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## **Export, FDI and Firm Productivity**

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Many empirical papers tested the theoretical predictions of Helpman, Melitz and Yeaple (HMY, 2004) which sorts firms at different internationalization states according to their productivity levels. While these papers ignore the fact, that theoretical predictions of HMY only apply to firms that become engaged in market-driven foreign direct investment (FDI), we apply a more precise methodology using a French firm sample with more than 110 000 observations. Our results show that firms with a broader investment strategy, reflecting a great importance of market-driven motives, show higher productivity levels than firms with less encompassing foreign investment strategies. We conclude that the methodology is well-suited to sort firms according to the importance of market-driven FDI.

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## **I. Introduction**

The conditions under which some firms in the same industry become exporters and others conduct outward FDI have received considerable interest in the theoretical and empirical literature. It is widely recognized that the mode chosen for serving foreign markets depends on the relative size of trading and sunk costs. A firm choosing to export benefits from the concentration of production and can therefore exploit economies of scale but it has to pay trade costs. If the firm is deciding to become a multinational instead, then it can produce closer to each market but has to pay higher sunk and fixed costs, since production capabilities have to be duplicated. Addressing this trade-off, Helpman, Melitz and Yeaple (HMY, 2004) advocate that the mode chosen by firms reflects their productivity level: Only the most productive firms become multinational enterprises (MNEs), whereas firms with intermediate productivity enter foreign markets via exports. The least productive companies produce for the domestic market only. A number of empirical tests on the comparison of productivity differences between MNEs, exporters and domestic firms have been carried out in recent years (see Greenaway and Kneller, 2007). Independent from differences in sample size and measurement issues all empirical studies show that MNEs are the most productive firms (see Table A-1 in the Appendix).

Most existing studies suffer from three major methodological shortcomings. First, all studies provide evidence for manufacturing firms only. It is yet unclear, how robust these patterns are across business sectors. By using a rich panel of up to 110 000 French enterprises from all business sectors, including a large range of manufacturing and service sectors, we address this issue. Second, being precise, the theoretical predictions of HMY only apply to firms that become engaged in market-driven (horizontal) FDI, which refers to horizontal production structures of MNEs that replicate the same

product, service or process in another country. Hence, in order to derive a valid empirical test of the HMY model one needs to differentiate between market-driven (horizontal) and resource-driven (vertical) FDI. Previous studies persistently stress the different motives for FDI, but not many scholars have empirically differentiated between them. One reason could be that motives for FDI are usually mixed (see e.g. Yeaple, 2003) and hard to disentangle empirically. Third and finally, any empirical test of the HMY hypothesis might be biased if information about firm productivity in the pre-entry period (i.e. before becoming engaged in FDI) is not available and if the post-entry change in productivity might matter to a large extent. In this paper we tackle both measurement issues and thus, we are able to enhance the precision of an empirical test of the HMY hypothesis.

Keeping data limitations on the firm level in mind, the literature suggests two approaches in order to classify firms' foreign investments into resource-driven and market-driven FDI. The first approach, the so-called *host country approach*, was theoretically developed by Head and Ries (2003). Here, low-productivity firms may gain more from resource-driven motives than highly productive firms. The former typically enters only low-wage but not high-wage countries via FDI whereas firms with market-driven motives are highly productive, entering both, low-wage and high-wage countries. Head and Ries (2003) observe that more productive Japanese MNEs seem to invest to a larger extent in high-wage countries than less productive Japanese MNEs.

The second approach, called *simple NACE approach*<sup>1</sup>, was recently applied by Alfaro and Carlton (2009) to analyse the FDI pattern between high-wage countries in more detail. A similar industry affiliation of the parent company and its subsidiary is usually assumed to fulfil the condition for market-driven FDI, while vertical subsidiaries are

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<sup>1</sup> The NACE (Nomenclature générale des Activités dans les Communautés Européennes) classification is the statistical industrial code for economic activities in the European Union.

active in industries that are upstream (or downstream) from their parent's industry. Applying the simple NACE approach in the context of the HMY hypothesis provides additional insights with respect to the accuracy of the NACE approach to distinguish between market-driven and resource-driven FDI.<sup>2</sup> Thus, our analysis has a practical implication for researchers.

The rest of the chapter is organized as follows. Section II presents the dataset. In Section III the empirical findings for the productivity ranking of French companies according to their mode of internationalization are presented and discussed. Section IV concludes.

## **II. Data**

The analysis in this paper is restricted to French companies and their international status in the years 2002, 2004 and 2005. Three AMADEUS updates (113, 136 and 146) are used to record the FDI status in the respective years which allows to build a repeated cross-section dataset. While our analysis mainly based on firm records in 2004 information for 2002 and 2005 are considered to check the robustness of our findings.<sup>3</sup> All firms in a given year are classified into one of three groups depending on their export and FDI status. Domestically oriented companies (D) neither export nor hold any foreign investment assets; domestic exporters (DX) export but do not undertake FDI; and multinational enterprises (DI) engage in foreign direct investments.<sup>4</sup> Of course, the majority of multinationals in the DI group is also engaged in export activities. According to the OECD (2008) foreign investment is defined as being direct if a non-

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<sup>2</sup> Alfaro and Charlton (2009) were the first in applying this approach to analyse the FDI pattern between high-wage countries in more detail.

<sup>3</sup> Each AMADEUS update allows to observe the internationalization status of companies for the year in which the update was released. Unfortunately, the status in 2003 is not known as no AMADEUS update from this year is available to the authors.

<sup>4</sup> Abbreviations for the D, DX and DI group follow closely the cited literature.

resident investor holds 10% or more of the equity of a resident enterprise. These direct investment enterprises will be classified as DI type. An ownership share of at least 10% ascertains an effective voice in the management of the company, implying that the investor is able to decisively influence its course.

We restrict the data to companies that have a complete record on key economic indicators like employees, turnover, intangible assets and material costs. Furthermore, the dataset has been purged from outliers in turnover, material cost, employment cost, intangible and tangible fixed assets by dropping observations belonging to the upper and lower 1<sup>st</sup> percentile of the entire distribution for any variable. In sum, 435 871 French companies have a complete record for the year 2004 (see Table 1). Moreover, the AMADEUS database allows to identify the host country of foreign subsidiaries and their type of business via the industry affiliation (NACE code). Based on this information we are able to improve the methodology for empirical tests of the HMY hypothesis.

The availability of a large dataset allows to differentiate between major industry sectors. Six industry groups have been defined in order to guarantee a minimum of 50 observations per industry for each internationalization status. A short overview of the descriptive statistics is given in Table 1. A general observation is that domestically oriented companies (D) constitute always the largest group followed by exporters (DX) and multinational companies (DI). Moreover, exporters (DX) are usually older, have more employees and a higher turnover than domestic companies (D). In turn, the average multinational company (DI) is bigger and older than the average exporter.

**< Table 1 around here >**

### III. Empirical findings

#### *Measurement Issues*

The methodological standard for testing the HMY self-sorting hypothesis is the Kolmogorov-Smirnov (KS) test (Kolmogorov, 1933 and Smirnov, 1939) which is based on the concept of stochastic dominance of one distribution over another. In contrast to the mean and median comparison which only evaluates a single moment of the distribution, the KS test exploits the characteristics of the entire productivity distribution. Two- and one-sided KS tests are carried out to test for the stochastic dominance of two cumulative distributions  $S_N$  and  $S_M$ . For  $S_N$  to be stochastically dominated by  $S_M$ , one must reject the null hypothesis of the two-sided KS test on the equality of distributions and fail to reject the null hypothesis of the one-sided KS test on lower values of  $S_M$ . Stochastic dominance of alternative  $M$  over alternative  $N$  implies graphically that the cumulative distribution  $S_M$  is situated to the right of  $S_N$  and thus, the difference between  $S_M$  and  $S_N$  for a specific firm  $i$  is negative (see Figure 1). The KS test only allows to compare two distributions at a time. Therefore, in a first step domestic-oriented companies (D) are compared to exporters (DX) and in a second step exporters (DX) are compared to multinational companies (DI). In case that DX stochastically dominates D and DI stochastically dominates DX, then DI also dominates D due to transitivity.

In this paper two broad types of productivity measurement are taken into account. The simplest and most frequently encountered single-factor measure is labour productivity which measures output per worker. In contrast, total factor productivity (TFP) relates output to combined inputs of labour, capital and intermediate goods (e.g. materials, energy and services) and thus, TFP is not affected by changes in the ratio of capital to labour or the ratio of intermediate goods to labour. However, TFP has higher data

requirements on capital and intermediate goods (see Levinsohn and Petrin, 2003 for further explanations).

*KS tests based on the traditional approach*

The findings for entire sample as well as for selected industries in 2004 are depicted in Table 2. Starting with the entire sample ('All industries'), the null hypothesis of the equality of distribution can be rejected in all years whereas the one-sided tests do not lead to the rejection of the corresponding null hypothesis at the conventional significance levels. This implies that the HMY ranking  $D \prec DX \prec DI$  is confirmed, since the confluence of these two test results indicates stochastic dominance. Figure 1 gives a graphical illustration of the cumulative density function of TFP for D, DX and DI for the year 2004.

**< Figure 1 around here >**

**< Table 2 around here >**

The two-sided and one-sided KS tests also confirm the productivity ranking of  $D \prec DX \prec DI$  for five of six industry groups. Only the construction industry does not exhibit any clear productivity pattern between domestic-oriented companies, exporters and MNEs. The two-sided KS test regarding the equality of distribution between DX and DI and both one-sided tests between nationals and exporters (i.e. testing  $D \prec DX$  and  $DX \prec D$ ) do not lead to the null hypothesis being rejected. Three considerations might help to explain these results. First, the relevance of resource-driven FDI might be higher in the construction sector than in other industries. Following from that and the theoretical model of Head and Ries (2003), more low productive construction firms



have been engaged in FDI. Second, the construction and building market is dominated by local players (Handelsblatt, 2007, p. 12). Thus, local presence in markets is of utmost importance for both low productive and high productive firms. Third and finally, temporally project-oriented co-operations with the involvement of a large number of consortium partners are quite common in the construction industry. Here, sunk costs of FDI might be comparatively low so that the difference between exporters and multinational becomes negligible.

*Permanent differences in the productivity ranking between MNEs and exporters*

In the Introduction we argued that the productivity difference between MNEs and exporters can be driven by both, differences in the pre-entry level of productivity and the post-entry change in productivity of firms that become engaged in FDI based on feedback and learning effects. One way to detect the existence of both effects is to compare the productivity path of exporters that actually become engaged in FDI (infant MNEs) to continuous exporters and to firms with a long experience in investing abroad (continuous or incumbent MNEs).

**< Table 3 around here >**

Table 3 presents the mean TFP of firms that are continuous domestic companies (D–D), continuous exporters (DX–DX) and continuous MNEs (DI–DI) across the observed time period and of exporters that become engaged in FDI (DX–DI) i.e. these infant MNEs switch the internationalization status between 2004 and 2005. The findings suggest that infant MNEs already have a much higher productivity in the years before the change compared to continuous exporters which can be calculated by the pre-entry TFP difference between infant MNEs and continuous exporters that do not invest

abroad. In contrast, the post-entry change in the productivity is calculated by the TFP difference between incumbent MNEs and infant MNEs. Based on this calculation we observe that the pre-entry TFP difference is approximately 0.68 whereas the post-entry TFP change amounts only to about 0.10 in the year 2002 and 2004. Maybe, infant MNEs close the productivity gap in the long term and thus, we cannot exclude that feedback and learning effects may matter for home plants of MNEs. These effects do not seem to play the major role in explaining the productivity ranking between MNEs and exporters, however. This finding is clearly in line with results of Girma *et al.* (2007). The authors detect that differences in productivity amongst groups of firms are rather permanent with no significant differences in the growth rates.

#### *KS tests based on qualified approaches*

While we reject the KS test for the construction sector, it is probable that the missing information on firm level about the relevance of market-driven and resource-driven motives for going abroad might matter. Firm-specific information on the imports of intermediate goods and the internationalization strategy constitute the best solution to distinguish between market-driven and resource-driven FDI. However, with the exception of Görg *et al.* (2008)<sup>5</sup>, this kind of information is usually not available at the firm level. Subsequently, assumptions and approximations are needed to improve the empirical tests of the HMY model.

Following the *host country approach* by Head and Ries (2003) firms with FDI in both, low- and high-wage countries ( $DI_{LoHi}$ ) are assumed to have the highest productivity followed by firms that only invest in low-wage countries ( $DI_{Low}$ ). The main reason behind this ranking is the fact that firms in the  $DI_{LoHi}$  group are characterised by a much

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<sup>5</sup> He used information from the Irish Economy Expenditure Survey to focus on the level of international outsourcing at the firm level, defined as the ratio of imported materials over total wages, and the ratio of imported service inputs over total wages. The higher the ratio the larger will be the incentive for resource-driven FDI.

broader investment strategy, reflecting an outstanding relevance of market-driven FDI with their presence in many different countries. In this paper and in line with Barba Navaretti (2010) we classify the 25 high-income OECD members (World Bank, 2008) as high-wage countries, whereas the remaining ones form the group of low-wage countries. In order to compare all FDI types we also consider MNEs that invest only in high-wage countries ( $DI_{High}$ ). No theoretical predictions exist with respect to the productivity level of the latter. On the one hand, one may expect a higher market potential in well-developed countries compared to less-developed ones. On the other hand, Konings and Murphey (2006) detect significant employment substitution effects between affiliates of European MNEs in the north of the European Union and its parent firms. However, they do not find employment substitution effects between parent firms and their affiliates in low-wage southern regions of the European Union nor in Central and Eastern Europe. These empirical findings demonstrate that high-wage countries are also target countries for resource-driven FDI. In line with this conclusion, Alfaro and Charlton (2009) detect substantial vertical FDI within developed countries.

Table 4 lists the total number of observations in the respective FDI groups. Compared to the initial sample size of 2493 we lost 25 observations due to missing information on the host country. While productivity ranking between alternatives DX and DI is characterized by permanent differences in productivity levels (as discussed in the previous section), we can group together new (infant) and incumbent MNEs. In fact, firms in the  $DI_{LoHi}$  group have on average 8.8 subsidiaries in 6.4 different countries (approx. 60% in high-cost and 40% in low cost countries) whereas firms in the  $DI_{Low}$  group have on average only 1.3 subsidiaries across 1.2 low-cost countries. From an empirical point of view, the former is actually characterised by a much broader investment strategy with the presence in many different countries compared to firms in the two remaining FDI groups.

< Table 4 around here >

The KS test results for the TFP comparison of the three FDI types are reported in Table 5. The major finding is that MNEs with a broader investment strategy ( $DI_{LoHi}$ ) seem to exhibit a higher productivity than either of the remaining two groups of MNEs. This finding is clearly in line with Head and Ries (2003) who predict that the most productive firms invest in a wider range of countries, whereas less productive firms invest either in low- or high-wage countries. Controlling for the actual number of affiliates does not fundamentally alter the KS test results in our study. Even though not reported here, further KS tests show that all three groups of MNEs statistically dominate exporting firms with respect to TFP.

< Table 5 around here >

The null hypothesis on the equality of distributions between firms engaged only in low-wage countries and firms engaged only in high-wage countries cannot be rejected. In this case no stochastic dominance ordering with respect to TFP can be established. This finding might be driven by the fact that high-wage countries are also targets of substantial vertical FDI. In sum, the findings suggest the following TFP ranking for exporters and the three FDI types:  $DX \prec DI_{Low} \approx DI_{High} \prec DI_{LoHi}$ .

Following from that any other methodology is applicable if ex-ante classified firms with market-driven FDI outperform remaining firms with respect to total factor productivity.

By following Alfaro and Charlton (2009) we want to explore a second methodology in order to capture the heterogeneity of FDI activities. Alfaro and Charlton use the 2 and 4-digit SIC industry code, called *simple NACE-approach* to distinguish between

horizontal and vertical FDI. They classify horizontal subsidiaries as plants that have the same industry code as their parents, while vertical subsidiaries are active in industries that are upstream from their parent's industry. Taking the 'same industry' should fulfil the condition for horizontal (market-driven) FDI, i.e. implying horizontal production structures that usually occur when MNEs replicate the same product, service or process in another country.

We classify French MNEs similar to Alfaro and Charlton (2009) based on the NACE 2-digit industry code. In addition, subsidiaries from the wholesale and retail sector (NACE 2-digit code 50, 51 and 52) often act as a commercial agency for the mother company, so that a comparatively strong market-driven orientation could be assumed. Along similar lines, Krautheim (2009) introduces an extension of the HMY model by introducing 'export-supporting FDI' which is proxied by manufacturing firms that own wholesale and retail affiliates.<sup>6</sup>

The group defined as 'different' comprises MNEs for which none of the subsidiaries has the same industry code as the mother company<sup>7</sup> and none of the subsidiaries is a trading company. The latter group is expected to be comparatively less market-driven because of a more diverse firm network, as captured by the different NACE codes which might signal a higher vertical value-chain integration and which in turn allows to exploit cost advantages. Finally, MNEs with subsidiaries in 'same and different' industries are characterised by a large industrial footprint. From our point of view, however, the information is not sufficient to evaluate whether the latter are more or less market-driven than MNEs with foreign subsidiaries in the 'same' industry only. Table 6 reports

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<sup>6</sup> His model predicts that the most productive firms choose horizontal FDI, followed by export-supporting FDI and classic exporting.

<sup>7</sup> A different industry code for the mother company and the subsidiary usually implies that the subsidiary is active in an upstream or downstream industry (within the production and value chain) with respect to the industry of the mother company.

the number of observations for the NACE approach. Due to a large number of missing NACE codes, the sample size is much lower than the host country sample.

< Table 6 around here >

The KS test results for the simple NACE approach are presented in Table 7. The two-sided test regarding the equality of distributions indicates no significant productivity differences between MNEs that have subsidiaries solely in the ‘same’ or ‘different’ industries.<sup>8</sup> Assuming that firms with market-driven FDI are more productive than firms with resource-driven FDI, the finding does not confirm the hypothesis that MNEs with subsidiaries being active in same industries are more likely to follow market-driven motives than other firms investing abroad. This finding clearly contradicts the view that the ‘same’ industry affiliation for the parent firm and subsidiary is a suitable proxy to distinguish between resource-driven and market-driven FDI.

In contrast, MNEs that have subsidiaries in the ‘same and different’ industry sectors ( $DI_{SaDi}$ ) stochastically dominate any other group according to the NACE classification. This finding is robust when controlling for the actual number of foreign affiliates. A broad industrial network could signal higher organisational and managerial capabilities and economies of scope implying advantages to gain market shares in foreign markets. We then suggest to classify firms with a broad industrial network as firms with an outstanding relevance of market-driven FDI, called *modified NACE approach*.

< Table 7 around here >

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<sup>8</sup> A more detailed typology based on the NACE 4-digit level may reduce the problem of mis-classification (see Alfaro and Charlton, 2009 for empirical findings). Overall, taking the NACE 4-digit level instead of the NACE 2-digit level results in very similar findings.

Clearly, no approach can fully substitute the need for precise information about FDI motives at the firm level, but given our type of data, the host country approach and the modified NACE approach which take complex investment strategies into account constitute a good approximation to differentiate between various types of FDI.

#### **IV. Conclusion**

In this paper we investigated the ‘self-sorting hypothesis’ of the Helpman, Melitz and Yeaple (HMY) model based on a large panel data set of 110 000 French firms. In line with many other studies, the productivity ranking as postulated by the HMY model is confirmed for the French sample with MNEs exhibiting the highest productivity level followed by exporters and domestic-oriented companies, respectively. With the exception of the construction industry, the results are endorsed for five major industry sectors. We further detect that the productivity ranking is mostly characterized by permanent productivity differences across the various groups of internationalized firms. Since the HMY model is only valid for market-driven FDI, we applied the so-called *host country approach* suggested by Head and Ries (2003) to obtain more accurate empirical test results. In line with the theoretical predictions of Head and Ries (2003) we detect that firms with broader investment strategy, reflecting greater importance of market-driven motives, are more productive than MNEs with investments in low-wage countries only. We further observe that MNEs with investments in high-wage countries do not outperform MNEs with investments in low-wage countries. This evidence is in line with recent findings of Konings and Murphey (2006) and Alfaro and Charlton (2009) suggesting that high-wage countries are also targets of substantial vertical FDI. Furthermore, we made an alternative attempt to distinguish between resource-driven and market-driven FDI by comparing the industry codes of the mother companies and

their subsidiaries in the so-called *simple NACE approach*. In fact, the simple NACE approach, applied so far in the literature, does not work very well. However, we are able to detect the expected productivity ranking when firms are re-classified according to our *modified NACE approach* which accounts for more complex investment strategies.

In sum, both, the host country approach and the modified NACE approach seem to constitute an appropriate methodology to classify MNEs according to the underlying market and resource motives for investing abroad even if information about FDI motives, imports and intermediate goods are not available. Both approaches can be applied to relevant research questions, e.g. analyzing the effects of market-driven and resource-driven FDI on firm performance or employment.

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## Appendix

**Table A-1: Productivity ranking in empirical studies on the internationalization of firms**

Author(s)	Data source	Data description	Method	Results
Arnold and Hussinger (2006)	Micro Database Direct Investment (MiDi) from the German Bundesbank	Germany, manufacturing firms with more than 5 employees, 1996-2002, 60-115 firms engaged in FDI.	KS test; TFP	$D \prec DX \prec DI$
Castellani and Zanfei (2007)	Second Community Innovation survey (CIS), ELIOS (European Linkages and Ownership Structure) based on 'Who owns Whom' and 'Amadeus'	Italy, manufacturing firms, 1994-1996, 164 MNEs which control only non-manufacturing firms abroad and 123 MNEs which control at least one foreign manufacturing firm.	OLS with dummy variables; TFP	$D \approx DX \prec DI$
Girma <i>et al.</i> (2004)	ABSEI (Annual Business Survey of Economic Impact)	Ireland, manufacturing firms with more than 10 employees, 2004, 246 firms engaged in FDI.	KS test; Turnover, value added, profit per employee	$D \approx DX \prec DI$
Girma <i>et al.</i> (2005)	OneSource, 'Who owns Whom' and 'Acquisition Monthly' for 1996	UK, manufacturing firms (public limited companies) with more than 50 employees, 1990-1996, 116-185 firms engaged in FDI.	KS test; TFP	$D \prec DX \prec DI$
Head and Ries (2003)	Stock market data, overseas affiliates based on another survey conducted in 1991	Japan, 1,070 manufacturing firms (publicly listed), 459 firms engaged in export and FDI and further 44 firms engaged in FDI but without export activity.	Mean test and OLS; TFP and other measures	$D \prec DX \prec DI$
Kimura and Kiyota (2006)	Kigyō Katsudō Kihon Chōsa Houkokusho (survey data)	Japan, manufacturing firms with more than 50 employees and at least ¥30 million in capital, 1994 and 2000, 2,765 firms engaged in FDI.	OLS with dummy variables; TFP	$D \approx DX \prec DI$
Wagner (2006)	Hannover Firm Panel (HFP), personnel interviews for random sample	Lower Saxony (Germany), manufacturing firms with more than 5 employees, 1995, 70 firms engaged in FDI.	KS test; value-added per worker	$D \prec DX \prec DI$

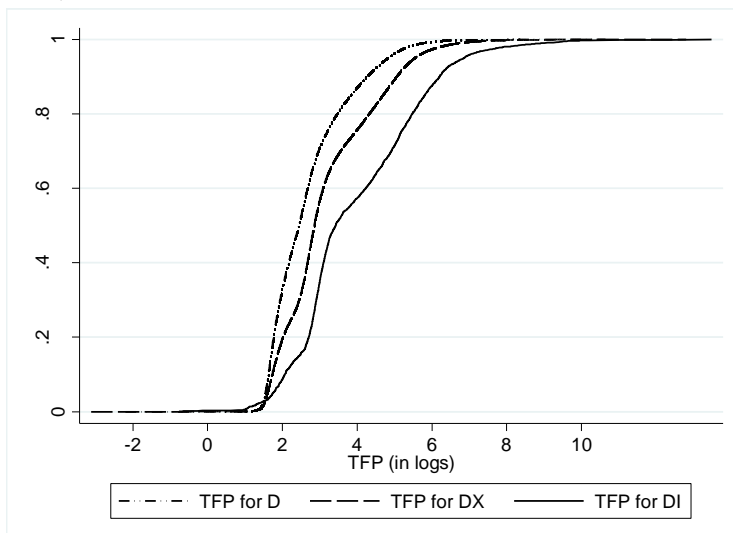
*Notes:* D: companies who serve the domestic market only, DX: exporters, DI: firms investing abroad.  $D \prec DX$  implies that exporters tend to display a higher productivity than companies that only serve the domestic market; etc. KS: Kolmogorov-Smirnov (KS) test (Kolmogorov, 1933 and Smirnov, 1939), TFP: total factor productivity (see Levinsohn and Petrin, 2003 for calculation).

## Table and Figures in the main text

**Table 1. Descriptive statistics for the year 2004**

	Number of firms (in %)		Employees (mean)	Turnover (mean)	TFP (mean)	Age (mean)
ALL industries						
D	354 629	(81.4%)	11	1809	2.67	13
DX	78 749	(18.1%)	87	19 914	3.16	19
DI	2493	(0.6%)	451	175 221	3.97	25
Manufacturing						
D	49 294	(63.1%)	13	1959	3.00	14
DX	27 500	(35.2%)	63	14 701	3.39	21
DI	1362	(1.7%)	560	243 460	4.02	32
Construction						
D	73 435	(96.3%)	10	1285	2.19	11
DX	2722	(3.6%)	104	17 401	2.18	16
DI	77	(0.1%)	446	90 911	2.27	26
Wholesale & trade						
D	116 997	(77.2%)	9	2448	1.96	13
DX	34 074	(22.5%)	23	8986	2.37	17
DI	555	(0.4%)	327	119 482	2.89	25
Transport communication financial intermediation real estate and renting						
D	15 001	(75.9%)	19	3929	4.61	14
DX	4652	(23.5%)	179	29 265	5.13	19
DI	119	(0.6%)	428	163 946	5.87	25
IT services						
D	4268	(67.3%)	13	1490	3.96	8
DX	1979	(31.2%)	47	6507	4.17	10
DI	98	(1.5%)	252	37 037	4.35	13
Services for companies						
D	16 274	(79.3%)	22	1550	4.54	10
DX	4106	(20.0%)	43	5280	5.00	12
DI	135	(0.7%)	133	26 653	5.69	18

**Figure 1. Cumulative density function of TFP for D, DX and DI (all industries, 2004)**



**Table 2. KS tests for TFP in 2004**

Industry	Nace Codes	Two-sided KS tests		One-sided KS tests	
		$H_0$ : DX-D $\approx$ 0	$H_0$ : DI-DX $\approx$ 0	$H_0^*$ : DX-D $<$ 0	$H_0^*$ : DI-DX $<$ 0
All industries	15-74	0.2080 (0.000)	0.2376 (0.000)	-0.0006 (0.949)	-0.0006 (0.998)
Manufacturing	15-37	0.1628 (0.000)	0.2431 (0.000)	-0.0005 (0.991)	0.000 (1.000)
Construction	45	0.0664 (0.000)	0.0854 (0.592)	-0.0664 (0.000)	*
Wholesale & retail trade	50-52	0.3485 (0.000)	0.4349 (0.000)	-0.0001 (1.000)	0.0000 (1.000)
Transport, communication, financial intermediation, real estate & renting	60-71	0.3287 (0.000)	0.4729 (0.000)	-0.0026 (0.951)	-0.0233 (0.881)
IT services	72	0.1477 (0.000)	0.1577 (0.014)	-0.0005 (0.999)	-0.0061 (0.993)
Services for companies	74	0.2929 (0.000)	0.3936 (0.000)	-0.0002 (1.000)	-0.0015 (0.999)

*Notes:* The KS-statistic is reported with the  $p$ -value given in parentheses. If the two-sided KS test on the equality of distributions does not lead to the null hypothesis being rejected, no one-sided test is carried out (marked with \*). Similar results for the entire sample and industries are obtained for the labour productivity measure and for the years 2002 and 2005. Results are available upon request.

**Table 3. TFP path of domestic companies, exporters and MNEs**

Group	2002	2004	2005
DI-DI	3.99	4.02	4.05
DX-DI	3.89	3.91	3.95
DX-DX	3.19	3.23	3.25
D-D	2.61	2.65	2.67

*Notes:* The DX-DI firms (infant MNEs) switch the internationalization status between 2004 and 2005.

**Table 4. MNE statistics according to the host country approach (2004)**

	No. of firms		No. of subsidiaries per MNE (mean)	No. of foreign countries covered (mean)
Low-wage country ( $DI_{Low}$ )	463	(19%)	1.3	1.2
High-wage country ( $DI_{High}$ )	1610	(65%)	1.7	1.5
Low and High wage country ( $DI_{LoHi}$ )	395	(16%)	8.8	6.4
<i>Total</i>	2468	(100%)		

**Table 5. KS tests for TFP according to the host country approach (2004)**

Two-sided KS test			One-sided KS test		
$H_0: DI_{High} - DI_{Low} \approx 0$	$H_0: DI_{LoHi} - DI_{High} \approx 0$	$H_0: DI_{LoHi} - DI_{Low} \approx 0$	$H_0^*: DI_{High} - DI_{Low} \prec 0$	$H_0^*: DI_{LoHi} - DI_{High} \prec 0$	$H_0^*: DI_{LoHi} - DI_{Low} \prec 0$
0.0481 (0.351)	0.1488 (0.000)	0.1824 (0.000)	*	-0.0352 (0.455)	-0.0363 (0.571)

Notes: See Table 2.

**Table 6. Number of MNEs according to the NACE approach (2004)**

Different NACE ( $DI_{Diff}$ )	268	(28%)
Same NACE ( $DI_{Same}$ )	494	(52%)
Same and different NACE ( $DI_{SaDi}$ )	195	(20%)
<i>Total</i>	<i>957</i>	<i>(100%)</i>

**Table 7. KS tests for TFP according to the modified NACE approach (2004)**

Two-sided KS test			One-sided KS test		
$H_0: DI_{Same} - DI_{Diff} \approx 0$	$H_0: DI_{SaDi} - DI_{Same} \approx 0$	$H_0: DI_{SaDi} - DI_{Diff} \approx 0$	$H_0^*: DI_{Same} - DI_{Diff} \prec 0$	$H_0^*: DI_{SaDi} - DI_{Same} \prec 0$	$H_0^*: DI_{SaDi} - DI_{Diff} \prec 0$
0.0923 (0.088)	0.2055 (0.000)	0.1756 (0.001)	*	-0.0278 (0.806)	-0.0298 (0.818)

Notes: See Table 2.