable to further investigate due to confidentiality considerations.
12. See Girma, Görg, and Strobl (2004) for a discussion of the Kolmogorov–Smirnov test.

13. In some studies in this strand of empirical literature, firm-fixed effects models are estimated next to pooled OLS models. However, the trade status of individual firms is generally relatively stable. The panel consists of approximately 446,000 unique firms of which about 47,000 switch import status during the observed period, corresponding to less than 11% of the population. 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, leading to biased estimates of the trade premia.
14. A firm is considered being an exporter, resp., importer in a particular year if it reports an export, resp., import value larger than zero in that year.
15. The dummy variable indicating whether a firm is ultimately controlled by a foreign company is not derived from the underlying ownership structure, it indicates whether the controlling entity is effectively located abroad.
16. The Dutch provinces align with the second level of regional aggregation of the Nomenclature of Units for Territorial Statistics (NUTS2) developed by the European Union.
17. Trade premia are calculated as $100(\exp(\beta) - 1)$.
18. Note that the number of observations included in the analysis varies with the import dimension under consideration, since we only include observations for which the complete breakdown of imports along the import dimension under consideration is available.
19. From this section onwards we only discuss empirical results using TFP as measure productivity, since the findings for labor productivity do not deviate to a noteworthy extent. The results using labor productivity as measure of productivity are available from the authors on request.
20. The geographic regions are described in detail in Table A2 in the appendix.
21. Note that the analysis only contains firms that import by definition, implying that non-traders and sole exporters do not need to be accounted for.
22. We also experimented with a Herfindahl-like measure of geographic concentration of imports. The findings corroborated the findings using the number of geographic markets as a measure of dispersion and are thus not reported separately for space considerations.
23. Illustrative in this respect are back-of-the-envelope calculations indicating that about 60% of Dutch imports from China are destined for re-exporting, while this fraction is estimated to be about 30% for imports from Belgium and Germany.
24. We thank an anonymous referee for pointing us to this interpretation of our findings.

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Appendix:

Table A1. Productivity premia of Dutch firms (pooled OLS, 2002–2008).

	Total factor productivity			Labor productivity		
	All firms	Manufacturing	Wholesale and retail trade	All firms	Manufacturing	Wholesale and retail trade
Trade dummies						
Non-trader	Reference	Reference	Reference	Reference	Reference	Reference
Only imports	0.113***	0.078***	0.135***	0.203***	0.166***	0.226***
	(31.19)	(14.96)	(28.19)	(49.70)	(28.41)	(41.74)
Only exports	0.174***	0.134***	0.213***	0.272***	0.226***	0.316***
	(26.43)	(15.40)	(22.28)	(36.93)	(23.38)	(29.68)
Two-way trader	0.330***	0.234***	0.372***	0.468***	0.348***	0.515***
	(72.59)	(34.94)	(62.27)	(92.04)	(46.37)	(77.10)
Control variables						
Domestically controlled	Reference	Reference	Reference	Reference	Reference	Reference
Foreign controlled	0.269***	0.150***	0.327***	0.232***	0.151***	0.247***
	(21.63)	(8.00)	(20.71)	(16.96)	(7.07)	(14.26)
Firm size (FTE, log)	0.275***	0.252***	0.313***	0.130***	0.091***	0.189***
	(225.87)	(167.92)	(152.17)	(93.08)	(53.69)	(79.55)
No. of observations	1,035,534	589,782	445,752	1,080,245	614,041	466,204
adj. R^2	0.192	0.213	0.176	0.108	0.114	0.109

Notes: All regressions include year-sector and region fixed effects. Standard errors are clustered at the firm level. *t*-Statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table A2. Regional aggregation of origin countries (description).

Region	Remarks
Neighboring countries	Germany and Belgium
Northern EU15	Luxembourg, United Kingdom, Ireland, Denmark, Finland, Sweden, Austria
Southern EU15	France, Greece, Italy, Portugal, and Spain
Non-EU Northwestern Europe	Norway, Switzerland, and Iceland,
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
Advanced Asia*	Japan, South Korea, Singapore, Hong Kong, Taiwan, Brunei Darussalam, and Macao
Developing Asia*	Asia and Pacific except advanced Asia
Australia and New Zealand	Except Pacific
North America	Includes United States and Canada
Latin America and the Caribbean	Includes Brazil and Mexico

*The advanced Asian countries are identified by GDP per capita levels of at least $ 25,000 (2008 PPP values in constant 2005$).

Table A3. Matrix of bilateral significance of estimated productivity premia by region (Table 1, column 2).

	Neigh. count.	North. EU-15	South. EU-15	non-EU N-W Eur.	Aus. & NZl	Adv. Asia	North Am.
Neighboring countries	–						
Northern EU-15	0.14	–					
Southern EU-15	0.00	0.01	–				
Non-EU Northwestern Europe	0.00	0.00	0.02	–			
Australia and New Zealand	0.00	0.00	0.01	0.12	–		
Advanced Asia	0.00	0.00	0.00	0.00	0.71	–	
North America	0.00	0.00	0.00	0.00	0.42	0.35	–
Latin America and the Caribbean	0.00	0.00	0.00	0.00	0.45	0.52	0.88
Rest of EU	0.00	0.00	0.00	0.01	0.85	0.78	0.31
Rest of Europe	0.00	0.00	0.00	0.00	0.18	0.15	0.30
Sub-Sahara Africa	0.00	0.00	0.00	0.00	0.05	0.02	0.06
Developing Asia	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Middle East and North Africa	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	Lat. Am. & Car.	Rest of EU	Rest of Eur.	Sub-Sah. Afr.	Dev. Asia	M-East & N. Afr.
Latin America and the Caribbean	–					
Rest of EU	0.43	–				
Rest of Europe	0.50	0.13	–			
Sub-Sahara Africa	0.15	0.02	0.41	–		
Developing Asia	0.00	0.00	0.03	0.38	–	
Middle East and North Africa	0.00	0.00	0.01	0.20	0.33	–

Notes: Values represent bilateral *p*-values obtained from regressions of firm-level productivity on import shares by region with varying baseline regions. The dashed lines identify the aggregation into six regions for the analysis in Section 7. Dark (light) shading indicates significantly different at 5% (10%).

Table A4. Matrix of bilateral significance of estimated productivity premia by factor intensity (Table 2, column 2).

	Primary products	High-tech products	Natural-resource-intensive	Human-capital-intensive	Unskilled-labor-intensive
Primary products	–				
High-tech products	0.98	–			
Natural resource intensive	0.00	0.00	–		
Human capital intensive	0.00	0.00	0.78	–	
Unskilled labor intensive	0.00	0.00	0.00	0.00	–

Notes: Values represent bilateral *p*-values obtained from regressions of firm-level productivity on import shares by product group with varying baseline products. The dashed lines identify the aggregation into three product groups for the analysis in Section 7. Dark (light) shading indicates significantly different at 5% (10%).

Table A5. Import origin, factor intensity, degree of dispersion, and total factor productivity (pooled OLS, 2002–2008).

	Manufacturing sectors			Wholesale and retail trading		
	(1)	(2)	(3)	(4)	(5)	(6)
Import shares by geographic import market						
Northern EU-15 (incl. neighboring countries)	0.255***			0.422***		
Southern EU-15	0.108			0.301***		
Non-EU Northwestern Europe	0.0773*			0.161***		
Transition countries & South America	0.0194			0.00630		
Other advanced countries	Reference			Reference		
Developing countries	−0.0710**			−0.159***		
Import shares by intensity market						
High-tech and primary products		0.000564			0.142***	
Human-capital- and natural-resource-intensive		Reference			Reference	
Unskilled-labor-intensive		−0.108**			−0.120***	
Import shares by geographic intensity market						
Northern EU-15 incl. neighboring countries						
High-tech and primary products			0.252***			0.539***
Human-capital- and natural-resource-intensive			0.314***			0.513***
Unskilled-labor-intensive			0.242*			0.403***
Southern EU-15						
High-tech and primary products			0.117			0.453***
Human-capital- and natural-resource-intensive			0.245*			0.434***
Unskilled-labor-intensive			−0.0539			0.294***
Non-EU Northwestern Europe						
High-tech & primary products			0.122**			0.309***
Human-capital- and natural-resource-intensive			0.0426			0.193***
Unskilled-labor-intensive			0.121			0.131
Transition countries & South America						
High-tech and primary products			0.0168			0.151*
Human-capital- and natural-resource-intensive			0.118			0.101
Unskilled-labor-intensive			−0.0847			−0.0441
Other advanced countries						
High-tech and primary products			0.0358			0.201***
Human-capital- and natural-resource-intensive			Reference			Reference
Unskilled-labor-intensive			−0.0395			−0.189***
Developing countries						
High-tech and primary products			−0.00435			0.0175
Human-capital- and natural-resource-intensive			−0.0556			−0.169***
Unskilled-labor-intensive			−0.138**			−0.133***
Degree of dispersion of imports						
Number of geographic markets (log)	0.0526*			0.125***		
Number of intensity markets (log)		0.0424			0.0767***	
Number of geographic intensity markets (log)			0.0272			0.0916***
Control variables						
Non-exporter	Reference	Reference	Reference	Reference	Reference	Reference
Exporter	0.151***	0.207***	0.152***	0.200***	0.304***	0.188***
Domestically controlled	Reference	Reference	Reference	Reference	Reference	Reference
Foreign controlled	0.124***	0.143***	0.127***	0.271***	0.341***	0.253***
Firm size (FTE, log)	0.201***	0.222***	0.202***	0.230***	0.297***	0.227***
No. of observations	8,869	8,869	8,869	21,009	21,009	21,009
adj. R^2	0.283	0.274	0.284	0.265	0.238	0.271

Notes: All regressions include a full set of year-sector and region dummies.
Standard errors are clustered at the firm level. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.