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ABSTRACT

The Internationalization Process of Firms: from Exports to FDI*

This paper shows that uncertainty can lead firms to follow a gradual internationalization process. We describe a model in which firms are uncertain about their ability to earn profits in a foreign market and must decide whether or not to serve it, and whether to do so through exports or foreign affiliate sales. We show that a firm may first test the foreign market via exports, before engaging in foreign direct investment (FDI). To assess the evidence, we exploit a unique dataset of firm-level exports and FDI in individual destination countries, covering all Belgian companies over the 1998-2008 period. We show that a firm's FDI entry in a foreign market is almost always preceded by its export entry. More uncertain foreign market conditions lead new exporters to delay FDI entry decisions. Our analysis suggests that exports and FDI, although substitutes from a static perspective, may be complements over time, since the knowledge acquired through export experimentation can lead firms to start investing abroad.

JEL Classification: D21, F10 and F13
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1 Introduction

In recent decades, more and more companies have started to operate internationally, selling their goods to foreign customers through exports or local subsidiary sales. When deciding whether and how to serve a new market, firms face considerable uncertainty: they may be unaware of local regulations and legal requirements for selling their goods in a particular foreign market; they may also be uncertain about the size of foreign demand and the adequacy of their products to local tastes. In this paper, we examine how uncertainty affects firms' choices to serve foreign markets through exports or horizontal foreign direct investment (FDI).[1]

A vast literature in international business emphasizes that uncertainty about the "characteristics of the specific national market – its business climate, cultural patterns, structure of the market system, and, most importantly characteristics of the individual customer" can lead firms to follow a gradual internationalization process, serving a foreign market via exports before deciding whether to invest there (Johanson and Vahlne, 1977). Indeed, firms almost never establish affiliates in a foreign market without first "testing" it via exports. For example, looking at all Belgian manufacturing firms that started to invest abroad during the 1998-2008 period, we find that in almost 90% of the cases they were already serving the foreign market via exports (see Section 4).

Standard static models of firms' internationalization choices cannot explain why FDI entry is almost always preceded by export entry. In these models, a firm will either serve a foreign market through export *or* FDI (e.g. Markusen, 1984; Brainard, 1997; Helpman *et al.*, 2004). To explain switches from one mode to the other, we describe a simple dynamic model of export and FDI choices, which formalizes the idea of a gradual internationalization process. In the spirit of Jovanovic (1982), firms are uncertain about their ability to earn profits in a foreign market, and can only discover it by operating there. In this setting, we show that firms may first test a foreign market via exports, before establishing foreign affiliates. The intuition for this result is simple: in the face of uncertainty, exporting allows to experiment in a foreign market at a lower fixed cost; if a firm discovers that it can earn large enough profits by serving foreign consumers,

[1] Horizontal FDI refers to the establishment of foreign production facilities with the purpose of serving the local market. In their review of the empirical literature on FDI, Markusen and Maskus (2003) and Blonigen (2005) conclude that most FDI is horizontal in nature. Indeed, foreign affiliates worldwide sell most of their products locally. For example, over the period 2005-2010, less than 19 percent of affiliate sales were sold outside of the country of production (UNCTAD, 2011). Since our goal is to examine firms' choices on how to serve customers in a foreign market, we abstract from vertical FDI, which involves the fragmentation of the production process across different countries to reduce costs. See Hanson *et al.* (2005) for a study on vertical FDI.

it establishes production facilities to avoid paying the trade costs. If all uncertainty is resolved upon entering the foreign market, export experimentation will last only one period, at the end of which firms will decide whether or not to switch to FDI. If instead firms are still uncertain about their profitability following export entry, they will experiment for several periods, preferring to "wait and see" and postpone the decision to establish foreign affiliates. Foreign market uncertainty should thus delay FDI entry by new exporters, in line with the predictions of real options investment models (e.g. McDonald and Siegel, 1986; Dixit and Pindyck,1994).

To assess the evidence, we exploit a unique dataset from the National Bank of Belgium, which provides detailed information on exports and FDI activities of all companies registered in Belgium over the 1998-2008 period. This allows us to study the dynamics of firms' internationalization choices in individual foreign markets and examine whether uncertainty affects the probability of switches from exports to FDI.

In our benchmark analysis, we focus on destinations outside the European Single Market, in which Belgian firms face more uncertain demand and supply conditions than inside the Single Market. We classify a firm as a "new exporter" if it starts exporting to a country, after at least five years of not exporting there.[2] We restrict the attention to new exporters that have foreign affiliates in at least one of the destination countries during our sample period. This guarantees that firms in our sample are at least potentially confronted with the proximity-concentration tradeoff under uncertainty described in our theoretical model.

As in recent studies on export dynamics (e.g. Eaton *et al.*, 2008; Albornoz *et al.*, 2012), we find that firms start by exporting small amounts and are likely to drop out of the foreign market in the first years after entry; export volumes and survival probability increase significantly in the following years. In line with our theoretical model, these findings suggests that firms engage in a process of trials and errors in foreign markets.

The key novelty of analysis is that export experimentation can lead firms to start investing in the foreign market: new exporters may become "new FDIers". The panel structure of our data allows us to trace export and FDI entry of each individual Belgian firm in a foreign market and measure the time spell occurred between the creation of the investment opportunity in a foreign market (export entry) and the first investment

[2]Our definition of export entry is more stringent than the one used in most studies of export dynamics, in which a firm is classified as a new exporter if it exports to a foreign market, after just one year of no exporting (Besedes and Prusa, 2006; Eaton *et al.*, 2008; Ruhl and Willis, 2008). This allows us to identify firms that start experimenting in foreign markets and to minimize the number of re-entries: in our sample, these account for only 3.4 percent of export entries; if we used the standard definition, they would instead account for 50 percent of export entries.

undertaken by the firm in that market (FDI entry). Using proportional hazard models, we can then examine whether uncertainty affects the probability that a new exporter starts engaging in FDI, avoiding (left and right) censoring problems.[3] In all regressions, we include firm fixed effects to account for time-invariant firm characteristics that may affect export and FDI decisions, exploiting variation in the degree of uncertainty faced by individual firms (across countries, and within countries over time).

To capture the extent of uncertainty faced by a new exporter, we construct four alternative variables: i) a firm's export experience in a foreign market, measuring the number of years in which it has been serving the market via exports; ii) a dummy variable identifying countries that implement bilateral investment treaties (BITs) with Belgium, making investment conditions in these countries more predictable; iii) the exit rate of new exporters in a foreign country, which provides a direct measure of the extent of uncertainty and experimentation in that country; iv) the variance of the World Bank's index of the quality of a country's business regulations, which captures uncertainty in its regulatory environment.

As expected, we find that uncertainty deters new exporters from investing in a foreign market: the hazard of FDI entry increases significantly with a firm's export experience in a foreign country and with the implementation of investment treaties; more uncertain foreign market conditions (captured by a higher exit rate of new exporters and a higher variance in the quality of business regulations) have the opposite effects, leading to a significant drop in the probability of FDI entry. The effects are sizable: a one standard deviation increase in export experience increases the probability of FDI entry by up to 190%; the implementation of a BIT raises the probability of new FDI by almost 100%; a one standard deviation increase in the exit rate of new exporters and in the variance of the World Bank's index of regulation reduce the likelihood of new FDI by around one third and two thirds, respectively.

We perform a series of robustness checks, showing that the uncertainty measures continue to be significant and with the expected sign when we control for alternative determinants of FDI decisions, include country fixed effects to account for any time-invariant characteristics of destination markets, use different samples of countries and firms, and employ different econometric methodologies to estimate the occurrences of FDI entry by new exporters.

[3]Empirical studies of real option theories employ proportional hazard models to verify whether uncertainty delays investment decisions. For example, Hurn and Wright (1994) and Favero *et al.* (1994) use Cox or Weibull regression models to analyze irreversible investment choices under uncertainty, estimating the delay between the discovery of an oil field and its development. Kogut and Chang (1996) consider the spell between sequential investments by Japanese electronics firms in the United States.

Our results show that firms' export and FDI decisions must be understood as part of a broader dynamic strategy to serve foreign markets in the face of uncertainty. They suggest that, even when exports and FDI represent alternative ways of serving a foreign market – and are thus substitutes from a static perspective – they may be *complements over time* – since the knowledge acquired through export experience can lead firms to invest abroad. This can help to explain why most studies fail to find evidence of a positive effect of trade protection on FDI (e.g. Grubert and Mutti, 1991; Blonigen, 1997) and why drastic reductions in transport costs and trade barriers over the past few decades have been accompanied by a surge (rather than a fall) in horizontal FDI.[4]

Our analysis has important implications concerning the effects of trade and FDI liberalization. Governments often try to attract FDI to bring much-needed capital, new technologies, marketing techniques, and management skills, while also making efforts to reduce trade barriers. Contrary to the standard literature on the proximity-concentration tradeoff (e.g. Markusen, 1984; Brainard, 1997; Helpman et al., 2004), this paper suggests that these two objectives are not necessarily at odds with each other: trade liberalization may actually foster FDI, by lowering the costs of export experimentation. The converse is also true: FDI liberalization may lead to export entry, by increasing the option value of export experimentation.

The remainder of this paper is organized as follows. Section 2 briefly reviews the literature related. Section 3 presents a model of firms' internationalization choices under uncertainty. Section 4 describes the datasets and variables used in our empirical analysis. In Section 5, we examine the role of uncertainty in explaining FDI entry decisions by new exporters. Section 6 concludes.

2 Related literature

Our paper builds on the vast literature on the proximity-concentration tradeoff, which examines firms' decision on whether to serve a foreign market, and whether to do so through export or horizontal FDI. These modes of market access have different relative costs: FDI involves a higher fixed cost, but lower variable costs than exporting. The key prediction of traditional models of the proximity-concentration tradeoff is that firms will invest abroad when the gains from avoiding trade costs outweigh the costs of maintaining capacity in multiple markets (e.g. Markusen, 1984; Horstmann and Markusen, 1992; Brainard, 1997; Markusen and Venables, 2000). Our paper shows that, when firms are

[4]Between 1990 and 2010, sales by foreign affiliates worldwide have increased from $5 trillion to $33 trillion (UNCTAD, 2011).

uncertain about their profitability in a foreign market, they may experiment by serving the market via exports – the mode characterized by lower fixed costs – before switching to FDI.[5]

Helpman *et al.* (2004) introduce firm heterogeneity à la Melitz (2003) into a simple model of the proximity-concentration tradeoff and show that the higher fixed cost of FDI give rise to selection effects: the most productive firms engage in FDI, the less productive ones will export, and the least productive ones serve only the home market. Using data on exports and FDI sales of US firms in 38 countries and 52 industries, they provide cross-sectional evidence supporting this prediction. The paper by Helpman *et al.* (2004) emphasizes the importance of productivity differences in explaining static export and FDI choices of different firms within sectors. Our paper focuses instead on the *dynamic* choices of *individual firms*, highlighting the importance of market uncertainty and experimentation.[6]

The paper by Rob and Vettas (2003) is more closely related to ours. They describe an infinite horizon model in which a multinational firm can serve a foreign market via exports, horizontal FDI, or a combination of the two. Foreign demand grows stochastically over time: in each period, it either continues to grow or stops growing forever. FDI entails the risk of creating under-utilized capacity in the case that the market turns out to be small, so the firm always starts with exports and switches to FDI if demand is large enough. Our paper differs from Rob and Vettas (2003) in two main dimensions. First, in their model firms are only uncertain about foreign demand; we assume instead that they are more generally uncertain about their profitably in the foreign market, which can be affected by both demand and supply conditions. Second, and most importantly, while their analysis is only theoretical in nature, we bring the predictions of our model to the data, exploiting detailed information about the dynamics of firms' exports and FDI choices in individual foreign markets.

The idea that uncertainty can lead firms to delay investment is central to real options theory. This suggests that, if investments are irreversible and market conditions are uncertain, firms may prefer to minimize current investments but secure an option to

[5]Horstmann and Markusen (1996) develop a theoretical model of multinationals' decisions when foreign market conditions are uncertain. Rather than on the choice between exports and FDI, their analysis focuses on the choice between serving a foreign market via FDI or through a contractual arrangement with a local agent who has superior information about the market characteristics.

[6]A recent paper by Ramondo *et al.* (2010) introduces country-specific productivity shocks in a static model of the proximity-concentration tradeoff with heterogeneous firms; their analysis does not examine firms' dynamics and experimentation, focusing instead on the relationship between cross-country differences in output fluctuations and cross-country patterns of exports and affiliate sales. Oldenski (2012) estimates interaction effects between task content and country characteristics in firms' decision between exports and horizontal FDI, emphasizing the importance of information transmissions.

invest at a later time (e.g. McDonald and Siegel, 1986; Dixit and Pindyck,1994, Guiso and Parigi, 1999). In these models, uncertainty increases the range of inaction where investment is zero as the firm prefers to "wait and see" rather than undertaking a costly action with uncertain consequences. Our paper shows that, when faced with the choice on how to serve foreign markets, firms may first "test" a foreign market via exports and later establish foreign affiliates; uncertainty delays the decisions of new exporters to start investing in the foreign market.[7]

The difficulty for firms to acquire information about foreign markets has long been emphasized by the aforementioned international business literature. Starting from Johanson and Vahlne (1977), many studies have argued that market-specific knowledge can only be gained by operating in individual foreign markets, is often tacit in nature, highly dependent on individuals, and thus difficult to transfer to other individuals or other contexts. To acquire such knowledge, firms first serve foreign markets via exports and eventually, in some cases, establish foreign production subsidiaries.[8] Our paper develops a simple dynamic model to formalize these ideas and provides systematic evidence for firms' gradual involvement in foreign markets.[9]

Finally, our paper is related to the recent but increasingly vast literature on firms' export dynamics. These studies identify some stylized facts about new exporters: they begin by exporting small amounts and are likely to drop out of the foreign market in the following few years; conditional on surviving, their export volumes grow rapidly and account for a substantial proportion of export growth.[10] Theoretical models seeking to account for firms' export dynamics emphasize learning about foreign markets and trade relationships.[11] Most related to our analysis is the recent paper by Albornoz *et*

[7]As pointed out by Bloom *et al* (2007), one of the main difficulties in testing real options models is the extreme rarity of observations with zero investment. Since few new exporters establish foreign affiliates, studying their FDI entry decisions provides an ideal setting to verify whether uncertainty delays investments.

[8]This literature also suggests that firms may first engage in joint ventures with local firms, which provide the right (but not the obligation) for future investment (e.g. Chi, 2000) and can help to obtain knowledge about local market conditions (Chi and McGuire, 1996). Once uncertainties have been reduced, firms involved in joint ventures may choose to purchase more equity in the venture, sell their equity share, or dissolve the venture (e.g. Kumar, 2005). See Raff and Ryan (2008) for an analysis of the timing of FDI projects.

[9]The international business literature has relied on case studies or surveys to examine firms' internationalization choices. For example, the seminal contribution by Johanson and Vahlne (1977) is based on case studies of few Swedish firms, while the more recent paper by Brouthers *et al.* (2008) relies on a survey of Dutch and Greek firms.

[10]See, for example, Eaton *et al.* (2008) for Columbian firms, Aeberhardt *et al.* (2009) for French firms, Lawless (2009) for Irish firms, and Albornoz *et al.* (2012) for Argentinian firms.

[11]One of the earlier papers on trade dynamics and incomplete information is Rauch and Watson (2003). They describe a model with costly search in which a buyer from a developed country is uncertain about whether exporters from developing countries are able to fill a large scale order. In this setting,

al. (2012). They consider a setting in which firms discover their profitability in foreign markets by exporting to them and examine the dynamics of their *export* choices *across* different destinations. Our focus is instead on how learning and experimentation *within* a given destination can lead firms to switch from *exports to FDI*.

3 Export and FDI choices under uncertainty

3.1 Setup

As discussed in the introduction, the literature in international business has put forward the idea that firms follow a gradual internationalization process: the need to acquire knowledge about local demand and supply conditions leads them to serve a foreign market via exports before engaging in FDI.

In this section, we develop a simple dynamic model of firms' export and FDI choices to formalize this idea. There are two main ingredients of our model. First, in line with the proximity-concentration tradeoff literature (e.g. Markusen, 1984; Horstmann and Markusen, 1992; Brainard, 1997; Markusen and Venables, 2000), we assume a cost asymmetry between exports and FDI: exporting involves a lower fixed cost, while FDI involves lower variable costs. Second, firms are uncertain about their profitability in foreign markets. To capture the process of experimentation, we follow Albornoz *et al.* (2012), who describe a simple two-period game in which firms are initially uncertain about demand and supply conditions in a foreign market and can only learn whether they can profitably serve it by actually operating there.

Our theoretical model abstracts from firm heterogeneity, which has been extensively studied in the literature (e.g. Head and Ries, 2003; Helpman *et al.*, 2004), focusing on the dynamics of the internationalization choices of individual firms. We consider a representative risk-neutral firm producing good k in its domestic market, which must decide whether to serve a foreign market i, and whether to do so via exports or foreign affiliate sales.

Variable costs comprise two components: a known unit cost of production, which is normalized to zero, and an unknown unit cost of distributing the good in the foreign market, c_{ik}. If the firm serves the foreign market via exports, it bears a unit trade cost

trade relations start small because importers "test" exporters by placing small orders that reveal their type. Eaton *et al.* (2010) develop a model where producers learn about the appeal of their products by devoting resources to finding consumers and observing the experiences of competitors. Freund and Pierola (2010) focus on the incentives of firms to develop new export products in the face of uncertainty about export costs. Their analysis of the frequency of entry and exit from foreign markets for Peruvian firms in the non-traditional agricultural sector in Peru shows a process of "trial and errors".

τ_{ik} (reflecting both transport costs and barriers to trade) and incurs a one-time fixed cost equal to F_{ik}^E (e.g. capturing the costs of learning about customs procedures). If instead the firm engages in FDI, setting up a foreign production subsidiary, it avoids paying the trade costs, but incurs a one-time fixed cost $F_{ik}^I > F_{ik}^E$. Both fixed costs are assumed to be irreversible.[12] The firm faces a linear demand in the foreign market: $q_{ik}(p_{ik}) = a_{ik} - p_{ik}$, where q_{ik} and p_{ik} denote the output sold in the foreign market and the corresponding price, and a_{ik} is an unknown parameter.

Following Albornoz *et al.* (2012), uncertainty in foreign profitability is captured by the random variable

$$\mu_{ik} \equiv a_{ik} - c_{ik}, \tag{1}$$

with continuous cumulative distribution function $G(.)$ on the support $[\underline{\mu}_{ik}, \overline{\mu}_{ik}]$ and mean $E\mu_{ik}$. $\overline{\mu}_{ik}$ is realized with the highest possible demand intercept and the lowest possible distributions cost; $\underline{\mu}_{ik}$ is realized under the opposite extreme scenario. As discussed below, before serving the foreign market, the firm knows the distribution $G(.)$. However, it can only discover it own profitability in the foreign market if it operates there, either through exports or FDI.[13]

To simplify notation, in what follows we drop country and sector subscripts, with the understanding that country variables refer to foreign market i and sectoral variables refer to industry k.

For a proximity-concentration tradeoff to arise, the fixed cost of FDI must be larger than the fixed cost of exporting. We assume the following:

Assumption 1 $F^I \geq \frac{1}{2}(2\sqrt{F^E} + \tau)^2$.

This restriction ensures that the cost of setting up a subsidiary is sufficiently large that FDI does not always dominate exports as a mode of serving the foreign market.

3.2 Timing and entry strategies

Without loss of generality, we assume that the firm does not discount the future. The timing of decisions is as follows:

[12] The fixed cost of setting up a foreign subsidiary in a given market is also assumed to be independent of whether or not a firm has already exported to that market. The implications of relaxing this assumption are discussed in footnote 17.

[13] In line with standard models of the proximity concentration tradeoff, our analysis focuses on firms' choice between exports and horizontal FDI. In Appendix A-1, we show that the logic of our model can also be applied to understanding firms' decision on whether or not to invest in a distribution network.

$t = 1$: the firm chooses between exporting to the foreign market, setting up a foreign subsidiary, or not entering the market at all. If the firm decides to enter via exports (FDI), it pays the per-destination fixed cost F^E (F^I) and chooses how much to sell in that period. At the end of this period, if the firm has sold a positive amount, it infers μ from its profit.

$t = 2$: if the firm has not entered the foreign market at $t = 1$, it decides whether or not to do so. If the firm has entered at $t = 1$, it decides whether to exit the foreign market, serve it under the same mode, or switch mode.

The setup is similar to Jovanovic (1982)'s model of firm dynamics, in which individuals are uncertain about their entrepreneurial ability and can only discover it through the process of starting a new firm. In our model, firms can only find out their profitability in a foreign market by actually serving it, via exports or foreign affiliate sales. Firms choose between three possible entry strategies:

a) Entry via exports at $t = 1$: in the first period, the firm pays the fixed cost F^E, exports to the foreign market and discovers its profitability; in the second period, it decides whether to continue serving the foreign market through exports, switch to FDI, or exit;

b) Entry via FDI at $t = 1$: in the first period, the firm pays the fixed cost F^I and serves the foreign market through its foreign subsidiary; in the second period, the firm decides whether to continue serving the foreign market through FDI, switch to exports, or exit;

c) No entry in the foreign market at $t = 1$.

In what follows, we solve for the firm's optimal decisions by backward induction.

3.3 Period $t = 2$

a) Entry via exports at $t = 1$

Consider first the case in which the firm has started serving the foreign markets via exports in the first period, discovering its profitability μ. In the second period, it must decide whether to continue exporting, open a foreign subsidiary, or exit the foreign market. If it continues to export, its second-period profits are given by

$$\pi^{EE}(\tau, q^{EE}) \equiv (\mu - \tau - q^{EE})q^{EE}. \tag{2}$$

The firm choose q^{EE} so as to maximize (2), which yields second-period export sales equal to $\hat{q}^{EE}(\tau) = K_{\{\mu>\tau\}}\frac{\mu-\tau}{2}$, where $K_{\{.\}}$ is an indicator variable, here denoting whether $\mu > \tau$. Second-period export profits can then be re-written as

$$\pi^{EE}(\tau) = K_{\{\mu>\tau\}}\Big(\frac{\mu-\tau}{2}\Big)^2. \tag{3}$$

Alternatively, if the firm discovers that it is very profitable in serving the foreign market, it may decide that it is worthwhile to pay the fixed cost of setting up a foreign subsidiary to avoid paying the variable trade costs of exporting. In this case, second-period profit are given by

$$\pi^{EI}(F^I) \equiv (\mu - q^{EI})q^{EI} - F^I. \tag{4}$$

Maximization of (4) yields the optimal quantity decision $\hat{q}^{EI} = \frac{\mu}{2}$. The profits obtained from establishing a production facility at $t = 2$ are thus equal to

$$\pi^{EI}(F^I) = \Big(\frac{\mu^2}{4} - F^I\Big), \tag{5}$$

which are positive if realized profitability is above $\mu^I \equiv 2\sqrt{F^I}$.

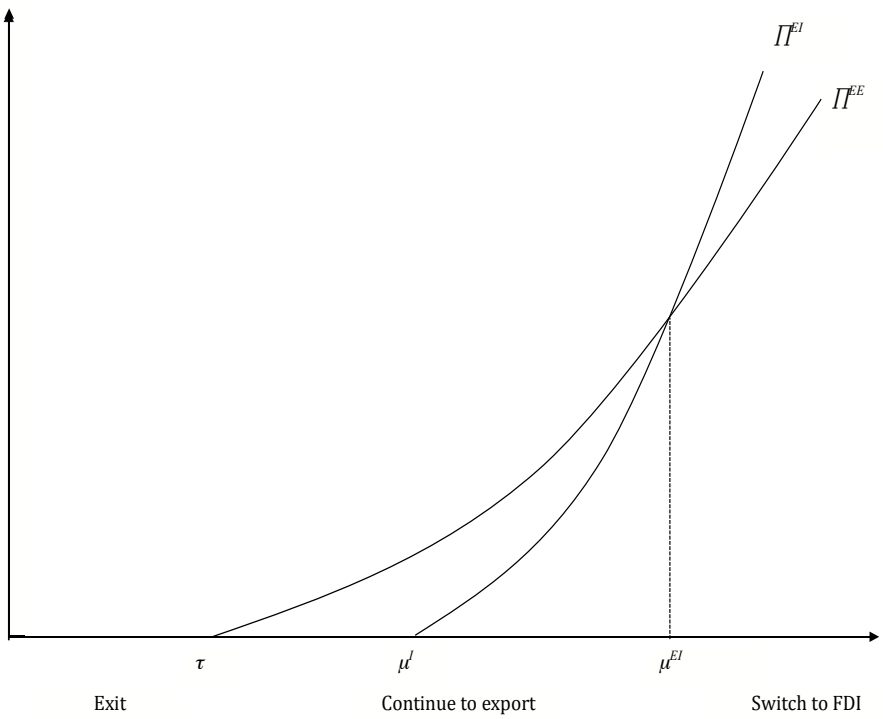
Comparing (5) with (3), we can derive the threshold of realized profitability above which the firm will switch from exports to FDI:

$$\mu^{EI} \equiv \frac{2F^I}{\tau} + \frac{\tau}{2}. \tag{6}$$

Figure 1 illustrates second-period export and FDI profits for a firm that has entered the foreign market via exports in the first period. Depending on its realized profitability, the firm decides whether to continue serving the foreign market, and whether to do so via exports or FDI: if μ is below the unit trade cost τ, exports and FDI profits are both negative, so the firm exits the foreign market; if $\tau < \mu < \mu^{EI}$, export profits are positive and higher than FDI profits, so the firm continues to serve the foreign market via exports; finally, if $\mu > \mu^{EI}$, realized profitability is high enough that FDI profits are higher than export profits, so the firm is willing to pay the fixed cost of setting up a foreign subsidiary to avoid trade costs. We can state the following:

Result 1 *After entering the foreign market via exports and discovering its profitability μ, the firm will exit if $\mu < \tau$, will continue to export if $\tau < \mu < \mu^{EI}$, and will switch to FDI if $\mu > \mu^{EI}$.*

Figure 1: Strategies of the firm $t = 2$, following entry via exports at $t = 1$



b) Entry via FDI at $t = 1$

Consider next the case in which the firm establishes a production facility in the foreign market at $t = 1$, paying the one-time fixed cost F^I. In this case, second-period FDI profits are equal to $\pi^{II} = (\mu - q^{II})q^{II}$. Substituting optimal foreign affiliate sales, $\hat{q}^{II} = \frac{\mu}{2}$, yields

$$\pi^{II} = \frac{\mu^2}{4}. \tag{7}$$

Notice that, once the firm has paid the fixed cost of setting up a foreign subsidiary, its FDI profits are always positive, implying that exiting the foreign market in the second period is a dominated strategy. Starting to export after entering the foreign market via FDI is also a dominated strategy. To verify this, notice that the profits associated with switching from FDI to exports in the second-period can be written as

$$\pi^{IE}(\tau, F^E) = \left(\frac{\mu - \tau}{2}\right)^2 - F^E. \tag{8}$$

Comparing (8) with (7), it is straightforward to verify that, for any level of realized profitability, $\Pi^{II} > \Pi^{IE}(\tau, F^E)$. Continuing to serve the foreign market through FDI is thus always preferable to switching to exports. The intuition for this result is simple: once the firm has paid the sunk cost F^I, starting to serve the foreign market via exports would imply paying an additional fixed cost F^E, as well as the trade cost τ for each unit sold in the foreign market. Thus, if there is a change in the firm's mode of serving the foreign market, it involves a switch from exports to FDI (see Result 1) rather than vice versa.

c) No entry at $t = 1$

Finally, if the firm has not entered in the first period, it has not discovered its profitability in the foreign market. In the second period, it does not enter and earns zero profits.

3.4 Period $t = 1$

Having derived second-period profits, we can now move to the analysis of first-period entry strategies. In what follows, we evaluate the profits associated with different entry strategies from an ex ante perspective, i.e. when the firm is still uncertain about its profitability in the foreign market.

a) Entry via exports at $t = 1$

Entering the foreign market via exports in the first period yields expected second-period profits equal to

$$V^E(\tau, F^I) = \int_{\tau}^{\mu^{EI}} \left(\frac{\mu - \tau}{2}\right)^2 dG(\mu) + \int_{\mu^{EI}}^{\overline{\mu}} \left(\frac{\mu^2}{4} - F^I\right) dG(\mu). \tag{9}$$

Equation (9) captures the option value of serving the foreign market in the second period, once the firm has discovered its profitability: the first term is the option value of continuing to export, while the second is the option value of switching to FDI.

Overall expected profits from entering the foreign market via exports can thus be written as

$$\omega^E(\tau, F^E, F^I, q^E) \equiv \int_{\underline{\mu}}^{\overline{\mu}} (\mu - \tau - q^E) q^E dG(\mu) - F^E + K_{\{q^E > 0\}} V^E. \tag{10}$$

The first two terms of (10) represent expected first-period profits from export entry. The last term captures expected second-period profits, as defined in equation (9). It is useful

to define the threshold of profitability for which the firm expects zero first-period profits from entering via exports:

$$\mu^E \equiv 2\sqrt{F^E)} + \tau. \tag{11}$$

Optimal first-period export volumes depend on expected profitability in the foreign market. When $E\mu > \mu^E$ ($E\mu = \mu^E$), expected first-period export profits are positive (zero) and the firm will set export volumes equal to $\hat{q}^E = \frac{E\mu - \tau}{2}$. In scenarios in which $\tau < E\mu < \mu^E$, expected profits in the first period are negative, but the firm will still export a positive amount $\hat{q}^E = \frac{E\mu - \tau}{2}$, as long as overall expected profits from export entry are positive. Finally, consider scenarios in which $E\mu < \tau$. Again, expected first-period profits will be negative, but the firm may still be willing to "test" the foreign market, exporting an arbitrarily small amount $\epsilon > 0$, as long as $(E\mu - \tau - \epsilon)\epsilon - F^E + V^E > 0$. Expected profits from entering the foreign market at $t = 1$ via exports can thus be rewritten as

$$\begin{aligned} \Omega^E(\tau, F^I, F^E) \equiv & \int_{\tau}^{\overline{\mu}} \Big(\frac{\mu - \tau}{2}\Big)^2 dG(\mu) - F^E \\ & + K_{\{q^E>0\}} \Big\{ \int_{\tau}^{\mu^{EI}} \Big(\frac{\mu - \tau}{2}\Big)^2 dG(\mu) + \int_{\mu^{EI}}^{\overline{\mu}} \Big(\frac{\mu^2}{4} - F^I\Big) dG(\mu) \Big\}. \end{aligned} \tag{12}$$

We denote with $\tilde{\mu}^E$ the threshold of expected profitability above which $\Omega^E > 0$.

b) Entry via FDI at $t = 1$

As discussed in Section 3.3, if the firm enters the foreign market via FDI at $t = 1$ it will always continue serving the market via foreign affiliate sales at $t = 2$. From an ex-ante perspective, overall profits from FDI entry can thus be written as

$$\omega^I(F^I, q^I) \equiv 2 \int_{\underline{\mu}}^{\overline{\mu}} (\mu - q^I) q^I dG(\mu) - F^I. \tag{13}$$

Substituting optimal subsidiary sales, $\hat{q}^I = \frac{\mu}{2}$, we can rewrite the firm's expected profits from entering the foreign market via FDI as follows:

$$\Omega^I(F^I) \equiv \frac{1}{2} \int_{\underline{\mu}}^{\overline{\mu}} \mu^2 dG(\mu) - F^I. \tag{14}$$

We denote with $\tilde{\mu}^I$ the critical threshold of expected profitability above which $\Omega^I > 0$.

c) No entry at $t = 1$

The firm does not enter the foreign market, earning zero profits.

Entry decisions

From the analysis above, we can derive the firm's entry strategy. There are three possible cases to consider, depending on expected profitability in the foreign market before entry. First, if $E\mu < \tilde{\mu}^E$, expected profits from both export and FDI entry are negative, so the firm will decide not to serve the foreign market. Second, if $\tilde{\mu}^E < E\mu < \tilde{\mu}^I$, expected profits from export entry are positive and exceed expected profits from FDI entry, so the firm will start serving the foreign market via exports. Finally, if $E\mu > \tilde{\mu}^I$, expected profits from FDI entry are larger than expected profits from export entry, so the firms will start serving the foreign market by setting up a subsidiary. We can thus state the following:

Result 2 *The first-period entry decision depends on expected profitability in the foreign market. If $E\mu < \tilde{\mu}^E$, the firms does not enter; if $\tilde{\mu}^E \leq E\mu < \tilde{\mu}^I$, it enters via exports, possibly switching to FDI in the second period; if $E\mu > \tilde{\mu}^I$, it enters directly via FDI.*

It easy to show that, when experimentation matters (i.e. when the firm would not enter the foreign market in the absence of uncertainty), the firm will enter via exports rather than FDI. To verify this, consider the limit case in which $E\mu = \mu^E$ as defined in equation (11), in which the firm expects to make zero first-period profits from export entry. In this case, overall expected profits from export entry are equal to

$$\Omega^E = \int_{\tau}^{\mu^{EI}} \left(\frac{\mu - \tau}{2}\right)^2 dG(\mu) \int_{\mu^{EI}}^{\overline{\mu}} \left(\frac{\mu^2}{4} - F^I\right) dG(\mu) > 0, \tag{15}$$

while expected profits from FDI entry are given by[14]

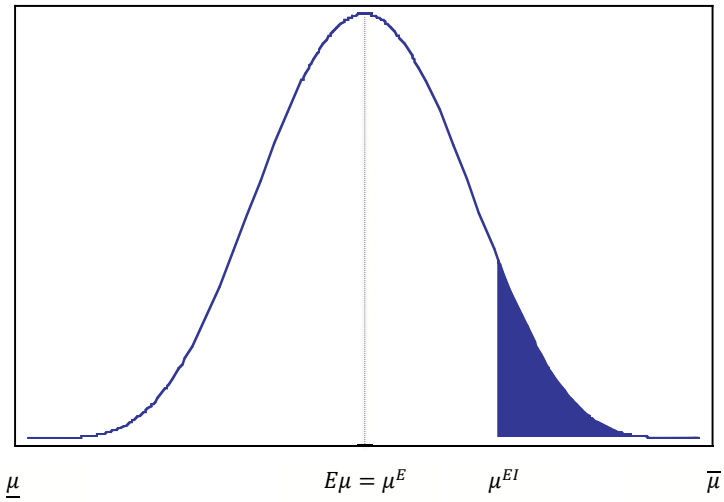
$$\Omega^I = \frac{1}{2}(2\sqrt{F^E} + \tau)^2 - F^I \leq 0. \tag{16}$$

In this scenario, uncertainty leads to a gradual internationalization process: the firm enters the foreign market via exports, even if it expects to make zero profits in the first period; in the second period, if its realized profitability is high enough, it starts investing in the foreign market.

[14]The fact that expected profits from FDI entry cannot be positive when $E\mu = \mu^E$ follows from the restriction on the fixed cost of FDI (Assumption 1).

As an illustration, in Figure 2 we have drawn the probability density function of a beta-type distribution of the random variable μ, with mean equal to μ^E.[15] As discussed above, when $E\mu = \mu^E$, the firm enters the foreign market via exports, even if it expects to make zero profits in the first period. The shaded area captures the probability that the firm starts investing in the second period, which is equal to $1 - G(\mu^{EI})$.[16,17]

Figure 2: Probability of a switch from exports to FDI at $t = 2$



An important feature of our model is that exports and horizontal FDI are substitutes from a static perspective – since they represent alternative ways to serve a foreign market – but may be complements over time – since the market-specific knowledge acquired through exports experience can lead firms to set up foreign production plants.

[15]The beta distribution is often used to model the behavior of random variables limited to intervals of finite length. It is parametrized by two positive shape parameters, denoted α and β. The probability density function in Figure 2 corresponds to a beta distribution with $\alpha = \beta = 6$, with support $[\underline{\mu}, \overline{\mu}]$.

[16]The higher is the degree of uncertainty faced by the firm ex ante (the higher is the variance of the variable μ), the more likely is the firm to switch from exports to FDI ex post. This can be seen by drawing a mean-preserving spread of the distribution in Figure 2: the shaded area gets larger, corresponding to an increase in the probability of a switch.

[17]We have assumed that the fixed cost of establishing a production facility in a foreign market is independent of whether the firm has previously exported to that market. This is the case if F^E includes costs that are specific to exporting (e.g. learning about customs procedures) and F^I captures only FDI costs (e.g. building a foreign production plant). However, serving a foreign market may involve fixed costs that are common to both exports and FDI (e.g. designing a marketing strategy). In this case, the fixed costs of exports and FDI could be rewritten as $F^E = K + f^E$ and $F^I = K + f^I$, respectively, with $f^I > f^E$. Our results would continue to hold under this alternative formulation of the fixed costs, but the switch from exports to FDI will be more likely. Under this alternative formulation, the profitability threshold above which a firm with switch from exports to FDI is $\mu^{EI\prime} = \frac{2f^I}{\tau} + \frac{\tau}{2} < \mu^{EI}$ and the probability of a switch is thus $1 - G(\mu^{EI\prime}) > 1 - G(\mu^{EI})$.

This dynamic complementarity between exports and FDI can explain why most studies on the determinants of FDI fail to find a significant effect of trade protection.[18] It can also help to explain why, notwithstanding major reductions in trade barriers and transport costs in recent decades, foreign affiliates sales have not fallen, but have actually expanded faster than exports of goods and services (Helpman, 2006).

Our analysis has important implications concerning the effects of trade liberalization. Governments often try to achieve two broad objectives: attract FDI to bring much-needed capital, new technologies, marketing techniques, and management skills; and liberalize their economies (unilaterally, or in the context of regional/multilateral trade negotiations). In static models of the proximity-concentration tradeoff, these two objectives are clearly in conflict with each other: reducing import barriers makes exporting a more attractive option, reducing the incentives for FDI. In contrast, our analysis suggests that, when firms are uncertain about foreign market conditions, a reduction in trade costs may actually foster FDI, by lowering the cost of export experimentation.[19]

The implications of FDI liberalization also differ sharply from those of standard internationalization models. Consider a situation in which a government allows foreign firms to invest in its country, removing a pre-existing ban on FDI. In our model, this may lead some firms to start exporting. The intuition for this result is that the possibility of setting up foreign affiliates increases the option value of export entry.[20] In contrast, in standard internationalization models, FDI liberalization cannot trigger export entry.

3.5 Testable implications

Results 1 and 2 above show that, when faced with uncertainty, a firm may start serving a foreign market via exports and later switch to FDI, if it discovers that it can earn large

[18] As pointed out by Blonigen (2005), most studies do not find robust evidence of tariff-jumping FDI (e.g. Grubert and Mutti, 1991; Blonigen, 1997). One of the only exceptions is the paper by Blonigen (2002). Interestingly, this finds evidence of tariff-jumping FDI by multinational firms in the United States, a setting in which uncertainty is unlikely to play much of a role.

[19] To verify this, consider a scenario in which trade costs are initially such that $\tau > E\mu - 2\sqrt{F^E}$, implying that first-period expected profits from entering the foreign market via exports are negative. Also assume that the expected first-period export loss exceeds the option value of serving the foreign market in the second period, so the firm will choose not to serve the foreign market. Now consider a reduction in the trade costs to $\tau = E\mu - 2\sqrt{F^E}$. The firm now expects to make zero export profits at $t = 1$, but is willing to enter the foreign market export to secure the possibility of positive profits at $t = 2$. With probability $1 - G(\mu^{EI})$, export experimentation will then lead the firm to start investing in the foreign market.

[20] When FDI is banned, the option value of export entry is equal to $\int_{\tau}^{\overline{\mu}} \left(\frac{\mu-\tau}{2}\right)^2 dG(\mu)$. Following FDI liberalization, an exporting firm can establish a production plant if it discovers that its profitability exceeds the threshold μ^{EI}, so the option value increases to $\int_{\tau}^{\mu^{EI}} \left(\frac{\mu-\tau}{2}\right)^2 dG(\mu) + \int_{\mu^{EI}}^{\overline{\mu}} \left(\frac{\mu^2}{4} - F^I\right) dG(\mu)$.

enough profits in that market. The first empirical prediction of our model can thus be stated as follows:

Prediction 1 *Uncertainty can lead firms to follow a gradual "internationalization process", testing a foreign market via exports, before engaging in FDI.*

This prediction is driven by the option value of entry: when firms are uncertain about their profitability in a foreign market, they are willing the pay the fixed cost associated with export entry to find out whether serving the foreign market is actually worthwhile. In our simple two-period model, all uncertainty is resolved as soon as the firm starts serving the foreign market. This implies that experimentation occurs only during the entry period; in the second period, if realized profitability is high enough, the firm immediately switches to FDI. The model can be easily extended to multiple periods, to allow for information acquisition to take time. In this setting, there will be an option value of waiting: new exporters will prefer to "wait and see", continuing to serve the foreign market via exports until they are certain that it is worthwhile to establish foreign subsidiaries. This leads us to our second prediction:

Prediction 2 *Foreign market uncertainty delays FDI entry by new exporters.*

This prediction is in line with real options models, which show that, if investments are irreversible and market conditions are uncertain, firms prefer to minimize current investments but secure an option to invest later (e.g. McDonald and Siegel, 1986; Dixit and Pindyck,1994, Guiso and Parigi, 1999).

4 Datasets and variables

The goal of our empirical analysis is to verify whether uncertainty affects firms' internationalization choices, as predicted by our theoretical model. For this purpose, we exploit a unique dataset of firms' exports and FDI in individual foreign markets from the National Bank of Belgium (NBB), covering the whole population of companies registered in Belgium. Data on exports and FDI can be linked to firm-level accounts through the value added tax number, a unique code identifying each firm.[21] We restrict our attention to manufacturing firms (i.e. four-digit codes belonging to sectors between 15 and

[21]Firms can serve foreign buyers through three channels: they can export their products to foreign customers, serve them through foreign subsidiaries, or license foreign firms to produce their products. In line with our theoretical model, and given the very limited role played by the third channel (i.e. less than 0.4 percent of Belgian firms engage in foreign markets via licensing), we focus on the first two channels.

37 of NACE revision 1) and impose a threshold in terms of employment (i.e. at least 5 employees).

In this section, we describe the datasets and variables used in our empirical analysis (see also Table A-3 in the Appendix).

4.1 Export and FDI data

Data on exports since 1993 come from the NBB Foreign Trade dataset, which allows us to identify the countries to which a firm is exporting in a given year. Trade data on individual transactions concerning exports or imports are collected separately at company level for intra-EU (Intrastat) and extra-EU (Extrastat) trade. For each transaction, this data gives the product code, the type of transaction, and the destination or origin of the goods, the value, the net mass and units. In outonr benchmark analysis, we focus on destinations outside the EU Single Market (defined as of 2008).[22] There are two reasons for this choice. First, the Extrastat dataset is based on customs declarations and covers virtually all trade transactions (all flows are recorded, unless their value is smaller than 1,000 euro or their weight smaller than one ton). The Intrastat dataset is less exhaustive, covering only firms whose annual trade flows (receipts or shipments) exceed a considerable threshold; moreover, the reporting threshold has been increased twice during our sample period (from 104,115 euros to 250,000 euros in 1998, and to 1 million euros in 2006), creating potential problems of inconsistency of firms' export status. Second, and more importantly, our theoretical model best applies to destinations outside the European Single Market, in which Belgian firms face more uncertain market conditions.[23]

To identify new exporters, we define the variable $Export\ entry_{f,i,t}$, which is equal to 1 if firm f starts exporting to country i in year t, not having exported to that country in any of the previous five years. Notice that this definition does not suffer from left-censoring problems: for all export entries in the 1998-2008 period, we can observe exports in the previous five years (since firm-level export data is available from 1993). Also, our definition is more stringent than the one usually applied in empirical studies of export dynamics, in which any firm that exports to a foreign market in a particular year, after

[22]The EU Single Market comprises the 27 EU Member States plus Iceland, Liechtenstein and Norway through the European Economic Area. Switzerland is also considered part of it because it has a series of bilateral treaties with the EU. In the Appendix, we provide descriptive statistics of export and FDI activities of Belgian firms in the world, and in countries outside the EU Single Market.

[23]In robustness checks, we show that our results continue to hold when we extend the analysis to the twelve countries that have joined the European Union during our sample period. As expected, we find instead no support for the predictions of our model when focusing on older EU members, in which Belgian firms should face little uncertainty.

just one year of no exporting, is classified as a new exporter (e.g. Besedes and Prusa, 2006; Eaton *et al.*, 2008; Ruhl and Willis, 2008). This allows us to focus on firms that start operating in a foreign market, drastically reducing the problem of re-entries (see footnote 2).

Data on FDI come from the annual Survey on Foreign Direct Investment of National Bank of Belgium. Conducted since 1997, the survey provides information on all firms involved in foreign direct investment relations. FDI is defined as international investments through which a resident entity in one economy acquires an interest in a resident entity of another economy than that of the investor. The Survey on Foreign Direct Investment includes all companies holding at least 10 percent of the social capital of foreign firms and those of which at least 10 percent of the shares are owned by foreign investors. All firms are required to report their FDI stocks and flows in individual foreign countries.

To identify firms that start to invest in a foreign market, we define the variable $FDI\ entry_{f,i,t}$, which is equal to 1 if firm f has positive FDI stocks in country i in year t, having no FDI stock in that country in the previous year.[24]

Table 1: FDI entries

Year	Direct FDI entries	Gradual FDI entries	Total FDI entries
1998	0	20	20
1999	3	28	31
2000	5	52	57
2001	8	50	58
2002	3	24	27
2003	1	24	25
2004	4	27	31
2005	16	24	40
2006	5	33	38
2007	6	19	25
2008	1	27	28
Total	32 (13.68%)	328 (86.32%)	380 (100%)

Notes: The table includes all FDI entries by Belgian manufacturing firms in countries outside the European Single Market over the 1998-2008 period. An FDI entry is "gradual" ("direct") if the firm that starts investing has (not) been exporting to the foreign country in any of the previous five years.

Table 1 provides statistics on all Belgian manufacturing firms that started to invest outside the European Single Market during the 1998-2008 period. Notice that, in

[24]In some rare instances, a firm has positive FDI stocks in a foreign country in only one year of our sample. We do not classify these instances as FDI entries, since they are likely to reflect short-term financial transactions rather than long-term investments to serve the foreign market.

line with the first prediction of our theoretical model, firms engage in a gradual internationalization process: in the overwhelming majority of cases (86.32%), FDI entry is preceded by export entry, i.e. the investing firm was already serving the foreign market via exports.[25]

Previous studies argue that most FDI is horizontal in nature (e.g. Markusen and Maskus, 2003; Blonigen, 2005). Indeed, UNCTAD (2011) reports that over the period 1990-2010 less than 20 percent of foreign affiliate sales worldwide is exported outside the host country, suggesting that most FDI is driven by market-access considerations. Unfortunately, the Survey on Foreign Direct Investment does not contain information about the destination of foreign affiliate sales, which would help us to directly identify foreign investments aimed at serving customers in the host country. However, the evolution of firms' exports to a foreign country before and after FDI entry suggests that investment in foreign markets are usually driven by market-access motives: in many instances, a firm's exports drastically fall after FDI entry, suggesting the establishment of foreign production subsidiaries;[26] in other cases, the firm's exports increase dramatically, reflecting investments in a distribution network.[27] As stressed in Appendix A-1, the logic of our theoretical model applies not only to horizontal FDI, but also to export-supporting FDI (investments in foreign distribution centers and sales offices to penetrate export markets).

In robustness checks, we exploit information on intra-firm trade from the NBB Survey on Foreign Direct Investment to rule out some FDI entries as being potentially vertical in nature. To this end, we compute the share of exports (out of total affiliate sales) that the foreign subsidiary ships back to the Belgian firm in the years following FDI entry. We classify FDI entries as vertical if exports to the Belgian parent company exceed one third of the affiliate's sales.

4.2 Uncertainty measures

To capture firm-specific uncertainty in a foreign market, we define the variable *Export Experience*$_{f,i,t}$, which measures ln (1 + number of years of positive exports) of firm f in country i following export entry. The higher is export experience, the more information

[25]This is a lower bound, since it is based on firms' exports in the five years before FDI entry. Similar patterns have been documented for French firms by Gazaniol (2012), who finds that 95% of new FDIs are preceded by exports in the same country.

[26]This is the case, for example, of a Belgian manufacturer whose exports to the United States decreased by over 80 percent after setting up its first US subsidiary.

[27]This is the case, for example, of a Belgian manufacturer whose exports to Australia increased by over 400 percent after the firm started investing there.

the firm should have acquired in the foreign market.[28]

We use three country-level measures of uncertainty. First, we construct the variable $BIT_{i,t}$, which is equal to 1 if country i has implemented a bilateral investment treaty (BIT) with Belgium at time t. One of the main goals of BITs is to reduce the uncertainty faced by foreign investors, by setting up dispute settlement provisions. According to UNCTAD (2006), dispute settlement provisions are "one of the key elements in diminishing the country risk, and thus encourage investors of one contracting party to invest in the territory of the other" (p. 99).[29] Following the implementation of these treaties, Belgian new exporters should thus face less uncertainty in the destination market.

The variable *Export exit*$_i$ measures the average exit rate of Belgian new exporters in country i (in the year following export entry). It provides a direct measure of the extent of uncertainty and experimentation in a foreign market: in our theoretical model, the more uncertain are conditions in a foreign market (the larger the variance of the variable μ), the higher is the probability that, after entering a foreign market via exports, a firm discovers that its realized profitability is below the unit trade cost τ and exits the foreign market.[30]

Our last measure of uncertainty is the variable *Variance regulation*$_i$. This is the variance of the World Bank's index *Regulation*$_{i,t}$ (over the 1998-2008 period), which captures perceptions of the ability of the government of country i to formulate and implement sound policies aimed at promoting private sector development (Kaufmann *et al.*, 2009). The higher is *Variance regulation*$_i$, the more unpredictable are local business conditions.

4.3 Other controls

The Central Balance Sheet Office of the NBB collects the annual accounts of all companies registered in Belgium. They provide measures for firms' value added, turnover, intermediate consumption, employment, and capital stock. Using this data, we control for firm characteristics that are known to affect their export and FDI choices: the

[28] Using a log specification allows us to capture the non-linear effect of a firm's export experience on its probability of FDI entry (see the bottom-left panel of Figure 5). We take the log of (1 + number of years of positive exports) to allow for the possibility that a firm may start investing with no export experience. Notice that our definition of export experience does not coincide with the number of years since export entry, since it excludes years in which a firm does not export to a foreign market.

[29] Previous studies show that BITs have a positive effect on FDI (e.g. Egger and Pfafferamayr, 2004; Neumayer and Spess, 2005, Egger and Merlo, 2012).

[30] Including the variable *Export exit*$_i$ in the analysis of FDI entry decisions of individual new exporters is unlikely to raise endogeneity concerns, since there are on average 65 Belgian new exporters per destination country.

variable $Employment_{f,t}$ is the number of full-time equivalent employees and is used as a proxy for firm size; the variable $Productivity_{f,t}$ measures the firm's value added per employee; the dummy variable $MNE_{f,t}$ identifies multinational firms.[31]

To proxy for the size of the destination market, we use the variable $GDP_{i,t}$. In some specifications, we also include the dummy variable $Common\ language_i$, which is equal to 1 if the foreign market i shares an official language with Belgium.[32]

Our analysis focuses on the acquisition of market-specific knowledge by individual firms. To allow for possible learning spillovers across markets, we have constructed the variables $Exports\ in\ region_{f,t-1,r}$ and $FDI\ in\ region_{f,t-1,r}$, which measure respectively the number of countries in continent r in which firm f is exporting to and in which it has foreign affiliates at $t-1$.[33]

Trade costs (including both transport costs and trade barriers) can affect firms' choice to serve a foreign market through exports or FDI decisions. To control for transport costs, we use the variable $Distance_i$, which measures the distance between the capital of Belgium and the capital of country i. To control for trade barriers, we have used data available from the World Integrated Trade Solution (WITS) to construct the variable $Tariff_{i,t,k}$, which measures the average tariff applied by country i over the previous three years vis-à-vis imports from Belgium in sector k (at the 4-digit NACE level).[34]

[31]Information about foreign ownership comes from the Survey on Foreign Direct Investment. We follow the definition of the IMF's Balance of Payments Manual, according to which a multinational enterprise is one in which a foreign investor owns, either directly or indirectly, at least 10 percent of its capital or voting power.

[32]As an alternative, we have tried to include the variable $Common\ spoken\ language_i$ from Melitz and Toubal (2012), which measures the probability that a pair of people selected at random from the two countries understand one another in some language, obtaining similar results.

[33]Other studies have emphasized that firms may learn in foreign markets from "pioneers" (e.g. Hausmann and Rodrik, 2003; Segura-Cayuela and Vilarrubia (2008). To account for within-industry learning, we have also constructed the variables $Exports\ by\ other\ firms_{i,t-1,k}$ and $FDI\ by\ other\ firms_{i,t-1,k}$ measuring, respectively, the number of Belgian firms in sector k (at the 2-digit NACE) exporting or having foreign affiliates in country i at $t-1$. Since the estimated coefficients for these variables were never significant, we did not include them in our main regression results.

[34]The procedure to construct average tariffs is rather cumbersome and involves different steps. The original tariff data in WITS are reported at the 6-digit level of the Harmonized System (HS6), while the activity of a firm, as identified in the Belgian annual accounts, is defined by a 5-digit code from the NACE classification. We have thus aggregated HS data into NACE codes, taking into account that the HS classification changed various times during our sample period. In order to minimize the subjectivity of such procedure, we relied on the fact that WITS also reports average tariffs aggregated at the 3 digits of the ISIC (revision 3) classification. For about 30 percent of the NACE codes, we found a one-to-one mapping between 3-digit ISIC and 4-digit NACE classification. When an ISIC code could map into more than one NACE code, we recovered the HS6 tariff lines underlying the ISIC code and manually assigned them to NACE codes. This procedure was straightforward for about 33 percent of NACE codes. In the remaining cases, some discretion had to be applied. For about 14 percent of the NACE codes, it was impossible to assign only one NACE code to each given HS6. In this case, we used a higher level of aggregation by imputing the average tariff of a given ISIC code to the NACE codes

5 Uncertainty and FDI entry by new exporters

Table 1 above shows that firms almost never establish affiliates in a foreign market without first "testing" it via exports: in almost 90% of the cases, FDI entry is preceded by export entry. This fact cannot be explained by standard models of firms' internationalization choices, in which a firm will either serve a foreign market through export *or* FDI. It is instead in line with the first empirical prediction of our model, according to which uncertainty leads firms to follow a gradual internationalization process: they start by serving a foreign market via exports, to acquire information about local demand and supply conditions; if they discover that they can earn large enough profits, they are willing to set up a foreign production plant to reduce variable costs.

The goal of this section is to assess the validity of the second prediction of our theoretical model, according to which uncertainty in foreign market conditions should delay investment decisions of new exporters, lowering their probability of FDI entry.

5.1 Descriptive statistics on new exporters

As discussed in Section 4.1, we classify a firm as a new exporter if it exports to a given market in a particular year, after at least five consecutive years of no exporting to that market. This definition is more stringent than the standard one used in the literature on export dynamics (which requires only one year on no exporting before an export entry) and allows us to identify firms that start serving a foreign market.

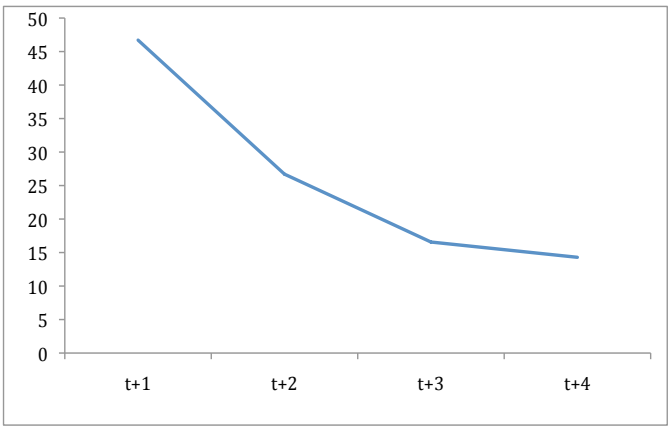
When examining FDI decisions of new exporters, we restrict the sample to Belgian firms that have foreign affiliates in at least one country outside the European Single Market, at any time during our sample period. This guarantees that the firms included in our analysis are at least potentially confronted with the choice between export and FDI, as in our theoretical model. The sample includes 4,797 export entries by Belgian firms in countries outside the European Single Market over the period 1998-2008.

According to our model, new exporters will exit the foreign market, if they discover that their profitability is too low to justify the trade costs. Indeed, when looking at the survival rate of Belgian new exporters, we find that many firms exit the foreign market in the years following entry. In Figure 3, we apply the standard definition of exit used in the literature (i.e. at least one year of no exports after entry) and focus on the 2,642 export entries occurred during the 1998-2003 period (so that we can observe at least five years of exports following entry). In line with previous studies, we find that in almost

assigned to it. In these cases, we have aggregated at a level intermediate between 3 and 4-digit NACE, since an ISIC code is a subset of a 3-digit NACE code.

50% of the cases new exporters exited the foreign market after one year of exporting. The death rate falls steadily in the following years (around 12% at $t+5$).[35]

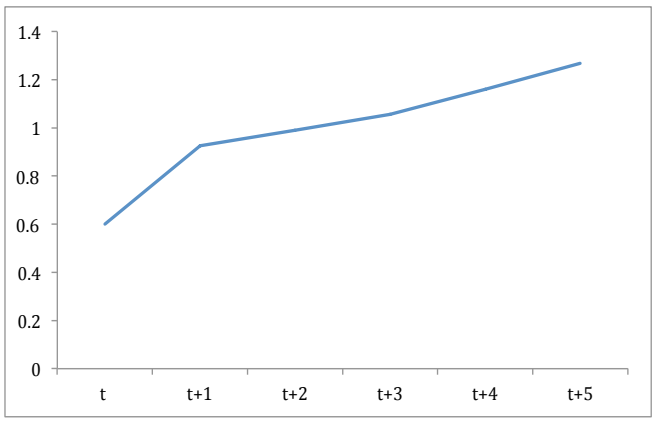
Figure 3: Exit rate of new exporters



Note: Exit rates based on the number of new exporters surviving in the previous year.

Our model also suggests that, when firms are uncertain about their profitability in the foreign market, they should start by exporting small amounts; following an initial trial period, conditional on surviving as exporters, their export volumes should expand. This is indeed the pattern emerging from Figure 4, in which we have plotted the ratio of exports to average exports of the firm (between the entry year t and $t+5$), averaged for all firms that start exporting to a new market during the 1998-2003 period and continue to export in that market in the following five years.

Figure 4: Evolution of exports of new exporters



Note: Ratio of exports to average exports of the firm (between t and $t+5$).

[35]If we use a more stringent definition of death (at least five years of no exports after entry), new exporters exit in around 26% of cases: of the 2,642 export entries occurred during the 1998-2003 period, in 697 cases the firm did not export in any of the following five years after entry.

The statistics on the survival rate and the evolution of exports of Belgian new exporters are in line with the findings of previous studies on export dynamics (e.g. Eaton *et al.*, 2008; Aeberhardt *et al.*, 2009; Lawless, 2009). They suggest a process of trial and errors: in the face of uncertainty, firms experiment in foreign markets via exports, to find out whether they can make profits serving them; they often exit the market after an initial trial period; conditional on surviving, they expand their export volumes.

5.2 Empirical methodology and results

In the remainder of this section, we employ survival analysis to examine whether uncertainty faced by a new exporter in a foreign market affects its decision to start investing there. Survival analysis is widely used in economics to estimate the time it takes for an event to materialize; in our case, the event of interest is the FDI entry of a new exporter.[36]

Survival analysis does not suffer from right censoring problems, since it explicitly takes into account the fact that FDI entry may not occur for some firms in some countries by the end of the sample. Starting from the year in which a firm begins exporting to a foreign market (export entry), each firm is tracked over time until it opens a subsidiary in that country (FDI entry), or until the end of the sample if no FDI ever occurs.[37] Using this methodology, we can examine the determinants of FDI entry decisions of all Belgian firms that started exporting to a foreign market during the 1998-2008 period.[38]

We use a proportional hazard model to estimate the hazard rate $h_{f,i}(t)$, i.e. the probability that new exporter f starts investing in country i at time t:

$$h_{f,i}(t) = h_0(t) \exp(\beta X_{f,i,t}), \tag{17}$$

where $h_0(t)$ is the baseline hazard rate, $X_{f,i,t}$ is the matrix of covariates and β is the vector of coefficients to be estimated. If the covariate are time-invariant, the β coefficients can

[36] Empirical studies of real option theories have used survival analysis (also called duration analysis) to verify whether uncertainty delays investment decisions (e.g. Hurn and Wright, 1994; Favero *et al.*, 1994; Kogut and Chang, 1996). Duration models are also widely used in labor economics, to study the time it takes for unemployed workers to find a job.

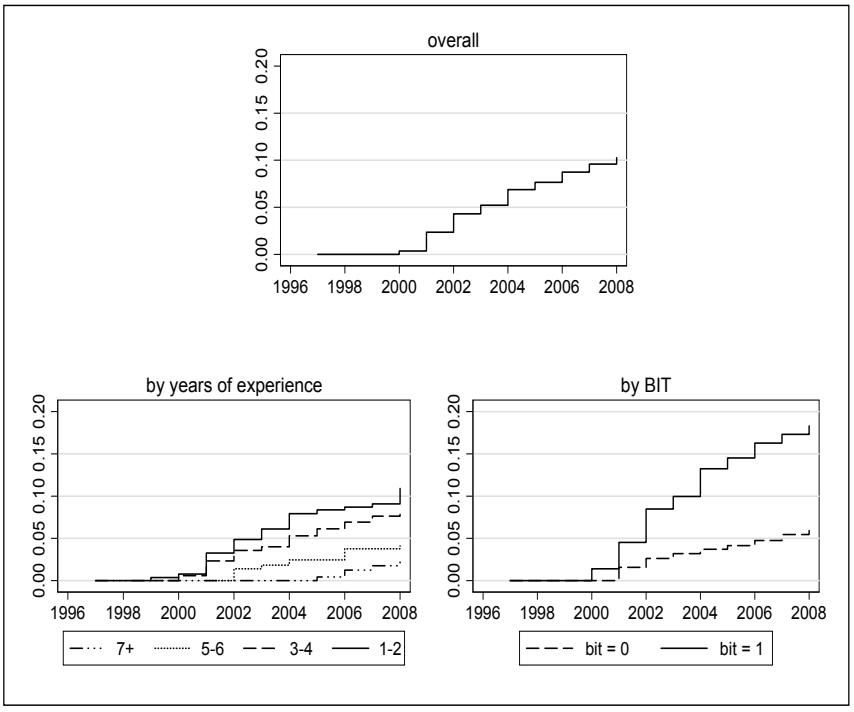
[37] In survival analysis, each firm is included in the analysis until the time when the event under investigation occurs. After that point, no more information can be learned from that firm. Instead, a firm that never engages in FDI will be included until the end of the sample.

[38] If we used alternative methodologies to estimate the probability of FDI entry, we would need to restrict the analysis to new exporters for which we can observe k periods following export entry, to avoid problems of right censoring. For example, we could focus on the export entries that have occurred during the 1998-2003 period and use a linear probability model to estimate the likelihood of FDI entry within $k = 5$ periods. This methodology would drastically reduce the number of observations and would impose a restriction on the time it takes for a new exporter to start investing in the foreign market.

be interpreted as the proportional effect of the variable on the hazard rate of FDI entry. In our benchmark regressions, we estimate the β coefficients using the partial likelihood method advocated by Cox (1975). This is a semi-parametric model that allows us to remain agnostic about the functional form of the baseline hazard rate $h_0(t)$.

To have a first look at the data, in Figure 5 we plot the Kaplan-Meier cumulative hazard function, which depicts the cumulative probability of FDI entry over time based on the count of FDI entries in each period out of the total number of firms that may start FDI. The top figure captures the probability of export entry for the overall sample of new exporters, while the two figures below illustrate how this probability varies with two of our uncertainty measures. The bottom-left figure distinguishes the cumulative hazard function by the extent of a firm's export experience (1-2 years, 3-4 years, 5-6 years, or more), showing that this has a positive but decaying effect on the probability of FDI entry. The bottom-right figure shows that new exporters are more likely to start investing in foreign countries in which the host government has implemented a bilateral investment treaty with Belgium.

Figure 5: Kaplan-Meier cumulative hazard functions



In our analysis of FDI entry decisions, we always include firm fixed effects, exploiting variation in the degree of uncertainty faced by individual new exporters. This is in line with our theoretical analysis, in which we examine how uncertainty affects export and

FDI choices of a representative firm, abstracting from the role of firm heterogeneity. This identification strategy also helps to reduce concerns about possible selection effects, since it relies on variation in the internationalization choices of individual firms, depending on the degree of uncertainty they face in different foreign countries or within countries over time.

Table 2 presents the results of our benchmark regressions. The key regressors of interest are the four variables capturing the degree of uncertainty faced by new exporters in a foreign market: the variable *Export experience*$_{f,i,t}$, which measures ln (1 + the number of years) in which firm f had positive exports to country i since entry;[39] the dummy variable $BIT_{i,t}$, which is equal to one if country i has implemented a bilateral investment treaty with Belgium at time t; the average exit rate of new exporters in country i, *Export exit*$_i$, capturing how likely are firms to engage in a process of trials and errors in this country; and the variable *Variance regulation*$_i$, which measures the variance of the World Bank's index of regulatory quality of country i. According to our theoretical model, *Export experience*$_{f,i,t}$ and $BIT_{i,t}$ should lower uncertainty and thus increase the probability of FDI entry, while the variables *Export exit*$_i$ *Variance regulation*$_i$ should have the opposite effect.[40]

In column (1), we include the firm-level measure of uncertainty (*Export experience*$_{f,i,t}$), two of the country-level measures of uncertainty ($BIT_{i,t}$ and *Export exit*$_i$), other country-level controls, and firm fixed effects. In line with our model's prediction, the estimated coefficients for *Export experience*$_{f,i,t}$ and $BIT_{i,t}$ are positive and significant, while the coefficient of *Export exit*$_i$ is negative and significant. These results are unaffected when we add all time-varying firm characteristics (see column 2), and when we include the variable *Tariff*$_{i,t-1,k}$, which leads to a considerable reduction in the number of observations due to the limited availability of tariff data (see column 3).

[39] Using a log specification allows us to capture the decaying effect of a firm's export experience on its probability of FDI entry (see bottom-left panel of Figure 5). We have also tried including dummy variables for different years of export experience, obtaining similar results.

[40] Investment treaties may also stimulate investment by new exporters by lowering the fixed cost of setting up foreign affiliates. In our model, a reduction in F^I lowers the threshold of realized profitability above which a firm switches from exports to FDI, $\mu^{EI} \equiv \frac{2F^I}{\tau} + \frac{\tau}{2}$.

Table 2: FDI entry of new exporters

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Export experience$_{f,i,t}$	1.370***	1.391***	1.255***	1.307***	1.320***	1.221***	1.269***	1.325***	1.481***
	(0.298)	(0.337)	(0.372)	(0.298)	(0.332)	(0.375)	(0.326)	(0.371)	(0.469)
BIT$_{i,t}$	1.602***	1.476***	1.478***	1.602***	1.463***	1.432***	1.954**	1.856**	1.725**
	(0.319)	(0.336)	(0.405)	(0.300)	(0.324)	(0.373)	(0.767)	(0.821)	(0.777)
Export exit$_i$	-5.923***	-5.797***	-5.975**						
	(2.010)	(2.053)	(2.527)						
Variance regulation$_i$				-12.550**	-15.390**	-17.459**			
				(5.577)	(6.218)	(8.586)			
Regulation$_{i,t}$				0.420**	0.462**	0.449*	1.363	2.067	2.904*
				(0.196)	(0.199)	(0.262)	(1.389)	(1.317)	(1.601)
GDP$_{i,t}$	0.273***	0.275***	0.284***	0.252***	0.267***	0.281***	-0.133	-0.070	-0.105
	(0.048)	(0.055)	(0.062)	(0.048)	(0.057)	(0.062)	(0.597)	(0.618)	(0.610)
Distance$_i$	0.091**	0.086*	0.108**	0.054	0.060	0.082			
	(0.040)	(0.050)	(0.053)	(0.044)	(0.053)	(0.054)			
Common language$_i$	0.270	0.129	0.518	0.097	0.091	0.281			
	(0.555)	(0.606)	(0.671)	(0.490)	(0.537)	(0.546)			
Employment$_{f,i,t}$		2.666	2.527		2.725	2.608		2.671	2.870
		(3.233)	(3.074)		(3.289)	(3.127)		(3.449)	(3.426)
Productivity$_{f,i,t}$		-9.838	-13.597		-10.182	-15.215*		-8.481	-14.446
		(6.233)	(9.012)		(6.374)	(9.126)		(7.040)	(9.721)
MNE$_{f,i,t}$		2.863***	2.393***		2.973***	2.506***		3.172***	2.558***
		(0.833)	(0.922)		(0.824)	(0.929)		(0.748)	(0.890)
FDI in region$_{f,t-1,r}$		-0.189*	-0.218		-0.242**	-0.272*		-0.589*	-0.537
		(0.111)	(0.145)		(0.106)	(0.140)		(0.312)	(0.328)
Exports in region$_{f,t-1,r}$		0.026	0.027		0.047*	0.053		0.031	0.060
		(0.024)	(0.029)		(0.027)	(0.033)		(0.034)	(0.043)
Tariff$_{i,t-1,k}$			-0.913			0.083			2.262*
			(1.480)			(1.285)			(1.223)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	No	No	No	No	Yes	Yes	Yes
Observations	5,072	4,969	3,818	5,072	4,969	3,818	2,903	2,842	2,258
Export entries	907	898	624	907	898	624	499	495	366
FDI entries	62	62	50	62	62	50	62	62	50
Log likelihood	-338.7	-328.3	-250.3	-334.2	-322.3	-245.7	-312.9	-295.5	-220.1

Notes: The dependent variable is $h_{f,i}(t)$, the probability that new exporter f starts investing in country i at time t. The table reports the estimated coefficients of Cox regression models, with robust standard errors in parenthesis. * denotes significance at the 10% level, ** 5% level, and *** 1% level. The sample includes all FDI entries by new exporters in countries outside the EU Single Market during the 1998-2008 period.

In columns (4)-(6), we reproduce the same specifications of columns (1)-(3), replacing the variable *Export exit*$_i$ with an alternative measure of country uncertainty, *Variance regulation*$_i$, and adding the level of regulation as an additional control.[41] As expected, the coefficients for *Export experience*$_{f,i,t}$, $BIT_{i,t}$ remain positive and significant and the coefficient of *Variance regulation*$_i$ is negative and significant.

Finally, in columns (7)-(9) we include country fixed effects to account for all time-invariant characteristics of destination markets; in these regressions, we exclude all time-invariant country-level controls (*Export exit*$_i$, *Variance regulation*$_i$, *Distance*$_i$, and *Common language*$_i$). These results confirm that a firm's export experience has a positive effect of the likelihood of FDI entry. The coefficient for the dummy variable $BIT_{i,t}$ remains positive and significant, indicating that new exporters are more likely to start investing in a foreign country after its government implements an investment treaty with Belgium.

As for the other controls, we find a positive and significant coefficient of the variables *Regulation*$_{i,t}$ and $GDP_{i,t}$, indicating that new exporters are more willing to engage in FDI in countries that have sounder regulations and in larger markets; the coefficient on $GDP_{i,t}$ looses significant in columns (4)-(6), suggesting that there is too little within-country variation in GDP during our sample period to capture the role of market size. The estimated coefficient for the dummy $MNE_{f,t}$ is always positive and significant, showing that multinational firms are more likely to switch from exports to FDI. The negative and significant coefficient of the variable *FDI in region*$_{f,t-1,r}$ suggests instead that new exporters are less likely to engage in FDI if they already have affiliates in neighboring countries. Finally, notice that the tariff coefficient is positive and significant (in one specification), providing some evidence for tariff-jumping FDI. In line with our theoretical model, this suggests that, once a firm has started testing a foreign market via exports, higher tariffs unambiguously make a switch from exports to FDI more appealing.[42] The other controls are mostly insignificant.

[41] We do not include *Export exit*$_i$, *Variance regulation*$_i$ and *Regulation*$_{i,t}$ together because of multicollinearity issues. If we were to include these three regressors together, their individual significance would decrease although they would be jointly significant, a clear symptom of multicollinearity.

[42] In our model, an increase in τ at $t = 2$, following export entry at $t = 1$, lowers the threshold of realized profitability above which a firm switches from exports to FDI, $\mu^{EI} \equiv \frac{2F^I}{\tau} + \frac{\tau}{2}$. In contrast, as pointed out at the end of Section 2, an increase in τ before the entry decision at $t = 1$ may end up reducing FDI, if it prevents the firm from export experimentation.

Table 3: Impact of uncertainty measures on the probability of FDI entry by new exporters

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Export experience$_{f,i,t}$	162.73***	166.15***	142.73**	151.34***	153.26***	136.94**	148.47**	158.59**	189.76*
	(2.95)	(2.63)	(2.24)	(2.87)	(2.59)	(2.18)	(2.56)	(2.30)	(1.94)
	0.80	0.79	0.84	0.80	0.79	0.84	0.88	0.87	0.90
	[0.71]	[0.70]	[0.71]	[0.71]	[0.70]	[0.71]	[0.72]	[0.72]	[0.72]
BIT$_{i,t}$	60.23***	47.57***	47.77***	60.16***	46.34***	43.25***	95.45**	85.65**	72.51**
	(5.02)	(4.39)	(3.65)	(5.34)	(4.52)	(3.84)	(2.55)	(2.26)	(2.22)
	0.36	0.37	0.38	0.37	0.37	0.38	0.48	0.48	0.48
	[0.48]	[0.48]	[0.49]	[0.48]	[0.48]	[0.49]	[0.50]	[0.50]	[0.50]
Export exit$_i$	-37.29***	-36.76***	-34.82***						
	(-3.75)	(-3.58)	(-2.95)						
	0.47	0.47	0.46						
	[0.08]	[0.08]	[0.07]						
Variance regulation$_i$				-61.64***	-69.01***	-71.62***			
				(-3.77)	(-4.70)	(-4.07)			
				0.04	0.04	0.04			
				[0.08]	[0.08]	[0.07]			
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	No	No	No	No	Yes	Yes	Yes

Notes: For the specifications in Table 2, the table reports the percentage impact of a one-standard deviation change in each of the four uncertainty measures on the hazard rate, except for the dummy variable BIT$_{i,t}$ for which the effect of a switch from 0 to 1 is reported. The rows below each percentage impact report robust z-statistics in brackets, followed by the mean, and the standard deviation in square brackets, respectively. * denotes significance at the 10% level, ** 5% level, and *** 1% level.

The results presented in Table 2 show that our uncertainty measures are statistically significant and affect the decision to engage in new FDI, as predicted by our theoretical model. However, it is difficult to grasp their economic significance from the estimated coefficients due to the non-linearity of the estimator. To this end, in Table 3 we report the percentage change on the hazard rate resulting from a standard deviation increase of the regressors (in the case of the continuous uncertainty measures *Export experience*$_{f,i,t}$, *Export exit*$_i$, and *Variance regulation*$_i$) or a switch from zero to 1 (in the case of the dummy variable $BIT_{i,t}$), for all the specification presented in Table 2. The table also reports the mean and standard deviation of each variable, to summarize the extent of its variation. Looking at Table 3, we see that *Export experience*$_{f,i,t}$ increases the probability that a new exporter starts investing in the foreign market by up to 190%. The implementation of a bilateral investment treaty raises the probability of FDI entry by up to 95%. *Export exit*$_i$ and *Variance regulation*$_i$ have also a sizable effect, decreasing the probability of new FDI by about one third or two thirds, respectively.

Table 4 shows the results of additional estimations, in which we have verified the robustness of our results to alternative econometric methodologies. First, in columns (1)-(3), we reproduce the baseline specifications of Table 2 (columns 1, 4 and 7), using a parametric Weibull proportional hazard rate model to estimate the probability of FDI entry of new exporters. The Weibull model imposes a specific functional form on the baseline hazard, $h_0(t) = pt^{p-1}\exp(\beta_0)$, where $p > 0$ is an ancillary parameter to be estimated and β_0 is a constant. The baseline hazard rate is constant if p is equal to 1 while it is increasing (decreasing) for p above (below) 1. An incorrectly specified baseline rate would lead to inconsistent estimates. If the baseline hazard rate is not mis-specified, the estimates obtained with the parametric Weibull model should not systematically differ from those obtained with the semi-parametric Cox model. Columns (1)-(3) show that the results of Table 2 are unaffected when we use this alternative methodology to estimate the probability that new exporters start investing in foreign markets.[43]

[43]Notice that the ancillary parameter is larger than one and statistically significant, implying an ever increasing baseline hazard rate. Since this restrictive assumption is not verified in our data (most FDI entries occur in the first four years following export entry), we present the results of the non-parametric Cox model as our benchmark.

Table 4: FDI entry by new exporters, robustness checks

	Weibull regressions			First entry spells only		
	(1)	(2)	(3)	(4)	(5)	(6)
Export experience$_{f,i,t}$	0.624***	0.565***	0.598***	1.356***	1.293***	1.245***
	(0.186)	(0.181)	(0.199)	(0.297)	(0.296)	(0.325)
BIT$_{i,t}$	1.494***	1.481***	1.704**	1.601***	1.598***	1.961**
	(0.314)	(0.305)	(0.790)	(0.320)	(0.300)	(0.768)
Export exit$_i$	-5.966***			-5.906***		
	(1.859)			(2.009)		
Variance regulation$_i$		-12.060**			-12.878**	
		(5.189)			(5.676)	
Regulation$_{i,t}$		0.430**	-1.115		0.416**	1.376
		(0.195)	(1.368)		(0.196)	(1.389)
GDP$_{i,t}$	0.262***	0.237***	-1.230***	0.273***	0.252***	-0.130
	(0.046)	(0.047)	(0.462)	(0.048)	(0.048)	(0.597)
Distance$_i$	0.076**	0.032		0.092**	0.056	
	(0.037)	(0.040)		(0.041)	(0.044)	
Common language$_i$	0.194	-0.050		0.269	0.097	
	(0.517)	(0.457)		(0.555)	(0.490)	
p (ancillary parameter)	5.157***	5.198***	5.703***			
	(0.195)	(0.195)	(0.232)			
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No	No	Yes
Observations	5,072	5,072	2,903	5,014	5,014	2,864
Export entries	907	907	499	884	884	485
FDI entries	62	62	62	62	62	62
Log likelihood	173.5	177.7	203.9	-338.4	-333.8	-312.5

Notes: The dependent variable is $h_{f,i}(t)$, the probability that new exporter f starts investing in country i at time t. Columns (1)-(3) report the estimated coefficients of Weibull models, while columns (4)-(6) report the estimated coefficients of Cox models. In columns (1)-(3), we include all new exporters over the 1998-2008 period; in columns (4)-(6), we focus on the sub-sample of first entry spells only, excluding all observations corresponding to re-entries. Robust standard errors in parenthesis. * denotes significance at the 10% level, ** 5% level, and *** 1% level.

As discussed in Section 4.1, we use a stringent definition of export entry (at least five consecutive years of no exporting before entry), which minimizes the problem of firms entering several times in the same foreign market. Nevertheless, some firms in our sample re-enter the same foreign market once. Following previous studies on export dynamics (e.g. Besedes and Prusa, 2006), in columns (4)-(6) of Table 4 we verify that our results are robust to focusing on first entry spells only, excluding all observations corresponding to re-entries. In all specifications, the coefficients for the variables *Export experience*$_{f,i,t}$ and $BIT_{i,t}$ remain positive and significant, while the coefficients for *Export exit*$_i$ and *Variance regulation*$_i$ continue to be negative and significant, confirming that uncertainty in foreign market conditions delays FDI entry by new exporters.

In Table 5 we show that our results are robust to using different samples of destinations countries and FDI entries. In columns (1)-(3), we once again reproduce our benchmark results (columns 1, 4 and 7 of of Table 2), but use information on intra-firm trade between the foreign affiliate and the Belgian parent firm to remove vertical FDI entries (see discussion in the previous section). Although this reduces the number of observations in our analysis, the results confirm that a firm's export experience, investment treaties with Belgium and less uncertain market conditions increase the probability that new exporters establish foreign affiliates. In columns (4)-(6) we include firms that started to export to the twelve countries that have joined the European Union during our sample period (ten Central and Eastern European countries, plus Cyprus and Malta). Many new exporters also started to invest in these countries. In all specifications, our uncertainty measures have the expected sign and are significant. However, the point estimates are somewhat smaller, suggesting that there may be less uncertainty in these countries compared to destinations outside the European Single Market. This is particularly the case for the variance of regulation, whose coefficient drops by two third and is only significant at 10 percent.

In the following, we discuss the results of two additional robustness checks, which we do not report to save on space.[44] First, as a "falsification exercise", we have restricted our analysis to foreign markets in which Belgian firms should face little or no uncertainty. In our analysis so far, we have only included destinations outside the European Single Market (Tables 2 and 4, columns 1-3 of Table 5) or added the twelve countries that have become members of the Single Market during our sample period (columns 4-7 of Table 5). In a series of additional estimations, we have restricted the analysis to older members of the Single Market, which have long removed barriers to trade in goods

[44]The results are available upon request.

and factor mobility with Belgium.[45] As expected, uncertainty has little or no effect on FDI entry decisions of new exporters in these destination countries: the coefficients of the variables *Export experience*$_{f,i,t}$, *Export exit*$_i$, and *Variance regulation*$_i$ maintain the expected sign, but are only significant in some specifications.[46]

Table 5: FDI entry by new exporters, robustness checks

	Excluding vertical FDI			Including EU accession countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Export experience$_{f,i,t}$	1.193***	1.163***	1.072***	1.265***	1.264***	1.196***
	(0.293)	(0.293)	(0.305)	(0.250)	(0.248)	(0.260)
BIT$_{i,t}$	1.606***	1.552***	1.713**	1.484***	1.497***	1.754***
	(0.359)	(0.329)	(0.780)	(0.302)	(0.296)	(0.602)
Export exit$_i$	-7.096***			-4.980***		
	(2.064)			(1.724)		
Variance regulation$_i$		-12.537**			-3.323*	
		(5.747)			(1.937)	
Regulation$_{i,t}$		0.357	1.578		0.289*	1.089
GDP$_{i,t}$	0.285***	0.272***	-0.493	0.235***	0.228***	-0.082
	(0.054)	(0.055)	(0.624)	(0.044)	(0.045)	(0.504)
Distance$_i$	0.114***	0.082*		0.082***	0.058**	
	(0.042)	(0.046)		(0.028)	(0.026)	
Common language$_i$	-0.029	-0.278		0.126	-0.042	
	(0.642)	(0.578)		(0.505)	(0.501)	
		(0.219)	(1.626)		(0.167)	(1.028)
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	No	No	Yes	No	No	Yes
Observations	4,503	4,503	2,217	8,741	8,741	5,174
Export entries	815	815	385	1,482	1,482	851
FDI entries	53	53	53	91	91	91
Log likelihood	-282.3	-279.7	-253.3	-552.7	-552.5	-514.5

Notes: The dependent variable is $h_{f,i}(t)$, the probability that new exporter f starts investing in country i at time t. The table reports the estimated coefficients of Cox regression models. In columns (1)-(3), we exclude "vertical" FDI entries of new exporters; in columns (4)-(6), we include all FDI entries by new exporters in countries outside the EU Single Market during the 1998-2008 period. Robust standard errors in parenthesis. * denotes significance at the 10% level, ** 5% level, and *** 1% level.

[45] In this case, the sample includes eighteen destination countries: the fourteen countries that, together with Belgium, represent EU15, plus Iceland, Liechtenstein, Norway and Switzerland.

[46] The variable $BIT_{i,t}$ cannot be included in these regressions, since old members of the European Single Market have long adopted rules to protect firms investing in each others' markets.

As a final robustness check, we excluded firm fixed effects, comparing FDI entry decisions of different new exporters. This leads to a much bigger sample (i.e. five times as large) since new exporters that never engage in new FDI are now part of it. In this setup, we can include not only time-varying firm-level controls (e.g. $Employment_{f,i,t}$, $Productivity_{f,i,t}$, $MFN_{f,i,t}$, $FDI\ in\ region_{f,t-1,r}$), but also time-invariant firm characteristics. In particular, we have included the variable $Differentiated_f$, which measures the degree of product differentiation of the main sector in which a firm is active. This is constructed based on the well-known index devised by Rauch (1999), who classifies products according to three different types: homogeneous goods, which are traded in organized exchanges (e.g. wheat); goods that are not traded in organized exchanges, but for which a published reference price can be found in specialized publications (e.g. polyethylene); and differentiated goods, which fall under neither of the two previous categories.[47] As argued by Rauch (1999) and Rauch and Trindade (2000), search barriers to trade are higher in differentiated sectors. This would suggest that new exporters selling homogenous products may be more likely to start investing in foreign markets. However, the opposite may be true, if the fixed cost of setting up a production plant is higher in homogeneous than in differentiated sectors. In all specifications, the coefficient of the variable $Differentiated_f$ was never significant. As for our key variables of interest, the sign and significance of $Export\ experience_{f,i,t}$, $BIT_{i,t}$, $Export\ exit_i$, and $Variance\ regulation_i$ were unaffected, confirming that uncertainty delays FDI entry by new exporters.

6 Conclusions

A vast literature in international business studies argues that uncertainty leads firms to follow a gradual internationalization process, testing a foreign market via exports before deciding whether to invest there. In this paper, we have presented a simple dynamic model of export and FDI choices to formalize this idea. Firms are uncertain about their ability to earn profits in a foreign market and must decide whether or not to serve it,

[47] To apply Rauch (1999)'s measure to our analysis, we matched his sector classification (SITC Rev.2 at 4 digits) with the NACE classification used in the Belgian data. To do so, we proceeded in two steps. First, we used the conversion tables by Affendy *et al.* (2010) to map SITC Rev.2 4-digit sectors into ISIC Rev.2 4-digit sectors. For each ISIC code, we computed the fraction of sub-sectors that are classified as being differentiated according to Rauch. Second, using correspondences from Eurostat, we mapped ISIC Rev.2 4-digit sectors into NACE Rev.1 3-digit sectors. This level of aggregation minimizes the number of multiple matches, since NACE activities at the 3-digit level are comparable to ISIC activities at the 4-digit level. For each 3-digit NACE manufacturing industry, we then constructed the variable $Differentiated_f$, which measures the share of sub-sectors of the main industry in which firm f is active that are classified by Rauch (1999) as being differentiated. This variable cannot be included in specifications with firm fixed effects, since very few firms change their main sector of activity.

and whether to do so through exports or foreign affiliate sales. In this setting, firms may first serve a foreign market via exports, which allows them to experiment at a lower fixed cost; if they discover that serving the market is profitable enough, they will establish foreign subsidiaries to reduce variable costs. The more uncertain are foreign market conditions following export entry, the less likely should be the switch from exports to FDI.

In our empirical analysis, we have assessed the validity of these predictions by exploiting a unique firm-level dataset, covering exports and FDI in individual destination markets for all companies registered in Belgium over the 1998-2008 period. In line with the idea of a gradual internationalization process, we find that a firm's FDI entry is almost always preceded by its export entry: in the overwhelming majority of cases (almost 90%), firms that start investing in a foreign market do so after serving it via exports. When firms start exporting to new market, the probability of FDI entry depends on the extent of uncertainty they face: new exporters are more likely to engage in FDI once they have accumulated enough export experience in a foreign country, when the host country's government implements a bilateral investment treaty, and when local market conditions are more predictable (e.g. lower variance in the quality of business regulations).

Our analysis shows that firms' export and FDI decisions must be understood as part of a broader dynamic strategy to serve foreign markets in the face of uncertainty. It suggests that, although exports and horizontal FDI are substitutes from a static perspective – since they represent alternative ways of serving a foreign market – they may be complements over time – since the knowledge acquired through export experience can lead firms to invest abroad. In contrast to the predictions of standard models of internationalization choices that abstract from uncertainty and experimentation, our results imply that trade liberalization may actually foster FDI – by decreasing the cost of experimenting in foreign markets – and FDI liberalization may stimulate exports – by increasing the option value of export entry.

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A-1 Export-supporting FDI

Recent studies have emphasized the importance of "export-supporting FDI", i.e. investments in foreign subsidiaries established to set up distribution centers and sales offices to penetrate export markets (e.g. Krautheim, 2007; Aeberhardt *et al.*, 2009; Arkolakis, 2010).

In what follows, we show that the logic of our theoretical model can be applied to a setting in which exporting firms decide between distributing their exports through a local agent and establishing their own distribution network. In this case, firms face a tradeoff between the higher variable costs of using local distributors and the higher fixed costs of setting up foreign distribution centers and sales offices. We can derive conditions under which firms will follow a process of gradual involvement in foreign markets, using local distributors before establishing their own distribution network.

Consider a representative firm producing good k which must decide whether to export to foreign market i, and whether to do so through local agents or by setting up its own distribution network. As in the model described above, we normalize unit production costs to zero and denote unit trade costs with τ_{ik}. If the firm relies on a local agent, we assume that its unit distribution costs are equal to c_{ik}. If instead the firm invests in its own distribution network in the host country, the unit distribution costs are equal to $c_i k - \phi$. Independently of the mode of distribution, the firm incurs a sunk export cost F^E_{ik}, (e.g. capturing the costs of dealing with customs procedures). To establish its distribution network, it incurs an additional one-time fixed cost F^I_{ik}.

Dropping country and sector subscripts to simplify notation, second-period profits of the exporting firm are given by $\Pi^E = (E\mu - q^E - \tau)q^E - F^E$, if it uses a local distributor, and $\Pi^I = (E\mu + \phi - q^I - \tau)q^I - F^E - F^I$, if it invests in its own distribution network, where $E\mu$ captures the expected profitability of serving the foreign market.

If can be show that, in scenarios in which experimentation matters (i.e. when the firm would not enter the foreign market in the absence of uncertainty), the optimal strategy of the firm is to test the foreign market, by exporting small quantities and using local distributors; after an initial trial phase, the firm will decide to exit the foreign market, continue to export via local distributors, or establish its own distribution network. The probability that the firm starts investing in the second period is $1 - G(\mu^{EI'})$, where

$$\mu^{EI'} = \frac{2F^I}{\phi} - \frac{\phi}{2} + \tau. \tag{A-1}$$

As in the case of horizontal FDI, uncertainty about foreign market conditions can lead new exporters to delay FDI entry in the foreign market. However, export-supporting FDI differs from horizontal FDI in two important ways. First, the firm's exports increase (rather than decrease) following FDI entry. Second, higher trade barriers decrease (rather than increase) the likelihood that the firm starts engaging in FDI.[48] The intuition for this result is simple: trade costs reduce the volume of exports over which the firm can amortize the fixed costs of setting up a distribution network.

[48] To verify this, notice that the threshold identified by equation (A-1) is increasing in τ (while the threshold identified by equation (6) is decreasing in τ).

A-2 Descriptive statistics on exports and FDI

In what follows, we present some descriptive statistics about exports and FDI activities of Belgian firms. We restrict our attention to manufacturing firms (i.e. four-digit codes belonging to sectors between 15 and 37 of NACE revision 1) and impose a threshold in terms of employment (i.e. at least 5 employees).

In Table A-1 we reports descriptive statistics for all destinations and then for those outside the EU Single Market. Notice that Belgian firms are very open: over the entire sample, on average 52 percent of firms export. Notice that the total number of exporting firms is decreasing over time, but this observation is partly driven by the fact that the minimum threshold required for firms to report their intra-EU exports has significantly increased during the sample period (the Intrastat dataset includes transactions exceeding a value of 104,115 euros in 1993-1997, 250,000 euros in 1998-2005, and 1 million euros in 2006-2008). Instead the number of firms exporting outside the Single Market has not changed significantly during our sample, since the threshold required for export activities to be reported has remained constant during the sample period (all transactions with a value higher than 1,000 euro or a weight higher than 1,000 Kg are included).

Table A-1 also shows that firms engaging in outward FDI are a much smaller group (4.6% of the total number of Belgian firms). When considering the location of foreign affiliates, it is clear that most of them are located within the Single Market. However, the presence outside the Single Market is increasing over time, reaching a peak in 2006, when the number of firms with outward FDI is almost double than the number at the beginning of the sample.

Table A-1: Population of firms by export and FDI status

Year	Total Firms	World		Outside EU Single Market	
	in Belgium	Exporting	With FDI	Exporting	With FDI
1998	8,763	4,561	346	2,876	98
1999	8,839	4,566	347	2,852	103
2000	8,787	4,557	360	2,851	121
2001	8,667	4,575	435	2,824	146
2002	8,499	4,520	446	2,814	143
2003	8,416	4,511	451	2,786	148
2004	8,350	4,454	464	2,828	150
2005	8,345	4,392	388	2,824	143
2006	8,369	3,958	391	2,807	154
2007	8,372	3,869	379	2,862	157
2008	7,168	3,477	323	2,543	137

Table A-2 reports the total number of export and FDI relationships (i.e. firm-destination pairs) that Belgian firms maintain every year. Combining Tables A-1 and A-2, we see that firms export to 13 countries on average. Restricting our attention to firms that serve destinations outside the European Single Market, on average they export to 9 countries and have foreign affiliates in 2.3 countries.

Table A-2: Export and FDI relationships

Year	Export Relationships		FDI Relationships	
	World	Outside SM	World	Outside SM
1998	55,822	23,119	974	214
1999	56,025	22,923	1,004	230
2000	57,330	23,748	1,127	283
2001	58,603	24,135	1,335	330
2002	58,693	24,172	1,383	332
2003	58,846	24,025	1,369	336
2004	60,046	24,517	1,324	334
2005	60,774	25,194	1,222	322
2006	57,155	25,366	1,312	390
2007	57,156	25,591	1,296	387
2008	53,408	24,764	1,147	349

Table A-3 provides some statistics on the size and productivity of three groups of firms Belgian firm, defined based on 1998, the first year of our sample (the same patterns hold for any other year in our sample period): those that did not export to any country outside the European Single Market (Domestic firms), those that exported to at least one country outside outside the Single Market (Exporting firms), and those that engaged in FDI in at least one destination outside the Single Market (Firms with FDI).

Table A-3: Firm size and productivity

	Mean	St. dev.	Min	Max
Domestic firms				
Employment	69	123	5	1,600
Productivity	67.32	67.03	2.19	485.95
Exporting firms				
Employment	470	1055	5	9,736
Productivity	74.62	53.02	5.21	894.59
Firms with FDI				
Employment	1,750	2,036	10	7,297
Productivity	83.94	32.83	5.16	310.38

Notes: Employment in units; productivity is value added (in thousands) divided by employment (in units). Statistics based on first year of our sample.

It should be stressed that these statistics are based on a sample of firms that export to at least one country outside of the EU Single Market during the 1998-2008 period. Firms defined as domestic in 1998 would be exporting at some other point in time and, as such, are thus likely to be larger and more productive that truly domestic firms (i.e. firms that never export). With this caveat in mind, Table A-3 confirms the sorting patterns emphasized by the literature on heterogeneous firms and trade (e.g. Head and Ries, 2003; Helpman *et al.*, 2004): firms that only serve the domestic market are on average smaller and less productive than firms that export to foreign markets; in turn, exporting firms tend to be smaller and less productive than firms that engage in FDI.

A-3 Definition of variables and sources

Export entry$_{f,i,t}$	Dummy equal to 1 if firm f starts exporting to country i in year t, after at least 5 years of no exports (NBB Foreign Trade Data)
FDI entry$_{f,i,t}$	Dummy equal to 1 if firm f starts investing in country i in year t (NBB Survey on Foreign Direct Investment)
Export experience$_{f,i,t}$	ln (1 + number of years of positive exports) of firm f in country i following export entry
Export exit$_i$	Average exit rate of new exporters in country i (in the year following export entry) (NBB Foreign Trade Data)
BIT$_{i,t}$	Dummy equal to 1 if country i implements a bilateral investment treaty with Belgium in year t (ICSID)
Variance regulation$_i$	Variance of the variable Regulation$_{i,t}$ over our sample period (Kaufmann *et al.*, 2009)
Regulation$_{i,t}$	Index of regulatory quality of country i (Kaufmann *et al.*, 2009)
GDP$_{i,t}$	Gross Domestic Product of country i in year t in constant 2000 US$ in billions (WDI)
Distance$_i$	Distance in km between Bruxelles and the capital of country i in thousands (CEPII)
Common language$_i$	Dummy equal to 1 if country i shares an official language with Belgium (CEPII)
Employment$_{f,t}$	Employment of firm f in year t in thousands (NBB Central Balance Sheet Data)
Productivity$_{f,t}$	Value added of firm f in thousands divided by its employment in thousands (NBB Central Balance Sheet Data)
MNE$_{f,t}$	Dummy equal to 1 if firm receives inward FDI (NBB Central Balance Sheet Data)
FDI in region$_{f,t-1,r}$	Number of countries in region r in which firm f has foreign affiliates at $t-1$
Exports in region$_{f,t-1,r}$	Number of countries in region r in which firm f exported at $t-1$
Differentiated$_f$	Share of sub-sectors in the main industry of firm f (at 3-digit NACE level) classified as differentiated (Rauch, 1999)
Tariff$_{i,t,k}$	Average tariff (at 4-digit NACE level) over previous three years, applied by country i to imports from Belgium of good k (WITS)

Notes: See Section 4 for detailed information on the construction of the variables. Acronyms: NBB: National Bank of Belgium; ICSID: International Centre for Settlement of Investment Disputes; WDI: World Development Indicators; CEPII: Centre d'Etudes Prospectives et d'Informations Internationales; WITS: World Integrated Trade Solution.