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Temporary Trade and Heterogeneous Firms

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Temporary trade and heterogeneous firms*

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Abstract

Using Hungarian firm-level export data, we show that about one third of firm-destination and about one half of firm-product-destination export spells are short-lived, or temporary, in each year. This is inconsistent with theories where comparative advantage is stable and market entry costs are sunk. We show how endogenous choice between variable and sunk cost trade technologies can explain the empirical importance and some characteristics of temporary trade. We build a simple model in which the likelihood of temporary trade, defined by a simple filter, depends on productivity and capital cost of the firm as well as well known gravity variables of destinations. These predictions are borne out by the data; the likelihood of temporary trade rises with lower productivity, higher capital cost of the firm, further location and larger GDP of destination countries.

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1 Introduction

Most trade theories predict a stable export activity once comparative advantage warrant it or the sunk cost of establishing one is paid for. In these models, fluctuations in trade are only possible inasmuch these conditions such as factor prices or demand, may change dramatically. However, firms often export their products to a given destination for a short period or in a series of short spells.

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Indeed, instability of exports, or temporary trade, is a key feature of trade relationship for all kinds of firms and products.

We study the length of export spells in firm-product-destination level data for Hungary. Our dataset covers all trade transactions in manufactured goods exported directly by manufacturing firms for the 1997-2003 period. We classify each firm-destination trade flow as either permanent or temporary by introducing a simple *trade relationship stability filter*. Permanent trade is an uninterrupted export spell that is at least four years long, while temporary trade can be either a short spell or a non-continuous export relationship.

Using our filter, we show that temporary trade is present at every layer of firm-product-destination level trade relationships, and it is quite an important feature. About a fifth of firms who sell domestically in every year will export in a temporary fashion only. About 35% of destination and 57% of product-destination specific export is temporary in nature.

To understand the prevalence and the determinants of temporary trade, we build a model in which heterogenous firms can pick a trade cost structure. All firms can export at a high marginal cost, but certain firms will chose to lower this trade cost by paying a sunk cost. The endogenous choice between variable and sunk cost trade technologies can yield, for some firms and destinations, an equilibrium outcome of short-term trade. Our model shows that the likelihood of temporary trade depends on productivity and capital cost of the firm as well as key features of destination markets such as size and distance. The model is related the marketing cost model of Arkolakis (2008) where trade behaviour is endogeneously determined and is related to market size.

We then take our model to the data and find that (i) more productive firms are more likely be engaged in trade relationships in a permanent fashion, and (ii) temporary trade is more likely with distant and small markets as well as homogeneous products.

Our work is related to recent empirical papers that emphasise the importance of short term relationships - mostly at a bilateral level. These relationships are not only characteristics of small markets like Hungary or Colombia (Eaton et al. (2007)), but also of large economies such as the US and Germany. Besedes and Prusa (2006), for example, show that the median duration of exporting a product is between two and four years in the United States.

We make several contributions to this empirical literature. First, we provide a filter which enables us to analyse the factors affecting the stability of trade. Second, we show that temporary trade is an important characteristic of international trade. Third, using a random effect probit model, we show that the likelihood of temporary trade rises with lower productivity, higher capital cost of the firm, further location and larger GDP of destination countries, and that these are in line with our simple model. We extend the analysis to the firm-destination-product level and find that product differentiation increases the probability of a permanent trade relationship. Fourth, we show that trade liberalization leads to an increase of the extensive margin of both kinds of exporters, and leads to a more positive effect on the intensive margin of permanent exporters.

On the theory side, our starting point is a heterogeneous firms model, following Melitz (2003), where firms pay a sunk cost to start exporting. The fact that we find that about half of all trade relationships are short-term, points to the limitation of simple sunk cost based models following Melitz, particularly if one endorses that exporting sunk costs are large, as found in Das et al. (2007).

Our theoretical contribution is to introduce the possibility that heterogeneous firms can choose between two trade technologies. This choice depends on firm characteristics, and has a persistent effect, which leads to heterogeneity across firms in their export behavior. In a simple model with endogenous technology choice we provide a number of predictions which can be matched with evidence from the data. This is important as allowing firms to extract less from an export sale but avoid paying a large one-off cost, can make the large number of short spells quite understandable - even without assuming very large and frequent productivity shocks.

We believe that temporary trade is also relevant for policy analysis. Temporary trade is an important phenomenon at a national (i.e. bilateral) level as well, with about half bilateral destination-product specific relationships being temporary in nature. The reason for this is that in a small economy, a handful of firms export a product to a given market, and as a consequence, firm-level temporary trade strongly affects the stability of bilateral trade. The most striking result is that we find only one firm behind a quarter of these bilateral trade relationships in 2000. Also, in half of occasions, there are less than three firms exporting a product to a given destination. This suggests that decisions of a small number of firms may lead to significant changes in the pattern of trade flows - firm-level variability may play a very important role in bilateral flow dynamics[1]

This paper is organised as follows. In the section 2, we detail our dataset, and describe our definition of temporary and permanent trade relationship only to show the prevalence of temporary trade. Section 3 presents the model that links temporary trade to a choice of trade technology. Section 4 introduces the evidence on temporary trade patterns. The last section concludes.

2 Data and patterns in temporary trade

This section first introduces our proposed trade relationship stability filter. After briefly presenting the dataset, we use our filter to show the prevalance of temporary trade.

2.1 What is temporary trade?

Some recent empirical papers emphasize the importance of short term relationships - mostly at a bilateral level. These relationships are not only characteristics of small markets, like Hungary or Colombia but also of large economies such as the US and Germany. Besedes and Prusa (2006), for example, show that the

[1] For details, see Table 7 in the Appendix.

median duration of exporting a product is between two and four years in the United States. Similarly, Nitsch (2009) shows that the same phenomenon can be observed in Germany - the majority of trade relationships exists for only one to three years. Eaton et al. (2005) look at …rm-level trade ‡ows in Colombia, only to …nd a large importance of one-time exporters. Hess and Persson (2010), looking at the duration of EU imports at bilateral trade data, …nd that even at national level, a large share of trade relationships are short lived, and some stability in importing a product masks shifts in source countries. Focusing at the product level Bernard et al. (2010) demonstrates that in 1997, about quarter of output by stable (producing at least between 1992 and 2002) …rms comes form newly (within …ve years) added products and another quarter of products will be lost within 5 years.

Instead of looking at the duration of an export spell or churning of products, our aim is to classify each …rm-destination trade ‡ow in a year as either permanent or temporary. To do that we introduce a simple *trade relationship stability filter*, which will enable us to analyse the determinants of temporary trade. The …lter works as follows.

First let us denote the value of a trade ‡ow by …rm i to market k at year t as R_{ik}^{t}. Let $t = t_0$ be the base year in which we would like to classify the active trade relationships, i.e. those …rm-destination combinations for which $R_{ik}^{t_0} > 0$. For each such i, k combination one can de…ne a spell, $S_{ik}^{t_0}$, which denotes the number of consecutive years, including τ, for which …rm i exported to market k. Thus, if $R_{ik}^{t_0-2} = 0; R_{ik}^{t_0-1} > 0; R_{ik}^{t_0} > 0$ and $R_{ik}^{t_0+1} = 0$, then $S_{ik}^{t_0} = 2$. Based on this, we say that …rm i exports to market k in a *permanent* way if $S_{ik}^{t_0} > \theta$, and the export ‡ow is *temporary* whenever $S_{ik}^{t_0} \leq \theta$, where θ is a positive integer. In practice, θ may represent a period long enough to include some longer than one year trade ‡ows but short enough not to include stable trade relationships.

While this approach is arbitrary to some extent, we …nd it quite useful and straightforward. It enables one to classify all trade ‡ows in a cross section, and explain whether a ‡ow is temporary by binary dependent variable methods. We consider this as a more natural framework of analysis than for example modelling the length of the spells with duration models because of three reasons. First, as we will argue in the theory section, temporarily exporting …rms may have chosen endogenously a di¤erent trading technology than permanent exporters, which motivates a binary rather then a continuous framework with respect to time when modelling trade spells. Second, in duration modelling the choice of the time period is a delicate issue: using all spells within a period, for example, may lead to over-representation of short spells and various truncation problems. Third, the interpretation of the results from our approach is quite straightforward: the marginal e¤ect shows how the probability that the ‡ow is permanent changes when the explanatory variable changes.

In this paper, we will report most results with $\theta = 3$, i.e. we require a permanent trade ‡ow to last at least four years. Note that for this exercise to work one needs data for years between $t_0 - \theta$ and $t_0 + \theta$, because this enables one to be sure whether each ‡ow is at least $\theta + 1$ year long. In this way, as we have trade data until 2003, we will classify all trade relationships in $t_0 = 2000$

into either the temporary or permanent category. The choice of this year was motivated by the fact that post-communist transition and the most important structural changes in Hungarian economy already took place before 1997, thus the observed dynamic nature of trade relationships is not a consequence of transition. At the same time, this is an interesting period in time featuring a gradual European integration process and a dynamic export-led growth.

On the choice of the time window, four years of consecutive exporting is long enough to be considered as permanent - in line with the results of Besedes and Prusa (2006), who estimate the duration of trade relationships and find that the survival rates decrease rapidly in the first 4-5 years (to about 45-50%), and remain reasonably stable afterwards. We consider this definition of temporary trade relationship quite conservative. We have also experimented with other definitions, in which temporary trade was even more important[2].

Also, the method can be easily extended, with appropriate indexing, to other levels of aggregation: the bilateral level, the firm level or the firm-product-destination level. In each case, one can classify all cross-sectional units in year t_0 based on the length of their respective spells.

2.2 The dataset

The dataset covers all export data from Hungary, for the 1992-2003 period. The data is structured at a firm-product-destination level with one observation in the database being the export of a product j by firm i to country k in year t.

The dataset comes from a merger of two sources. Firm level balance sheet and income statement data by APEH, the tax authority. Transaction level data comes from the Customs statistics and contains information on transaction value and quantity. This dataset consists of manufacturing firms and manufacturing products only. Thus, all information is related to direct export by a manufacturing firm. The values of export are calculated as free on board.

The product dimension of the dataset is disaggregated; it is broken down to 6-digit Harmonized System (HS) level. We define a product as a 6-digit category, although using more aggregated (4-digit) categories does not change our results. "Motor cars and vehicles for transporting persons" is an example for a 4-digit category, while "Other vehicles, spark-ignition engine of a cylinder capacity not exceeding 1,500 cc" is an example of 6-digit category.

Data covers exports for 169 countries and over 700 HS6 product categories.

Note that the Hungarian trade structure is close to EU countries as described in Mayer and Ottaviano (2008) even if the concentration and role of large firms is slightly higher in Hungary than in most EU countries. Hungary is about as open as Ireland or Belgium and accordingly the share of trading firms is

[2] According to an alternative definition, temporary trade is defined as a trade relationship, in which we can observe at least 1 positive value in a given 4-year period, but the cell is not active for all four years. With this definition, 20-30 percent more relationships will be classified as temporary. Results available on request.

fairly close to the ratios in those countries[3]. Certain aspects of the data are comparable to previous …ndings on US and some European data (Baldwin and Harrigan (2007), Mayer and Ottaviano (2008)) International comparisons are important to underline the generality of our …ndings. Furthermore, the dataset o¤ers both intra and extra EU trade until Hungary's EU membership in 2004, and the …rm-transaction level of the dataset allows for uncovering trade stability at …rm level.

2.3 Importance of temporary trade

Based on the trade relationship stability …lter, we have calculated the share of temporary trade in Hungary, which we present in Table 1. The main result is that about 32 percent of …rm-destination export relationships was temporary in 2000. The share of temporary trade is even larger at the …rm-product destination level: 56.5 %.[4] This shows that temporary trade is not a curiosity: it is an important fact of international trade.

Note that our unit of observation is a …rm-destination (or later, a …rm-destination-product) speci…c relationship. Temporary trade is important in terms of the number of trade relationships. If, instead, one is interested in volumes, that will be much overshadowed by transactions by some very large …rms. For instance, motor vehicle export of a major German multinational car company to Germany - alone accounts for 11% of total Hungarian direct export volume by manufacturing …rms. The 100 largest relationships account for over 40% of the trade volume. No wonder that the volume of temporary trade relationship is just 2% at destination and 8% at destination-product level of all the trade volume.

Because our de…nition is arbitrary to some extent, we have conducted a number of checks which con…rmed that the share of temporary trade is similar when we modify the sample or the …lter. Indeed, we consider robustness checks along four dimensions: dropping nuisance (i.e. very small) deals, dropping far-away countries, changing the number of years and the base year. First, if we restrict the sample only to signi…cant trade ‡ows, the …gure is somewhat smaller, but it is still larger than 25 percent. Second, temporary trade is important both in the enlarged European Union and outside it. Note, however, that temporary trade is more frequent for less important trade partners. (Hungary's most important export destinations are members of the enlarged EU). Third, with $\theta = 4$, the share of temporary trade goes up to almost 40 percent. Fourth, in 1995, a period of signi…cant structural reforms, the share of temporary trade was even higher, 37 percent. Thus, one may conclude that when looking at the number of trade relationships, temporary trade is important at every level.

[3] For more on the Hungarian dataset and a set of descriptive statistics regarding trading …rms, see Békés et al. (2011).

[4] As for the 56.5% of temporary relationships, 20pp are temporary transactions in permanent products, 31.5% are temporary products by permanent …rms and 5% of transactions are carried out by temporary …rms. From a destination angle, the share of temporary transactions in permanent destinations is 39% and temporary destinations by permanent …rms account for

Description	Permanent	Temporary	Temp. share
Firm-destination			
Full sample	11650	5434	31.81%
Products >10 Mn USD*	6630	2279	25.58%
Destinations>10 Bn USD*	11509	5242	31.29%
Only EU25	8663	3425	28.33%
Only non-EU25	2987	2009	40.21%
Base year: 1995	5442	3540	39.41%
4 year de…nition	9375	5666	37.67%
Firm			
Full sample	3809	731	16.10%
Firm-product destination			
Full sample	29084	37790	56.51%
*Product and destination categories are de…ned at aggregate level.			

Table 1: Number of observations

3 Modelling Temporary Trade

3.1 Relating to previous literature

As argued earlier, traditional trade models overlook the possibility of unstable trade relationship as a mass phenomenon. However, we are not the …rst to argue that as …rms face uncertainty, their trading activity may not be stable; this issue was analysed both at the …rm and at the …rm-product level.

Most recent advances in this literature keep the basic story of Melitz (2003)- and retain the assumption of some sunk cost related to the start exporting, but allow for some sort of shocks. Uncertainty of export pro…tability may come from several sources: it may be speci…c to the …rm, such as productivity, or per period …xed cost, may be speci…c to a product / destination such as taste changes, or political and appropriation risk. These di¤erent shocks may a¤ect …rm behaviour di¤erently. In this short review, we aim at placing our approach in a set of recent advances, looking at sources of instability at the …rm level …rst followed by an overview of points raised by destination as well as product level models.

A number of recent models provide a dynamic extension of the Meltiz-model. These models introduce more than one period, a per-period …xed cost and uncertainty in the …xed cost or productivity. In these models …rms are heterogeneous in terms of productivity, and uncertainty a¤ects …rms di¤erently according to their selected feature. In Ghironi and Melitz (2005) …rms pay a sunk cost to start exporting and then pay a per period …x cost as well as an iceberg trade cost to export every period. Firms may abstain from exporting in a given period owing to the …xed per period cost. This setup allows for macro-economic shocks to propel …rm entry and exit and hence, create churning (at the …rm level) and

13% of all transactions.

volatility in …rm exports.

Indeed, the most basic source of uncertainty is related to …rms' overall productivity. A shock to the marginal cost of production may stem from human resources or technology or a change in the behaviour of competitors. Such a shock would a¤ect the …rm's general conduct, its decision to enter or exit foreign (or even domestic) markets.

A similarly important source of uncertainty is shocks to the per-period …xed cost. In dynamic extensions of the Melitz model, this may be equivalent to a shock to …rm productivity. A good example for these models is Segura-Cayuela and Vilarrubia (2008), in which …rms pay a per period …xed cost and observe their per-period productivity as well as past behaviour of other …rms. At every step they calculate the value of entry (into an export market) and decide upon available market information. In the lack of full information, it may be worth waiting before entering a new market. The higher the uncertainty, the fewer …rms enter at a given period. Although not explicitly modelled in the paper, exit would take place if a shock to productivity is so large that it makes future payments of per period …xed costs unlikely to be worth. In the Arkolakis (2008) model of marketing costs with product di¤erentiation and …rm heterogeneity, a …rm will enter a market whenever it pro…ts from even a single consumer. However, marginal cost is related to the number of additional consumers reached. Thus, di¤erent …rms may rely on di¤erent strategies and try to reach more or fewer consumers

Firm-destination level trade dynamics may be modelled in a similar way. If uncertainty is modelled by a shock to the iceberg trade cost (i.e. ad valorem and not per period …xed costs), exit can also happen and it may be destination-speci…c. In line with this approach, Crozet et al. (2008) suggest that volatile macroeconomic background (such as the exchange rate) will create large shocks, and some …rms will suddenly exit - despite the fact that their past productivity advantage was high enough for exports. As exchange rate or political shocks are country speci…c, this type of uncertainty will unequally a¤ect a …rm's export to di¤erent countries.

A second class of models derives trade dynamics from contractual frictions rather than uncertainty about costs.

Note that besides uncertainty, asymmetric information may also lead to temporary trade. If the attributes of a trading partner cannot be observed by an exporter when they meet when a …rm …rst tries to …nd a new partner, it can be optimal to 'test' potential foreign partners by starting small. Rauch and Watson (2003) argued new entrants should only continue the relationship if the potential partner successfully stood this test. In this spirit, Besedes (2006) shows that initial size, risk and search costs play an important role in determining the duration of a trade relationship. Higher reliability and lower search costs lead to larger initial transactions and longer duration. Furthermore, Araujo and Ornelas (2007) argue that in the presence of incomplete contracts, starting in small makes sense, as it is a good way to uncover reliability.

In Aeberhardt et al. (2009) exporting requires the presence of a local distributor in each market, and it takes time to learn the quality of distributors. Thus,

the size of export shipment of a firm to a destination grows as the relationship matures. In this model, persistence is a consequence of informational friction (i.e. lack of knowledge on distributors) rather than sunk costs. This approach de facto allows firms to invest less in the beginning and pay at every level once the reliability of distribution channel is revealed - i.e. their is a tradeoff between the sunk cost and per-period costs.

An important extension to these models is allowing firms to choose from a menu of different trade technologies. It is important as a uniform fixed cost models requires large costs to explain firm entry patterns, a prediction that contradicts the existence of many small exporters (found for French firms by Eaton and Kramarz (2010).

Ruhl and Willis (2008) construct a dynamic discrete choice model of exporting to match empirical patterns of domestic and export market growth. In addition to a firm level fixed cost, there is a per-period market-level cost if the firm wishes to maintain export market presence. Such a cost structure will allow for exit and allow to explain mixed persistence by exporters.

Another approach is taken by the literature started by Arkolakis (2008), where firms may choose a marketing technology in a framework where costly advertising is needed to reach more and more consumers. In Arkolakis and Muendler (2010), firms first incur a broad market-entry cost and then an additional fixed product-entry cost that is in line with the magnitude of the particular overseas presence. Importantly, these are related to product distribution (wholesale, storage, transportation, retail, etc.) at given markets. If the marginal cost of adding a product at an already overtaken market is small, such a cost structure may lead to high churning. This is also the case in Buono et al. (2008) , who find that firms often stop exporting to one market while start exporting to another.

So far we have only discussed firm-specific shocks. However, temporary trade at the firm product level may come from shocks which are related to products which does not result in the firm quitting from exporting altogether. International evidence suggests a majority of export shipments being carried out by multiproduct firms[5] These models extend the logic of dynamic Melitz models to the firm-product level.

In a very relevant paper for our purpose, Bernard et al. (2010) use a multiproduct setting, where a firm decides both entry and exit as well as in which product markets (such as goods and countries) to participate. Firms enter by incurring a sunk entry cost and observe both their initial productivity (otherwise called firm attribute), and a product-firm specific consumer taste for the characteristics embodied in its blueprint for every product (also called expertise). In this setup productivity remains firm-specific (i.e. shared by all products at the given firm) but consumer tastes are firm-product specific.

In this framework, TFP raises the probability of producing yet another product and hence, a firm's product range is increasing in its productivity. At the

[5] For EU evidence, see Mayer and Ottaviano (2007), for US evidence see Bernard et al (2007). For descriptive statistics on multi-product firms in Hungary, see Békés et al. 2011

same time, TFP also determines overall profitability and hence entry and exit with taste (expertise) determining only the composition of the traded bundle. This approach allows for "churning" in the product market - i.e. firms would drop (reduce the bundle size) and add (increase the bundle size) products while remaining an exporter. Bernard et al. (2011) extend their earlier model and allow for country-specific product attributes that vary across both products and countries. In addition to the fixed costs, the constant marginal cost of production for each product (at each country) is now defined by a relevant composite firm ability.

Another consequence of product or destination related shocks is the possibility of sequential exporting Albornoz et al. (2010). In their model, a firm's success in foreign markets is uncertain, but correlated across destinations. This setup explains starting small as well as high exit rates of new exporters and importantly, rapid expansion of new destinations of surviving firms. It implies that the likelihood of not exiting a market is correlated with not exiting another one. This is also a type of variable cost based trade as it allows for paying costs only to try one market rather than the full sunk cost of all the potential operation.

Another angle is offered by Mayer et al. (2010), where firms export a product mix based on their productivity. In conjunction with Eckel and Neary (2010), firms rank their products by their competence and shocks as well as competition will affect product mix in an orderly rather than a random fashion. Unlike in Bernard et al. (2010), Mayer et al. (2010) posit that firms will lose products that are furthest from core competencies. For our perspective this means that there is likely to be a set of products that are exported at a rather stable manner and another set of volatile mix of products (or product-destination) further away from core competency.

Overall, our approach combines the basic world view behind dynamic Melitz-type models with endogenous trade technology choice: firms are heterogeneous and they face uncertainty in terms of their future productivity and they may choose from two trading technologies, paying a large fee - sunk cost - upfront in return for lower costs later or paying less now but more at every period. Also, when extending the model and in the empirical work we rely strongly on the logic of multi-product firm models.

A key lesson from these models is that firm behaviour becomes heterogeneous: varible cost structures make firms more sensitive to shocks and hence they are more likely to exit quickly from exporting. We will argue that this is why the share of firms relying on variable cost trade technology determines the prevalence of temporary trade.

3.2 A simple dynamic model

In this section we present a simple model to illustrate the idea of two types of trading technologies. Our aims with this model are twofold. First, it illustrates that short term exports may differ qualitatively from longer term exports because firms exiting in the short run are more likely to use a technology we define

as variable cost trading technology. Second, the model illustrates that gravity a¤ects the choice of trading technologies: on larger markets a given …rm is more likely to choose what we de…ne a sunk cost trade technology.

We use a number of simplifying assumptions to make the model as tractable as possible. Firms from the (small) home country develop a product, and make their export decision. We assume that …rms which develop the new product in each period can enter the export market freely in latter periods to exclude real-option value calculations. Our analysis, however, focuses on a cohort of …rms which starts exporting in a given period.

In the model, …rms are heterogenous with respect to their productivity (or ability): …rm i has a productivity ϕ_i, which is …rm-speci…c but is common to all markets of the …rm i. Countries are indexed by $k = (1..K)$ and are endowed with L_k units of labour that are supplied inelastically with zero disutility. The representative consumer in each country derives utility from the consumption of a continuum of I products that we normalize to the interval $[0; 1]$. Consumers have the traditional CES utility for the products.

Consumption of goods in country k is a CES function of goods produced by all countries' …rms. There is monopolistic competition a la Dixit and Stiglitz (1977), and the equilibrium price of a product variety is a constant mark-up over marginal cost. Cost in turndepends on both …rm ability and transport cost to the destination country k, τ_{ik}. Our model follows an export decision of a …rm, i.e. starting to sell the product to a new market. The net revenue for …rm i from supplying country k is

$$r_k(\phi_i, \tau_{ik}) = (\tau_{ik})^{1-\sigma} w_k L_k (\rho P_k \phi_i)^{\sigma-1} \tag{1}$$

where $\sigma = 1/(1-\rho)$ is the elasticity of substitution across varieties, L_k is size of labour force in the destination country, w_k is the wage level in the destination country and P_k is the price index of destination country[6]. We can assume that …rm ability is distributed according a Pareto distribution with parameters m_0 and $\kappa > 1$. For tractability, we also introduce $\varphi_i \equiv {\phi_i}^{\sigma-1}$.

First we will describe the decision of …rm i whether to export to market k. For brevity, we will omit the destination country index, but we will index the variables which may change in time by t.

Our model has three periods. In period 1, a …rm decides whether to start exporting, picks one of the two available export technologies, and receives profits accordingly. At periods 2 and 3, the …rm may decide to continue or halt exporting; we interpret period 2 as the short-term period and period 3 is the long-term period.

At the beginning of each period, …rms face stochastic shocks to their productivity: with probability p, their φ increases with a factor of $d > 0$, thus $\varphi_{it+1} = d\varphi_{it}$, and with probability $1 - p$ productivity falls in a similar pro-

[6] Most models assume the probability of an external "death by *force majeure* events" independent of productivity or attribute. Here we only consider …rms that operate throughout our period of interest and hence, disregard this option. Note that introducing such an option would not change results.

portion: $\varphi_{it+1} = \frac{1}{d}\varphi_{it}$. We also assume that …rms discount their pro…ts with $\delta_1 > 0$ and $\delta_2 > 0$ in period 2 and 3, respectively. (As periods can have a di¤erent expected length (i.e. long-term is likely to be longer than the short term), we opted for this general approach rather than a more traditional use if δ and δ^2.) We assume that, while the model is stochastic, all parameters are common knowledge for all …rms.

In the …rst period …rms may choose between two trading options called variable cost trade (VCT) technology and sunk cost trade (SCT) technology. Both kinds of …rms have to pay a …xed cost in every period, which is normalized to 1. The sunk cost technology also requires an up-front sunk cost investment in period 1, $S > 0$, and its advantage is a low transportation cost, τ. VCT technology …rms, on the other hand, do not have to pay a sunk entry cost, but they do not have an established network, which results in larger transportation cost: it is $(\chi^{\frac{1}{\sigma-1}})\tau$, where $\chi > 1$, and $\chi^{\frac{1}{\sigma-1}} > 1$. Note that we assume that the transport cost depends on the elasticity of substitution across varieties, which, in this simplest form of the model, is just a constant. In the model extension in section 5, we will elaborate on the rationale for this formula.

For simplicity, we assume that SCT …rms, which have payed the sunk cost, can always export with a transport cost of τ in period 3, even if the …rm does not export in period 2. We also assume that compared to the stochastic shock, the transportation cost advantage is not too large: $d > \chi$.

As it was shown previously, the export revenue of a …rm, whenever it exports, is a function of φ_{it} and the chosen trade technology. When exporting with VCT technology, the revenue of the …rm is determined by: $R^{SCT}(\varphi_{it}) \equiv r^k(\phi_{it}, \chi^{\frac{1}{\sigma-1}}\tau) = \frac{1}{\chi}(\tau)^{1-\sigma}w_k L_k(\rho P_k)^{\sigma-1}\varphi_{it}$. As now we only consider the problem of …rms on a speci…ed market, thus we will denote $R \equiv \frac{1}{\chi}(\tau)^{1-\sigma}w_k L_k(\rho P_k)^{\sigma-1}$, and hence,

$$R^{VCT}(\varphi_{it}) = R\varphi_{it} \qquad (2)$$

Note that $R^{VCT}(\varphi_{it})$ is a positive linear function of φ_{it}. Also, revenue with SCT technology is higher than with VCT :

$$R^{SCT}(\varphi_{it}) = \chi R\varphi_{i1} \qquad (3)$$

In what follows, we assume that sunk and …xed costs are constant across markets, while it follows from our speci…cation that $R^{SCT}(\varphi_{it})$ and $R^{VCT}(\varphi_{it})$ are increasing in market size. Finally, for simplicity, we assume that …rms choose to export when doing it leads to a pro…t of 0, and choose the sunk-cost technology whenever they are indi¤erent between the two kinds of export technologies.

Figure 1 shows the mechanics of our model for VCT technology-type …rms. In period 1, the …rm observes its initial productivity φ_{i1}, from which it calculates its $R^{VCT}(\varphi_{i1})$. The …rm will export in this period if this is larger than 1 (denoted by the dash line in the …gure), with a …rst period pro…t of $\pi_{i1}^{VCT} = R\varphi_{i1} - 1$. In period 2, the …rm will receive a shock: with probability p its export

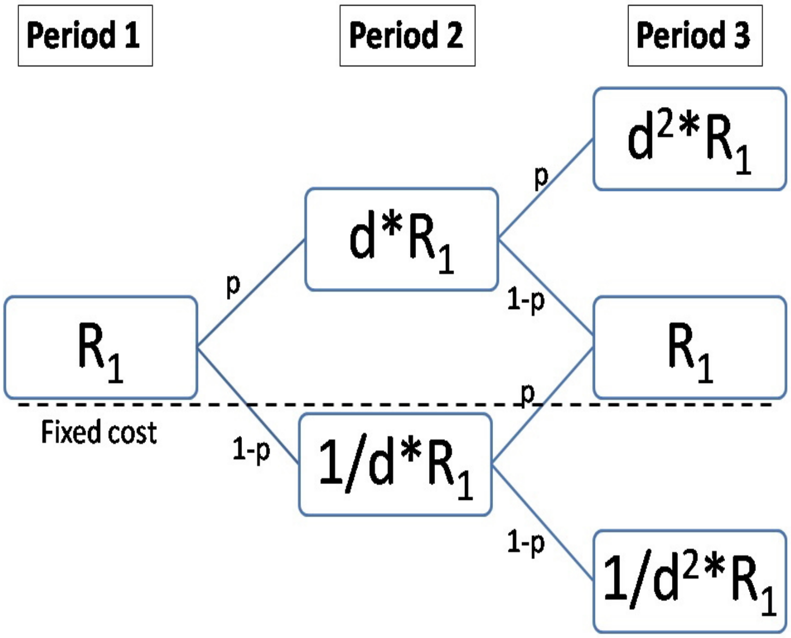

Figure 1: State of nature tree from model

revenue increases to $dR\varphi_{i1}$ and with probability $1-p$, it will decrease to $\frac{1}{d}R\varphi_{i1}$. As, the revenue in this latter case is below 1, the ...rm will export only after a positive shock in period 2 - as shown in the ...gure with revenue being below the dashed line. If, following a second period positive shock, the ...rm receives a positive shock in the third period as well, its potential export revenue will increase to $d^2R\varphi_{i1}$ with probability p, and fall back to $R\varphi_{i1}$ with probability $1-p$; it will export in both cases. After a negative shock in the second period, on the other hand, it will only export after a positive ...rst-period shock.

An important consequence of this setup is that the probability of exporting in di¤erent periods and the expected export pro...t only depends on the value of φ_{i1}. If, as in Figure 1 $1 \leq R\varphi_{i1} < d$, the ...rm will export with probability 1 in period 1, p in period 2 and $p^2 + p(1-p)$ in period 3. Also, its expected pro...t, $E\Pi^{VCT}(\varphi_{i1})$, is the discounted sum of expected pro...ts in the three periods. If, however, initial productivity is somewhat larger, e.g. $d \leq R\varphi_{i1} < d^2$ (which would mean that export revenue from initial productivity is higher relative to 1), it will become pro...table to export even after a bad shock in the second period, and the ...rm will only exit in the third period after two bad shocks.

For ...rms opting for the SCT technology, the setup is similar, save that they pay a sunk cost in the beginning but the threshold of exporting becomes lower as their net revenue is higher.

In what follows, we characterize the behaviour of VCT and SCT-type ...rms,

then show how ...rms choose the export technology and ...nally we formulate some predictions.

3.3 VCT technology firms

A VCT technology ...rm exports whenever its export revenue is not lower than the per-period ..xed cost: $R\varphi_{it} \geq 1$. We will calculate the exit rates and the expected pro...tability for each φ_{it} to be able to predict the optimal trading technology choice and the exit rate.

Because of the discrete nature of the stochastic process in the model, the expected pro...t is not a smooth function of φ_{it}. To handle this, it is useful to classify the ...rms into three categories according to the ...rst time they may stop exporting. Naturally, ...rms with $R\varphi_{i1} < 1$ do not start exporting, and we will not deal with them here. Second, as we have seen in Figure 1, ...rms with $1 \leq R\varphi_{i1} < d$ stop exporting in period 2, as their potential export revenue may sink under the ..xed costs with probability $1-p$. Third, the potential export revenue of ...rms with $d \leq R\varphi_{i1} < d^2$ is always higher than the ..xed cost in period 2, but may stop exporting in period 3 after two bad shocks with probability $(1-p)^2$. Finally, ...rms with a very high potential export revenue, i.e. $R\varphi_{i1} \geq d^2$ always export in all three periods.

To derive the expected pro...t from exporting, consider a ...rm for which $1/R \leq \varphi_{i1} < d/R$. The export revenue of this ...rm is the discounted sum of export revenues in all periods and states of the world:

$$E\Pi^{VCT}(\varphi_{i1}) = AR\varphi_{i1} - B \tag{4}$$

where $A = \left[1 + \delta_1 pd + \delta_2 p^2 d^2 + \delta_2 p(1-p)\right]$ and $B = \left[1 + \delta_1 p + \delta_2 p^2 + \delta_2 p(1-p)\right]$.

Consider now a ...rm, with higher productivity, where $d/R \leq \varphi_{i1} < d^2/R$. This ...rm may only exit in the long run; and hence, the expected export pro...t includes the second period revenue even after a bad shock before the second period:

$$E\Pi^{VCT}(\varphi_{i1}) = AR\varphi_{i1} - B + \delta_1(1-p)\left(\frac{1}{d}R\varphi_{i1} - 1\right) \tag{5}$$

Note that the function is continuous in $\varphi_{i1} = d/R$, because in that point the ...rm is indi¤erent in period two after a bad shock.

Finally, ...rms with the highest productivity always export. Accordingly, their expected pro...t is

$$E\Pi^{VCT}(\varphi_{i1}) = AR\varphi_{i1} - B + \delta_1(1-p)\left(\frac{1}{d}R\varphi_{i1} - 1\right) + \delta_2(1-p)^2\left(\frac{1}{d^2}R\varphi_{i1} - 1\right) \tag{6}$$

This function is also continuous when $\varphi_{i1} = d^2/R$. Also, $E\Pi^{VCT}(\varphi_{i1})$ is (weakly) convex in φ_{i1}, as an increase in φ_{i1} has two positive e¤ects: export is pro...table in more states of nature, and the pro...t increases from already pro...table states of nature.

3.4 SCT technology firms

The problem of SCT technology …rms is very similar to VCT-type …rms:

$$E\Pi^{SCT}(\varphi_{i1}) = \begin{cases} \chi AR\varphi_{i1} - B - S & \text{if } \frac{1}{\chi R} \leq \varphi_{i1} < \frac{d}{\chi R} \\ \chi AR\varphi_{i1} - B + \delta_1(1-p)\left(\frac{1}{d}\chi R\varphi_{i1} - 1\right) - S & \text{if } \frac{d}{\chi R} \leq \varphi_{i1} < \frac{d^2}{\chi R} \\ \chi AR\varphi_{i1} - B + \delta_1(1-p)\left(\frac{1}{d}\chi R\varphi_{i1} - 1\right) + \\ \delta_2(1-p)^2\left(\frac{1}{d^2}\chi R\varphi_{i1} - 1\right) - S & \text{if } \frac{d^2}{\chi R} \leq \varphi_{i1} \end{cases} \tag{7}$$

Similarly to $E\Pi^{VCT}(\varphi_{i1})$, this function is continuous and increasing in φ_{i1}.

Using these functions for VCT and SCT technology …rms, the following proposition shows that when comparing two …rms with the same φ_{i1} but with di¤erent trading technologies, the VCT technology …rm is more likely to exit earlier and hence, be classi…ed as a temporary trader.

Proposition 1 *For any given $\varphi_{i1} \geq 1/R$, the probability that an SCT technology firm exit in period 2 is not larger than the probability that a VCT-type firm exits.*

Proof. Let us analyse the problem for di¤erent intervals. (i) When $\frac{1}{R} \leq \varphi_{i1} < \frac{d}{\chi R}$, the probability of exit in period 2 for both types of …rms is $1-p$. (ii) If $\frac{d}{\chi R} \leq \varphi_{i1} < \frac{d}{R}$, the probability of exit in period 2 for an SCT technology …rm is 0, while it is $1-p$ for VCT-type …rms. (iii) if $\varphi_{i1} \geq \frac{d}{R}$, neither …rm type exits in period 2. ■

3.5 Technology choice

Naturally, a …rm chooses SCT technology whenever the expected pro…t from it is higher than that from the VCT, i.e. $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) \geq 0$. To characterize this choice, we analyse the behaviour of the left-hand side of this equation.

First, we will make an assumption in order to ensure that the sunk cost is large enough to ensure that it is not pro…table to export with the sunk cost technology, when it is not pro…table to export with the VCT technology. This means, that $S > \chi A - B$. The motivation for this assumption is that otherwise VCT would clearly be dominated by SCT for all …rms.

One consequence of this assumption is that, when $\varphi_{i1} < 1/R$, it is not profitable to export at all. For larger productivity draws, the following proposition holds.

Lemma 2 *When $\varphi_{i1} \geq 1/R$, the $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ function is continuous and (strictly) monotonically increasing. Also, $\lim_{\varphi_{i1}\to\infty} E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) = \infty$.*

Proof. The continuity is the consequence of the fact that the two expected pro…t functions are continuous.

The monotonicity is also intuitive. As the function is the sum of two functions which are linear in di¤erent intervals, it can be also represented in such a way. Taken into account that $1 < \chi < d$, the endpoints of the relevant intervals for φ_{i1} are $1/\chi R, 1/R, d/\chi R, d/R, d^2/\chi R, d^2/R$. Di¤erentiating the $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ function separately for each interval, we get positive derivatives for all intervals.

When $\varphi_{i1} \geq d^2/R$, the function is $(\chi - 1) A(\varphi_{i1}) + \delta_1(1-p)\left(\frac{1}{d}(\chi - 1) R\varphi_{i1} - 1\right) + \delta_2(1-p)^2\left(\frac{1}{d^2}(\chi - 1) R\varphi_{i1} - 1\right) - S$. The last term is a constant, and the …rst three terms are positive and positive linear functions of φ_{i1}, thus the limit of the $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ function is ∞. ■

The intuition behind the monotonicity property is that there are two reinforcing e¤ects when φ_{i1} increases. First, it becomes pro…table to export in more and more branches of the tree in Figure 1. This means that the higher the φ_{i1} of SCT technology …rms, the more states of nature they can enjoy their transport cost advantage in (assuming, that they have paid the sunk cost). Second, the pro…t in branches where the …rm already exports increases faster with the SCT technology because of the lower transport cost.

As for the result regarding the limit property of $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ comes from the fact that the only e¤ect of productivity increase is that pro…ts in each branch increase when $\varphi_{i1} \geq d^2/R$, and both types of …rms export at all branches of the tree. Because of the transportation cost advantage, SCT technology …rms bene…t more from this advantage.

The main consequence of these results is that there is a cuto¤ value, φ_{i1}^* such that all …rms below this choose the VCT technology, and …rms with a higher export revenue potential choose the SCT technology:

Proposition 3 *When $S > \chi A - B$, there is a cutoff φ_{i1}^*,where $E\Pi^{SCT}(\varphi_{i1}^*) - E\Pi^{VCT}(\varphi_{i1}^*) = S$. All firms with $1/R \leq \varphi_{i1} < \varphi_{i1}^*$ choose the VCT technology, and firms with $\varphi_{i1} \geq \varphi_{i1}^*$ choose the SCT technology.*

Proof. As $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ is a strictly monotonously increasing continuous function when $\varphi_{i1} > 1/R$, also $E\Pi^{SCT}(1/R) - E\Pi^{VCT}(1/R) < 0$ when $S > \chi A - B$; and $\lim_{\varphi_{i1} \to \infty} E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) = \infty$, there should be one and only one φ_{i1}^*, where $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) = S$. For $\varphi_{i1} < \varphi_{i1}^*$, $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) < 0$, thus it is more pro…table to choose the VCTT technology. Conversely, when $\varphi_{i1} \geq \varphi_{i1}^*$, $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) \geq 0$, it is more pro…table to use the SCT technology. ■

Given the cuto¤ φ_{i1}^*, we can calculate the share of …rms entering with either type of technologies. According to our assumption, the distribution of $\phi_{i1} = \varphi_{i1}^{\frac{1}{\sigma-1}}$ is Pareto with parameters with m_0 and $\kappa > 1$. Without loss of generality, we can assume that $m_0 = 1/R^{\frac{1}{\sigma-1}}$, the lowest productivity exporter, because we are interested in the share of SCT …rms across exporters rather than all …rms. The share of …rms entering with VCT technology is

$n_{VCT} = F(\varphi_{i1}^{*\frac{1}{\sigma-1}}) = 1 - \left(\frac{1}{R\varphi_{i1}^{*\frac{1}{\sigma-1}}}\right)^{\kappa}$, and naturally the share of …rms entering with the SCT technology is $n_{SCT} = \left(\frac{1}{R\varphi_{i1}^{*\frac{1}{\sigma-1}}}\right)^{\kappa}$. Using this, we can calculate the average ϕ_{i1} for both kinds of …rms: it is $\frac{\kappa\varphi_{i1}^{*\frac{1}{\sigma-1}}}{\kappa-1}$ for SCT-type …rms and $\frac{1/R^{\kappa}}{1-\left(1/R\varphi_{i1}^{*\frac{1}{\sigma-1}}\right)^{\kappa}}\frac{\kappa}{\kappa-1}\left(R^{\kappa-1} - \frac{1}{\varphi_{i1}^{*\frac{\kappa-1}{\sigma-1}}}\right)$ for VCT-type …rms.

3.6 Predictions of the model

We diSCTuss four key predictions of the model. First we show that on average VCT-type …rms are more likely to exit in the short term than SCT-type …rms both because of their lower revenue conditional on productivity and because of the composition e¤ect. This means that temporary exporters on average behave di¤erently from permanent traders because of their di¤erent initial technology choice. Second, we show that the probability that a particular …rm exports with the SCT technology is an increasing function of market size. Third, we analyze the e¤ect of trade liberalization on the margins of trade, and show that it leads to an increase in the number of both VCT and SCT …rms, and that the increase in average exports of SCT …rms is larger than that of VCT …rms. Fourth, we show that the share of SCT-traders and thus of temporary trade increases if …rms discount the future less steeply, i.e. if δ_1 and/or δ_2 is larger. Throughout this analysis we will assume that a cuto¤ value exists, i.e. the sunk cost is large enough ($S > \chi A - B$). We de…ne …rms who export in the …rst period but exit in the second period as temporary traders.

Proposition 4 *On average, VCT technology exporters are more likely to exit in period 2 (temporary trader)*

Proof. Consider VCT technology type …rms. Such a …rm will only exit in the second period if it gets a bad shock, and its initial productivity is between $1/R$ and d/R; for …rms in this interval the probability of exit is $1 - p$. If $\varphi_{i1} \geq d/R$ the …rm will not stop exporting in period 2. SCT technology …rms behave similarly: they exit in period 2 with probability $1 - p$ but for them the condition is: $\frac{1}{\chi R} < \varphi_{i1} \leq \frac{d}{\chi R}$. As a consequence, we have to check 3 cases.

(1) if $\frac{1}{R} \leq \varphi_{i1}^{*} < \frac{d}{\chi R}$, all VCT-type …rms exit with a probability $1 - p$. SCT …rms below $\frac{d}{\chi R}$ also exit with probability $1 - p$; the share of such …rms from all SCT-type …rms is $1 - \left(\frac{1}{R\varphi_{i1}^{*\frac{1}{\sigma-1}}}\right)^{\kappa}$, thus the share of exiting SCT-type …rms is $(1 - p)\left[1 - \left(\frac{1}{R\varphi_{i1}^{*\frac{1}{\sigma-1}}}\right)^{\kappa}\right]$ which is smaller than the probability that a VCT-type …rm exits, i.e. $1 - p$.

(2) if $\frac{d}{\chi R} \leq \varphi_{i1}^{*} < \frac{d}{R}$. Similarly to case (1), all VCT-type …rms exit with a probability $1-p$. On the other hand, no SCT-type …rm exits even after a bad shock.

(3)if $\frac{d}{R} \leq \varphi_{i1}^{*}$. Now only those VCT-type …rms exit with probability $1-p$ for which $\varphi_{i1} < \frac{d}{R}$. The share of these …rms is non-zero. On the other hand, no SCT-type …rm exits in period 2. ■

This proposition shows our central argument: temporary and permanent traders di¤er from each other qualitatively, because they are likely to have chosen di¤erent trading technologies.

Next, we model the e¤ect of market size, L_k on trade technology choice. As in this theorem we distinguish between di¤erent markets, we will index the relevant variables with k.

Proposition 5 *If a firm with productivity φ_{i1} exports to any market k with VCT, there is ceteris paribus a threshold market size, $L_{\varphi_{i1}}^{*}$, such that the firm exports with VCT to markets with $L_k < L_{\varphi_{i1}}^{*}$ and exports with SCT to markets with $L_k \geq L_{\varphi_{i1}}^{*}$.*

Proof. For this proposition we have to show that φ_{i1}^{*} is decreasing in L_k, and that the …rm chooses the SCT when $L_k \to \infty$. As we know that $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) < 0$ on a given market L_k, there will be a threshold regarding L.

Note …rst that $R_k = (\tau_{ik})^{1-\sigma} w_k L_k (\rho P_k \phi_i)^{\sigma-1} = aR$ is a positive linear function of L_k. We have to investigate all relevant intervals of the $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ function separately and solve for φ_{i1}^{*} on each interval separately. Having di¤erentiated the expression for φ_{i1}^{*} with respect to aR it is clear that φ_{i1}^{*} is decreasing with market size.

Second, when $L_k \to \infty$, it will be true for each …rm that $\varphi_{i1} > d^2/R$, in which case $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1}) = (\chi-1) K(\varphi_{i1}) + \delta_1 (1-p) \left(\frac{1}{d}(\chi-1) R\varphi_{i1} - 1\right) + \delta_2 (1-p)^2 \left(\frac{1}{d^2}(\chi-1) R\varphi_{i1} - 1\right) - S$, the limit of which is w.r.t. L is ∞, thus SCT technology is more pro…table in the limit. ■

In a similar spirit, we extend the previous result to the transport cost.

Proposition 6 *If a firm with productivity φ_{i1} exports to any market k with VCT, there is ceteris paribus a threshold transportation cost, $\tau_{\varphi_{i1}}^{*}$, such that the firm exports with VCT to markets with $\tau_k > \tau_{\varphi_{i1}}^{*}$ and exports with SCT to markets with $\tau_k \leq \tau_{\varphi_{i1}}^{*}$.*

Proof. Analogous to the previous proof. ■

The empirical content of these propositions is that a …rm is more likely to choose SCT on a larger market than on a smaller one; thus, when controlling for productivity or …rm …xed e¤ects, these propositions predict a positive coe¢ cient for GDP and a negative coe¢ cient for distance.

Interestingly, our model does not predict that the share of SCT …rms on a larger market is larger. This is a peculiarity of the Pareto distribution. On larger markets, the productivity threshold of the sunk cost technology is lower but so is the threshold for exporting at all. Because of the characteristics of the

Pareto distribution, the inflow of new exporters is exactly such that the share of SCT firms remains unchanged relative to a smaller market.

However, empirically it is true that the share of permanent traders is an increasing function of market size without controlling for productivity or firm fixed effects. Our model would only provide this prediction with assuming some other productivity distribution function or 'tilting the table' for the SCT in larger markets, assuming for example that its transportation cost advantage is increasing with market size.[7]

Based on the intuition of the previous results we may formulate a proposition about the effect of trade liberalization on the different margins.

Proposition 7 *Trade liberalization leads to an increase in the number of both VCT and SCT exporters (extensive margin). Exports/firm (the intensive margin) increases for SCT-type firms if $\sigma > 2$, and the growth of the intensive margin is smaller for VCT-type firms than for SCT firms.*

Proof. The threshold productivity of exporting, $\widehat{\phi}_{i1}$, (where firms are indifferent between exporting and exporting with the VCT) is given by $A(\tau_{ik})^{1-\sigma} w_k L_k (\rho P_k \widehat{\phi}_{i1})^{\sigma-1} \equiv B$. By taking logarithms of both sides and differentiating w.r.t transportation cost yields $\frac{\partial \ln \widehat{\phi}_{i1}}{\partial \ln \tau_{ik}} = 1$, thus, at the margin a 1 % decrease in transportation cost leads to a 1 percent decrease in the threshold. Similarly, the taking log and differentiating the threshold between the VCT and SCT technologies, φ^*_{i1}, yields $\frac{\partial \ln \varphi^*_{i1}}{\partial \ln \tau_{ik}} = 1$. Taking into account the properties of the Pareto distribution, this means that the number of VCT and SCT firms increases in the same proportion at the margin as a result of trade liberalization.

Consider now the intensive margin of SCT firms. There are two effects here. First, all previous SCT-type firms export more by $-\frac{\partial \ln(\tau_{ik})^{1-\sigma}}{\partial \ln \tau_{ik}} = (\sigma - 1)\varepsilon$ percent. Second, the threshold falls by $\varepsilon = \partial \ln \tau_{ik}$ percent, leading to a composition effect which has a negative effect on the intensive margin, reducing the average productivity by ε percent. When $\sigma = 2$, the revenue is a linear function of productivity, hence the two effects are equal: the intensive margin does not change. When $\sigma > 2$, however, higher productivity firms have a larger weight in average revenue than in the average productivity, thus a decrease of ε in average productivity as a consequence of the change in the threshold leads to a smaller proportional decrease in average revenue. As a result, when $\sigma > 2$, the intensive margin increases as a consequence of trade liberalization - and note that in most estimates σ is estimated to be around 5[8].

Consider now VCT firms. Here there is a third effect as well: the highest productivity formerly VCT firms become SCT firms, which has a negative effect on average productivity and revenues. Thus the increase in the intensive margin is smaller for VCT firms than for SCT firms. ■

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[7] Another such 'trick' would be to assume that there is no transportation cost for SCT-firms. While it is a completely realistic assumption in the export vs. FDI choice in Helpman et al. (2004), here it seems less attractive.

[8] For example, Lai and Trefler (2002) estimates σ for several countries and models and finds σ to be between 4.7 and 7.2.

The logic of the extensive margin result is straightforward: the decrease in trade cost makes both exporting in general and the SCT more impressive. For small changes and Pareto distribution the number of …rms exporting with both technologies increases in similar proportions. The logic of the intensive margin result is that for SCT-type …rms, when σ is large enough, the increase in the exports of the most productive …rms is larger than the composition e¤ect coming from some less productive …rms switching to the SCT technology. In case of VCT …rms, however, there are two composition e¤ects: some less productive …rms become exporters and the most productive of these …rms become SCT …rms. Note, that if σ is large, it is easily possible that the intensive margin of these …rms decreases.

Finally, we turn to the question of the discount factor, and show that the larger it is (i.e. the less steeply a …rm discounts future), the higher the share of permanent traders is. The intuition of this result is clear: the lower discount decreases the return of investing into the SCT technology.

Proposition 8 *The share of SCT-type traders is increasing in δ_1 and δ_2. Also, the share of temporary traders is a non-decreasing function of δ_1 and δ_2.*

Proof. As S does not depend on the discount factors, it is enough to show that (i) $E\Pi^{SCT}(1/R) - E\Pi^{VCT}(1/R)$ is smaller when the discount factors are smaller, and that (ii) the derivative of $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ is non-increasing in the discount factors. These together mean that, with some abuse of notation, that if $\delta_1 < \delta_1'$, for all R_{i1}, $E\Pi^{SCT}(\varphi_{i1}, \delta_1) - E\Pi^{VCT}(\varphi_{i1}, \delta_1) \geq E\Pi^{SCT}(\varphi_{i1}, \delta_1') - E\Pi^{VCT}(\varphi_{i1}, \delta_1')$, and the same is true for $\delta_2 < \delta_2'$. From this one can conclude that φ_{i1}^* is a non-increasing function of the discount factors. Because of Proposition 1 this also means that the share of temporary traders is a non-decreasing function of the discount factors.

(i) $E\Pi^{SCT}(1) - E\Pi^{VCT}(1) = (\chi - 1)R(1 + \delta_1 pd + \delta_2 \left[p^2 d^2 + p(1-p)\right]) - S$. Di¤erentiating this w.r.t. δ_1 yields $(\chi - 1)Rpd > 0$. Di¤erentiating w.r.t δ_2 yields $(\chi - 1)R\left[p^2 d^2 + p(1-p)\right] > 0$.

(ii) The proof comes from calculating the derivatives of $E\Pi^{SCT}(\varphi_{i1}) - E\Pi^{VCT}(\varphi_{i1})$ for each interval. ■

4 Empirical evidence

The model presented earlier considers a …rm starting to export and exiting based on its technology choice and productivity shocks. However, as trade technology choice - in contrast with trade spells - is not observable in our database, we use the trade relationship stability …lter introduced in section 2 to test predictions. This cross-section tool allows us to consider all trading …rms and not only those who start trading at a given base year and identify short and long term trade ‡ows. As we have shown that there is a strong connection between trade technology choice and the length of trade ‡ows, we are convinced that showing that our predictions describe well the di¤erence between permanent and temporary trade provides some empirical support to our framework.

This section presents the evidence regarding trade patterns. We have three predictions generated from the model.

(**E1**) More productive …rms are more likely to trade at permanent fashion, controlling for market characteristics (Proposition 3)

(**E2**) Trade with larger and closer markets are more likely to be permanent, controlling for …rm characteristics. (Propositions 6 and 5)

(**E3**) Firms with higher capital cost (i.e higher discount rate) are, ceteris paribus, more likely to trade temporary. (Proposition 8)

(**E4**) Trade liberalization leads to an increase of the extensive margin of both kinds of exporters, and leads to a more positive e¤ect on the intensive margin of permanent exporters. (Proposition 7)

We will test these hypotheses by modelling the probability that a …rm-destination relationship is permanent in nature. In order to test these hypotheses …rst we present the empirical strategy deriving an estimable equation from the model outlined in the previous section. Second, we describe the empirical model, and present results and some robustness checks. Finally we extend our setup to allow for multiple products and carry on with a transaction level analysis.

4.1 Empirical model

We estimate …rm i supplying to country k is

$$\Pr(T_{ik}) = F(\alpha + \boldsymbol{\beta}'\mathbf{F}_i + \boldsymbol{\gamma}'\mathbf{M}_k + \mu_i + \lambda_k + \epsilon_{ik}) \tag{8}$$

where $\mathbf{F}_i$ refers to …rm level characteristics (ability, capital cost) and $\mathbf{M}_j$ includes destination market features (size, distance). Further, μ_i are …rm level …xed e¤ects, and λ_k are destination-level random e¤ects.

Our left hand side variable $T_{ik} = 1$ if a relationship is permanent, and $T_{ik} = 0$ if temporary.

To investigate 8, motivated by the methodolgy in Harrigan and Deng (2008) and Mayer et al. (2010), we estimate linear probability and probit models with destination-level random e¤etcs and di¤erent sets of …xed e¤ects. We opt for this approach to allow for using transaction level approach as well as product and/or …rm level …xed e¤ects as a control for heterogeneity.

In terms of measurement, productivity (or ability) is proxied by Total Factor Productivity or TFP, …m size, export to total sales share and a dummy is used for multi-product …rms. GDP and GDP per capita are all measured in logs at a standard fashion. Transport cost is simply measured by distance with data from CEPII. Further, we use Industry (NACE2) dummies. For details on variables, see the Appendix.

Capital cost is proxied by credit risk and we chose an index used by banks to assess credit risks suggested by BIS (2006) and investigated by Forlani (2010). The Solvency Ratio (SR) is the ratio of net assets of the …rm plus long-term debts to total assets plus leftover stock. It measures the ability of a …rm to

service its debt and to accomplish long-term development[9]. The higher the ratio of internal and secured funding, the smaller the likelihood of payment problems, and hence, the lower the capital cost for the …rm.

$$SR = \frac{\text{Equity + Reserves + Pro…ts + LT debt}}{\text{Total Assets + Stock of goods}}$$

Another cause for lower capital cost would be within multinational group sales where the internal funding may be cheaper. Unfortunately, the data is unable to detect within group sales, i.e. when Audi Hungary exports to its German parent or another subsidiary in Spain. However, one can assume that within group sales would require very low sunk cost and hence predict stable trade relationship. We use a foreign ownership dummy, which may be considered as a proxy to presence of within group sales, and hence, should imply a greater likelihood of permanent trade. Of course, foreign share being both related to within group sales and cost of capital may be hardly disentangled.

As introduced in section 3, …rms are assumed to avoid a sudden death shock. In terms of empirical exercise, we omitted …rms who exported in 2000 but either (i) were born after 1996 or (ii) exited before 2004. Thus, all …rms studied were operating during our 7-year window of 1997-2003. As a result, we excluded 27.3% of …rms which corresponds to 20.3% of relationships (for details, see Table 8 in Appendix.) Given that all these …rms are intrinsically temporary traders, our results regarding the importance of temporary trade are conservative.

Next, we present our baseline results and some robustness checks.

4.2 Results

To test predictions E1-E3, we estimated 8 using a random e¤ect probit model. Table 2 presents the results. The …rst column includes the key variables, productivity (TFP), credit cost (solvency ratio) as well as the gravity variables: GDP (total GDP and GDP per capita) and transport cost (distance). All coe¢ cients presented are marginal e¤ects.

Evidence is in line with model predictions. Results (column 1) suggest that more productive and better …nanced …rms are more likely to trade at a permanent level. In terms of export markets, market size (total GDP) is positively correlated with the probability to export at a permanent fashion, while high trade cost (proxied by distance) acts as hindrance. In column (2) control variables are added to better model …rm ability. Size, export share and product scope (proxied by a multi-product dummy) all enter signi…cantly with the expected positive sign and other results change in size only when controls are added.

One may argue that the success of trade a¤ects …rm size or productivity, creating a simultaneity problem. To solve this, instead of values for 2000, values for 1997 were used in the third column - with no apparent di¤erence (column 3). Finally, to test separately for …rm speci…c or destination speci…c variables,

[9] As an alternative, in line with BIS, we used the Financial Independence Index (FII), which is simple net assets (equity, reserves, pro…ts) to the total assets - with no a¤ect on results.

VARIABLES	(1) Probit	(2) Probit	(3) Probit, Lag	(4) Lin.prob	(5) Lin.prob
GDP (ln)	0.119***	0.134***	0.119***	0.053***	0.071***
	(0.013)	(0.015)	(0.013)	(0.008)	(0.008)
GDP pcapita (ln)	0.108***	0.100***	0.090***	0.018	0.022
	(0.023)	(0.027)	(0.024)	(0.013)	(0.015)
Distance (ln)	-0.258***	-0.336***	-0.252***	-0.119***	-0.145***
	(0.017)	(0.021)	(0.018)	(0.008)	(0.010)
TFP	0.218***	0.056***	0.180***	0.015**	
	(0.011)	(0.013)	(0.013)	(0.006)	
Solvency Ratio	0.125***	0.186***	0.084***	0.061***	
	(0.033)	(0.035)	(0.031)	(0.010)	
Foreign-owned, D		0.085***		0.025***	
		(0.025)		(0.009)	
Export share		0.650***		0.201***	
		(0.036)		(0.031)	
No. employees		0.131***		0.040***	
		(0.008)		(0.002)	
Multi-product …rm, D		0.630***		0.232***	
		(0.088)		(0.041)	
Fixed e¤ects	Nace2	Nace2	Nace2	Nace2	Firm
Observations	16,660	16,633	13,674	16,633	17,084
R-squared	0,05	0,09	0,04	0.12	0.09
Number of dest	169	169	167	169	169
log likelihood	9660	9167	7748		

Pseudo R squared is noted for Probit models

Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2: Random E¤ect probit and RE Linear probability model, dependent variable: T=1 if relationship permanent, 0 if temporary

destination and …rm …xed e¤ects were introduced in a linear probability model. Results remained unchanged (columns 4 and 5).

To see economic impact, we evaluate the basic probit model at sample means (see Table 6 Appendix for values). At those values, the probability to be a permanent exporter is 74.4%. One standard deviation increase in productivity raises this probability by 2.4 percentage points. If the GDP of a destination rises by one standard deviation, the probability to export there at a permanent fashion rises by 2.5 pp. Similarly, a one standard deviation increase in per capita income has an e¤ect of 0.7pp.

Several robustness checks have been carried out regarding …rm scope, product size and destination importance, see section 7.3 and Table 10 in Appendix. Our results were robust to excluding a large number of unimportant destination markets, small shipments and single-product …rms.

4.3 Margins of trade

In this subsection we test our predictions (E4) about the e¤ects of trade liberalization. As Hungary underwent signi…cant liberalization between 1995 and 2000, we have chosen these two dates to compare the intensive and extensive margins of permanent and temporary trade ‡ows, which we present. For this, we simply calculated the number of …rm-destination export ‡ows seperatelly for total, temporary and permanent trade as a measure for the extensive margin, and divided total trade volume with this to yield a proxy for the intensive margin. Table 3 present the change in intensive and extensive di¤erent margins between 1995 and 2000.

The results are in line with our predictions. First, and most importantly, the reaction to trade liberalization of temporary and permanent trade is di¤erent. Second, both extensive margins increased, but this increase was larger for permanent trade. (While our model predicted both temporary and permanent extensive margins to increase, it does not predict a greater increase of temporary trade; this may be a consequence of the Pareto distribution function, as diSCTussed earlier.) Third, while the intensive margin of permanent trade increased by 25 %, it *decreased* by a similar amount for temporary trade. This is very much in line with our prediction that trade liberalization leads to entry of less productive exporters, and to a switch by the most productive temporary exporters to permanent trade.

Our results have some consequences for empirical work. Simple extensive-intensive margin calculations can be misleading as a result of di¤erent composition e¤ects and the qualitative di¤erence between short- and long-term trade. One possible solution for this is to use a similar …lter to distinguish between the dynamics of permanent and temporary trade.

Margin	Decomposed factor	2000 vs 1995
Total mfg firms' trade	Volume (m USD)	162,1%
Extensive margin	Number of relationships	89,7%
Intensive margin	Avarege size ('000 USD)	38,2%
Permanent mfg firms' trade	Volume (m USD)	169,2%
Extensive margin	Number of relationships	114,0%
Intensive margin	Avarege size ('000 USD)	25,8%
Temporary mfg firms' trade	Volume (m USD)	9,7%
Extensive margin	Number of relationships	52,5%
Intensive margin	Avarege size ('000 USD)	-28,1%

Table 3: Decomposing the extensive and intensive margin with the filter

5 Extension to transaction level

So far we have taken the simplified view of looking at firm-destination level models. However, most product creation and destruction happens within firms (Broda and Weinstein (2010), Bernard et al. (2010)). This phenomenon may be observed in our case, the within firm-destination level of trade, i.e. the transaction level suggests that 56.5% of all product relationships are temporary.

Before turning to firm-destination-product level analyses, note that temporary trade is important across products, broad economic categories or even product heterogeneity types. Table 4 shows the shares of various types of trade relationships by two classification methods. It presents categories where temporary trade is the most and least frequently present. First, relationships were grouped by the products and aggregated up to the 2-digit level of Harmonised Systems (HS2). This is the level that described broad industries such as textiles or metals. As shown in the table, temporary trade is very important in all categories despite considerable heterogeneity. This confirms that temporary trade is not an industry specific phenomenon.

	Most frequent		Least frequent	
HS2	animal products	78%	plastics, rubbers	46%
BEC	other	75%	intermediate	50%

Table 4: Share of temporary trade by good categories. Figures come from national aggregates.

Second, we considered the UN's Broad Economic Categories (BEC), a classification which groups tradable goods by the main end use. Temporary trade turns out to be very important in all categories, especially capital goods and raw materials. This suggests that temporary trade is present in all steps of the production process from raw materials to consumer goods.

Overall, we found that temporary trade is not a feature for a particular group of products.

5.1 Transaction level setup

Our model can easily be extended to the …rm-product-destination level. This time the decision of …rm i may be exporting a speci…c product j for the …rst time or exporting product j to a speci…c new destination k. In this case, the sunk cost of doing so must be contrasted to other cost factors (as in Bernard et al. (2010)). The net revenue now also depends on the product feature and σ_j, the elasticity of substitution in the CES function, the model is based on, may vary by product characteristics as well.

The transport cost under VCT technology is a factor $\chi^{\frac{1}{\sigma_j-1}}$ of the transport cost under SCT. Thus, the di¤erence between VCT and SCT depends on σ_j. As a higher σ_j implies more product homogeneity and the expression is negatively related to sigma, the more di¤erentiated are products, the larger the di¤erence between VCT and SCT technologies.

This assumption is based on the idea that transport cost is made up of two components: haulage and distribution/retail. Haulage depends on the weight of the product and is irrelavant for the choice of trade technology. However, distribution and retail both in terms of actual transport and marketing costs depend on how special products are. Transporting bulk products such as wheat is likely to take place az a very standardized fashion using simple warehouses. Di¤erentiated products, instead, will be shipped via multi-modal transpont routes, with its speci…cations being frequently checked on site(s). When investing in a trade relationhsip, a methodology may be devised whereby some speci…cations and testing framework are given at the beginning. Thus, this latter component will di¤er in terms of trade technology choice; variable trade cost technology implies higher per unit costs than sunk cost technology.

As a consequence, new prediction from model suggests that:

(**E5**) Products with higher sunk cost relative to …xed and variable trade costs (heterogeneous goods) are more likely be traded permanently.

To estimate this, we simply build on the three categories suggested by Rauch (1999): heterogeneous, homogeneous and quoted priced goods. As a proxy relative costs, the Rauch index of heterogeneity dummy equals 1 if the good is classi…ed as heterogeneous, and 0 otherwise. We test a prediction not directly related to our model. Given the nature of product and destination speci…c …xed costs, a …rm shall …nd it cheaper to sell a product in a country if it knows the market (other products are sold) or the has experience (the product is sold at other markets). In other words, permanent trade is more likely in key products (that are sold at several markets) and key markets (where several product categories are sold).

In addition to this prediction, there are several other product-level explanations for an unstable trade relationship. Most importantly, …rms do actually export "unusual" items as found in Békés and Muraközy (2011). The most distant from the core product in terms of relevance are products that are not even produced by the …rm, but instead are inputs of the …rm: …xed assets or inventories. Our data suggest that asset and inventory sales is responsible for more than 22% of temporary trade transactions, while its importance at permanent

trade transactions is just 2.2% - one-tenth of the value for temporary trade. We created two variables to capture assets and inventories - for details, see Békés and Muraközy (2011).

Another similar explanation for temporary trade is lumpy export of goods that are too large to be sold every year. Aircrafts, ships or telecommunication network equipment may be exported infrequently[10]. Such phenomenon would be picked up as temporary trade - as an 'on and o¤' pattern. Hence, we distinguish the most valuable (highest unit value) items from all products by de…ning a dummy if the unit value of a particular item is within the highest 10% of values within the product category.

We estimate …rm i supplying good j to country k is

$$\Pr(T_{ijk}) = F(\alpha + \boldsymbol{\beta}'\mathbf{F}_i + \boldsymbol{\gamma}'\mathbf{M}_{ik} + \boldsymbol{\delta}'\mathbf{P}_{ij} + \mu_i + \vartheta_j + \lambda_k + \epsilon_{ijk}) \qquad (9)$$

where $\mathbf{F}_i$, $\mathbf{M}_{ik}$ are the same as before, $\mathbf{P}_{ij}$ stands for product (and …rm-product) features (e.g. heterogeneity), μ_i represents …rm …xed e¤ects, ϑ_j product …xed e¤ects and λ_k destination random e¤ects. In all regressions, we control for possible di¤erences in costs according to use of goods, relying on UN's Broad economic category dummies (Consumer, Capital, Parts, Intermediates, Raw materials). Our left hand side variable $T_{ijk} = 1$ if a transaction level relationship is permanent, and $T_{ijk} = 0$ if temporary.

The model is estimated with probit regression as well as using a linear probability model with …rm or product …xed e¤ects as well as destination random e¤ects.

5.2 Transaction level results

Table 5 presents results from the transaction level speci…cation using the random e¤ect probit model with 4-digit NACE industry dummies. First of all, results con…rm earlier results from …rm-destination level analysis (column 1). More productive …rms with lower capital costs are more likely to trade a product at a permanent fashion. Further, gravity variables remain important when product heterogeneity is allowed. .

Then, the positive and signi…cant coe¢ cient of Rauch di¤erentiated product variable suggests that products, where trade is expected to be more costly or contracting intensive is likely to be exported at a more permanent fashion. By the same token, products that are unlikely to be the actual product of the …rm (assets as well as inventories) are indeed more likely to temporary traded.

Finally, key products (i.e. products that are sold in more than just the actual market) and key markets (i.e. destinations where the …rm sells more than just the actual product) are more likely to permanently traded.

All these results are con…rmed when …rm level controls are added (in column 2). The random (destination) e¤ect probit is extended by product …xed e¤ects

[10] Armenter and Koren (2010) notes that in 2005 the biggest US shipments categories included aircraft ($42 million), spacecraft ($5 million), tanker ships ($15 million) and oating drilling platforms ($5 million).

(column 3) and firm fixed effects (column 4). As a final test on gravity variables firm-product fixed effects are introduced in column (5). Key results on GDP and distance as well as firms size or export share as proxy to ability remain unchanged. TFP looses all its effects when extra controls are added (columns 2,3) confirming a close relationship between measured TFP and product mix.

6 Conclusions

This paper defined a trade relationship stability filter and used it to tell apart two distinct export startegies: permanent and temporary trade. Our theoretical contribution was to allow heterogeneous firms to choose between sunk cost and variable cost trade technologies. In a simple model with endogenous technology choice we provided a number of predictions which were matched with evidence from Hungarian data.

We showed that temporary trade is present at every layer of firm-product-destination level trade relationships, and it is quite an important feature. All kinds of firms use temporary trade and all sorts of products are traded at a temporary fashion. Using a random effects probit model, we showed that firm productivity, capital cost, destination features and a number of firm-product characteristics have an important effect on trade stability, and that these are in line with our simple model. Our results were robust to excluding a large number of unimportant destination markets, small shipments and single-product firms.

Two suggestions may be drawn from our analysis. First, sunk cost models work very well for a large share of export volume. At the same time, allowing firms to extract less from an export sale but avoid paying a large one-off cost, can make the large number of short spells quite understandable - even without assuming very large and frequent productivity shocks.

Second, our results suggest that researchers and policymakers interested in a reaction to a policy change such as trade liberalization may be also interested in how the policy affects these two types of firms. For example, a within categorisation of intensive versus extensive margin may help understand what exact costs the policy modification has. A change in the extensive margin of permanent traders would suggest that trade liberalization altered market conditions making new exporters enter. This may be due to a change in productivity distribution of firms owing to new input prices. An increase in the extensive

	(1)	(2)	(3)	(4)	(5)
GDP (ln)	0.029***	0.028***	0.047***	0.040***	0.068***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.010)
GDP per capita (ln)	0.041***	0.040***	0.004	0.013	-0.001
	(0.013)	(0.012)	(0.014)	(0.011)	(0.017)
Distance (ln)	-0.068***	-0.073***	-0.101***	-0.079***	-0.117***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)
TFP	0.019***	-0.006	-0.005		
	(0.005)	(0.006)	(0.006)		
Solvency Ratio	0.034***	0.036***	0.042***		
	(0.010)	(0.010)	(0.008)		
Foreign-owned, D		0.040***	0.047***		
		(0.008)	(0.008)		
Export share		0.108***	0.084***		
		(0.022)	(0.023)		
Number of employees		0.017***	0.012***		
		(0.003)	(0.003)		
Multi-product …rms, D		0.014	0.013		
		(0.045)	(0.038)		
Rauch di¤. good, D	0.028	0.032*		0.032*	
	(0.019)	(0.018)		(0.017)	
High value items, D	-0.089***	-0.093***		-0.057***	
	(0.023)	(0.023)		(0.022)	
Assets, D	-0.199***	-0.201***	-0.177***	-0.121***	
	(0.023)	(0.021)	(0.011)	(0.018)	
Inventories, D	-0.060**	-0.075***	-0.084***	-0.168***	
	(0.025)	(0.023)	(0.013)	(0.012)	
Key product (D)	0.244***	0.231***	0.184***	0.265***	
	(0.016)	(0.016)	(0.016)	(0.016)	
Key market (D)	0.025***	0.003	0.036***	0.061***	0.180***
	(0.008)	(0.010)	(0.010)	(0.009)	(0.009)
Fixed e¤ects	NACE4	NACE4	Prod	Firm	Firm-Prod
Observations	65,385	65,312	65,312	66,911	66,911
R-squared	0.108	0.116	0.0717	0.0796	0.0840
Number of dest	169	169	169	169	169

BEC Dummies included. Robust standard errors in parentheses

** p<0.01, ** p<0.05, * p<0.1

Table 5: Random E¤ect probit and RE Linear probability model, dependent variable: T=1 if relationship permanent, 0 if temporary

References

Aeberhardt, R., I. Buono, and H. Fadinger (2009). Learning and the dynamics of exporting: Theory and evidence from french …rms. Unpublished.

Albornoz, F., H. F. C. Pardo, G. Corcos, and E. Ornelas (2010). Sequential exporting. Discussion papers, Department of Economics, University of Birmingham.

Altomonte, C. and G. Békés (2009). Trade complexity and productivity. FEEM Discussion Paper 62.09.

Araujo, L. and E. Ornelas (2007). Trust-based trade. Discussion Papers 820, CEP.

Arkolakis, C. (2008). Market penetration costs and the new consumers margin in international trade. NBER Working Papers 14214, National Bureau of Economic Research, Inc.

Arkolakis, C. and M.-A. Muendler (2010). The extensive margin of exporting products: A …rm-level analysis. NBER Working Papers 16641, National Bureau of Economic Research, Inc.

Armenter, R. and M. Koren (2010). A balls-and-bins model of trade. DP 7783, CEPR.

Baldwin, R. and J. Harrigan (2007). Zeros, quality and space: Trade theory and trade evidence. *NBER Working Paper* (13214).

Békés, G., P. Harasztosi, and B. Muraközy (2011). Firms and products in international trade: Data and patterns for hungary. *Economic Systems forthcoming*.

Békés, G. and B. Muraközy (2011). Unusual trading pattern: Assets and inventories.

Bernard, A. B., S. J. Redding, and P. K. Schott (2010). Multiple-product …rms and product switching. *American Economic Review 100*(1), 70–97.

Bernard, A. B., S. J. Redding, and P. K. Schott (2011). Multi-product …rms and trade liberalization. *Quarterly Journal of Economics forthcoming*.

Besedes, T. (2006). A search cost perspective on duration of trade. *Review of International Economics 15*(5), 835–849.

Besedes, T. and T. J. Prusa (2006). Ins, outs, and the duration of trade. *Canadian Journal of Economics 39*(1), 266–295.

BIS (2006). International convergence of capital measurement and capital standards: A revised framework - comprehensive version. Technical report, Bank for International Settlements.

Broda, C. and D. E. Weinstein (2010). Product creation and destruction: Evidence and price implications. *American Economic Review 100*(3 (June)), 691–723.

Buono, I., H. Fadinger, and S. Berger (2008). The micro dynamics of exporting: Evidence from french …rms. Technical report, University of München. December.

Crozet, M., P. Koenig, and V. Rebeyrol (2008). Exporting to insecure markets: A …rm-level analysis. CEPII.

Das, S., M. J. Roberts, and J. R. Tybout (2007). Market entry costs, producer heterogeneity, and export dynamics. *Econometrica 75*(3 (May)), 837–873.

Dixit, A. and J. E. Stiglitz (1977). Monopolistic competition and optimum product diversity. *American Economic Review 67*, 297–308.

Eaton, J., M. Eslava, M. Kugler, and J. Tybout (2007). Export dynamics in colombia: Firm-level evidence. Technical Report 13531, NBER.

Eaton, J., S. Kortum, and F. Kramarz (2005). An anatomy of international trade: Evidence from french …rms.

Eaton, Jonathan, S. K. and F. Kramarz (2010). An anatomy of international trade: Evidence from french …rms. WP 14610, NBER.

Eckel, C. and J. P. Neary (2010). Multi-product …rms and ‡exible manufacturing in the global economy. *Review of Economic Studies 77*(1), 188–217.

Forlani, E. (2010). Liquidity constraints and …rms export activity. Development Working Papers 291/April, Centro Studi Luca dÁgliano, University of Milano.

Ghironi, F. and M. J. Melitz (2005). International trade and macroeconomic dynamics with heterogeneous …rms. *The Quarterly Journal of Economics 120*(3), 865–915.

Harrigan, J. and H. Deng (2008). China's local comparative advantage. WP 13963, NBER.

Helpman, E., M. Melitz, and S. Yeaple (2004). Export versus fdi with heterogenous …rms. *aer 94*(1), 300–316.

Hess, W. and M. Persson (2010). Exploring the duration of eu imports. Working Paper Series 849/Aug, Research Institute of Industrial Economics.

Lai, H. and D. Tre‡er (2002). The gains from trade with monopolistic competition: Speci…cation, estimation, and mis-speci…cation. NBER Working Papers 9169, National Bureau of Economic Research, Inc.

Mayer, T., M. J. Melitz, and G. I. Ottaviano (2010). Market size, competition and the product mix of exporters. Research series 2010-202 (Oct), National Bank of Belgium.

Mayer, T. and G. Ottaviano (2008). The happy few: The internationalisation of european …rms. *Intereconomics: Review of European Economic Policy 43*(3), 135–148.

Melitz, M. J. (2003). The impact of trade in intra-industry reallocations and aggregate industry productivity. *Econometrica 71*(6), 1695ï¿1725.

Nitsch, V. (2009). Die another day: Duration in german import trade. *Review of World Economics 145*(1), 133–154.

Olley, S. G. and A. Pakes (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica 64 (6) 64*(6), 1263–1298.

Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of International Economics 48*(1), 7–35.

Rauch, J. E. and J. Watson (2003). Starting small in an unfamiliar environment. *International Journal of Industrial Organization 21*(7), 1021–1042.

Ruhl, K. and J. L. Willis (2008). New exporter dynamics.

Segura-Cayuela, R. and J. M. Vilarrubia (2008). Uncertainty and entry into export markets. Banco de Espana Working Papers 0811, Banco de Espana.

7 Appendix

7.1 Descriptive and additional statistics

In Table 6, variables descriptions and basic descriptive statistics are presented. Table 7 presents the number of ...rms per nationally aggregated destination-product level for the year 2000. Table 8 describes the loss of ...rms from the sample due to entry in 1997-99 or exit in 2001-2003 or both late entry and early exit (short presence). When considering all ...rms in the sample, we lost 15.6% of ...rms owing to late entry and 8.6% owing to early exit and 3.1% due to short presence. Relationships are ...rm-destination speci...c[11].

Industry dummies are either at the 2-digit or the 4-digit level of NACE rev3. Broad economic category dummies (Consumer, Capital, Parts, Intermediates, Raw materials) are based on UN de...nitions. Product ...xed e¤ects (HS2, HS6) are based on UN Harmonized Systems de...nitions.

7.2 Firm level results

The model introduced in section 3.2 can be simpli...ed by assuming that there is only one market and there are no destination speci...c shocks. Thus, ...rms may be permanent or temporary exporters as such. We have seen that even at this aggregated level, there is quite some variation.

We estimate ...rm i export status:

$$\Pr(T_i) = F(\alpha + \boldsymbol{\beta}'\mathbf{F}_i + \mu_i + \epsilon_i) \tag{10}$$

where $\mathbf{F}_i$ refers to ...rm level characteristics (ability, capital cost) and μ_i are industry dummies, respectively. Our left hand side variable $T_i = 1$ if a ...rm is permanent exporter, and $T_i = 0$ if temporary exporter.

[11] Note that we miss some data for 187 ...rms and over 2000 ...rm-destination pairs and hence the di¤erence for regressions.

Variable	At the …rm level Description	N. Obs	Mean	SD
Firm-destination level				
TFP	Total Factor Productivity is measured by a modi…ed Olley and Pakes (1996) de…ned in Altomonte and Békés (2009)	4405	0.589	1.051
Number of employees	Number of employees comes from the balance sheet, includes all full time employees, and is in logs	4454	103.2	402.3
Export to sales	Export to total sales share is de…ned by balance sheet of the …rm.	4540	0.409	0.382
Multiproduct d	Multiproduct dummy equals to 1 if the …rm sells more than one HS6 product to the same country.	4540	0.950	0.220
Multi-destination d	Multi-destination dummy equals to 1 if the …rm sells the same product to more than one country	4540	0.824	0.381
Foreign d	Foreign ownership is de…ned by a dummy=1 if non-domestic residents hold more than 10% of equity.	4540	0.400	0.490
Solvency Ratio	The Solvency Ratio (SR) is the ratio of net assets of the …rm (equity, reserves, pro…ts) plus long-term debts to total assets plus leftover stock (intermediate inputs and unsold …nal output). It is de…ned in relative terms to industry median.	4471	-0.078	0.541
Firm-destination level				
Ln Distance	Distance (CEPII)	17084	6.907	1.003
Ln GDP	GDP (overall)	17084	19.522	1.604
Ln GDP/capita	GDP/capita	17084	9.616	0.756
Firm-product-destination level				
Rauch heterogeneity	Rauch index of heterogeneity (dummy, 1 if heterogeneous products, 0 for wholesale or reference priced), conservative measure is used. See Rauch (1999)	66911	0.888	0.315
Same prod, other count	Firm exports the same product to di¤erent country (dummy)	66911	0.542	0.498
Same count, other prod	Firm exports other products to the same country (dummy)	66911	0.878	0.327
Large item d	Large items are de…ned as products whose unit value is above 90% of product range average. Unit values are de…ned as USD volume over units given for the actual HS6 product category.	66911	0.020	0.140
Asset d	Assets, de…ned as in Békés and Muraközy (2011) proxy exported items, which are likely to have been assets such as machinery.	66911	0.037	0.188
Inventory d	Inventories de…ned as in Békés and Muraközy (2011) proxy exported items, which are likely to have been inventories such as parts, raw materials.	66911	0.085	0.279

Table 6: Variables - descriptive stats

No of …rms/cell	No. Cells	Percent
1	15938	25.1%
2	8982	14.1%
3	6276	9.9%
4	4432	6.9%
5	3275	5.1%
6	2616	4.1%
7	2499	3.9%
8	1600	2.5%
9	1746	2.7%
10	1530	2.4%
More	14483	22.8%

Table 7: Number of observations

	Firms	Relationships
Late entry	939	2633
Early exit	518	2023
Short presence	184	393
Not in sample	1641	5049
In sample	4540	19754
Total	6187	24803

Table 8: Share of temporary trade by good categories

Model	(1) Probit	(2) Probit	(3) Probit	(4) Lin.prob
TFP	0.064***	0.015***	0.019***	0.016**
	(0.007)	(0.004)	(0.004)	(0.006)
Export share in sales		0.211***	0.216***	0.236***
		(0.013)	(0.014)	(0.014)
N. of employees (log)		0.033***	0.037***	0.039***
		(0.003)	(0.003)	(0.003)
Multi-product ...rms (Dummy)		0.194***	0.206***	0.341***
		(0.033)	(0.036)	(0.032)
Solvency Ratio	0.013	0.019***	0.020**	0.039***
	(0.011)	(0.007)	(0.008)	(0.013)
Foreign-owned (Dummy)		0.024***	0.026***	0.013
		(0.008)	(0.008)	(0.010)
Sector dummies	Nace2	Nace2	Nace4	Nace2
Observations	4,353	4,335	3,986	4,335
(Pseudo) R-squared	0.0926	0.312	0.340	0.237
Log-likelihood	-1670	-1255	-1162	

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Linear Probability and Probit models, dependent variable: T=1 if ...rm is permanent trader, 0 if temporary

To measure the e¤ect of ...rm level variables, we both use probit and linear probability models, only to see very little di¤erence. Firm level results con...rm that the key question is the impact of ...rm ability and cost of capital: Firms are more likely to be permanent traders when more productive and have lower capital cost.

7.3 Robustness test

We have carried out several robustness tests to the baseline results presented in section 4.2. After repeating the baseline speci...cation ($Base$), we ...rst present the possible impact of nuisance items, as we omitted small shipments worth less than 10.000USD (labelled as No_small). This has somewhat reduced the size of coe¢ cients but has not qualitatively a¤ected results. Second, we dropped "exotic" destinations, keeping the 100 most important markets only ($Top100$).The results are basically unchanged from the baseline model, suggesting that it is not far-away, peculiar locations that drive results.

Third, we divided our sample into exports by single ($SProd$) and multi-product ($MProd$) ...rms. There is a fairly small number of relationships of single-product ...rms at this level of aggregation. While ...rm level variables show limited variation, GDP and distance matters even within single product ...rms.

	(1)	(2)	(3)
VARIABLES	multiprod	Non_small	top100 dest
GDP (ln)	0.133***	0.156***	0.131***
	(0.015)	(0.019)	(0.029)
GDP per capita (ln)	0.100***	0.165***	0.184***
	(0.027)	(0.033)	(0.058)
Distance (ln)	-0.336***	-0.394***	-0.363***
	(0.021)	(0.026)	(0.040)
TFP	0.054***	0.017	0.036
	(0.013)	(0.020)	(0.022)
Solvency Ratio	0.188***	0.314***	0.186***
	(0.035)	(0.053)	(0.055)
Foreign-owned, D	0.088***	0.111***	0.094**
	(0.025)	(0.037)	(0.041)
Export share	0.638***	0.494***	0.787***
	(0.037)	(0.056)	(0.057)
Number of employees	0.133***	0.134***	0.155***
	(0.008)	(0.012)	(0.013)
Multi-product …rms, D		0.545***	0.814***
		(0.142)	(0.131)
Observations	16,379	9,899	6,750
Number of dest	169	145	50
log likelihood	-9024	-3959	-3395
Pseudo R-squared	0,08	0,08	0,11

Destination RE included. Standard errors in parentheses,
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Random E¤ect probit, dependent variable: T=1 if relationship permanent, 0 if temporary