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Abstract

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JEL Classification: F14, F23

Keywords: Firm Heterogeneity, sorting, export, FDI, Outsourcing, internationalization mode, ordered logit

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The ladder of internationalization modes: Evidence from European firms*

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Abstract

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1 Introduction

Globalization and market integration did not only provide an opportunity for more firms to serve foreign markets, it also opened the door to choose from a number of ways (or modes) to serve those markets: FDI and outsourcing, for example, has become a viable option for a growing number of firms.[1] The very detailed survey data used in this paper reveals that 63% of European manufacturing

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[1] According to UNCTAD, foreign direct investment from European Union countries has risen sixfold in real terms in the past three decades, while exports quadrupled. According to ISG, a consultancy quoted by The Economist (2013), when we consider US and European outsourced contracts, the share of deals with foreign counterparties doubled during the 2003-2012 period.

firms with at least 10 employees do sell abroad and 25% of these firms engage in internationalization modes beyond direct exporting and FDI.

Recent research has shown that internationalization modes can often be ranked based on the commitment or fixed cost they require and, therefore, a growing number of productive firms self-select into more and more demanding modes. This self-selection process can be interpreted as an extensive margin of trade and has been shown to have important consequences for reallocation and gains from trade (Helpman et al., 2004). Such sorting has been studied between different modes. The seminal model of Helpman et al. (2004) proposed a model of sorting between exporting and horizontal FDI, where FDI requires a more substantial fixed cost but a lower variable cost than exporting. This cost structure generates a sorting between non-traders, exporters, and firms conducting FDI. A similar trade-off and sorting pattern was recently proposed regarding the decision between indirect and direct exporting (Ahn et al. (2011); Felbermayr and Jung (2011) Lu et al., 2014).[2] Another sorting pattern was observed in the relationship between export, outsourcing, and FDI (Greenaway and Kneller, 2007; Tomiura, 2007).

However, mainly because of the scarcity of information, most studies have focused on a few internationalization modes only. A limitation of this approach is either that many distinct modes are handled as one category or, more importantly, some modes are ignored (i.e. firms conducting some modes are treated as non-traders). As a result, only a part of the firm's choice set is modeled. The main aim of this study is to contribute to the sorting literature by analysing many internationalization modes within an integrated theoretical and empirical framework.

In particular, we investigate how firms sort into internationalization modes - a setup which we call the ladder of internationalization. We rely on a cross-country cross-sectional dataset, with direct survey information on multiple internationalization modes at the firm level, and we study the distance between the steps of this ladder as well as features of the sorting mechanism itself. We contribute to the literature in three ways.

First, we use a survey database gathered in the European Firms in a Global Economy (EFIGE) project, which includes a wealth of information on many internationalization modes and is linked to balance sheet data from the AMADEUS database. The dataset is unique as it both covers a wide range of internationalization as well as innovation measures and may be linked to balance sheet data.[3]

The questionnaire distinguishes several modes of serving the foreign market. First, firms can sell their products directly to corporate and final consumers; this is *Direct export*. Second, they may sell to local intermediaries, who will then sell the products to consumers abroad; this is *Indirect export*. Third, they may invest abroad and set up a service affiliate, *Service FDI*, to sell locally. Fourth, they may outsource production to a partner, dubbed *Outsourced manufacturing*. Fifth, having invested abroad, they may have sales from foreign production for the host market called *Manufacturing FDI*. Importantly, the data enable us to distinguish between vertical and horizontal motives for foreign manufacturing. As our primary interest lies in the manner of serving the foreign markets (and this is what sorting frameworks model), horizontal outsourcing and FDI will be considered as internationalization modes (the dependent variable) while vertical outsourcing and FDI will be explanatory variables in some specifications controlling for foreign sourcing decisions.[4]

Second, to guide our empirical analysis, we extend a sorting model to a choice among N potential

[2]There has also been empirical evidence on the role of indirect exports: Ahn et al. (2011) found that 20% of China's export is carried out by intermediaries, while Blum et al. (2010) report that around 35% of imports into Chile are done through intermediaries.

[3]For instance, AMADEUS has information about the existence of foreign affiliates, but does not contain reliable export data. Widely used US data (such as Ramondo et al. (2016)) have no information on indirect trade or the nature of FDI. Plus, most datasets are not matched with innovation data (such as the one used by Tomiura (2007). Close to this dataset is the CapItalia survey as EFIGE was partially modelled on it.

[4]Our approach may also contribute indirectly to the discussion of differences between vertical and horizontal MNCs. Because of the lack of data, the empirical literature on FDI has pooled various sources (as in Girma et al. (2005) or Arnold and Hussinger (2010)) or used industry information to identify the vertical motive Ramondo et al. (2016). Instead, we have information of the motivations from the survey.

modes. In the model firms are heterogeneous both in their productivity (supply side) and the quality of their product (demand side).[5] In particular, we extend the models of Crozet et al. (2013) and Aw and Lee (2014) to a choice among N potential modes. In order to describe a ladder of internationalization, we characterize the cost structure of each mode with two parameters: its fixed cost level and the associated iceberg-type marginal trade costs, and assume that modes with lower trade costs have progressively higher fixed costs. In terms of empirical methodology, our model suggests that an ordered logit regression may be appropriate to estimate sorting along multiple variables.

Third, besides descriptive tools, we estimate multinomial and ordered logit regressions which allow firms to choose from the set of internationalization modes we observe and control for industry, country variables and firm-level characteristics. Multinomial logit models require weaker functional form assumptions while ordered logits provide estimates which are more closely related to our model. We examine sorting along two measures: TFP and a composite measure of product 'Innovativeness'. One interpretation is that TFP is a proxy for productivity while product innovation is more closely related to product appeal or quality. Another possible interpretation is that these are two related (and correlated) measures of firm capabilities.

Importantly, results are very consistent across specifications. There seems to be three clear 'clusters' or main steps on the ladder of internationalization: first, indirect exporting, which is very similar to no trade; second, direct exporting and outsourced manufacturing; and third, service and manufacturing FDI. These clusters differ significantly, but there seems to be a hierarchy of modes within each of these clusters. Innovativeness seems to be an even stronger predictor of sorting than productivity. We also show that the relative role of the two variables may differ across modes. For example, in the case of outsourced manufacturing, only innovativeness is a significant predictor of selection.

This analysis complements a number of empirical studies on sorting. The patterns in our data reinforce the emphasis on sorting for direct export and FDI as in Helpman et al. (2004). Similarly to us, using Japanese data, Tomiura (2007) found evidence for sorting between outsourcing and FDI making firms. However, our results contrast with studies that found strong sorting into indirect exporting (for example, Felbermayr and Jung (2011) and Ahn et al. (2011)). In line with a growing literature we also find evidence that firm capabilities may be multidimensional: Innovativeness seems to have a strong association with internationalization mode choice, even when controlling for TFP (as in Crino and Epifani (2014)).

Finally, let us point out some important constraints of our analysis. Most importantly, our data is cross-sectional, hence it is not possible to estimate causal effects. This, to some extent, reflects a trade-off between measuring many internationalization modes precisely and estimating causal effects. In addition, we have information on trade modes at the firm level rather than at the firm-destination or firm-product level. In a sense, we observe the most demanding mode the firm is employing in any of its markets. Analysis based on more detailed data could possibly unravel even finer patterns of internationalization. Third, while our results are suggestive that sorting is multidimensional, we cannot clearly distinguish between supply and demand factors because our empirical measures are likely to be correlated both with productivity and quality, though in different ways. Fourth, our database includes data only on manufacturing firms while sorting patterns may differ significantly in the service sector.

The paper is laid out as follows. The next section introduces a simple theoretical framework that guides our empirical analysis. In Section 3, we introduce our dataset, explain how we classify firms

[5] The emphasis on two-dimensional heterogeneity is motivated by recent evidence on substantial and important quality differentiation across firms even with similar productivity. For instance, Kugler and Verhoogen (2009, 2012); Iacovone and Javorcik (2012); Atkin et al. (2015) present evidence that foreign sales and prices are correlated with quality. Crozet et al. (2013) demonstrate that higher quality good exporters will sell to more markets at a higher average price. Manova and Zhang (2012) investigate prices and inputs as related to input and output quality. To examine the channels, quality may be modelled in various ways. Crozet et al. (2013) present a quality interpretation of the Melitz model and show that quality is an important aspect of firms' export decisions. Crinò and Epifani (2012) and Aw and Lee (2014) add quality as part of heterogeneity driven by demand conditions across various markets. Hallak and Sivadasan (2013) introduce two sources of productivity difference; process productivity and product productivity, both drawn randomly.

into internationalization modes and how we calculate the explanatory variables and show some stylized facts. Section 4 presents our results, while we conclude in Section 5.

2 Modelling the ladder of internationalization

We outline a simple model of sorting with multiple modes and two dimensions (productivity and product quality). The model follows Crozet et al. (2013) and Aw and Lee (2014) but extends that framework to N modes. We describe this model in more detail in Appendix A.

This model assumes two countries and that firms can serve the foreign market by N possible trade modes, each of which can be characterized by their fixed costs, F^n, and their marginal cost, τ^n. We assume that internationalization modes can be ordered according to both the investment they require and the marginal cost advantage they yield. In particular, we assume that:

$$F^n < F^{n+1},\ \forall n \quad \text{and} \quad \tau^n > \tau^{n+1},\ \forall n \tag{1}$$

Firms are heterogeneous in two dimensions: productivity ($\omega(i)$) and quality ($a(i)$). We assume that it is more costly to produce higher quality products, with $\gamma \geq 1$ representing the marginal cost of producing higher quality goods. Higher quality, in turn, is appreciated by consumers, who have a CES utility function with quality as a demand shifter. $\lambda \geq 1$ shows the importance of quality in consumer preferences relative to prices. We assume that consumers value quality more than its cost, i.e. $\lambda \geq \gamma$.

Under these conditions, both productivity and quality matter in sorting. In particular, $\lambda - \gamma$, the difference between consumer valuation and the cost of higher quality shows the importance of quality in sorting relative to productivity.

Under these assumptions we can demonstrate (see Appendix A) that the threshold curve for mode n in the productivity-quality space (when firms are indifferent between modes $n-1$ and n, $\Pi^{n-1}(i) = \Pi^n(i)$) is the following hyperbola:

$$\bar{\omega}^n(a) \equiv \left(F^n - F^{n-1}\right)^{\frac{1}{\sigma-1}} \left(\frac{E}{P}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma^{\frac{\sigma}{1-\sigma}}}\right) \left(\left(\tau^n\right)^{1-\sigma} - \left(\tau^{n-1}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} a(i)^{\gamma-\lambda} \tag{2}$$

where $\sigma > 1$ is the elasticity of substitution, E is total expenditure and P is the price level in the foreign market.

The specification in this model can be very easily interpreted in an ordered logit framework. First, let us define

$$T^n \equiv \begin{cases} \left(F^1\right)^{\frac{1}{\sigma-1}} \left(\frac{E}{P}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma^{\frac{\sigma}{1-\sigma}}}\right) \left(\tau^1\right)^{-1} & \text{if } n = 1 \\ \left(F^n - F^{n-1}\right)^{\frac{1}{\sigma-1}} \left(\frac{E}{P}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma^{\frac{\sigma}{1-\sigma}}}\right) \left(\left(\tau^n\right)^{1-\sigma} - \left(\tau^{n-1}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} & \text{if } 1 < n \leq N \\ \infty & \text{if } N < n \end{cases}$$

According to equation (2), firms choose internationalization mode n whenever

$$\ln T^n \leq \ln \omega(i) + (\lambda - \gamma) \ln a(i) < \ln T^{n+1}$$

Based on this, we can define a latent variable, $y^*(i)$:

$$y^*(i) \equiv \ln \omega(i) + (\lambda - \gamma) \ln a(i) + e(i) \tag{3}$$

and assume that $e(i)$ has a standard logistic distribution and reflects any unobserved heterogeneity across firms related to internationalization choices.

We only observe the chosen internationalization mode, $y(i)$:

$$\begin{array}{ll} y(i) = 0 & \text{if } y^*(i) < \ln T^1 \\ y(i) = 1 & \text{if } \ln T^1 \leq y^*(i) < \ln T^2 \\ & \vdots \\ y(i) = N & \text{if } \ln T^N \leq y^*(i) \end{array} \tag{4}$$

Equations (3) and (4) form an ordered logit model with the $\ln T^n$ values serving as thresholds for $y^*(i)$, a linear combination of quality and productivity.

Altogether, the main prediction of the model is that an ordered logit model of productivity and quality should describe well the internationalization mode choice, and the probability of choosing a more 'demanding' mode should increase both in productivity and quality in such a framework.

3 Data, definitions and methods

In this section, we will first present the dataset we are using including the definitions and characteristics of the key variables of the model: productivity, innovativeness and internationalization modes. This will be followed by a description of our regression approach.

3.1 The dataset

Our dataset is based on a representative sample of manufacturing firms with at least 10 employees, covering five European countries: France, Germany, Hungary, Italy, and Spain. The dataset was created by the EFIGE project, and is the first harmonized cross-country dataset in Europe[6] with detailed information on firms' international activities. It is a cross-section dataset with questions referring to the status in 2010. Importantly, these survey data from the EFIGE survey were merged with balance sheet information from AMADEUS, a collection of European balance sheets collected by the company Bureau van Dijk. Table B.8 in the Appendix presents the number of observations.

We have a dataset with 8581 manufacturing firms with at least 10 employees. The dataset has five countries (number of firms in brackets): France (2199), Germany (760), Hungary (162), Italy (2861) and Spain (2599). The distribution in terms of industries is: food/beverage (919), light industries such as textiles/leather (2086), metal (1881), machinery and equipment (1005), other heavy manufacturing such as chemicals (1550), electronics (702) and other/unclassified (167).

3.1.1 TFP and Innovativeness

In this work we will rely on two sorting variables: TFP (as is standard in the literature) and a composite measure of inputs and outputs of product innovation, which we will call 'Innovativeness' (similarly to Crino and Epifani (2014)).

These variables can be interpreted as proxies for the two dimensions of firm heterogeneity in our model, productivity ($\omega(i)$) and quality ($a(i)$). Proxying $\omega(i)$ with TFP is quite standard in the literature. There is less of a consensus on measuring quality. As has been frequently noted (e.g.

[6]For more on EFIGE data, see Barba Navaretti et al. (2011). The full EFIGE dataset is made up of seven countries, but the lack of data needed for reliable TFP estimates led us drop two countries. For two countries, Germany and Hungary, TFP cannot be estimated for many firms, and hence, in these countries the sample is not fully representative. Reassuringly, however, repeating the exercise on French, Spanish and Italian data gives very similar results.

Ludema and Yu (2016)), the quality of products is not directly observable.[7] Typical proxies include product classification based on 2-digit HS codes, measures of R&D spending or intensity, or within-product price variation. Our measure, the combination of innovative efforts and their results may be a good concept to proxy the unobserved variable, namely, the quality perceived by consumers.[8]

This interpretation of TFP and innovativeness as measures of productivity and quality undoubtedly raises a number of questions. Most importantly, these measures cannot be clearly linked to the model variables. Revenue TFP includes the higher prices paid by consumers for higher quality products. Further, our measure of innovativeness may be a noisy measure of product quality and may also be correlated with innovative efforts aiming at increasing physical productivity. As argued by Crino and Epifani (2014) as well as Kugler and Verhoogen (2012), such issues may lead to both upward and downward biases, with ambiguous net effects. There are no clear-cut solutions for such problems in a firm-level cross-section setting other than controlling for a large set of firm characteristics, which we do. Eventually we remain somewhat agnostic about the conceptual distinction between these variables but we find it suggestive that empirically both measures seem to be strongly and independently related to sorting.

Our basic TFP is estimated using the AMADEUS data between 2006 and 2010 with the method proposed by Wooldridge (2009). In this model, which is built on Levinsohn and Petrin (2003), value added is regressed on fixed assets (capital) and the number of employees. For unobserved productivity shocks we use materials and capital in a control function. The production function was estimated on the full AMADEUS dataset for all country-industry pairs (NACE rev.2, 3-digit industries) separately, and the estimated TFPs were merged to firms in the EFIGE survey. We describe our approach to TFP estimation in Appendix C.3, and report the average TFPs in Table B.1 in the Appendix.[9]

We use three innovative input and output measures (for the 2007-09 period) when creating our innovativeness measure: (i) a dummy showing if the firm spent anything on R&D; (ii) a dummy showing if the firm introduced product innovation; and (iii) a variable that counts the number of types of IPs created (applied for a patent, registered an industrial design, registered a trademark, claimed copyright). This variable takes values between 0 and 4. The composite Innovativeness variable is calculated as the mean of the three variables (after standardizing them).[10] Descriptive evidence (Table B.2 in the Appendix) suggests that the three measures have a similar, but noisier, relationship with mode choice than the composite one.

In our empirical analysis, we standardize both TFP and Innovativeness in order to make the results easier to interpret.

3.1.2 Internationalization modes

Owing to the wealth of information in the survey, the EFIGE dataset is exceptionally suitable for studying hypotheses about the internationalization mode choice of European firms. Given that measurement is a crucial point of interest, let us describe our variables in detail.[11]

Direct exporters were identified through the question "Has the firm sold abroad some or all of its

[7] An additional issue is that the definition of quality at the firm level is not straightforward even theoretically.

[8] Such information has been frequently used as a proxy for quality in previous research. Kugler and Verhoogen (2012), for example, claim that one may interpret R&D as a proxy for quality, arguing that firms will only invest in R&D whenever it is reasonable for it to have an impact on perceived quality. In similar fashion, Crino and Epifani (2014) hold that producing "higher-quality products requires higher fixed costs in terms of R&D and other innovation activities". Both of these arguments are based on points made earlier by Sutton (1991, 1998)

[9] Calculations have been repeated by estimating TFP with a fixed effects model, with no qualitative difference. Results are available on request.

[10] An alternative could be calculating the principal component. This, however, is inferior theoretically when some of the variables are dummies. Empirically, however, it yields nearly identical results on our sample.

[11] Note that managers were asked the questions as we describe them here; no additional definitions were provided them, hence they had to interpret all words in the questions. For example, different managers could interpret 'intermediary' differently. Note, however, that the questionnaire was extensively tested prior to the survey and managers are likely to understand the questions similarly.

own products/services in 2008?" by answering "directly from home country". *Indirect exporters* were those answering "Yes, through an intermediary based in home country" to the same question. This definition has at least two limitations. First, host-country based intermediaries are excluded from it. Second, it is easily possible that the product of the firm is exported by a domestic intermediary without the knowledge of the firm. As a result, we are likely to underestimate the number of indirect exporters and probably the premium of this mode, especially if firms relying on foreign intermediaries are more productive.

When defining foreign manufacturing, we required firms to report both the fact that they produce in the foreign country and that the product was sold abroad (either in the country of production or in other countries). The latter requirement guarantees that production has a horizontal motive in line with the theory of sorting as we will discuss below. In particular, a firm was classified as conducting *Manufacturing FDI* if it answered positively to "Does the firm currently run at least part of its production activity in another country?" - (a) "Yes, direct investments" *and* answered yes to Destination of production activity: "Sold in the foreign country where the production facility is located" or "Sold directly in third countries where the firm does not produce" or "Sold directly in third countries where other production facilities are located". A firm was considered conducting *Outsourced manufacturing* if it answered positively to "Does the firm currently run at least part of its production activity in another country?" - (b) "Yes, contracts and arm's length agreements with local firms" *and* answered yes to the same set of destination questions as for manufacturing FDI.

In contrast, vertical manufacturing FDI / contracted manufacturing is defined by choosing any of these answers: (i) "Imported into your firm's home country for use in production", (ii) "Imported into your firm's home country to be directly sold in the domestic market", (iii) "Imported into your firm's home country to be re-exported to third countries".

Let us emphasize again that our definitions guarantee that we only consider production abroad when it has a horizontal motive. This is a rare and appealing aspect of our data and the approach to these variables. Typically firm-level data do not distinguish between horizontal and vertical FDI (when a firm produces parts abroad only to ship it back to assemble it into the final product) and, therefore, does not disentangle the determinants of output-market sorting and input-sourcing considerations. Our approach here is close to Yeaple (2003), who uses data on local affiliate sales and export sales back to the USA of 1930 USA multinationals as collected by the Bureau of Economic Analysis (BEA). Unlike Yeaple (2003), we do not know the value of sales, but we do know if affiliates exported back to the home country.

In our dataset, about two-thirds of FDI-conducting firms and 40% of firms conducting outsourced manufacturing report a horizontal motive. It turns out that the motive for foreign production does not matter too much in terms of premia (for details, see Tables B.3, B.4 and B.5 in the Appendix). On average, FDI makers with horizontal motives are just 10% of a standard deviation more productive and practically as innovative as other FDI conducting firms. There is a similar case to be made regarding outsourced manufacturing.

Finally, firms are classified as conducting *service FDI* if they answered yes to the question: "Has the firm any affiliates, i.e. firms of which you own a share of at least 10%" and answered that some affiliates are abroad but did not report running part of their production in another country. This definition leads to an asymmetry: firms classified as conducting manufacturing FDI may also have service affiliates (which we cannot observe from the survey) but firms classified as service FDI-makers cannot have manufacturing FDI. This asymmetry may indeed affect our results by magnifying the extent of sorting between Service FDI and Manufacturing FDI if firms conducting both modes are in fact more productive than firms employing only one (Békés and Muraközy, 2016).

3.2 Prevalence of modes

First, let us look at the number of firms engaged in the various modes. In this sample, 38.5% of firms do not serve foreign markets at all. Table 1 shows that direct export is by far the most widely used foreign sales mode, with 56.2% of the firms conducting it.

Table 1: Number of firms conducting different modes

Mode	Number of firms	Share of firms
No foreign sales	3301	38.5%
Indirect export	688	8.0%
Direct export	4820	56.2%
Outsourced manufacturing	157	1.8%
Service FDI (Horizontal)	394	4.6%
Manufacturing FDI (Horizontal)	255	3.0%

The table shows the number and share of firms conducting each mode. Note that one firm can conduct multiple modes.

The share of indirect exporters (8% or 688 firms) is relatively low compared to what has been found by other researchers. Lu et al. (2014), for example, reports that 24% of Chinese firms export indirectly. This may be explained by the different definitions of indirect exporting. Only firms exporting through home country-based intermediaries are classified as indirect exporters in EFIGE, while other papers also include information about firms exporting through foreign intermediaries. This may limit the comparability of our results with other studies. In particular, if the fixed cost of exporting through domestic intermediaries is lower than that of exporting through foreign intermediaries, our estimates for indirect exporters' premia may be biased downwards.

As seen earlier, 3% (255) of firms conduct horizontal FDI, while 1.8% (157) of firms are engaged in outsourced manufacturing production with a horizontal motive. Non-manufacturing FDI is important quantitatively: it was carried out by 4.6% of firms. In our data, foreign production and horizontal manufacturing FDI is actually rarer than previously believed.[12]

3.3 Handling of combined modes

The total number of firms in Table 1 exceeds our sample size of 8581. The reason for this is the fact that 20% of firms serving foreign markets engage in more than one mode. For example, 59% of firms doing indirect export will also perform other modes - mostly direct export. Similarly, 69% of firms doing outsourced manufacturing will have at least one other mode.[13]

Indeed, for any empirical analysis of mode choice with multiple modes, the handling of combined modes is an important practical question. In our dataset, there are 23 different combinations of modes, some chosen by many firms, other by few. Figure 1 shows a box and whiskers graph for these modes borrowed (and applied for this dataset) from Békés and Muraközy (2016).

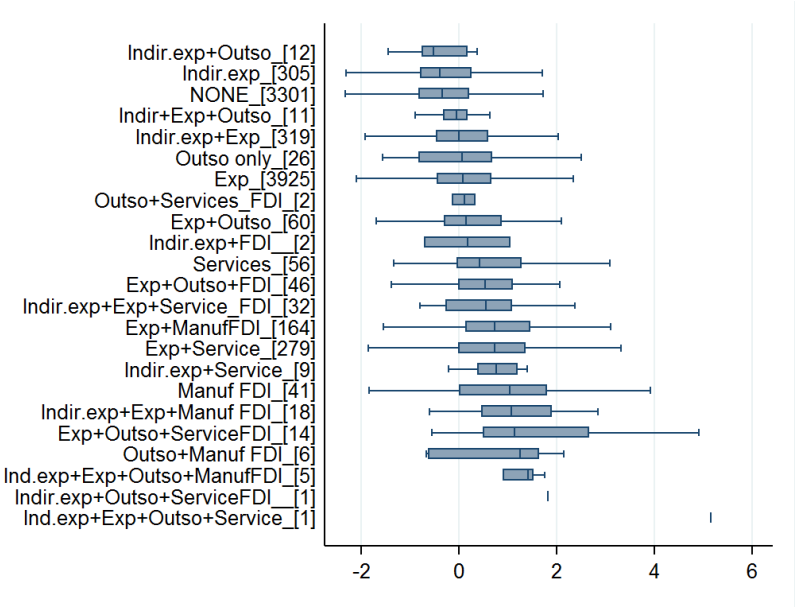
For all prevailing combinations of modes, we present key features of the distribution of standardized TFP (horizontal axis) as well as the number of firms conducting the given mode in squared brackets. The graph suggests both a ranking of various modes from top to bottom in terms of TFP and a great

[12]In terms of numbers, FDI-conducting firms represent between around 5 to 10 percent of firms in surveys similar to EFIGE, depending on the size of the threshold: in Italy, for example, 4.6 percent of firms employing at least 500 people conducted FDI (Benfratello and Razzolini, 2014) while 10.6 percent of German firms in the Mannheim Innovation Panel (Arnold and Hussinger, 2010) were engaged in foreign production. Of course, part of variation comes from different definitions.

[13]This may be, partly explained by the possibility that each firm can serve different markets with different modes.

deal of diversity of TFP within each mode. It also suggests that some combinations are quite infrequent (such as the first one: only 12 firms picked indirect exporting and outsourced manufacturing only).

Figure 1: All mode combinations and TFP



This figure shows a box plot (lower adjacent value, 25th, 50th and 75th percentile and upper adjacent value) of the distribution of standardized TFP for firms conducting each combination of internationalization modes. The numbers in square brackets are the number of firms conducting each particular combination. Abbreviations: Indir.exp is indirect exporting, Exp is direct exporting, Outso is outsourced manufacturing, Manuf FDI is manufacturing FDI, ServiceFDI is service FDI.

Considering all possible combinations as separate modes makes the model hard to estimate and especially to interpret. Part of the reason for mixed modes is, of course, multi-product firms selling each of their products in different fashion. Therefore, the large number of combinations observed in the data necessitates some kind of information compression, i.e. a classification of mode combinations into some larger clusters. In this paper we will assign firms conducting multiple modes according to the most 'highly-ranked' mode they conduct - a method called 'top-coding'. The motivation for this is that in a multi-product or multi-market version of the sorting model, more productive firms will enter more markets and will enter larger markets with more demanding modes. Choosing, say, the 'average' of these modes would confuse the extensive margin (many markets with lower ranked modes) with the internationalization mode margin. As a result, such a method may not yield clear thresholds. Top-coding, in contrast, classifies firms by the 'maximum' of modes, and thresholds are more clearly defined, showing whether the firm is productive enough to enter its top market and core product with a given mode. The results say less about smaller markets and other products.

Top-coding naturally requires an a priori ranking of modes. We rank the modes according to their average premia in Tables B.1 and B.2 in the Appendix. In this ranking, no foreign sales is followed, in the order of ranking, by indirect export, direct export, outsourced manufacturing, services FDI and manufacturing FDI.[14]

This information compression method tilts average values towards a predetermined ranking if more productive firms are indeed more likely to conduct multiple modes. If, for instance, direct exporting

[14]This is discussed in detail in Békés and Muraközy (2016), where we offer alternative solutions for this issue.

is ranked above outsourced manufacturing, firms doing both will be added to exporters and this will yield a relatively higher TFP and Innovativeness. If, instead, outsourced manufacturing is ranked ahead, firms doing both will be added to this category yielding an opposite ranking. This phenomenon matters only when a mode is conducted infrequently alone but often together with other modes with large productivity premia (Altomonte et al. (2013)) – which is exactly the case of outsourced manufacturing. We show that our results are robust to switching the rank of direct exporting and outsourced manufacturing in Table C.5 in the Appendix.

3.4 Discrete choice models

We estimate mode choice by a multinomial logit model in which the dependent variable, $y(i)$ is the top-coded mode for firm i (for non-internalized firms $y(i) = 0$), and $x(i)$ is the vector of explanatory variables: TFP, Innovativeness and industry[15]-year dummies:

$$P(y(i) = n) = \frac{e^{\beta_n x(i)}}{1 + \sum_{j=1}^{N} e^{\beta_j x(i)}} \tag{5}$$

It is hard to interpret the parameters of these models directly, so we will calculate marginal associations ($\partial p/\partial x$), also called marginal effects in causal contexts) and semi-elasticities to interpret the results. Marginal associations show the extent to which a firm is more likely to choose a given mode than an otherwise similar firm with a unit lower value of the explanatory variable. While informative, marginal associations do not provide a full picture regarding selection because their magnitude depends on the share of firms choosing each mode. For depicting the strength of selection into different modes, we also report semi-elasticities, i.e. the proportional increase in the probability of choosing each mode when the explanatory variable increases by one unit ($\partial \ln p/\partial X$). We expect that a ladder of internationalization would imply that the share of firms increases faster in a proportional sense for more 'demanding' modes, i.e. the estimated semi-elasticities are larger for higher ranked modes.

In addition, based on the approach in Section 2, we will run ordered logit models of the form:

$$y^*(i) \equiv \beta x(i) + e(i) \tag{6}$$

with the same explanatory variables and assume that $e(i)$ has a standard logistic distribution and reflects any unobserved heterogeneity across firms related to internationalization choices.

We only observe the chosen internationalization mode, $y(i)$:

$$\begin{array}{ll} y(i) = 0 & \text{if } y^*(i) < \ln T^1 \\ y(i) = 1 & \text{if } \ln T^1 \leq y^*(i) < \ln T^2 \\ & \vdots \\ y(i) = N & \text{if } \ln T^N \leq y^*(i) \end{array} \tag{7}$$

As we have suggested in Section 2, the coefficients of this model can be interpreted in the framework of our model.

First, as much as our measures can be interpreted as proxies for productivity and quality, the ratio of the estimated coefficients of innovativeness and productivity shows the relative weight of these variables in the latent variable, $\lambda - \gamma$, or the difference between the extra revenue and cost of producing higher quality relative to a unit increase in production costs. The larger the ratio, the more important innovativeness or quality relative to productivity in the selection process.

Second, the estimated cutoffs are the equivalents of the $\ln T^n$s. Comparing these can shed light

[15] We include dummies for the following industries: Food, Light industries, Metal, Machinery, Other heavy industry, Electronics, Motor vehicle, other manufacturing based on 2-digit NACE rev.2 codes.

on the differences in the cost structure of the modes: the larger the difference between the lower and upper thresholds of a mode, the more different its cost structure (its (F^n, τ^n) vector) from neighboring modes (see Appendix A).

Third, the estimated cutoffs reveal a lot about the premia. If the lower and upper cutoffs for a trade mode are very different from each other, its premium is likely to differ from its neighboring modes. The exact value of the premia, however, will also depend on the distribution of firms in the two-dimensional space.

4 Empirical evidence on mode choice

In this section, we present descriptive statistics by top-coded modes, followed by the multinomial and ordered logit models discussed in the previous subsection.

4.1 Descriptive evidence

First of all, Table 2 presents standardized TFP and Innovativeness by 'top-coded' mode.

Table 2: Standardized TFP and Innovativeness by top-coded mode

Mode	Firms		TFP		Innovativeness	
	N	Share	Mean	Sd	Mean	Sd
No foreign sales	3301	38.5%	-0.28	0.91	-0.41	0.81
Indirect export	305	3.6%	-0.29	0.99	-0.18	0.9
Direct export	4217	49.1%	0.13	0.92	0.17	0.94
Outsourced manuf.	109	1.3%	0.09	0.85	0.39	1.05
Service FDI	394	4.6%	0.73	1.27	0.76	1.01
Manufacturing FDI	255	3.0%	0.79	1.08	0.83	1.02
Total	8581	100.0%	0	1.00	0	1.00

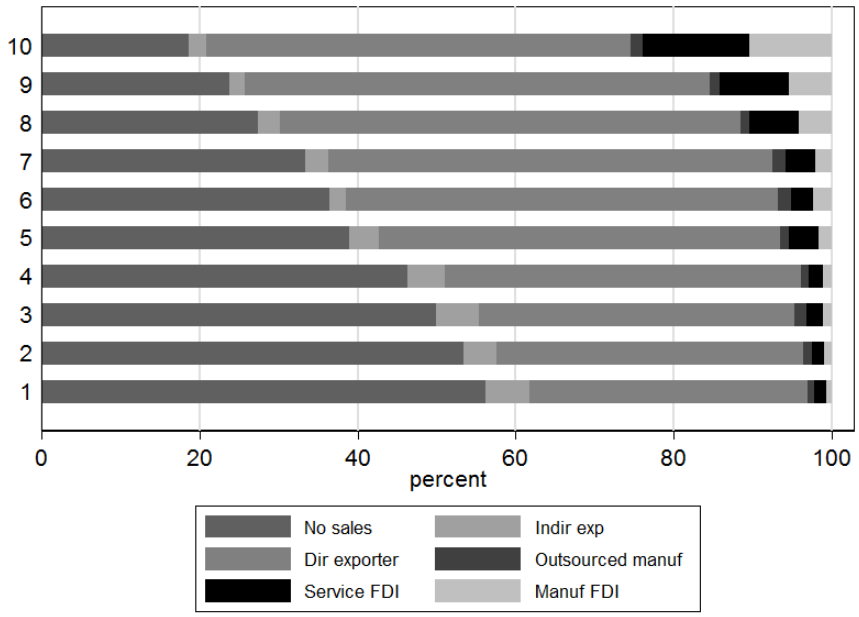
The table classifies each firm into the 'highest' mode they conduct ('top-coding', see details in the text) and reports the the number of firms and their average TFP and Innovativeness values in each mode. TFP is standardized Wooldridge TFP. Innovativeness is a standardized score of three innovation variables.

As expected, top-coding does reduce the number of firms classified as conducting less demanding modes. Still, direct exporting remains the most prevalent mode (it is conducted by 56.2% of firms while it is the top mode for 49.1%). The most important effect of top-coding is the fall in the number of indirect exporters from 8.1% in Table 1 to 3.6% after top-coding. This reflects that indirect exporting is often complemented by other modes.

With the exception of indirect exporters, the table reveals significant premia for the different internationalization modes. Direct exporters are about 0.4 standard deviations more productive than non-internationalized firms, while FDI makers are another 0.65 standard deviations above direct exporters. Even larger premia emerge with regard to firm innovativeness.

Based on these premia, one can basically observe three clusters. In the first group, we have non-internationalized firms and indirect exporters; direct exporters and outsourced manufacturers constitute the second group, about halfway between non-internationalized firms and FDI markers, while service and manufacturing FDI conducting firms constitute the third cluster. This supports the view that a small select group - dubbed the 'the happy few' by Mayer and Ottaviano (2008) - have a very sizable productivity premium and produces substantially more innovative products.

Figure 2: Share of different modes by TFP deciles



This figure groups firms into deciles based on their standardized TFP level, and shows the share of firms conducting each (top-coded) mode within each such TFP-decile.

Figure 2, which partitions TFP into ten deciles and presents the share of firms choosing each mode in each decile, provides a different view of the data by illustrating the joint distribution of TFP and mode choice. The share of direct exporters is gradually increasing in TFP, rising by almost 50% from the lowest (p1) to the highest (p10) TFP deciles. At the same time, the share of both service FDI and manufacturing FDI makers show a manifold rise. This confirms that, in line with the predictions of selection models, higher productivity is associated with increasingly higher likelihood of participation in these modes. In contrast, the share of indirect exporters seems to decline with TFP while that of outsourcing manufacturing is constant across TFP deciles. This provides no evidence for TFP-based selection into indirect export and outsourced production modes relative to no foreign sales. Note that repeating this exercise with our Innovativeness variable yields similar results.

4.2 Multinomial logit results

While these descriptive patterns are informative, modeling selection based on two variables and controlling for country and industry differences requires a regression approach.

Table 3 estimates the multinomial logit model. By and large, the estimated coefficients confirm the descriptive findings. First, with the exception of indirect export, the results provide evidence for two-dimensional sorting (both variables are significant at 1% significance level). The variables have similar magnitudes but the point estimates of Innovativeness are consistently larger for all modes. For indirect exporters, only Innovativeness is significant (at 1% significance level) suggesting that sorting into this mode is based solely on the innovativeness of firms.

Figure 3 shows the marginal associations between the two sorting variables and the probability of choosing each mode (at the average value of other variables). Importantly, the sorting variables have a qualitatively similar relationship with mode choice but the marginal association between mode choice and Innovativeness is stronger.

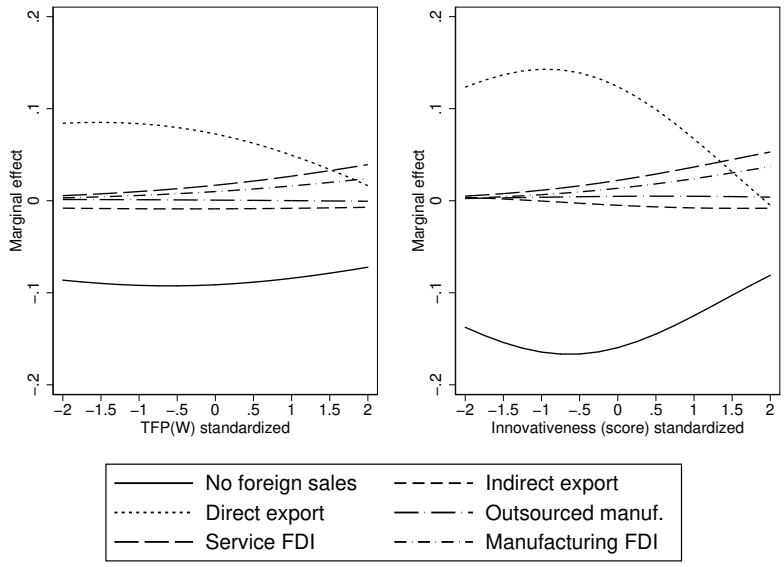
Table 3: Multinomial logit - core model

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	-0.00673	0.409***	0.349***	0.875***	0.876***
	(0.0758)	(0.0575)	(0.109)	(0.101)	(0.134)
Innovativeness	0.315***	0.666***	0.860***	1.187***	1.242***
	(0.0585)	(0.0361)	(0.108)	(0.0665)	(0.114)
Observations					8,581
Pseudo R-squared					0.121

This table shows the coefficients of the core multinomial logit model. In this model the dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

For low values of the sorting variables, the probability of not trading at all is declining sharply (about 10 and 15 percentage points for each standard deviation increase in TFP and Innovativeness, respectively), which is counterbalanced by a similar increase in the probability of direct exporting. For low values of the sorting variables, the larger these variables, the weaker their marginal association with the probability of choosing other modes.

Figure 3: Marginal associations between mode choice, TFP and Innovation



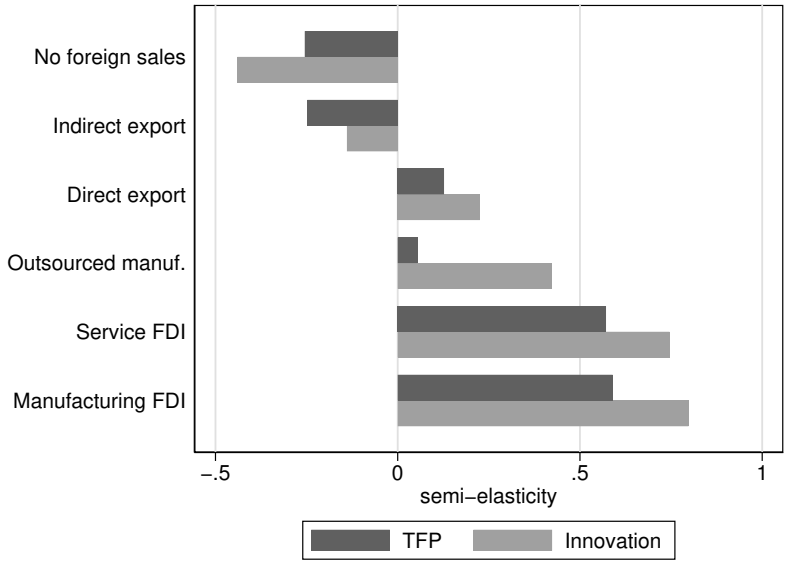
This figure shows the partial derivatives of the probability of choosing the different modes with respect to TFP and Innovativeness in the core multinomial logit model in Table 3.

In contrast, for larger values of TFP and Innovativeness, the marginal association with conducting direct exporting becomes gradually weaker while the marginal association with the two FDI modes is becoming stronger (to about 5 percentage point per one standard deviation increase) suggesting strong selection into these modes at higher levels of performance. The marginal association between

these variables and the probability of indirect exporting is negative but small[16] while the probability of outsourced production is positively associated with the sorting variables.

This overall pattern is consistent with sorting of firms into multiple modes. As productivity and innovativeness increase, the probability of serving foreign markets increases as well, and this marginal association is actually stronger for higher-ranked modes.

Figure 4: Semi-elasticities, Multinomial logit[17]



This Figure shows the semi-elasticities of TFP and Innovativeness on the probability of choosing the different modes in the core multinomial logit model in Table 3.

As we have already discussed, marginal associations depend on the probability of choosing each mode, while selection may be better illustrated with semi-elasticities (Figure 4). The picture suggests that there is, indeed, a ladder of internationalization. The semi-elasticities between the sorting variables and higher ranked modes are larger - in other words, the higher a mode is ranked, the quicker its share is increasing, in proportional terms, with firm performance. Within the big picture there is interesting variation.

First, the probability of indirect exporting is actually decreasing in both dimensions. This does not contradict sorting into this mode from non-exporting because the probability of non-trading decreases even quicker. Nevertheless, both descriptive statistics and the evidence from the multinomial logit model suggest that firms exporting only indirectly do not seem to be more productive than non-traders. At the same time, they seem to have more innovative products. Second, both TFP and Innovativeness have a positive relationship with exporting: firms with a one standard deviation higher TFP and Innovativeness are expected to have 15% and 22% higher probability of exporting, respectively. Third, outsourced manufacturing seems to be mainly determined by Innovativeness while TFP does not appear to play a role. Fourth, selection along both dimensions is very strong into both kinds of FDI with one standard deviation higher TFP and Innovativeness associated with about 60% and 80% larger probability of FDI, respectively. This finding reinforces that FDI has a very different cost structure from exporting.

[16]Note that this does not contradict the positive coefficient of Innovativeness for indirect export in the multinomial logit table, because that compares the probability of indirect export to no internationalization, which decreases more strongly with innovativeness of firms.

4.3 Ordered logit

Let us turn to the ordered logit model, which takes on more structure but is more in line with the simple model presented in Section 2 and may be easier to interpret than the multinomial logit.

Table 4: Ordered logit results

	(1)	(2)	(3)
TFP	0.476***	0.447***	0.359***
	(0.0462)	(0.0452)	(0.0386)
Innovativeness	0.694***	0.673***	0.570***
	(0.0313)	(0.0312)	(0.0308)
Foreign sourcing vars			YES
Management vars		YES	YES
Cut 2 - Direct Export	0.178***	0.18***	0.188***
	(0.0329)	(0.0897)	(0.0899)
Cut 3 - Outsourced. manuf	3.333***	3.375***	3.609***
	(0.112)	(0.181)	(0.151)
Cut 4 - Service FDI	3.523***	3.567***	3.814***
	(0.112)	(0.183)	(0.154)
Cut 5 - Manufacturing FDI	4.589***	4.647***	5.014***
	(0.150)	(0.209)	(0.179)
Observations	8,581	8,581	8,581
Pseudo R-squared	0.101	0.108	0.144

This table shows the coefficients of the ordered logit model, in which the dependent variable is the top-coded mode conducted by each firm, and the ordering is based on TFP premia (see text). TFP and Innovativeness are standardized. Foreign sourcing variables are: third party goods importer (importer of goods), outsourced product importer (vertical outsourcing manuf.), affiliate production importer (vertical manufacturing FDI). Management variables are: Centralization, Firm age, CEO age, and family ownership. Cutoff names show the category above the cutoff and are normalized w.r.t the first cutoff between no trade and indirect export. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The main results are presented in the first column of Table 4: both TFP and Innovativeness play a significant (at 1% significance level) role in internationalization mode choice. (Additional specifications are presented in Table B.7 in the Appendix.) As we have described in Section 3, the ratio of these TFP and Innovativeness coefficients, shows that one standard deviation increase in Innovativeness is associated with about 50% higher profits (y^*) than a similar increase in TFP.

The reported cutoffs are always normalized, i.e. show the difference between the given cutoff and the first cutoff (between no trade and indirect exporting) to make the results easier to interpret. The name of the variable is always the name of the mode above the cutoff (e.g. "Cut3 - Outs. manuf" is the lower cutoff for outsourced manufacturing - normalized with the first cutoff - and, at the same time, the upper cutoff of direct exporting).

As we have discussed, a large difference between the lower and upper cutoffs of a mode implies a large difference between it and its neighbors in terms of the cost structure (the (F^n, τ^n) vector). The point estimates reinforce the descriptive results about the three main steps of the ladder of internationalization. First, indirect exporting is similar to non-exporting, because its upper cutoff (Cut 2) is very close to its lower cutoff (0). Second, indirect exporting has a large support (more than 3 normalized units) showing that many firms choose it, and its cost structure is substantially different from no trade. Outsourced manufacturing is similar to exporting, while the two FDI modes are above the high cutoffs (3.5 and 4.5).

Third, as expected under sorting, cutoffs are strongly related to premia (Table 2). For modes with a large support (direct exporting, FDI modes) we see large premia relative to the modes below, while

premia are smaller for other modes.

4.4 Robustness

In this subsection we discuss some robustness checks with respect to the estimation sample, the variables and the methodology.

4.4.1 Estimation sample

Let us start with a robustness check regarding the estimation sample. As noted in Section 3, this European dataset covers five countries. Tables in the Appendix report the number of firms (B.8), mean TFP (Table C.1 in the Appendix) and mean Innovativeness (Table C.2 in the Appendix) by modes separately for each country. The ranking within each country is similar to the findings for the full sample except for some instances with very few observations (such as manufacturing FDI makers in Hungary). This underlines that our results may be representative of European countries in general.

4.4.2 Coding of modes

Let us turn to testing the robustness of the results with respect to the coding of modes. Here we consider three possible issues: i) top-coding may distort the results; ii) the way of top-coding matters; and iii) excluding vertical FDI and outsourcing affects the results.

Let us start with the effect of top-coding. In Figure B.1 in the Appendix we run separate logit models for each mode and compare the semi-elasticities with the multinomial logit results. In these logits, the dependent variable shows whether a firm employs each of the modes rather than the top-coded variables. Importantly, the results are very similar for the two sets of estimates. The main exception is the positive marginal association between Innovativeness and indirect exporting. This shows that many innovative indirect exporters conduct multiple modes and, hence, get classified into other modes by top-coding. All the other estimates are very similar in the two specifications.

We also repeated the multinomial logit estimation using another ordering for top-coding the modes. The results of an alternative top-coding with direct exporting being top-coded above outsourced manufacturing, are shown in Table C.5 in the Appendix. The main results are again robust to this change.

To check the extent to which omitting vertical FDI affects the results, we have re-run the models by coding firms engaged in any type of FDI or outsourcing as FDI makers or outsourcers. The results, which confirm that this is not a crucial issue, are presented in Table B.6 in the Appendix. This actually turns out to matter for outsourced production, where including these firms more than doubles the prevalence of this mode, and yields higher TFP coefficient estimates compared to the core model of Table 3.

4.4.3 Specification and estimation

The third set of robustness checks concerns specifications. First, we include a set of other explanatory variables into the model to control for potential confounders. Second, we estimate a generalized ordered logit model.

To control for potential confounders, we use two sets of control variables, international sourcing and management. Foreign sourcing is captured via three dummy variables (i) the firm is an importer of goods from third parties; (ii) it imports goods form its overseas manufacturing activities (vertical manufacturing FDI); and (iii) it imports goods form overseas outsourced manufacturing activities (vertical outsourced manufacturing). Adding these variables to the regression (Table C.3 in the Appendix) does not change the results. Management variables are Centralization (a dummy variable if key decisions are made in a centralized way), Firm age (based on the year of establishment), CEO's age, and Family

ownership (a dummy if the firm is majority family owned).[18] We add these management controls to the regression in Table C.4 in the Appendix for multinomial logit and in columns 2 and 3 in Table 4 for the ordered logit, which yields similar results.

Finally, one key assumption of the ordered logit model is the parallel lines assumption, meaning that all the βs in the ordered logit model are the same for all mode. In practice, this is often violated. To test this, we ran the Brant-test and an LR test that rejected the null hypothesis of parallel lines for both TFP and Innovativeness variables. To find out whether our results are affected by this problem, we estimated a generalized ordered logit model of Williams (2006), which allows non-parallel hyperbolae. Table C.6 in the Appendix shows that our main results are broadly robust to this change, but TFP seems to play an increasingly larger role when stepping up to more 'demanding' modes. Note also that the constants in the generalized ordered logit models play a similar role to the (negative of) thresholds in the ordered logit model. The results show that, similarly to the ordered logit, the lower cutoffs of outsourcing and FDI modes are significantly different from other modes.

5 Conclusion

A growing international trade and international business literature has provided ample evidence that firms may choose from a range of potential modes to serve customers in foreign markets.

To study this decision, we extended the Helpman et al. (2004) approach (only domestic sales, exporter and manufacturing FDI maker) by adding additional modes: indirect exporting, outsourced production, and service FDI. To understand sorting in such a diverse set of modes, we extended a productivity-quality two-dimensional sorting model to N potential modes.

This structure and the data with direct information on many internationalization modes with horizontal motives on firm-level in five European countries allowed us to study correlations between productivity, innovativeness and the mode firms choose. As firms may carry out sales via several modes simultaneously, we proposed a way to handle a wide array of mixed modes.

We found evidence consistent with the predictions of the sorting model. The ladder of internationalization is hence made up of various foreign sales mode options that can be ranked by the capabilities that firms need to have in order to proceed. We found that both productivity and innovativeness of firms play a substantial role in the internationalization mode choice. If anything, our measure of innovativeness seems to be more strongly related to mode choice than TFP.

Looking at relative ranking of modes, there seem to be three clear 'clusters' or main steps on the ladder of internationalization: (i) indirect exporting and no trade; (ii) direct exporting and outsourced manufacturing; and (iii) service and manufacturing FDI. These clusters differ significantly, but there seem to be a hierarchy of modes within each of these clusters.

In particular, we can infer a number of conclusions for the specific modes. Indirect exporters often do additional trade modes, and firms that only engage in indirect exporting show no productivity premium compared to non-traders (unlike for Ahn et al. (2011)). At the same time, they display an innovativeness premium. Outsourced manufacturing in our data was found to be rarely employed on its own. Also, we found this mode to be close to exporting in terms of productivity and innovativeness premia. The ranking between non-trade, export and FDI is in line with earlier studies (Helpman et al., 2004, Tomiura, 2007). FDI, both service and manufacturing, is clearly associated with the highest premia. While intuition may suggest a smaller fixed cost associated with service FDI, there seems to be very small difference between these two modes regarding either premia.

Obviously, cross-sectional data allowed us no causal discussion. Instead, our evidence should be considered as one that is consistent with the two-way N-mode selection model we built on.

In general, we believe that a better understanding of the relative cost structure of various interna-

[18] For 383 firms, management variables were imputed as a sample mean with an added imputation dummy variable.

tionalization modes and sorting itself matters for at least four reasons. First, when analyzing firms' internationalization strategies, we should not only consider adaptation along the 'conventional' extensive margin (start trading), and the intensive margin (selling more or less), but also on a margin of 'internationalization mode'. Second, the size of marginal and fixed costs attached to various modes of internationalization affects our understanding of gains from trade.[19] Third, our results confirm that product innovation is a key driver of selection into modes demanding more commitment on international markets. This reinforces that product innovation is worth pursuing by managers and promoting by policymakers. Fourth, our results may help understand how globally engaged firms respond to a mix of trade policies. Indeed, once knowing which types of trade costs (fixed or variable) are important, one can devise better policies to promote market access by, for example, designing policies aimed at alleviating liquidity constraints to support activities with especially high fixed costs.

[19]For instance, Irarrazabal et al. (2013) find that the marginal cost of foreign manufacturing production is often high owing to headquarter input requirements. As a result, the cost structure of exporting and foreign manufacturing production is similar and hence, shutting down FDI manufacturing production leads to relatively small welfare losses.

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Appendix A Theoretical framework

In this section we describe a theoretical framework for our empirical analysis of many internationalization modes when firms are heterogeneous both in terms of their productivity and the quality of their products. In order to do this, we build on the model of Aw and Lee (2014), who, in turn use the Crozet et al. (2013) framework. We generalize this model to many internationalization modes. An advantage of this framework is that it directly generates an empirically relevant ordered logit specification in which both productivity and quality has a positive association with choosing modes requiring stronger commitment in terms of fixed costs.

However, we somewhat modify the model to provide a better fit for our data. First, as not all internationalization modes are available at the firm-country level, we will study how the firm serves foreign markets in general. Second, differences in production costs between home and foreign will be included in the fixed costs of the different internationalization modes rather than displayed explicitly.

A.1 The cost structure of internationalization modes

Let us consider the decision of firm i which is based in the home country and considers serving consumers in the foreign country. The firm can choose between N internationalization modes. For example, in our empirical exercise the firm can choose from among five modes: indirect exporting, direct exporting, outsourcing, service FDI and manufacturing FDI.

In a very simple fashion, we will characterise the cost structure of each internationalization mode with two parameters: the fixed cost of entering the foreign market, $F^n \geq 0$, and an iceberg-type per-unit transportation cost, $\tau^n \geq 1$. We interpret these two parameters very broadly. The fixed cost includes every type of one-time expense like the cost of finding business partners, the cost of buildings and machinery or the administrative costs of setting up foreign operations. τ^n, besides transportation costs, includes less tangible elements such as the markup charged by intermediaries, the hold-up costs resulting from contractual frictions and the wage differences between countries. In what follows, we will call the vector of these two variables, $\{F^n; \tau^n\}$, the cost structure of mode n.

Our key assumption is that internationalization modes can be ranked in a way that serving the foreign market with a more 'demanding' internationalization mode requires larger fixed costs but allows the firm to transport the product with a smaller variable cost. Hence, we assume that:

$$F^n < F^{n+1}, \forall n \quad \text{and} \quad \tau^n > \tau^{n+1}, \forall n \tag{8}$$

Furthermore, we assume that for each mode:

$$\ln \frac{\left(F^{n+1} - F^n\right)\left(\left(\tau^{n+1}\right)^{1-\sigma} - \left(\tau^n\right)^{1-\sigma}\right)}{\left(F^n - F^{n-1}\right)\left(\left(\tau^n\right)^{1-\sigma} - \left(\tau^{n-1}\right)^{1-\sigma}\right)} > 0 \quad ,\forall n \tag{9}$$

where $\sigma > 1$ is the elasticity of demand.

A.2 Demand and technology

Consumers have a constant elasticity of substitution utility function:

$$U = \left(\sum_{i=1}^{n} \left[a(i)^{\lambda} q(i)\right]^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}},$$

where $a(i)$ shows the consumer's taste for variety i. We will interpret this demand shifter as

the 'quality' of the product, though it can also include brand recognition and other factors that are attractive to consumers. $\lambda \geq 1$ shows the importance of quality in consumer preferences relative to prices.

The demand function in the foreign market for variety i is:

$$q(i) = \tfrac{E}{P} a_i^{\lambda(\sigma-1)} p(i)^{-\sigma} \quad \text{where} \quad P = \sum_{j=1}^{n} a(j)^{\lambda(\sigma-1)} p(j)^{1-\sigma},$$

where E is the total expenditure and P is the price index in the foreign market.

Firms are heterogeneous in two dimensions: productivity and quality. We assume that both parameters are unknown before the firm enters, and that they are exogenous and cannot be modified after entry. $\omega(i)$ shows the physical productivity of firm i, while $a(i)$ denotes the quality of the product. Firms producing more innovative goods will have a higher unit cost. Without a loss of generality, we will assume that the wage level in the home country is 1 (and wage differences between the two countries are included in the fixed costs of different internationalization modes). The constant unit cost of production is:

$$c(i) = a(i)^{\gamma}/\omega(i),$$

where $\gamma \geq 1$ determines the marginal cost of producing more innovative goods. We assume that $\lambda > \gamma$, i.e. consumers appreciate quality more than its cost.

Under CES demand and monopolistic competition, firms set prices using constant markups. When the internationalization mode n is chosen, the price, revenue and profit are:

$$\begin{aligned}
p^n(i) &= \tfrac{\sigma}{\sigma-1} \tau_n c(i) \\
r^n(i) &= \tfrac{E}{P} \left(\tfrac{\sigma}{\sigma-1}\right)^{1-\sigma} a(i)^{\lambda(\sigma-1)} \left[\left(\tau^n\right)^{1-\sigma} \omega(i)^{\sigma-1} a(i)^{\gamma(1-\sigma)} \right] \\
\Pi^n(i) &= \tfrac{1}{\sigma} r^n(i) - F^n
\end{aligned}$$

A.3 Internationalization mode choice

The assumptions about the cost structure suggest that firms enter the foreign market whenever it is profitable for them to choose internationalization mode 1, $\Pi^1(i) > 0$. The condition for this is:

$$\tfrac{E}{P} \left(\tfrac{\sigma^{-\sigma}}{(\sigma-1)^{1-\sigma}} \right) a(i)^{(\lambda-\gamma)(\sigma-1)} \left(\tau^1\right)^{1-\sigma} \omega(i)^{\sigma-1} - F^1 \geq 0$$

One can express the threshold productivity level with the quality level of the firm and the model parameters. We will denote this threshold productivity function as $\bar{\omega}^1(a)$:

$$\bar{\omega}^1(a) \equiv \left(F^1\right)^{\frac{1}{\sigma-1}} \left(\tfrac{E}{P}\right)^{\frac{1}{1-\sigma}} \left(\tfrac{\sigma-1}{\sigma^{\frac{\sigma}{1-\sigma}}} \right) \left(\tau^1\right)^{-1} a(i)^{\gamma-\lambda}$$

Given our assumption that $\lambda > \gamma$, this locus is a hyperbola in the a-ω plane: if a firm can produce higher quality goods, its threshold productivity is smaller. The shape of the hyperbola depends both on the consumers' valuation of quality (λ) and the cost of producing it (γ). In particular, the hyperbola becomes steeper if $\lambda - \gamma$ increases; i.e. quality becomes more important for consumers relative to its cost. Other parameters, including the fixed cost, the elasticity of demand and market size do not affect the slope of this curve but they can shift it in and out. A smaller market size, for example, shifts the curve out, making it harder to enter the export market.

Figure A.1 shows such a function. Firms with a-ω combinations above the curve enter the foreign market, while firms below it will only produce for the domestic market (or exit).

The thresholds for choosing other internationalization modes can be derived similarly. Let us denote the curve when firms are indifferent between choosing trade mode $n-1$ and n with $\bar{\omega}^n(a)$. This curve is defined as $\Pi^{n-1}(i) = \Pi^n(i)$:

$$\bar{\omega}^n(a) \equiv \left(F^n - F^{n-1}\right)^{\frac{1}{\sigma-1}} \left(\frac{E}{P}\right)^{\frac{1}{1-\sigma}} \left(\frac{\sigma-1}{\sigma^{\frac{\sigma}{1-\sigma}}}\right) \left(\left(\tau^n\right)^{1-\sigma} - \left(\tau^{n-1}\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}} a(i)^{\gamma-\lambda} \tag{10}$$

Again, the shapes of these hyperbolae depend only on $\gamma-\lambda$; the cost structure of internationalization modes only shifts them out from the origo. Also, the assumption on the relative cost structure guarantees that the distance of these curves from the origo is increasing in n.

Figure A.2 shows that the model implies a two dimensional sorting. Firms will choose internationalization mode n if their $\omega - a$ combination is between the loci $\bar{\omega}^n(a)$ and $\bar{\omega}^{n+1}(a)$.

Figure A.1: Foreign entry

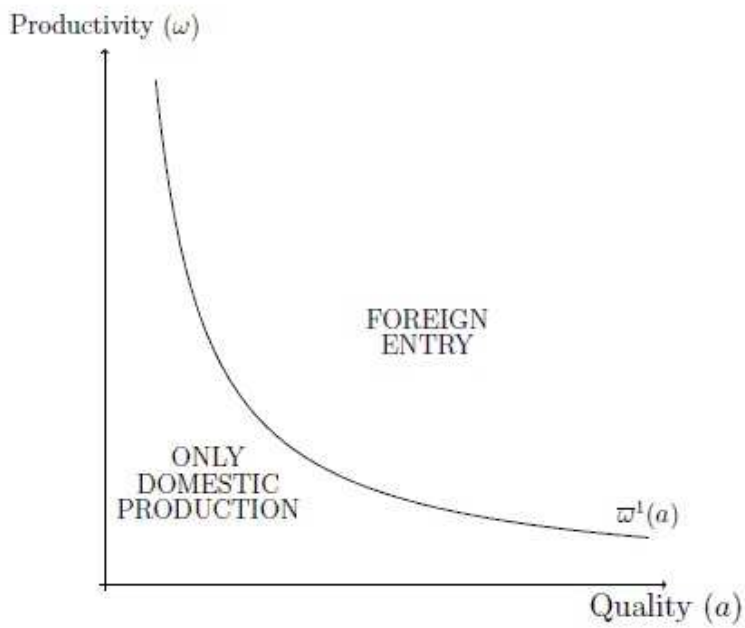
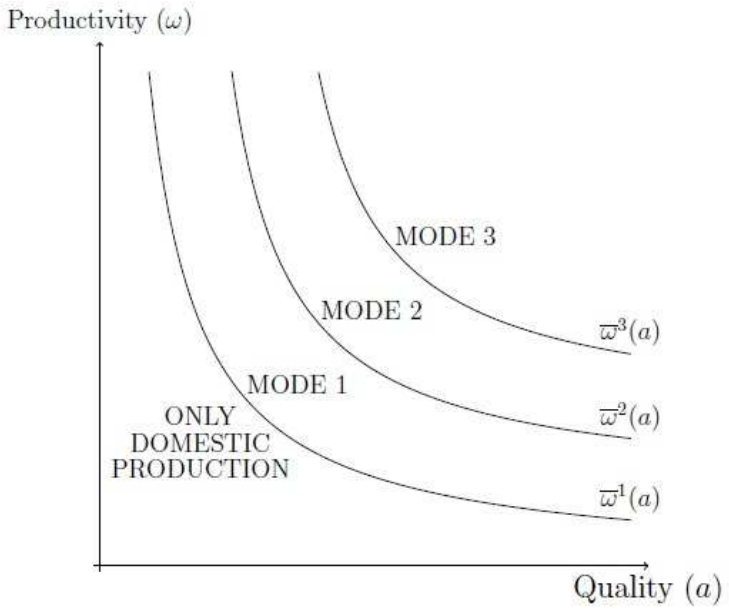


Figure A.2: Different entry modes



Appendix B Additional tables

Table B.1: TFP and standardized TFP by modes

	TFP		TFP (std)	
	Mean	Sd	Mean	Sd
No foreign sales	4.79	0.66	-0.28	0.91
Indirect export	4.99	0.72	-0.01	1.00
Direct export	5.13	0.70	0.2	0.98
Outsourced manuf.	5.26	0.78	0.37	1.08
Service FDI	5.52	0.92	0.73	1.27
Manufacturing FDI	5.56	0.78	0.79	1.08
All	4.99	0.71	0	1

The table classifies each firm into the 'highest' mode they conduct ('top-coding', see details in the text) and reports the the mean and standard deviation of TFP and standardized TFP for each such mode.

Table B.2: Components of the Innovativeness measure by top-coded modes

	Inno1	Inno2	Inno3	Innovativeness	
	Mean	Mean	Mean	Mean	Sd
No foreign sales	0.18	0.33	0.34	-0.41	0.82
Indirect export	0.44	0.52	0.59	-0.18	0.9
Direct export	0.49	0.58	0.65	0.17	0.94
Outsourced manuf.	0.91	0.66	0.75	0.39	1.05
Service FDI	0.93	0.73	0.8	0.76	1.01
Manufacturing FDI	0.96	0.73	0.84	0.83	1.02
All	0.36	0.48	0.52	0	1

This table shows the average values of the three components of our Innovativeness measure for each top-coded mode. Inno1 is a dummy showing whether the firm spent on R&D. Inno2 is a dummy showing whether the firm introduced product innovation. Inno3 is the sum of the number of types of IPs created (applied for a patent, registered an industrial design, registered a trademark, claimed copyright), divided by four. Innovativeness is a standardized score of these variables.

Table B.3: Vertical and Horizontal FDI and Outsourcing

	Manufacturing FDI			Outsourced manufacturing		
	N	TFP	Innovativeness	N	TFP	Innovativeness
All	385	0.73	0.78	359	0.37	0.52
Horizontal	255	0.79	0.82	157	0.37	0.65
Vertical	246	0.67	0.83	290	0.39	0.56

This table shows the number, average TFP and Innovativeness of firms conducting different types of FDI and outsourced manufacturing.

Table B.4: Manufacturing FDI categories

Direct Manufacturing FDI	Modes	Horizontal	Vertical	All
Sold in the foreign country where the production facility is located	192	254		385
Sold directly in third countries where the firm does not produce	134			
Sold directly in third countries where where other production facilities are located	48			
Imported into your firms home country for use in production	158		246	
Imported into your firm's home country to be directly sold in the domestic market	163			
Imported into your firms' home country to be re-exported to third countries	140			
Not answered	10			

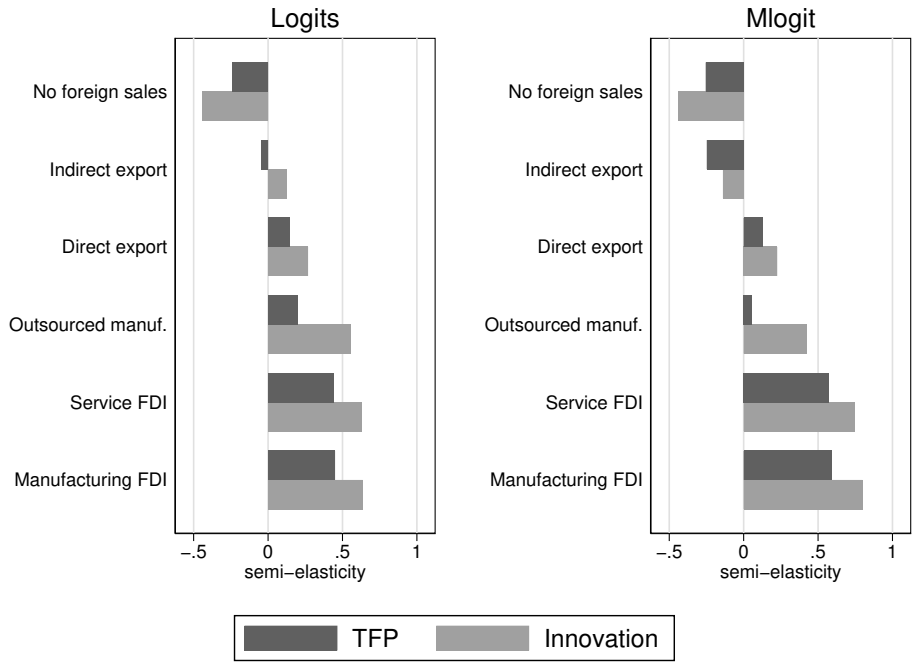
This table shows the number of firms conducting different types of FDI and the way they were classified (horizontal and vertical). Note that each firm can conduct multiple modes.

Table B.5: Outsourced manufacturing categories

Contracted Manufacturing	Modes	Horizontal	Vertical	All
Sold in the foreign country where the production facility is located	91	157		358
Sold directly in third countries where the firm does not produce	87			
Sold directly in third countries where where other production facilities are located	32			
Imported into your firm's home country for use in production	224		290	
Imported into your firm's home country to be directly sold in the domestic market	189			
Imported into your firms' home country to be re-exported to third countries	146			
Not answered	10			

This table shows the number of firms conducting different types of outsourced manufacturing and the way they were classified (horizontal and vertical). Note that each firm can conduct multiple modes.

Figure B.1: Average semi-elasticities, separate logits and mlogit [20]



This figure shows the average marginal effects (semi-elasticities) of TFP and Innovativeness on the probability of choosing the different modes estimated from separate logit models for each mode (left panel). The right panel shows the semi-elasticities estimated from the core multinomial logit model as a comparison.

Table B.6: No distinction between horizontal and vertical motives - multinomial logit

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	-0.0212	0.399***	0.467***	0.900***	0.898***
	(0.0767)	(0.0581)	(0.105)	(0.102)	(0.111)
Innovativeness	0.326***	0.661***	0.779***	1.210***	1.223***
	(0.0554)	(0.0372)	(0.0796)	(0.0641)	(0.0933)
Observations					8,581
Pseudo R-squared					0.119

This table shows the coefficients of the multinomial logit model when FDI and outsourcing modes include both horizontal and vertical activities, rather than only horizontal as in the core model. In this model the dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.7: TFP and Innovativeness: robustness of ordered logit results

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
TFP	0.593***		0.484***	0.571***		0.476***
	(0.0608)		(0.0563)	(0.0491)		(0.0462)
Innovativeness		0.797***	0.724***		0.755***	0.694***
		(0.0322)	(0.0317)		(0.0307)	(0.0313)
Constant cut1	-0.518***	-0.560***	-0.592***	-0.388***	-0.241***	-0.401***
	(0.0860)	(0.0932)	(0.0776)	(0.0310)	(0.0169)	(0.0320)
Constant cut2	-0.360***	-0.394***	-0.419***	-0.224***	-0.0685***	-0.223***
	(0.0889)	(0.0968)	(0.0805)	(0.0311)	(0.0199)	(0.0329)
Constant cut3	2.463***	2.565***	2.662***	2.700***	2.981***	2.932***
	(0.126)	(0.108)	(0.108)	(0.108)	(0.112)	(0.112)
Constant cut4	2.641***	2.745***	2.849***	2.881***	3.164***	3.122***
	(0.132)	(0.112)	(0.113)	(0.109)	(0.111)	(0.112)
Constant cut5	3.656***	3.771***	3.905***	3.910***	4.202***	4.188***
	(0.162)	(0.135)	(0.142)	(0.149)	(0.147)	(0.150)
Industry X country FE				YES	YES	YES
Observations	8,581	8,581	8,581	8,581	8,581	8,581
Pseudo R-squared	0.0364	0.0633	0.0862	0.0577	0.0815	0.101

This table shows the coefficients of ordered logit models with different sets of explanatory variables, in which the dependent variable is the top-coded mode conducted by each firm, and the ordering is based on TFP premia (see text). TFP and Innovativeness are standardized. Cutoff names show the category above the cutoff and are normalized w.r.t the first cutoff between no trade and indirect export. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B.8: Number of firms by country and top-coded mode

	Number of firms					
	France	Germany	Hungary	Italy	Spain	Total
No foreign sales	945	266	43	883	1164	3301
Indirect export	78	27	14	74	112	305
Direct export	950	302	87	1693	1185	4217
Outsourced manuf.	44	15	3	29	18	109
Service FDI	113	74	10	125	72	394
Manufacturing FDI	69	76	5	57	48	255
Total	2199	760	162	2861	2599	8581

The table classifies each firm into the 'highest' mode they conduct ('top-coding', see details in the text) and reports the number of firms separately for each country.

Appendix C

This Appendix C consists of three parts. Subsection C.1 includes additional descriptive evidence on sorting across modes by presenting how TFP and innovativeness differs across modes within countries. Subsection C.2 presents some of our regression results in detail and includes a number of robustness checks. Subsection C.3 describes our production function estimation procedure.

C.1 Further Descriptive Tables

Table C.1: Average TFP by country and top-coded mode

	Mean TFP (std)					
	France	Germany	Hungary	Italy	Spain	Total
No foreign sales	-0.13	0.21	-0.86	-0.13	-0.6	-0.28
Indirect export	-0.18	0.06	-0.61	0.05	-0.64	-0.29
Direct export	0.14	0.44	-0.56	0.29	-0.14	0.13
Outsourced manuf.	0.07	0.35	-0.24	0.32	-0.4	0.09
Service FDI	0.72	0.70	0.5	0.94	0.47	0.73
Manufacturing FDI	0.68	0.76	-0.22	1.15	0.65	0.79
Total	0.06	0.4	-0.56	0.2	-0.34	0

The table classifies each firm into the 'highest' mode they conduct ('top-coding', see details in the text) and reports the mean of the standardized TFP for each country and mode.

Table C.2: Average Innovativeness by country and top-coded mode

	Mean Innovativeness					
	France	Germany	Hungary	Italy	Spain	Total
No foreign sales	-0.37	-0.31	-0.51	-0.45	-0.42	-0.41
Indirect export	-0.33	0.4	-0.3	-0.25	-0.15	-0.18
Direct export	0.15	0.38	-0.19	0.16	0.18	0.17
Outsourced manuf.	0.61	1.05	-0.51	0.07	-0.03	0.39
Service FDI	0.84	0.97	0.65	0.67	0.59	0.76
Manufacturing FDI	0.66	0.87	0.36	0.88	1	0.83
Total	-0.03	0.26	-0.22	0	-0.08	-0.01

The table classifies each firm into the 'highest' mode they conduct ('top-coding', see details in the text) and reports the mean of the Innovativeness for each country and mode.

C.2 Additional robustness checks

Table C.3: Multinomial logit coefficients when controlling for foreign sourcing variables

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	-0.0424	0.332***	0.204*	0.780***	0.710***
	(0.0742)	(0.0513)	(0.116)	(0.0911)	(0.122)
Innovativeness	0.282***	0.598***	0.678***	1.106***	0.986***
	(0.0595)	(0.0353)	(0.0960)	(0.0685)	(0.119)
FS: third party goods	0.510***	1.014***	0.570***	1.303***	1.201***
	(0.116)	(0.0647)	(0.213)	(0.149)	(0.188)
FS: outsourced goods	0.516	0.734***	4.827***	1.656***	1.188***
	(0.475)	(0.205)	(0.274)	(0.291)	(0.343)
FS: affiliate prod goods	-0.205	0.631***	-0.700	-27.73***	4.117***
	(0.742)	(0.205)	(0.788)	(0.349)	(0.230)
Observations					8,581
Pseudo R-squared					0.181

This table reports coefficients of our baseline multinomial model when the following foreign sourcing variables are also included: third party goods importer (importer of goods), outsourced product importer (vertical outsourcing manuf.), affiliate production importer (vertical manufacturing FDI). The dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.4: Multinomial logit coefficients when controlling for foreign sourcing and management variables

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	-0.0583	0.326***	0.174	0.761***	0.714***
	(0.0764)	(0.0509)	(0.118)	(0.0895)	(0.128)
Innovativeness	0.271***	0.594***	0.673***	1.107***	0.975***
	(0.0592)	(0.0366)	(0.0938)	(0.0656)	(0.117)
FS: third party goods	0.509***	1.020***	0.557***	1.297***	1.178***
	(0.111)	(0.0642)	(0.214)	(0.147)	(0.190)
FS: outsourced goods	0.528	0.753***	4.818***	1.705***	1.185***
	(0.468)	(0.204)	(0.288)	(0.295)	(0.339)
FS: affiliate prod goods	-0.191	0.643***	-0.680	-39.15***	4.114***
	(0.740)	(0.207)	(0.808)	(0.482)	(0.226)
Managament vars	YES	YES	YES	YES	YES
Observations					8,581
Pseudo R-squared					0.186

This table reports coefficients of our baseline multinomial model when both foreign sourcing and management controls are included. Sourcing variables are: third party goods importer (importer of goods), outsourced product importer (vertical outsourcing manuf.), affiliate production importer (vertical manufacturing FDI). Management variables are: Centralized decision making, Firm age, CEO age, and Family ownership. The dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.5: Multinomial logit results with a different top-coding

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	-0.0197	0.325	0.409***	0.882***	0.879***
	(0.0763)	(0.210)	(0.0581)	(0.102)	(0.135)
Innovativeness	0.321***	0.484***	0.672***	1.183***	1.239***
	(0.0588)	(0.164)	(0.0351)	(0.0670)	(0.114)
Observations					8,553
Pseudo R-squared					0.123

This table shows the coefficients of the core multinomial logit model when direct exporting is considered as a 'higher' mode than outsourced manufacturing during the top-coding. In this model the dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table C.6: Generalized ordered logit

VARIABLES	Indirect export	Direct export	Outsourced manufacturing	Service FDI	Manufacturing FDI
TFP	0.414***	0.442***	0.561***	0.636***	0.588***
	(0.0284)	(0.0283)	(0.0397)	(0.0412)	(0.0530)
Innovativeness	0.687***	0.682***	0.710***	0.732***	0.690***
	(0.0283)	(0.0277)	(0.0421)	(0.0442)	(0.0650)
Constant	0.374*	0.199	-3.007***	-3.254***	-4.270***
	(0.211)	(0.211)	(0.216)	(0.218)	(0.228)
Observations	8,581	8,581	8,581	8,581	8,581
Pseudo R-squared	0.103	0.103	0.103	0.103	0.103

This table shows the coefficients when the core model is estimated with generalized ordered logit. In this model the dependent variable is the top-coded mode conducted by each firm, with 'no foreign sales' as the base category. TFP and Innovativeness are standardized. All columns include country-industry dummies. Robust standard errors, clustered at country-industry level, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

C.3 Production function estimation

We perform the production function estimation on the value added with capital and labor inputs following Wooldridge (2009). Wooldridge (2009) shows that the two-step production function estimation procedures developed by Olley and Pakes (1996), Levinsohn and Petrin (2003) and Ackerberg et al. (2015) can be implemented in a one-step generalized method of moments (GMM) framework.

The production function estimating equation with all variables in logs is

$$y_{it} = \beta_l l_{it} + \beta_k k_{it} + g\left(k_{i,t-1}, m_{i,t-1}\right) + \delta_t + \epsilon_{it}. \tag{11}$$

Value added output of firm i in year t (y_{it}) is a function of the current labor (l_{it}) and capital (k_{it}) use and a function $g(.)$ of lagged capital and material use, which proxies for the expected (in $t-1$) component of the current total factor productivity, while the δ_t are year intercepts. As it is customary in the literature, we specify function $g(.)$ as a third-degree polynomial with interaction terms.[21] The error term ϵ_{it} also incorporates the (unexpected) productivity shock.

The parameters of interest, β_l and β_k, measure the output elasticity of labor and capital, respectively. In order to obtain unbiased estimates, however, one has to account for the possible correlation between the current variable input (l_{it}) and the productivity shock in the error term. This is achieved by a generalized method of moments instrumental variable estimation, where l_{it} is instrumented with $l_{i,t-1}$, while all other right-hand side variables are instruments for themselves.

We measure value added output as sales minus material costs, labor input by the number of employees, capital input by fixed assets and material use by material costs of the firm. We deflate sales and material costs with industry- and country-specific producer prices and fixed assets with country-specific prices for capital goods.[22]

We estimate (Equation 11) on an unbalanced panel of the broadest possible set of French, German, Italian and Spanish firms in the Amadeus database over years 2004-2013. We perform the estimation separately by country and three-digit NACE industry.[23] Figure C.1 presents the histogram of the estimated output elasticities of labor for our baseline estimation sample. The estimated industry-country elasticities fall in a reasonable range with a sample mean of 0.66.

Based on the estimated output elasticities we can calculate the total factor productivity (in log) of firm i in year t as

$$\ln \mathrm{TFP}_{it} = y_{it} - \hat{\beta}_l^{(cj)} l_{it} - \hat{\beta}_k^{(cj)} k_{it},$$

where $\hat{\beta}_k^{(cj)}$ is the estimated output elasticity for capital, specific to country-industry cj. Figure C.2 presents histograms of the estimated firm-level productivities by country.

[21] The terms of the polynomial are hence $k_{i,t-1}$, $m_{i,t-1}$, $k_{i,t-1}m_{i,t-1}$, $k^2_{i,t-1}$, $m^2_{i,t-1}$, $k^2_{i,t-1}m_{i,t-1}$, $k_{i,t-1}m^2_{i,t-1}$, $k^3_{i,t-1}$ and $m^3_{i,t-1}$.

[22] The source of the price indices is Eurostat.

[23] We made sure that the number of observations per country and industry is not smaller than 50, otherwise we merged some three-digit industries.

Figure C.1: Histograms of $\hat{\beta}_l$ by country

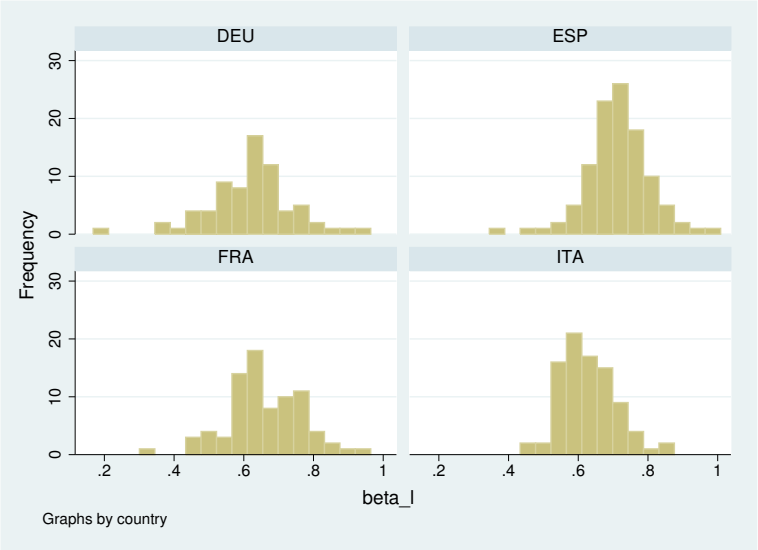


Figure C.2: Histograms of TFP by country