# The Micro Dynamics of Exporting – Evidence from French Firms

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## Abstract

This paper investigates the dynamics of export relationships – defined as shipments by a given firm to a given destination in a given year – using a panel of almost 25,000 French exporters over the five-year period 1995-1999. We describe how these export relationships evolve over time and present a number of stylized facts, which we relate to different theories of export dynamics, such as a dynamic sunk-cost model and the recent literature on exporting and learning.

We find that export relationships are very dynamic: a large fraction of export relationships are created or destroyed every year and export values within relationships fluctuate substantially. Most of these dynamics are explained by relationship-specific shocks rather than by supply and/or demand shocks. Moreover, upon entry, export values are small but they gradually expand as relationships mature. Finally, while many export relationships are volatile, others are persistent. Having previously exported to a given destination substantially increases the probability of exporting there in the current period. We argue that, taken together, these facts are more in line with a learning model than with the sunk-cost hypothesis.



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# 1 Introduction

This paper investigates the dynamics of export relationships – defined as shipments by a given firm to a given destination in a given year – using a panel of almost 25,000 French exporters over the five-year period 1995-1999. We describe how these export relationships evolve over time and present a number of stylized facts, which we relate to different theories of export dynamics, such as a dynamic Melitz (2003) model and the recent literature on exporting and learning.

Our results show that export relationships are very volatile. In a typical year of our sample, around 25% of all relationships are newly created and around 21% are destroyed (leaving a net creation of around 4%). In addition, export values associated with specific export relationships fluctuate a lot. Individual changes in export values add up to approximately 10% of the total value of French exports. Around 90% of the changes in export values occur within existing trade relationships (intensive margin), while newly created or destroyed relationships (extensive margin) contribute only around 10% to the changes in aggregate export values. Thus, while many relationships are created or destroyed every year, these involve small values.

We show that most of the creation and destruction of export relationships and most of the changes in export values are neither driven by firm-specific (productivity) shocks nor by destination-specific (demand) shocks but by shocks that hit individual export relationships.[1] This casts doubt on the relevance of the canonical sunk-cost models of export dynamics (e.g. Baldwin and Krugman (1989), Dixit (1989), Roberts and Tybout (1997)), which emphasize variation in firm productivity and real exchange rates as the main drivers of fluctuations in firms' export decisions. Instead, it lends support to learning models, in which firms face initial uncertainty either about the demand for their product in a given market (Arkolakis and Papageorgiou (2009), Eaton, Eslava, Krizan, Kugler and Tybout (2008)) or about the reliability of their local partner firms (Araujo and Ornelas (2007), Araujo, Mion and Ornelas (2012)). In such an environment, firms face relationship-specific uncertainty and often make mistakes, which may lead to a break-up of export relationships.

Next, we turn to a description of export values at the beginning of an export relationship and show that these involve small values. If an export relationship survives the initial phase, the value of exports grows fast. Again, this is more in line with a learning model, in which firms are initially reluctant to put too much at stake because uncertainty is large, than with a sunk cost model, in which firms enter with large quantities in order to overcome the sunk cost hurdle.

Finally, we show that while many export relationships are volatile, at the same time others are quite

[1] To capture all the volatility in the export relationships, we choose a short sample (from 1995-1999) to include the maximum number of possible destinations (146).

persistent. Around 46% of relationships are created or destroyed every year but these relationships are not randomly chosen. In particular, having exported to a specific destination in the previous year increases the probability of exporting to the same destination in the current period by almost 70 percentage points, even controlling for productivity and demand shocks. While state dependence of export decisions is a typical outcome of the sunk-cost model (see Roberts and Tybout (1997)), it is also consistent with learning models, in which firms have to export to a destination in order to learn about local demand or their local partners.

We now turn to a discussion of the related literature. Two closely related papers on firm-destination export dynamics are the descriptive studies of Eaton, Eslava, Kugler and Tybout (2007), who investigate the dynamics of Colombian exporters across destinations, and Lawless (2009), who studies the export patterns of a 5-years sample of Irish exporting firms across destinations. While the findings of these authors are broadly consistent with ours, the focus of those contributions is somewhat different. Eaton et al. (2007)'s descriptive analysis is centred on the observation that most new entrants in a given destination export very small values and only few survive in the long run. Those who do survive, however, grow very fast and contribute a fair amount to aggregate Columbian export growth in the longer run. Lawless (2009), on the other hand, is interested in exporters' simultaneous entry into and exit from a given destination, the gradual fashion in which exporters expand the number of destinations to which they export and the small contribution of new relationships to aggregate export growth. None of these papers use formal econometric techniques to support their findings and they also do not relate their results to the theories of export dynamics, as we do in the present paper.[2]

This paper is also related to the literature on export dynamics and sunk fixed costs (Baldwin and Krugman (1989), Dixit (1989)). Starting with the contributions of Roberts and Tybout (1997) and Bernard and Jensen (2004), a line of empirical work has investigated the dynamics of firms' export status. These papers use firm-level data sets that provide information on firms' aggregate export values but do not include data on export values or status by destination. Thus, they do not allow a study of the dynamics of individual export relationships. The main conclusion of those studies is that firms' export status is very persistent and that past export status is an important predictor of current export status, a finding that is interpreted as a piece of evidence in favour of the sunk-cost model. Das,

[2]Many other papers, such as Bernard, Eaton, Jensen and Kortum (2003), Bernard, Jensen, Redding and Schott (2007) and Bernard, Redding and Schott (2010) among the others, reveal stylized facts on firms that export, even if they do not focus on the export dynamics. Moreover other works use the same data as this paper to explore other characteristics of firms that export. Eaton, Kortum and Kramarz (2004) are the first to analyze the destination component of firms' export in a single year thus dissecting bewteen the behaviour of the intensive and the extensive margins of trade. More recently Berman, Berthou and Héricourt (2011) explore how firms' sales interact across markets, Berthou and Fontagné (2012), and Buono and Lalanne (2012) analyze how extensive and intensive margins react to change in trade costs, Bricongne, Fontagn, Gaulier, Taglioni and Vicard (2010) disentangle the effect of the crisis in 2008-2009 on trade margins.

Roberts and Tybout (2007) structurally estimate a model with heterogeneous firms and sunk costs to export using a panel of Columbian exporters. They find the sunk fixed costs to export to be as high as 400,000 US dollars for these firms. Critically evaluating these results, Ruhl and Willis (2008) have shown that the standard model of firm heterogeneity with sunk costs predicts export values which are too large upon entry and hazard rates that increase over time, which is at odds with the empirical evidence.

A more recent line of research is motivated by the empirical observations of Eaton et al. (2007) that entry into export markets usually occurs with small values and that hazards decline with the age of the export relationship. To explain these facts, Eaton et al. (2008) and Arkolakis and Papageorgiou (2009) develop models of Bayesian learning. In this setting, firms are initially uncertain about their local demand in the export market and therefore start small. If they discover that demand is large, however, export values grow fast.[3]

Finally, Araujo and Ornelas (2007) and Araujo et al. (2012) build models where exporters have to match with a local distributor in each market. Initially, the importer's type is unknown and has to be learned through experience. Some distributors run away with exported goods if they can. As a consequence, export values are initially small and increase as exporters become more confident about the reliability of their partners.

The paper is organized as follows: in Section two we sketch several alternative theories of export dynamics and discuss their implications. Section three describes the data set, Section four is dedicated to the empirics of export dynamics. Finally, Section five concludes.

## 2 A Shock-Augmented Melitz (2003) Model

In this section we sketch a simple multi-destination extension of Melitz (2003), augmented for three types of shocks: destination-specific demand shocks, firm-specific productivity shocks and relationship (firm-destination)-specific shocks. We derive the model's implications for the levels and growth rates of export values and for export probabilities in order to test to what extent such a model is consistent with the patterns observed in the French firm-level trade data.

[3] Other papers that emphasize learning about local demand are Segura-Cayuela and Vilarrubia (2008) and Albornoz, Pardo, Corcos and Ornelas (2012), who focus on learning from other exporters (export destinations).

## 2.1 The Baseline Model

Let firms be indexed by $i = 1, ..., I$, destinations by $c = 1, ..., C$ and time by $t = 1, ..., T$. Let $A_{ct}$ be total expenditure of destination $c$ consumers at time $t$, let $\tau_{ct}$ be variable trade costs with destination $c$ at time $t$ (reflecting tariffs, transport costs and real exchange rates with France) and let $\lambda_{ict}$ be the relationship-specific part of demand, reflecting demand for a particular variety in a specific destination at time $t$.

Consumers in every destination $c$ have Dixit-Stiglitz preferences[4] over differentiated varieties, which give rise to the following demand function for individual varieties:

$$x_{ict} = \frac{p_{ict}^{-\varepsilon} \lambda_{ict} A_{ct}}{P_{ct}^{1-\varepsilon}}, \tag{1}$$

where $p_{ict}$ is the price of firm $i$'s product in destination $c$ at time $t$, $\varepsilon > 1$ is the elasticity of demand and $P_{ct} \equiv (\sum_{i \in I_{ct}} p_{ict}^{1-\varepsilon})^{\frac{1}{1-\varepsilon}}$ is the price index in destination $c$ at time $t$. Firms are monopolistically competitive and are heterogeneous in productivity $\phi_{it}$, which is drawn each period from a distribution $G(\phi)$ with support on $(0, \infty)$. Their costs to produce $x_{ict}$ units for destination $c$ at time $t$ is described by the following cost function:

$$TC(\phi_{it}, x_{ict}) = (\tau_{ct}/\phi_{it})x_{ict} + f_{ct}, \tag{2}$$

where $\tau_{ct} \geq 1$ is an iceberg variable trade cost and $f_{ct}$ is the per-period fixed cost of exporting to destination $c$ at time $t$.[5] For each destination, firms maximize per-period profits from exporting subject to demand (1) and their cost function (2). The solution to the profit maximization problem implies that optimal prices are a fixed mark-up over marginal costs:

$$p_{ict} = \frac{\varepsilon}{\varepsilon - 1} \frac{\tau_{ct}}{\phi_{it}} \tag{3}$$

Thus, export values of firm $i$ to destination $c$ at time $t$ are given by:

$$p_{ict}x_{ict} = \left(\frac{\varepsilon - 1}{\varepsilon}\right)^{\varepsilon-1} \phi_{it}^{\varepsilon-1} \left(\frac{P_{ct}}{\tau_{ct}}\right)^{\varepsilon-1} A_{ct}\lambda_{ict} \tag{4}$$

Hence, up to a constant, we can write log export values as:[6] $\log(p_{ict}x_{ict}) \approx d_{it} + d_{ct} + u_{ict}$, where

[4] $U_c = \sum_{ict \in I_{ct}} (\lambda_{ict}^{-\varepsilon} x_{ict}^{\frac{\varepsilon-1}{\varepsilon}})^{\frac{\varepsilon}{\varepsilon-1}}$.

[5] It is standard to introduce variable trade costs as iceberg costs: for each unit of good to arrive in destination $c$, the firm has to ship $\tau_{ct} \geq 1$ units of the good.

[6] Here, $d_{it} \equiv (\varepsilon - 1)\log(\phi_{it})$, $d_{ct} \equiv \log\left(A_{ct}\left(\frac{P_{ct}}{\tau_{ct}}\right)^{\varepsilon-1}\right)$ and $u_{ict} \equiv \log(\lambda_{ict})$.

$d_{it}$ represents firm-time-specific factors, $d_{ct}$ represents destination-time-specific factors and $u_{ict}$ stands for relationship-specific factors. Denoting the difference operator by $\Delta$, export growth rates can be written as

$$g_{ict} = \Delta \log(p_{ict}x_{ict}) = \Delta d_{it} + \Delta d_{ct} + \Delta u_{ict}. \tag{5}$$

Thus, export growth rates are explained by three components: firm-specific productivity shocks ($\Delta d_{it}$), destination-specific demand shocks ($\Delta d_{ct}$) and relationship-specific shocks ($\Delta u_{ict}$).

We now derive the conditions for firms' export decisions to a given destination. Profits from exporting to destination $c$ at time $t$ are given by:

$$\Pi_{ict} = \frac{p_{ict}x_{ict}}{\varepsilon} - f_{ct} = 1/\varepsilon \left(\frac{\varepsilon - 1}{\varepsilon}\right)^{\varepsilon-1} \phi_{it}^{\varepsilon-1} \left(\frac{P_{ct}}{\tau_{ct}}\right)^{\varepsilon-1} A_{ct}\lambda_{ict} - f_{ct}. \tag{6}$$

Therefore, firm $i$ exports to destination $c$ at time $t$ if and only if $\frac{\Pi_{ict}}{f_{ct}} > 1$. Defining the latent variable $Z = \log\left(\frac{\Pi_{ict}}{f_{ct}}\right)$, a firm exports to a given destination if and only if $Z > 0$ and zero otherwise, where up to a constant $Z$ can be written as the sum of firm-time, destination-time and relationship-specific factors: $Z \approx d_{it} + d_{ct} + u_{ict}$. Thus, the probability that firm $i$ exports to destination $c$ at time $t$ is given by $Prob(Z > 0) = Prob(Y_{ict} = 1)$, where $Y_{ict} \in \{0, 1\}$ is an indicator variable for firm $i$'s export status to destination $c$ at time $t$. Hence:

$$Y_{ict} = 1 \iff d_{it} + d_{ct} + u_{ict} > 0. \tag{7}$$

Summing up, we have the following predictions on export values/growth rates and export status:

1. Changes in export values/ growth rates should be driven primarily by destination-specific demand shocks and by firm-specific productivity shocks because relationship-specific shocks are a residual that is unexplained in the model.

2. There should be no relation between export values and the age of the export relationship conditional on productivity and destination-specific demand. Firms enter a destination whenever they can overcome the fixed cost hurdle (when productivity and/or local demand is high) and choose the optimal quantity in each period.

3. The current export status should depend primarily on contemporaneous productivity and destination-specific demand, since changes in relationship-specific demand, which may cause entry or exit, remain unexplained in the model.

4. The model implies that there is no state dependence of export status, in the sense that having

exported to a destination in the previous period does not affect the probability of exporting to the same destination in the current period conditional on firm-time and destination-time specific factors.

### 2.2 Introducing Sunk Costs

We now add sunk fixed costs to export to the model. Let $\Omega_{ict} = (\phi_{it}, A_{ct}, P_{ct}, \tau_{ct}, \lambda_{ict})$ be the information set of firm $i$ regarding export destination $c$ at time $t$ and let $\Pi_{ict}(\Omega_{ict})$ be per-period profits as in equation (6). Assume now that in addition to the per-period fixed exporting cost there is also a sunk fixed cost of exporting, $\tilde{f}$, which has to be paid upon entry to any given destination $c$. Moreover, assume that $\tilde{f}$ is identical for all countries and firms. Finally, destination-specific demand and firm-specific productivity both follow AR(1) processes: $\log(A_{ct}) = \log(\bar{A}_c) + \rho_A \log(A_{ct-1}) + \nu_{ct}$ and $\log(\phi_{it}) = \log(\bar{\phi}_i) + \rho_\phi \log(\phi_{it-1}) + \epsilon_{it}$, where $\nu_{ct}$ and $\epsilon_{it}$ are normally distributed i.i.d shocks. In such a model, the price and quantity decisions conditional on exporting remain static as before. However, the presence of the sunk cost together with the Markov-processes for productivity and demand convert the firm's entry decision into a dynamic optimization problem, since the firm has to forecast future values of productivity and destination-specific demand when deciding about its export status in any given period. Thus, firms have to choose an infinite sequence of entry decisions $\{Y_{ict}, Y_{ict+1}...\}$. The Bellman equation for firms' entry problem is given by:

$$V_{ict}(\Omega_{ict}) = \max_{Y_{ict}} \{Y_{ict}[\Pi_{ict}(\Omega_{ict}) - \tilde{f}(1 - Y_{ict-1})] + \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict}]\}, \tag{8}$$

where $\delta$ is the discount factor and $E_t$ denotes expectations conditioned on information set $\Omega_{ict}$. It is optimal for firm $i$ to enter destination $c$ in period $t$, i.e. to choose $Y_{ict} = 1$ whenever

$$\Pi_{ict}(\Omega_{ict}) + \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict} = 1] - \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict} = 0] - \tilde{f}(1 - Y_{ict-1}) \geq 0. \tag{9}$$

Note that $\tilde{f}$ enters the expression both through past export status and the expression for the expectations as can be seen from equation (8). Similarly, $\Omega_{ict}$ enters the equation through $\Pi_{ict}(\Omega_{ict})$ and the expression for expected future profits because, given the Markov property of the information set, the current state set helps to forecast future values of $\Omega_{ict}$. This implies, of course, that more persistent shocks have larger effects on $Y_{ict}$, while small shocks may not move export status at all.

We can write condition (9) in reduced form by proxying for the term $\Pi_{ict}(\Omega_{ict}) + \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict} = 1] - \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict} = 0]$ with a combination of firm-time ($\delta_{it}$), destination-time ($\delta_{ct}$) and relationship-specific ($u_{ict}$) factors. In this way, we obtain a reduced-form equation for the probability of exporting:

$$Y_{ict} = 1 \iff \beta_1 Y_{ict-1} + \delta_{it} + \delta_{ct} + u_{ict} > 0 \tag{10}$$

Thus, in the presence of sunk costs, export decisions are state-dependent, in the sense that past export status matters for the current probability of exporting. Firms are more likely to export to a given destination once they have paid the sunk cost than when they have not, even when conditioning on productivity and destination-specific demand. This is because there are values of productivity and demand such that the net present value of exporting is positive if and only if the sunk cost has already been paid (see equation (9), where the term $\tilde{f}(1-Y_{ict-1})$ becomes zero whenever $Y_{ict-1} = 1$). Note also that given the linearity of the reduced-form model the coefficient of past export status measures the size of the sunk cost, since $\tilde{f} Y_{ict-1} = \beta_1 Y_{ict-1}$. Moreover, $\tilde{f}$ also enters in the (non-linear) expressions for the expectations: this is captured as part of the fixed effects and the error term, $\mu_{ict}$.[7]

Since the expected value from exporting is positively related to the expected net present value of per-period export profits – which are positive when per-period export revenues are larger than the per-period fixed cost $f_{ct}$ – a given proportional shock to destination-specific demand ($A_{ct}$) is less likely to induce firms to exit from a larger market (with higher $\bar{A}_c$). The reason is that in such a market, even when demand is low per-period profits are still positive. This implies that the previous export status should have a larger effect on the probability of exporting in larger markets. Similarly, a given proportional shock to idiosyncratic productivity should make exit less likely for those firms that have on average higher productivity (higher $\bar{\phi}_i$). Thus, in a regression of current export status on its past value and interactions of past export status with market size and productivity we expect the coefficients on the interaction terms to be positive:[8]

$$Y_{ict} = 1 \iff \beta_1 Y_{ict-1} + \beta_2 Y_{ict-1} A_{ct} + \beta_3 Y_{ict-1} \phi_{it} + \delta_{it} + \delta_{ct} + u_{ict} > 0 \tag{11}$$

Summarizing, the sunk-cost model has the following testable implications:

1. Firms should enter with large export values in order to recoup the sunk fixed cost.
2. Once a firm has entered an export destination, export values/growth rates should be explained

[7] Thus, correlation between observables and the error term seems likely. This may bias the estimate of the effect of past export status. Other studies, such as Roberts and Tybout (1997) or Bernard and Jensen (2004), face a similar problem since they also proxy for the non-linear expectation term with a linear expression of observables. They just assume that the error is uncorrelated with observables.

[8] Note that this model – at least in reduced form – is indistinguishable from a model where sunk fixed costs are destination- and/or firm-specific, being larger for larger destinations or more productive firms, i.e. $\tilde{f} = \tilde{f}_{ic} = \tilde{f}_c + \tilde{f}_i$. Such a model would also imply positive coefficients on the interaction terms.

mainly by current productivity and demand shocks and should be independent of relationship age.

3. Export decisions should be state-dependent.

4. State dependence of export decisions should be larger in bigger markets and for more productive firms.

## 2.3 Introducing Learning

The sunk-cost model provides an explanation for state dependence of exporting decisions. However, it does not provide any micro-foundation for relationship-specific shocks. We now sketch two models that micro-found such shocks: a first one, where there is uncertainty about product-specific demand in a given destination that has to be learned through experience and a second one, in which exporters are uncertain about the reliability of their local partners.

### 2.3.1 Learning about Local Demand

Here, we briefly sketch Arkolakis and Papageorgiou (2009)'s model of Bayesian learning about local demand. Initially, firms are uncertain about the demand for their product in a particular destination and they have to learn it through experience. The set-up is as follows. First, firms draw productivity according to a Markov process. Next, they choose the export quantity and pay a per period exporting fixed cost. Subsequently, firms receive a noisy signal about local demand. Given the signal, firms update their beliefs and decide whether to stay or exit.

The signals about idiosyncratic demand have the following form: Observed demand is $\lambda_{ict} = \exp(\alpha_{ic} + \epsilon_{ict})$, where $\alpha_{ic}$ is the true demand parameter that is drawn upon entry from a Normal distribution and $\epsilon_{ict} \sim N(0, \sigma^2)$ is i.i.d. noise.

In each period, firms optimally choose quantities in a static way given current expected demand, before the signal is observed. They maximize expected per-period profits

$$E_t[\Pi_{ict}(\Omega_{ict})] = E_t(p_{ict})x_{ict} - \frac{\tau_{ct}}{\phi_{it}}x_{ict} - f_{ct}, \tag{12}$$

subject to the expected inverse demand function $E_t(p_{ict}) = x_{ict}^{\frac{-1}{\varepsilon}} P_{ct}^{\frac{\varepsilon-1}{\varepsilon}} E_t(\lambda_{ict}^{\frac{1}{\varepsilon}}) A_{ct}^{\frac{1}{\varepsilon}}$. Here the expectations are over the distribution of $\lambda_{ict}$ conditional on having received $n$ signals with mean $\alpha_{ic}(n)$ and $\Omega_{ict} =$

$(\phi_{it}, A_{ct}, \tau_{ct}, P_{ct}, n, \alpha_{ic}(n))$. Then export values conditional on having received $n$ signals are given by

$$p_{ict}x_{ict}(n, \alpha_{ic}(n)) = \left(\frac{\varepsilon-1}{\varepsilon}\right)^{\varepsilon-1} \phi_{it}^{\varepsilon-1} A_{ct} \left(\frac{P_{ct}}{\tau_{ct}}\right)^{\varepsilon-1} \lambda_{ict}^{\frac{1}{\varepsilon}} [E_t(\lambda_{ict}^{\frac{1}{\varepsilon}})]^{\varepsilon-1}. \tag{13}$$

Due to Bayesian learning $E_t(\lambda_{ict}^{\frac{1}{\varepsilon}})$ follows a Markov process.[9] This implies that learning provides an explanation for relationship-specific shocks. If $E_0(\lambda_{ic0}^{\frac{1}{\varepsilon}})$ is small, initially, export values are relatively small due to uncertainty about local demand. Once firms have received several positive signals, they become confident that demand for their product is high and export values increase over time. Differently, negative signals cause a decrease in export values (and eventually exit). Since the learning gain is decreasing over time, export growth rates are initially large and decreasing over time.

Learning also makes the entry and exit decision dynamic: firms have to take into account that they only learn about local demand as long as they keep exporting. Thus, the export decision is the solution to the following Bellman equation:

$$V_{ict}(\Omega_{ict}) = \max_{Y_{ict}}\{E_t[\Pi_{ict}(\Omega_{ict})]Y_{ict} + \delta E_t[V_{ict+1}(\Omega_{ict+1})|Y_{ict}]\} \tag{14}$$

As a result of learning about local demand, firms are willing to make initial losses in order to learn their idiosyncratic demand. Thus, hazard rates are initially high, but after receiving a number of positive signals, they decline fast. Moreover, export decisions are state-dependent: since the idiosyncratic part of demand follows a Markov process, having exported in the previous period increases the probability of exporting in the current period, even when controlling for productivity and destination-specific demand, because it correlates with high values of idiosyncratic demand. Finally, in larger destinations, where average demand is higher, or for more productive firms the probability of a given export relationship surviving from one period to the next is greater even when conditioning on market size and productivity. This is because in these cases a smaller value of idiosyncratic demand is sufficient to make exporting worthwhile.

Thus, the model has the following predictions:

1. Changes in export values/growth rates should be driven by relationship-specific shocks in addition to productivity and demand shocks.

2. Export values should be initially small and increasing with age conditional on survival.

[9] In particular, one can show that the optimal forecast is given by $E_t[\log(\lambda_{ict})] = (1-k_t)E_{t-1}[\log(\lambda_{ict-1})] + k_t\epsilon_{ict}$ where $k_t = \frac{\hat{\sigma}_t^2}{\hat{\sigma}_t^2+\sigma^2}$ is the Kalman gain and $\hat{\sigma}_t^2$ is the posterior error covariance in period $t$.

3. Growth rates of export values should be decreasing with age conditional on survival.

4. Changes in export decisions should be driven by relationship-specific shocks in addition to productivity and demand shocks.

5. Export decisions should be state-dependent due to learning.

6. State dependence of export decisions should be larger in bigger markets and for more productive firms.

### 2.3.2 Learning about Local Partners

Finally, we sketch a model of learning about local partners. Araujo and Ornelas (2007), Aeberhardt, Buono and Fadinger (2011) and Araujo et al. (2012) develop a model where exporters have to match with local partners (importers) in each destination in order to export. There is incomplete information about the reliability of importers – some importers may violate contracts if local legal institutions are bad and hold up the exporters – and exporters have to learn the type of their partners through experience. Thus, initially firms export small quantities in order not to expose themselves to large losses if the importer does not respect the contract. While a contract violation leads to a termination of the export relationship, each time the contract is respected, the exporter becomes more confident that their partner is trustworthy and exports increase. This leads to export values that increase with the duration of the relationship and hazard rates that decline over time, as relationships involving unreliable partners are weeded out. Finally, export status is state dependent: a given firm is more likely to export to a given destination if she has exported there in the previous period because partners can be found only with a given probability and exporters are reluctant to give up a partner as long as they do not observe a contract violation. Moreover, state dependence depends on exporter and destination characteristics. In particular, state dependence is larger for more productive exporters and in larger export destinations because those relationships are more valuable for importers and so it is easier to sustain cooperation. Finally – and this prediction is specific to this type of model –, state dependence is larger in destinations with better legal institutions because unreliable importers who try to violate a contract are prevented from doing so by the legal system.

As in the baseline model sketched above, exporters are monopolists for their particular variety and consumers have Dixit-Stiglitz preferences. Thus, price and quantity decisions are static and export values are given by:

$$p_{ict}x_{ict} = \left(\frac{\varepsilon - 1}{\varepsilon}\right)^{\varepsilon-1} \phi_{it}^{\varepsilon-1} \left(\frac{P_{ct}}{\tau_{ct}}\right)^{\varepsilon-1} A_{ct}\lambda_{ict}, \tag{15}$$

where $\lambda_{ict} = \alpha[1 - \theta_{ict}(1-\gamma)]^{\varepsilon-1}$. Here, $\alpha$ is the fraction of profits that the contract assigns to the exporter, $\theta_{ict}$ is the subjective probability of the exporter that her partner is unreliable and $\gamma$ is a measure of the effectiveness of the local legal system. Thus, export values are decreasing in $\theta_{ict}$. Again, due to Bayesian learning about the type of the partner, $\lambda_{ict}$ and therefore export values follow a Markov process.[10]

Summarizing, this model delivers very similar predictions to the model of learning about local demand. In particular, the list of predictions from Section (2.3.1) is also valid for the model of learning about local partners.[11]

## 2.4 Implications

Here, we briefly sum up the testable implications of the different models sketched above. First, all models predict the presence of volatility in the extensive and the intensive margin of trade at the firm-country level. However, while according to the shock-augmented Melitz model both changes in export values (or export growth rates) and changes in export decisions are mainly the result of productivity and demand shocks, according to learning models relationship-specific shocks, for which different micro-foundations are provided, should be an important driver of those changes. Both models predict the existence of state dependence of export decisions. In the first case there is an option value of continuing a relationship because of the sunk entry cost and in the second case the option value of continuing a relationship is due to firms trying not to lose important information collected earlier. Moreover, in both models state dependence should be market- and firm-specific, i.e. it should be higher for bigger markets and more productive firms. However, while in the learning models firms start exporting by shipping small quantities, which eventually increase as relations get older and more reliable, the shock-augmented Melitz model predicts high export values upon entry that are independent of the age of the relationship. In next section we take these predictions to data to empirically explore firm export behaviour and to differentiate between the different models of export dynamics.

[10] Specifically, the subjective probability of the exporter that her partner is impatient conditional on the contract being respected is $\theta_{ict}(r) = \frac{\gamma\theta_{ict-1}}{\gamma\theta_{ict-1}+1-\theta_{ict-1}} < \theta_{ict-1}$, and the subjective probability conditional on a contract violation is $\theta_{ict}(v) = 1$.

[11] An exception is the prediction on the growth rate of export values, which should be increasing over time in this model.

## 3 Data

The main data source for our analysis is the Douanes data base, available at the French Statistical Agency (INSEE), which contains all French customs data. For each firm, it allows us to precisely observe its exports to any destination in a given year. Each firm is assigned to a sector using the 2-digit NES classification system. Thus, excluding agriculture and services, we have firms in 15 manufacturing industries.[12]

Douanes data report 97% of the value of national trade. According to the requirements of Eurostat, Douanes data should contain all flows which are above 1,000 euros for extra-EU trade. The reporting threshold for intra-EU trade, instead, changed several times in the sample period. It went from 250,000 French francs (FF) to 650,500 FF in 2001 and then was changed to 100,000 euros in 2002. Export values below this threshold are usually reported but reporting is incomplete because it is not compulsory under French law. To the extent that reporting below the threshold is a random draw from the population, this should not affect our results. In unreported robustness checks, which are available upon request, we have excluded EU destinations from our sample. All our results remained unaffected.

We combine the Douanes data with the Bénéfices Réels Normaux (BRN) data base, also available at INSEE, which provides detailed balance-sheet information. This data base allows us to construct labour productivity by firm measured as value added per worker. We take all and only those firms which export in at least one year in the time-span we are analysing. We abstract from non-exporters in our time-span, as they do not add any information to our analysis.[13] Thus, our sample is representative for the set of all French potential exporters during the sample period.[14]

To capture all the volatility in the export relationships we decide to use all the possible destinations in the dataset for which we also have data on covariates we use in the last part of the analysis, 146 destinations.[15] This choice forced us to limit the numbers of years of our analysis to five (we choose 1995-1999). In fact, considering the number of firms that export at least once to at least one destination in that period, the total amount of relationships may reach 18 millions (=5*146*24,536), the maximum

[12] A finer disaggregation is possible but not pursued in this paper as we are more interested in aggregate patterns than in sector-specific differences.

[13] In fact their behavior is perfectly explained by firm-time fixed effects.

[14] Note that not including non-exporters has no impact on our results on export dynamics as long as (sunk) fixed costs to export are destination-specific as our theoretical model suggests. We do not analyze sunk export costs that are independent of the export destination because this would require to use data on non-exporters.

[15] Country names and codes are reported in the appendix.

number of observations we could handle given the computational constraints we were subject to.[16,17] A different approach is to restrict the number of destinations and to increase the number of years instead. However, to analyse what drives creation and destruction of export relationships as well as variation at the intensive margin at the destination level, 5 years are long enough.[18] Differently, for a survival analysis of export relationships we would need a longer dataset, since the maximum duration in our sample is five years.

While we leave robustness checks with different samples (longer time-span, samples which include also firms that entry/exit the domestic market, and so on) for future research, our results are robust to the exclusions of some countries (those in the European union) and to the exclusions of very small and very big firms – we replicate all results excluding, alternatively, the 1st and 99th and the 10th and 90th percentile of export values.[19] Finally, external validation for some of our findings is provided by studies on other countries, like Lawless (2009) on a sample of Irish firms in the five-year time-span from 2001-2004, and Eaton et al. (2007) with a sample of Colombian firms, between 1996 and 2005.

We also use several control variables that come from other sources. Data on average real GDP and real GDP per worker for the sample period are from the Penn World Tables (Mark 6.2) and data on distance from Paris are taken from Rose (2004).

Table 1 presents descriptive statistics for firm and country variables. Export values, productivity and the number of export destinations by firm follow left-skewed distributions with a long right tail. The median export value is around 29,732 euros (exp (10.3)). The median number of destinations a firm exports to is 5, with a mean of 12 and a maximum of 143.

# 4 Dynamics of Export Relationships and Export Values

In this section we describe the export dynamics of French firms. We define an export relationship as observing a positive export value by a given firm to a given destination in a given year.[20]In this case,

[16]Note that we require any given firm to be an exporter both in Douanes and in BRN and we restrict the sample to firms that survived for the entire time-span. While the first requirement was necessary to have a cleaner database, the second was a simplifying choice. Observe that this choice does not bias our results since attrition occurs over longer time periods and mainly for small domestic firms rather than for exporters.

[17]Our data source is the same as the one used by Eaton et al. (2004) and Eaton, Kortum and Kramarz (2011). They report 34,035 exporters for the year 1986 that sell to 113 destinations outside France. We have fewer exporters in our data set for several reasons. First, we require exporters to exist continuously during the sample period. Second, we require firms to be both in the Douanes and in the BRN database and to have information on value added and employment. Finally, we focus on manufacturing sectors.

[18]Also Lawless (2009) uses a 5-year sample to provide evidence on entry/exit of firms.

[19]Results are available upon request.

[20]We do have information of exports at the firm-product level to a given destination. To the extent that firms export multiple products to a given destination, we do not observe shocks that affect only the number of products exported to a given destination. As a result, we will tend to underestimate the role of extensive margin adjustment for these exporters,

the indicator $Y_{ict}$ is equal to 1. When a relationship is created or destroyed, the value of exports changes through the *extensive margin*. Conversely, when the value of the exports changes within an existing relationship then trade is adjusting through its *intensive margin*. We first show how volatile export relationships and export values are. We then compute the contribution of productivity-, demand-, and relationship-specific shocks to changes in the status of export relationships and to changes in export values.

### 4.1 Volatility of Export Status, Export Relationships and Export Values

We start by describing fluctuations in export status, i.e. participation in export activity, which is the margin of adjustment analysed by Bernard and Jensen (2004).[21] In Table 2, we report for each year the number of exporters in the sample, the number of firms which cease to export and those which begin to do so. From one year to the next, almost 9% of exporters cease to export; conversely, a slightly higher 12% are new exporters. In a typical year of our sample, there is a net increase in the number of exporters, which – aggregating entries and exits into export activity – turns out to be relatively small (3%).

More dynamics can be uncovered when we dig deeper and investigate the volatility of export relationships.[22] Entry into and exit from specific export destinations are very frequent phenomena. In column (2) of Table 3 we report for each year the number of active relationships in the sample.

Columns (3) and (5) report the number of destroyed and created relationships year by year. We find that each year around 25% of all firm-destination relationships are newly created, while around 21% of relationships are destroyed, with the difference being positive net creation of export relationships. This suggests that there are a lot of trade micro-dynamics that remain hidden when we aggregate statistics to a firm's overall export status. Finally, it is worth noticing that around 50% of the destroyed relationships are re-created in at least one subsequent year and around 70% of created relationships are destroyed in at least one subsequent year in the sample. We can conclude that export relationships are very volatile.

We next analyse volatility in terms of export values. Are export values as volatile as export relations? We address this issue by separating the adjustment in export values that occurs within

since movements at the extensive margin will occur when a firm stops exporting all its products to a given destination.

[21] Bernard and Jensen (2004) use a data set that only provides information on whether a firm is an exporter or not. In our case we also know to which destination a firm exports, and therefore we can separately analyse the export-status and export-relationships of each firm.

[22] Note that export status volatility is a lower bound for relationship volatility. Both are identical if and only if all firms simultaneously enter into or exit from all destinations. Otherwise relationship volatility is larger than export status volatility.

newly created/destroyed relations (*extensive margin*) from the one that occurs within existing ones (*intensive margin*).

We denote with $Q_t$ the value of aggregate French exports (given by the sum of export values of all existing relations in a year, $q_{ict}$), and index firms by $i$, countries by $c$ and years by $t$. Thus,

$$Q_t = \sum_{i \in I} \sum_{c \in C} q_{ict}. \tag{16}$$

We consider growth in export values using midpoint growth rates:[23]

$$G_t = \sum_{c \in C} \sum_{i \in I} g_{ict} s_{ict}, \tag{17}$$

where $s_{ict}$ is the average export share of firm $i$ in country $c$ in total French exports, $s_{ict} = \frac{q_{ict}+q_{ict-1}}{Q_t+Q_{t-1}}$, and $g_{ict}$ is the midpoint growth rate of export value of firm $i$ in country $c$, $g_{ict} = \frac{q_{ict}-q_{ict-1}}{1/2(q_{ict}+q_{ict-1})}$.

To see to what extent adjustments in export values are due to the *extensive margin* and to the *intensive margin* we classify all export relationships into four subsets: *entry* – newly formed relationships (those for which $q_{ict-1} = 0$ and $q_{ict} > 0$ ), *exit* – destroyed relationships (for which $q_{ict-1} > 0$ and $q_{ict} = 0$), *increase* – continuing relations for which export values increase ($0 < q_{ict-1} < q_{ict}$), and *decrease* – continuing relations for which export values decrease ($q_{ict-1} > q_{ict} > 0$). We can thus write:

$$G_t = \sum_{ic \in entry_t} g_{ict} s_{ict} + \sum_{ic \in exit_t} g_{ict} s_{ict} + \sum_{ic \in increase_t} g_{ict} s_{ict} + \sum_{ic \in decrease_t} g_{ict} s_{ict}. \tag{18}$$

To get a better sense of the magnitudes and the relative contributions of each of the four terms we take absolute values of midpoint growth rates of all firm-destination relationships and aggregate them to obtain the gross export growth rate, $\widehat{G}_t$:

$$\widehat{G}_t = \sum_{ic \in entry_t} |g_{ict}| s_{ict} + \sum_{ic \in exit_t} |g_{ict}| s_{ict} + \sum_{ic \in increase_t} |g_{ict}| s_{ict} + \sum_{ic \in decrease_t} |g_{ict}| s_{ict} \tag{19}$$

Table 4 reports the gross (midpoint) growth rate, the contribution of each of the four components of decomposition (19), as well as the aggregate net growth rate for different years. The net midpoint growth rate of exports is roughly 1%, while the gross midpoint growth rate is almost 10%. This difference indicates that export values are very volatile as well, although less so than export relationships. The contributions of newly-created and destroyed relationships to the gross growth rate are respec-

[23]This overcomes the problem that we would have with ordinary growth rates, which are not defined for created/destroyed relations. Note that the midpoint growth rate lies in the interval [-2,2] and takes the value -2 in the case of exit and 2 in the case of entry.

tively 7.3% and 3.6% in 1996. The intensive margin explains the rest, with increasing values within existing relations explaining 48% and decreasing values within existing relations explaining 41%. This pattern is very similar across different years.[24] Moreover, as shown in Figure 1, the contribution of intensive and extensive margins to export dynamics seem to be quite similar across different sectors, suggesting that the volatility of export values is mainly due to changes along the intensive margin in all sectors. We conclude that while creation and destruction of export relationships is very frequent, those relationships involve shipments of small values, thereby contributing relatively little to the aggregate volatility of export values.

## 4.2 Explaining Volatility of Relationships and Export Values

We now investigate which kinds of shocks are responsible for the choice of French firms to enter and exit from various destinations (creation an destruction of export relationships) and to adjust their export growth rates. Are changes mainly due to firm-specific supply and destination-specific demand shocks or are they due to those shocks that hit a specific export relationship (firm-destination-specific shocks)? Should we find that the last type of shock is important, our analysis would support those theories that provide a micro-foundation for this kind of shock (i.e. learning models).

According to our shock-augmented Melitz model, the export decision of a given firm $i$ to a given destination $c$ at time $t$ can be expressed as

$$Y_{ict} = \delta_{it} + \delta_{ct} + u_{ict}. \tag{20}$$

Using a linear probability model with firm-time dummies, $\delta_{it}$, and destination-time dummies, $\delta_{ct}$, we can decompose the variance of $Y_{ict}$ into the variance of $\delta_{it}$ (firm-time-specific component), the variance of $\delta_{ct}$ (destination-time-specific component), and the residual variance (firm-destination-time-specific component) using standard analysis of variance (ANOVA) methods. Standard errors are clustered at the firm-destination level. In Table 5 we present the results of this decomposition by 2-digit NES sector.[25,26] For a typical sector, around 15% of the variance of export decisions is

[24]Following our approach, Bricongne et al. (2010) apply the same decomposition using a sample of French data at the product level that covers years from 2002 to 2007. Results are in line with the ones reported here. For instance they find that the contributions of newly-created and destroyed relationships, which they define at the product level, are respectively 6.5% and 5.9% in their sample period.

[25]Using the full sample for the ANOVA is not possible due to technical limitations. Moreover, analysis by sector has the advantage of making demand shocks sector-specific. Note that the number of observations in the extensive margin analysis is much higher than that in the intensive margin one, since in the former we need to include all possible destinations for each firm and each year, thus obtaining 17,911,280 observations (=24,536*146*5), while the latter only includes observations with positive export values.

[26]Sample selection is not a problem for the extensive margin analysis, since we use the full set of potential exporters and destinations. For the intensive margin analysis we use firm-time and country-time fixed effects. These should capture

explained by the firm-time-specific component (productivity), and another 15% by the destination-time-specific component (effective market size), while the remaining 70% are residual variance. Thus, the relationship-specific component is very important in explaining variation in export decisions. There is also quite a lot of variation across sectors in terms of the relative importance of the supply and demand component. For instance in the sector "Apparel, Textile and Leather Products" 19% of the variance is explained by the variance of supply against 9% explained by the variance of demand; conversely more than 21% of the export status of firms in the sector "Drugs, Soaps and Cleaners" is explained by the variance of supply, against 14% explained by the variance of demand.[27]

We next look at changes in the export status as the dependent variable. As suggested by our simple shock-augmented Melitz model (6), changes in export status should be driven by changes in export profits which may be due to firm-specific shocks, destination-specific shocks or relationship-specific shocks (i.e. the export status changes if $\Pi_{ict-1}/f_{ct-1} < 1$ and $\Pi_{ict}/f_{ct} > 1$ or the other way round). We define $C_{ict}$ as an indicator variable, which is equal to 1 if a firm enters or exits from a destination ($\Delta Y_{ict} \in \{-1, 1\}$) and 0 if a firm does not change its export status to a given destination ($\Delta Y_{ict} = 0$). Again, we use a linear probability model to decompose the variance of $C_{ict}$:

$$C_{ict} = \delta_{it} + \delta_{ct} + u_{ict}. \tag{21}$$

The explanatory variables include firm-time dummies, $\delta_{it}$, and destination-time dummies, $\delta_{ct}$, while $u_{ict}$ is an error term. Again, we perform the analysis by 2-digit NES sector. Results are reported in Table 6. It is evident that the bulk of the variation in entry and exit decisions (around 92,6% on average) remains unexplained by the sum of supply and demand shocks. Hence, most of the creation and destruction of export relations is due to relationship-specific shocks. Note that this pattern is very stable across different sectors. Moreover, the portion of variability explained by demand shocks (around 3 to 6 %) is rather similar to the one related to supply shocks (2 to 4%).[28]

Finally, we analyse the determinants of changes in export values of firms across destinations. Again, we conduct an ANOVA analysis, regressing midpoint export growth rates for each firm in each served destination between any two years, $g_{ict}$, on a set of firm-time ($\delta_{it}$) and country-time ($\delta_{ct}$) dummies as suggested by equation (5):

the main drivers of selection. If selection is on observables, controlling for them eliminates sample selection problems.

[27]Note that even when we run regression (20) adding past exporting status as explanatory variable, the residual explains almost 40% of the variance. We report these results in Table 13.

[28]Note that the firm-time and the destination-time component explain a much smaller fraction of the variance than in the case in which export status is the dependent variable. The reason is that here we are differencing out average firm and destination characteristics.

$$g_{ict} = \delta_{it} + \delta_{ct} + u_{ict}, \tag{22}$$

where the dummies have the usual interpretation. In Table 7 we report the fraction of the variance of the change in the intensive margin explained by the two sets of dummies as well as the residual variance, which represents the contribution of relationship shocks, for two samples: First, for the sample excluding entry and exit; second, for the sample including these observations. Results are very similar for both samples. Once more, demand and supply shocks have rather small explanatory power to explain intensive margin changes, representing respectively less than 1% and 17% of the total variance in the model. Relationship-specific shocks are instead what really matters for the growth rate of export value, explaining up to 82% of the total variation in growth rates. Although these shocks are important in all sectors, their explanatory power varies quite substantially across sectors from a minimum of 66% in "Printing and Publishing" to a maximum of 85% in the "Mechanic Equipment" industry. Moreover, supply shocks are much more important than demand shocks, in explaining growth rate variability.

Overall, the analysis reveals that relationship-specific shocks are key for explaining the dynamics of export relationships (extensive margin) and export values (intensive margin), while productivity and demand shocks are far less important. This corroborates the importance of learning models, which provide mechanisms for such shocks.

### 4.3 Small Export Values Upon Entry and the Role of Age

In this subsection we first document that export values are small when export relationships start and we then explore how export values change as relationships mature. The shock-augmented Melitz model predicts that firms should enter with large export values to overcome the fixed (sunk) cost hurdle and that export values are independent of the age of the export relationship. Differently, learning models highlight that initial export values should be small and that export values should grow with age conditional on survival.

We now take a closer look at export values in the first and in the last period of an export relationship. In Table 8 we report the average and median export values for all relationships, relationships that were created (terminated) in 1996 and for which this status persisted during the whole observation period and relationships that were created (destroyed) in 1996 but were destroyed (re-created) in some subsequent year. While the median export value for all relationships in 1996 was 27,796 euros, the median export value for relationships that were created in the same year was only 13,266 euros for those relations that survived for the rest of the sample period and 4,193 euros for those relationships that were destroyed in some subsequent year. Thus, initially export values are quite small. Moreover, those relationships that initially involve larger values are more stable. Similarly, those relationships that were destroyed permanently in 1996 involved median exports of 7,670 euros and those that were destroyed in 1996 and recreated in some subsequent year had median export values of 6,131 euros. Thus, also relationships that cease to exist tend to involve relatively small values.

To investigate whether entry values differ substantially across sectors, in Table 9 we report percentiles of export values upon entry by sector. The 10th percentile of export values upon entry varies from 659 euros in the "Printing and Publishing" sector to 1095 euros in the "Drugs" sector, while median export values vary between 3,129 and 7,359 euros (again in the same sectors). We conclude that the phenomenon of observing small entry values does not depend much on the specific sector we look at.

Moreover, even though starting relationships involve small export values, export values tend to increase as relationships mature. This is shown in Figure 2 where we report box plots of export values by age of the relationship.[29] Clearly, the median increases over time and the distribution becomes more left skewed, as some relations grow larger.[30] A more formal analysis of this phenomenon is reported in Table 10 where we regress export levels (in logs) on the age of the relationship as well as on firm-time and destination-time dummies for the sample excluding entry and exit.[31] Again, we cluster standard errors at the firm-destination level. Results reveal that, conditional on survival, export values increase strongly with the age of the relationship. Depending on the sector, an increase in age of one year increases export values by 50-70%. Notice also that the fraction of variance in export values explained by the relationship-specific component is around 50 percent.

Finally, when we regress the growth rate of exports, $g_{ict}$, on age as well as on the usual dummies, we find a negative and significant coefficient ranging from -0.05 to -0.13 for different sectors, as reported in Table 11.[32] This result suggests that, conditional on survival, the growth rate of exporters is larger in the initial years of the export relationship and tends to decline with age. This result is consistent with the first version of learning (Arkolakis and Papageorgiou (2009)).

Summarizing, the fact that firms tend to enter destinations with very small values which increase as the relationship gets older is not consistent with the shock-augmented Melitz model (with or without sunk costs), while it lends support to learning models.

[29] The box plot reports the median, the 25th and 75th percentiles as well as the minimum and maximum export values.
[30] We exclude the 5% largest observations from the plot because including them would make the graph unreadable.
[31] Results for the sample including entry and exit are very similar and are available upon request.
[32] Again, results are reported for the sample excluding entry and exit.

## 4.4 Persistence of Export Relationships and State Dependence

Both the Melitz model with sunk costs and the learning models predict that (some) export decisions will be persistent. We now document that even though we have previously presented evidence that a large fraction of export relationships are created and destroyed every year, at the same time there is a lot of persistence in export decisions, implying that creation and destruction of export relationships is not random.

First, we use a transition matrix to investigate persistence as well as the patterns of creation and destruction of export relationships in more detail. Each row of Table 12 refers to the firms which export to a given number of destinations, "0", "1", "2" and so on in 1995. Each column refers to the firms which export to a given number of destinations in the subsequent year (1996). Each cell reports the frequency with which firms that exported to a given number of destinations in 1995 transit to any of the column categories in the following year.[33] This means that the rows sum up to 100. The last row reports the frequency of exporters in each category in 1996.[34]

Almost 60% of all exporters export to four destinations or less and only 6.57 % of exporters export to 25 or more destinations.[35] Moreover, the transition matrix is diagonal-dominant. This means that, given any initial number of export destinations, the probability of continuing to export to the same number of destinations is higher than the probability of changing the number of destinations. Non-exporters tend to integrate into the export market gradually, typically by entering one destination only, and firms that exported to only one destination tend to add or drop only one the year after. Indeed, this observation holds for all the categories considered: either firms continue to export to the same number of destinations, or they transit to the nearest category to the left or to the right. This finding is in line with a recent literature that emphasizes learning across destinations (Albornoz et al. (2012)), which makes expansion from one destination to the next gradual, since firms learn about the appeal of their product to consumers in a given destination by exporting to nearby markets.

The previous table also shows that there is persistence in the number of relationships, since the probability of the number of relationships staying constant is much greater than the probability of the number of relationships changing from one year to the next. However, the transition matrix does not allow us to determine whether the identity of active relations is actually the same over time[36] and

[33]The last 3 columns and rows aggregate the number of export destinations in a somewhat arbitrary way. However, results are robust to defining intervals differently.

[34]Note that, as explained in the description of the data set, here we are considering those firms which export to at least one destination in at least one year in the time-span of our sample. Thus, the fraction of non-exporters in the population of all firms is much larger than the 22.62% reported here.

[35]Similar evidence is provided in Eaton et al. (2004).

[36]It may be that the number of export destinations remains constant but that the identity of export destinations

whether persistence is due to persistence of unobservable supply and demand shocks or due to state dependence of exporting decisions.

We now turn to a more formal analysis of persistence. To this end, we test for state dependence of exporting decisions by regressing the export status of a given firm on its past export status. Roberts and Tybout (1997) and Bernard and Jensen (2004) have interpreted state dependence of exporting as evidence for the presence of sunk costs. However, as outlined in the theory section, state dependence is equally consistent with learning models. We can improve upon the methodology employed by the previous authors, who only had information on firms' aggregate export status available, by exploiting the 3-dimensional nature of our panel. This allows us to control for both firm-time-specific ($\delta_{it}$) and destination-time-specific ($\delta_{ct}$) effects, i.e. for supply and demand shocks. We thus run the following linear probability model:

$$Y_{ict} = \beta_1 Y_{ict-1} + \delta_{it} + \delta_{ct} + u_{ict}, \tag{23}$$

for each sector, obtaining the results displayed in Table 13.[37] First, we find that state dependence is important in explaining firm export dynamics. The coefficient $\beta_1$ captures the effect of past export status on the current probability of exporting to a given destination. In fact, for an average sector, having exported to the same destination in the previous year increases the probability of exporting by around 67 percentage points (the coefficient is significant at the one per-cent level). This effect is similar for different sectors, ranging between 63% ("Electric and Electronic Equipment") and 72% ("Drugs, Soaps and Cleaners"). Second, even when controlling for past export status, the fraction of variance of export status unexplained by the model, while dropping substantially in magnitude (compare with Table 5), is still quite high. This is shown in Column (4) of the same table. The fraction of the variance of the dependent variable explained by the error term ranges from 32% ("Drugs, Soaps and Cleaners") to 48%("Printing and Publishing"). This is further confirmation that it is important to model relationship-specific shocks in order to explain firm-level export dynamics convincingly.

Finally, we investigate whether state dependence of export relationships is systematically related to firm and destination characteristics, as both sunk-cost and learning theories would suggest. To shed light on this issue we therefore run the following linear probability model, interacting past export status with market size proxies, as well as firm productivity (measured as value added per worker) :

changes. For example, a firm may export to Spain and Italy in 1995 and to Germany and Russia in 1996: in this case the transition matrix would report this observation on the diagonal since the number of active relations does not change from one year to the other.

[37] We cluster standard errors at the firm-destination level.

$$Y_{ict} = \beta_1 Y_{ict-1} + \beta_2 Y_{ict-1} A_{ct} + \beta_3 Y_{ict-1} \phi_{it} + \delta_{it} + \delta_{ct} + u_{ict}, \tag{24}$$

where $A_{ct}$ captures standard market size characteristics such as GDP, GPD per capita, and distance, while $\phi_{it}$ measures firm productivity. Results are reported in Table 14. We find that while the coefficient of past export status, $\beta_1$, – which now measures the impact of past export status when all the interaction terms are zero – is negative, the interaction terms are strongly significant and have the expected signs.[38] The interactions with GDP, GDP per capita and productivity are positive, while the interaction with distance (which is an inverse measure of effective market size) is negative. While the precise coefficient magnitudes differ somewhat across sectors, the qualitative results are stable across sectors. These findings are expected and consistent with both the sunk-cost hypothesis and learning models.

# 5 Conclusions

In this paper we have documented several stylized facts on export dynamics using a panel of French firms. Most changes in entry and exit decisions to export destinations as well as adjustments in export values cannot be explained by firm-specific or destination-specific shocks. Instead, they are driven by relationship-specific shocks, i.e. shocks that hit a given firm in a given export destination. Moreover, export values are small at the beginning of an export episode and increase over time if the export relationship is successful. Finally, export decisions are state dependent – past export behaviour is an important predictor for current export status.

As we explain in the paper, the combination of these stylized facts is more in line with a learning model of exporting than with a dynamic Melitz model with sunk costs. We have sketched two versions of learning models: one where exporters have to learn the demand for their product in a specific market and another one where exporters rely on local partners for exporting. Both versions yield very similar predictions and are thus consistent with the data. However, only in the second version of the learning model should institutions in the destination market matter for export behaviour. Better legal institutions makes it more likely that contracts between exporters and importers will be respected and therefore increases export values and the probability that an export relationship will survive from one period to the next. While we have not investigated this channel in the present paper, Araujo et al. (2012) provide evidence for this specific mechanism. Still, in order to assess the relative importance

[38]Evaluated at the mean of the interaction terms past export status still has a positive effect on the current export probability.

of the sunk-cost model and the different versions of the learning model quantitatively, one would have to structurally estimate a hybrid model that nests all the previous models. This task is left for future research.

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# A List of Countries

All the countries included in the analysis:

Antigua et Barbuda (AG), Albania (AL), Armenia (AM), Angola (AO), Argentina (AR), Austria (AT), Australia (AU), Azerbadjan (AZ), Barbados (BB), Bangladesh (BD), Burkina Faso (BF), Bulgaria (BG), Burundi (BI), Benin (BJ), Bolivia (BO), Brazil (BR), Botswana (BW), Belarus (BY), Belize (BZ), Canada (CA), Congo, Dem. Rep. (CD), Central African Republic (CF), Congo, Rep. (CG), Switzerland (CH), Cote d'Ivoire (CI), Chile (CL), Cameroon (CM), China (CN), Colombia (CO), Costa Rica (CR), Cuba (CU), Cyprus (CY), Czech Republic (CZ), Germany (DE), Denmark (DK), Dominique (DM), Dominican Republic (DO), Algeria (DZ), Ecuador (EC), Estonia (EE), Egypt (EG), Spain (ES), Ethiopia (excludes Eritrea) (ET), Finland (FI), Fiji (FJ), Gabon (GA), United Kingdom (GB), Granada (GD), Ghana (GH), The Gambia (GM), Guinea (GN), Equatorial Guinea (GQ), Greece (GR), Guatemala (GT), Guyana (GY), Guinea-Bissau (GW), Hong Kong (HK), Honduras (HN), Croatia (HR), Haiti (HT), Hungary (HU), Indonesia (ID), Ireland (IE), Israel (IL), India (IN), Islamic Rep. of Iran (IR), Island (IS), Italy (IT), Jamaica (JM), Jordan (JO), Japan (JP), Kenya (KE), Kyrgiz Republic (KG), Kazakhstan (KZ), Korea, Rep. (KR), Saint-Kitts and Nevis (KN), Cambodia (KH), Lebanon (LB), Santa-Lucia (LC), Sri Lanka (LK), Liberia (LR), Lesotho (LS), Lithuania (LT), Latvia (LV), Morocco (MO), Moldova (MD), Madagascar (MG), Macedonia (MK), Mali (ML), Macao (MO), Mauritania (MR), Malta (MT), Mauritius (MU), Malawi (MW), Mexico (MX), Malaysia (MY), Mozambique (MZ), Namibia (NA), Niger (NE), Nigeria (NG), Nicaragua (NI), Netherlands (NL), Norway (NO), Nepal (NP), New Zealand (NZ), Panama (PA), Peru (PE), Papua New Guinea (PG), Philippines (PH), Pakistan (PK), Poland (PL), Portugal (PT), Paraguay (PY), Romania (RO), Russian Federation (RU), Rwanda (RW), Seychelles (SC), Sweden (SE), Singapore (SG), Slovenia (SI), Slovak Republic (SK), Sierra Leone (SL), Senegal (SN), Sao Tome and Principe (ST), El Salvador (SV), Syrian Arab Republic (SY), Chad (TD), Togo (TG), Thailand (TH), Tunisia (TN), Turkey (TR), Trinidad and Tobago (TT), Taiwan (TW), Tanzania (TZ), Ukraine (UA), Uganda (UG), United States (US), Uruguay (UY), Uzbekistan (UZ), Saint-Vincent and the Grenadines (VC), Venezuela (VE), Vietnam (VN), Yemen (YE), South Africa (ZA), Zambia (ZM), Zimbabwe (ZW).

# B Figures and Tables

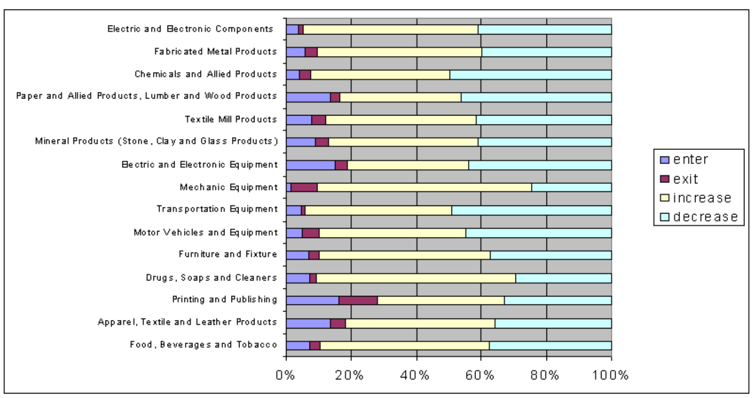


Figure 1: Intensive and extensive margin contributions to export growth by sector. The figure shows the contribution of new and destroyed relationships (extensive margin) and of continuing export relationships (intensive margin) to total sectoral export growth.

| | Level | N | Mean | SD | Min | 25th Pct. | Med. | 75th Pct. | Max |
|---|---|---|---|---|---|---|---|---|---|
| export value (log) | firm - year - destination | 871,794 | 10.4 | 2.3 | 0 | 8.7 | 10.3 | 11.9 | 22.2 |
| productivity (log) | firm - year | 122,680 | 5.6 | 0.5 | 0.5 | 5.3 | 5.6 | 5.9 | 12.5 |
| number of destinations | firm - year | 122,680 | 12 | 16.4 | 1 | 2 | 5 | 15 | 143 |
| GDP (log) | country | 144 | 17.3 | 2.1 | 11.8 | 15.7 | 17 | 18.9 | 22.9 |
| GDP p.c. (log) | country | 144 | 8.3 | 1.3 | 5.9 | 7.2 | 8.5 | 9.2 | 10.5 |
| distance (log) | country | 141 | 8.4 | 0.8 | 5.8 | 7.8 | 8.7 | 9.1 | 9.8 |

Table 1: Summary statistics. Data on export values are from Douanes. Export values are by firm-year-destination. Firm-level productivity is constructed from BRN data and is measured as value added per worker. Data on GDP and GDP per capita are from Penn World Tables (Mark 6.2), data on distance from Paris are from Rose (2004).

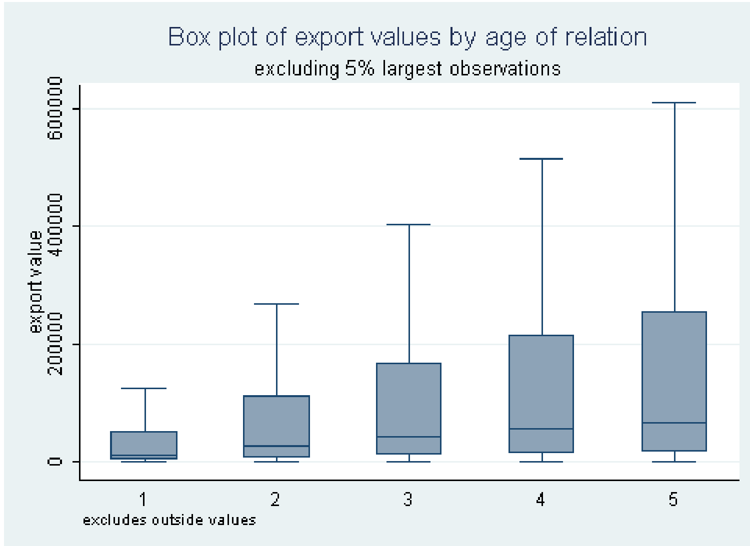


Figure 2: Export value distribution by relationship age. The figure shows box plots of export values on the vertical axis and relationship age on the horizontal axis.

| year | number of exporters | new exporters | as percentage | ceasing exporters | as percentage | net entry into export market | as percentage |
|---|---|---|---|---|---|---|---|
| 1995 | 18,382 | - | - | - | - | - | - |
| 1996 | 18,986 | 2,263 | 12% | 1,659 | 9% | 604 | 3% |
| 1997 | 19,513 | 2,299 | 12 % | 1,772 | 9% | 527 | 3% |
| 1998 | 19,950 | 2,164 | 11% | 1,727 | 9% | 437 | 2% |
| 1999 | 19,996 | 2,003 | 10% | 1,957 | 10% | 46 | 0.2% |

Table 2: Fluctuations in export status. The table presents entry and exit into exporting activity for the years 1995-1999.

| year | relationships | created | as percentage | destroyed | as percentage | net creation | as percentage |
|---|---|---|---|---|---|---|---|
| 1995 | 157,558 | - | - | - | - | - | - |
| 1996 | 167,279 | 43,629 | 27.7% | 33,908 | 21.5% | 9,721 | 6.2% |
| 1997 | 177,513 | 45,715 | 27.3% | 35,481 | 21.2% | 10,234 | 6.1% |
| 1998 | 183,595 | 44,721 | 25.1% | 38,639 | 21.7% | 6,082 | 3.4% |
| 1999 | 185,849 | 43,394 | 23.6% | 41,140 | 21.4% | 2,254 | 1.2% |

Table 3: Export relationships created and destroyed. The table reports creation and destruction of export relationships (defined by firm-destination) for the years 1995-1999.

| | gross | net | enter | exit | increase | decrease |
|---|---|---|---|---|---|---|
| 1996 | 0.100 | 0.011 | 7.3% | 3.6% | 48.1% | 41.0% |
| 1997 | 0.102 | 0.038 | 6.4% | 2.7% | 62.2% | 28.8% |
| 1998 | 0.097 | 0.016 | 5.0% | 3.7% | 53.4% | 37.9% |
| 1999 | 0.095 | 0.002 | 4.7% | 3.5% | 46.4% | 45.4% |

Table 4: Midpoint growth rates by year. Percentages explained by components.

| ANOVA: fraction of variance of $Y_{ict}$ explained by | | | | |
|---|---|---|---|---|
| | $\delta_{ct}$ | $\delta_{it}$ | $u_{ict}$ | Observations |
| *Food, Beverages and Tobacco* | 5.67% | 23.91% | 70.42% | 1,569,500 |
| *Apparel, Textile and Leather Products* | 9.09% | 18.49% | 72.43% | 1,190,630 |
| *Printing and Publishing* | 3.26% | 15.33% | 81.41% | 1,407,440 |
| *Drugs, Soaps and Cleaners* | 13.08% | 21.88% | 65.04% | 405,880 |
| *Furniture and Fixture* | 7.25% | 19.93% | 72.82% | 1,301,590 |
| *Motor Vehicles and Equipment* | 7.16% | 21.38% | 71.46% | 334,340 |
| *Transportation Equipment* | 7.89% | 20.46% | 71.46% | 239,440 |
| *Mechanic Equipment* | 7.13% | 19.46% | 73.42% | 2,476,890 |
| *Electric and Electronic Equipment* | 8.71% | 21.01% | 70.28% | 1,005,940 |
| *Mineral Products (Stone, Clay and Glass Products)* | 5.77% | 23.22% | 71.02% | 724,160 |
| *Textile Mill Products* | 9.68% | 20.69% | 69.63% | 941,700 |
| *Paper and Allied Products, Lumber and Wood Products* | 4.30% | 20.04% | 75.65% | 1,222,020 |
| *Chemicals and Allied Products* | 8.69% | 22.15% | 69.16% | 1,662,210 |
| *Fabricated Metal Products* | 4.51% | 18.33% | 77.16% | 2,871,090 |
| *Electric and Electronic Components* | 9.77% | 21.47% | 68.75% | 558,450 |

Table 5: Explaining the decision to export to a destination. ANOVA with linear probability model. The dependent variable is export status of firm $i$ to destination $c$ in period $t$. The explanatory variables are firm-time and destination-time dummies.

| ANOVA: fraction of variance of $C_{ict}$ explained by | | | | |
|---|---|---|---|---|
| | $\delta_{ct}$ | $\delta_{it}$ | $u_{ict}$ | Observations |
| *Food, Beverages and Tobacco* | 3.38% | 3.52% | 93.09% | 1,255,600 |
| *Apparel, Textile and Leather Products* | 6.40% | 1.19% | 92.41% | 952,504 |
| *Printing and Publishing* | 2.75% | 4.21% | 93.04% | 1,125,952 |
| *Drugs, Soaps and Cleaners* | 6.72% | 0.00% | 93.28% | 324,704 |
| *Furniture and Fixture* | 4.92% | 2.46% | 92.63% | 1,041,272 |
| *Motor Vehicles and Equipment* | 4.95% | 1.74% | 93.30% | 267,472 |
| *Transportation Equipment* | 5.29% | 2.35% | 92.36% | 191,552 |
| *Mechanic Equipment* | 4.63% | 2.75% | 92.62% | 1,981,512 |
| *Electric and Electronic Equipment* | 5.60% | 2.46% | 91.93% | 804,752 |
| *Mineral Products (Stone, Clay and Glass Products)* | 3.61% | 3.08% | 93.31% | 579,328 |
| *Textile Mill Products* | 5.99% | 0.86% | 93.15% | 753,360 |
| *Paper and Allied Products, Lumber and Wood Products* | 3.22% | 3.66% | 93.12% | 977,616 |
| *Chemicals and Allied Products* | 5.04% | 1.45% | 93.52% | 1,329,768 |
| *Fabricated Metal Products* | 3.15% | 2.91% | 93.94% | 2,296,872 |
| *Electric and Electronic Components* | 5.97% | 1.10% | 92.93% | 446,760 |

Table 6: Explaining changes in destination choice. ANOVA with linear probability model. The dependent variable is change in export status of firm $i$ to destination $c$ in period $t$. The explanatory variables are firm-time and destination-time dummies.

| ANOVA: fraction of variance of $g_{ict}$ explained by | | | | |
|---|---|---|---|---|
| Sample | $\delta_{ct}$ | $\delta_{it}$ | $u_{ict}$ | Observations |
| excluding entry and exit | 1.96% | 15.47% | 82.56% | 536,777 |
| including entry and exit | 2.17% | 15.50% | 82.34% | 863,404 |
| by NES sector (excluding entry and exit) | | | | |
| *Food, Beverages and Tobacco* | 2.43% | 19.94% | 77.62% | 44,583 |
| *Apparel, Textile and Leather Products* | 2.38% | 18.00% | 79.62% | 40,709 |
| *Printing and Publishing* | 3.26% | 30.72% | 66.01% | 17,436 |
| *Drugs, Soaps and Cleaners* | 4.55% | 11.51% | 83.93% | 30,907 |
| *Furniture and Fixture* | 2.73% | 17.62% | 79.66% | 38,622 |
| *Motor Vehicles and Equipment* | 6.86% | 17.35% | 75.79% | 10,443 |
| *Transportation Equipment* | 6.61% | 12.20% | 81.19% | 7,953 |
| *Mechanic Equipment* | 1.58% | 13.21% | 85.21% | 78,901 |
| *Electric and Electronic Equipment* | 2.09% | 13.49% | 84.42% | 39,007 |
| *Mineral Products (Stone, Clay and Glass Products)* | 4.04% | 16.21% | 79.75% | 20,516 |
| *Textile Mill Products* | 2.55% | 15.16% | 82.29% | 36.492 |
| *Paper and Allied Products, Lumber and Wood Products* | 2.93% | 25.26% | 71.81% | 22,017 |
| *Chemicals and Allied Products* | 1.46% | 14.91% | 83.63% | 68,338 |
| *Fabricated Metal Products* | 1.63% | 22.75% | 75.62% | 56,718 |
| *Electric and Electronic Components* | 3.73% | 12.41% | 83.86% | 24,135 |

Table 7: Explaining changes in export values. ANOVA. The dependent variable is midpoint growth rate export values of firm $i$ to destination $c$ in period $t$. The explanatory variables are firm-time and destination-time dummies.

| 1995-1996 | Observations | average | median |
|---|---|---|---|
| All relations in 1995 | 157,558 | 640,997 | 28,084 |
| Relations destroyed permanently in 1996 | 17,674 | 45,213 | 4,871 |
| Occasionally destroyed relations (for 1996 only) | 4,217 | 54,867 | 7,670 |
| All relations in 1996 | 167,279 | 630,214 | 27,796 |
| Relations created permanently in 1996 | 12,939 | 146,961 | 13,266 |
| Occasionally created relations (for 1996 only) | 13,929 | 24,125 | 4,193 |

Table 8: Average and median exports values (in Euros)

| NES sector | Entry values by percentile | | | | |
|---|---|---|---|---|---|
| | 10th | 30th | 50th | 70th | 90th |
| *Food, Beverages and Tobacco* | 963 | 2,911 | 6,522 | 15,314 | 56,098 |
| *Apparel, Textile and Leather Products* | 876 | 1,878 | 3,999 | 9,497 | 40,973 |
| *Printing and Publishing* | 659 | 1,497 | 3,129 | 8,583 | 41,376 |
| *Drugs, Soaps and Cleaners* | 1,095 | 3,201 | 7,359 | 19,742 | 84,750 |
| *Furniture and Fixture* | 866 | 1,877 | 3,927 | 9,783 | 36,942 |
| *Motor Vehicles and Equipment* | 882 | 2,577 | 6,715 | 16,362 | 85,082 |
| *Transportation Equipment* | 777 | 2,148 | 5,119 | 19,330 | 163,883 |
| *Mechanic Equipment* | 902 | 2,378 | 5,530 | 14,620 | 63,692 |
| *Electric and Electronic Equipment* | 955 | 2,470 | 5,793 | 13,980 | 52,484 |
| *Mineral Products (Stone, Clay and Glass Products)* | 953 | 2,347 | 5,971 | 14,779 | 60,394 |
| *Textile Mill Products* | 797 | 2,263 | 4,868 | 11,697 | 40,935 |
| *Paper and Allied Products, Lumber and Wood Products* | 892 | 2,928 | 6,636 | 14,695 | 62,439 |
| *Chemicals and Allied Products* | 979 | 2,456 | 5,723 | 14,023 | 54,882 |
| *Fabricated Metal Products* | 898 | 1,986 | 4,514 | 10,224 | 38,354 |
| *Electric and Electronic Components* | 854 | 1,953 | 5,151 | 14,729 | 63,951 |

Table 9: Entry values by percentile and 2-digit NES sector.

| | Regression: $q_{ict} = \beta_1 age_{ict} + \delta_{it} + \delta_{ct} + u_{ict}$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | $age_{ict}$ | Adjusted $R^2$ | Observations | Fraction of residual variance |
| *Food, Beverages and Tobacco* | 0.51*** | 0.47 | 59,651 | 45% |
| | (0.011) | | | |
| *Apparel, Textile and Leather Products* | 0.57*** | 0.40 | 54,733 | 52% |
| | (0.013) | | | |
| *Printing and Publishing* | 0.45*** | 0.45 | 24,261 | 42% |
| | (0.017) | | | |
| *Drugs, Soaps and Cleaners* | 0.48*** | 0.51 | 40,586 | 45% |
| | (0.012) | | | |
| *Furniture and Fixture* | 0.46*** | 0.44 | 52,085 | 48% |
| | (0.011) | | | |
| *Motor Vehicles and Equipment* | 0.57*** | 0.46 | 14,114 | 45% |
| | (0.027) | | | |
| *Transportation Equipment* | 0.64*** | 0.42 | 10,719 | 49% |
| | (0.031) | | | |
| *Mechanic Equipment* | 0.43*** | 0.35 | 107,002 | 57% |
| | (0.008) | | | |
| *Electric and Electronic Equipment* | 0.43*** | 0.44 | 52,591 | 51% |
| | (0.012) | | | |
| *Mineral Products (Stone, Clay and Glass Products)* | 0.48*** | 0.47 | 27,508 | 45% |
| | (0.016) | | | |
| *Textile Mill Products* | 0.52*** | 0.41 | 48,838 | 52% |
| | (0.012) | | | |
| *Paper and Allied Products, Lumber and Wood Products* | 0.55*** | 0.48 | 29,688 | 41% |
| | (0.015) | | | |
| *Chemicals and Allied Products* | 0.50*** | 0.49 | 90,752 | 46% |
| | (0.008) | | | |
| *Fabricated Metal Products* | 0.51*** | 0.46 | 76,480 | 44% |
| | (0.009) | | | |
| *Electric and Electronic Components* | 0.52*** | 0.44 | 32,118 | 50% |
| | (0.016) | | | |

***: significant at the 1% level.
Standard Errors, clustered at the firm-destination level, are reported in parenthesis.
(4) Fraction of variance of $q_{ict}$ explained by $u_{ict}$.

Table 10: Intensive margin analysis with age (1). Excluding entry and exit. The dependent variable is the export value (in logs) of firm $i$ to destination $c$ in period $t$. The explanatory variables are the age of relationship, firm-time and destination-time dummies.

| | Regression: $g_{ict} = \beta_1 age_{ict} + \delta_{it} + \delta_{ct} + u_{ict}$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | $age_{ict}$ | Adjusted $R^2$ | Observations | Fraction of residual variance |
| *Food, Beverages and Tobacco* (excluding entry and exit) | -0.107***<br>(0.007) | 0.09 | 44,583 | 77% |
| *Apparel, Textile and Leather Products* | -0.114***<br>(0.007) | 0.09 | 40,709 | 79% |
| *Printing and Publishing* | -0.059***<br>(0.012) | 0.13 | 17,436 | 66% |
| *Drugs, Soaps and Cleaners* | -0.087***<br>(0.008) | 0.09 | 30,907 | 84% |
| *Furniture and Fixture* | -0.099***<br>(0.008) | 0.08 | 38,622 | 79% |
| *Motor Vehicles and Equipment* | -0.134***<br>(0.015) | 0.10 | 10,443 | 75% |
| *Transportation Equipment* | -0.0571***<br>(0.020) | 0.05 | 7,953 | 81% |
| *Mechanic Equipment* | -0.037***<br>(0.006) | 0.04 | 78,901 | 85% |
| *Electric and Electronic Equipment* | -0.051***<br>(0.008) | 0.06 | 39,007 | 84% |
| *Mineral Products (Stone, Clay and Glass Products)* | -0.092***<br>(0.01) | 0.05 | 20,516 | 79% |
| *Textile Mill Products* | -0.123****<br>(0.008) | 0.08 | 36,492 | 82% |
| *Paper and Allied Products, Lumber and Wood Products* | -0.132***<br>(0.010) | 0.08 | 22,017 | 71% |
| *Chemicals and Allied Products* | -0.116***<br>(0.006) | 0.07 | 68,338 | 83% |
| *Fabricated Metal Products* | -0.117***<br>(0.007) | 0.08 | 56,718 | 75% |
| *Electric and Electronic Components* | -0.0973***<br>(0.010) | 0.06 | 24,135 | 83% |

***: significant at the 1% level.
Standard Errors, clustered at the firm-destination level, are reported in parenthesis.
(4) Fraction of variance of $g_{ict}$ explained by $u_{ict}$.

Table 11: Intensive margin analysis with age (2). Excluding entry and exit. The dependent variable is the midpoint growth rates of exports of firm $i$ to destination $c$ in period $t$. The explanatory variables are age of relationship, firm-time and destination-time dummies.

| 1995/1996 | 0 | 1 | 2 | 3 | 4 | 5 | (6 to 10) | (11 to 25) | 25 or more |
|---|---|---|---|---|---|---|---|---|---|
| 0 | **63.23** | 27.66 | 5.54 | 1.75 | 0.71 | 0.19 | 0.47 | 0.29 | 0.15 |
| 1 | 27.26 | **49.74** | 14.07 | 5.45 | 2.13 | 0.67 | 0.61 | 0.08 | 0.00 |
| 2 | 9.30 | 26.30 | **32.62** | 17.29 | 7.37 | 3.81 | 2.97 | 0.34 | 0.00 |
| 3 | 3.65 | 11.65 | 21.88 | **27.86** | 18.55 | 8.33 | 7.68 | 0.33 | 0.07 |
| 4 | 1.72 | 3.53 | 11.21 | 21.81 | **24.91** | 16.55 | 19.31 | 0.95 | 0.00 |
| 5 | 0.81 | 1.39 | 4.75 | 13.66 | 17.01 | **21.64** | 38.54 | 2.08 | 0.12 |
| (6 to 10) | 0.31 | 0.66 | 1.04 | 2.60 | 4.33 | 9.53 | **62.94** | 18.39 | 0.21 |
| (11 to 25) | 0.00 | 0.03 | 0.09 | 0.13 | 0.19 | 0.32 | 9.89 | **81.64** | 7.71 |
| 25 or more | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.21 | 0.07 | 6.49 | **93.17** |
| exporters (in%) | 22.62 | 20.53 | 9.59 | 6.80 | 4.80 | 3.79 | 11.97 | 13.34 | 6.57 |

Table 12: Transition matrix between 1995 and 1996. The rows (columns) refer to the number of destinations a given firm export in 1995 (1996). The cells show the fraction of export relationships that change from one category to the next between 1995 and 1996.

| | Regression: $Y_{ict} = \beta_1 Y_{ict-1} + \delta_{it} + \delta_{ct} + u_{ict}$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | $Y_{ict-1}$ | Adjusted $R^2$ | Observations | Fraction of residual variance |
| *Food, Beverages and Tobacco* | 0.70*** | 0.63 | 1,255,600 | 36.97% |
| | (0,002) | | | |
| *Apparel, Textile and Leather Products* | 0.65*** | 0.57 | 952,504 | 42.41% |
| | (0,002) | | | |
| *Printing and Publishing* | 0.65*** | 0.51 | 1,125,952 | 48.21% |
| | (0,004) | | | |
| *Drugs, Soaps and Cleaners* | 0.72*** | 0.67 | 324,704 | 32.38% |
| | (0,003) | | | |
| *Furniture and Fixture* | 0.66*** | 0.57 | 1,041,272 | 42.19% |
| | (0,003) | | | |
| *Motor Vehicles and Equipment* | 0.68*** | 0.6 | 267,472 | 39.52% |
| | (0,005) | | | |
| *Transportation Equipment* | 0.64*** | 0.57 | 191,552 | 42.60% |
| | (0,006) | | | |
| *Mechanic Equipment* | 0.64*** | 0.56 | 1,981,512 | 43.83% |
| | (0,002) | | | |
| *Electric and Electronic Equipment* | 0.63*** | 0.56 | 804,752 | 43.42% |
| | (0,003) | | | |
| *Mineral Products (Stone, Clay and Glass Products)* | 0.70*** | 0.62 | 579,328 | 37.45% |
| | (0,004) | | | |
| *Textile Mill Products* | 0.68*** | 0.62 | 753,360 | 38.15% |
| | (0,003) | | | |
| *Paper and Allied Products, Lumber and Wood Products* | 0.69*** | 0.6 | 977,616 | 41.71% |
| | (0,003) | | | |
| *Chemicals and Allied Products* | 0.70*** | 0.63 | 1,329,768 | 36.30% |
| | (0,002) | | | |
| *Fabricated Metal Products* | 0.70*** | 0.59 | 2,296,872 | 40.80% |
| | (0,002) | | | |
| *Electric and Electronic Components* | 0.67*** | 0.61 | 446,760 | 38.47% |
| | (0,003) | | | |

***: significant at the 1% level.
Standard Errors, clustered at the firm-destination level, are reported in parenthesis.
(4) Fraction of variance of $Y_{ict}$ explained by $u_{ict}$.

Table 13: State dependence analysis. Linear probability model. The dependent variable is export status of firm $i$ to destination $c$ in period $t$. The explanatory variables are lagged export status, firm-time and destination-time dummies.

| Regression: $Y_{ict} = \beta_1 Y_{ict-1} + \beta_2 Y_{ict-1} A_{ct} + \beta_3 Y_{ict-1} a_{it} + \delta_{it} + \delta_{ct} + u_{ict}$ | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) $Y_{ict-1}$ | (2) $Y_{ict-1} \times \log(distance)$ | (3) $Y_{ict-1} \times \log(GDPp.c.)$ | (4) $Y_{ict-1} \times \log(GDP)$ | (5) $Y_{ict-1} \times \log(productivity)$ | (6) Adjusted $R^2$ | (7) Obs. | (8) Residual Variance |
| *Food, Beverages and Tobacco* | -0.196 | -0.007 | 0.057 | 0.009 | 0.036 | 0.63 | 1,212,600 | 36.41% |
| | (0.040)*** | (0.002)*** | (0.003)*** | (0.001)*** | (0.003)*** | | | |
| *Apparel, Textile and Leather Products* | 0.051 | -0.037 | 0.040 | 0.008 | 0.060 | 0.58 | 919,884 | 41.91% |
| | (0.044) | (0.002)*** | (0.003)*** | (0.002)*** | (0.003)*** | | | |
| *Printing and Publishing* | 0.486 | -0.050 | 0.013 | 0.008 | 0.043 | 0.52 | 1,087,392 | 47.62% |
| | (0.067)*** | (0.004)*** | (0.005)*** | (0.003)*** | (0.006)*** | | | |
| *Drugs, Soaps and Cleaners* | 0.314 | -0.008 | 0.026 | -0.001 | 0.040 | 0.67 | 313,584 | 32.24% |
| | (0.048)*** | (0.002)*** | (0.003)*** | (0.002)*** | (0.004)*** | | | |
| *Furniture and Fixture* | -0.096 | -0.030 | 0.049 | 0.014 | 0.043 | 0.58 | 1,005,612 | 41.55% |
| | (0.046)** | (0.002)*** | (0.003)*** | (0.002)*** | (0.004)*** | | | |
| *Motor Vehicles and Equipment* | -0.027 | -0.035 | 0.027 | 0.022 | 0.050 | 0.61 | 258,312 | 38.82% |
| | (0.091) | (0.005)*** | (0.006)*** | (0.003)*** | (0.009)*** | | | |
| *Transportation Equipment* | -0.497 | -0.017 | 0.041 | 0.026 | 0.066 | 0.58 | 184,992 | 41.59% |
| | (0.104)*** | (0.005)*** | (0.006)*** | (0.003)*** | (0.012)*** | | | |
| *Mechanic Equipment* | -0.300 | -0.025 | 0.034 | 0.200 | 0.073 | 0.57 | 1,913,652 | 43.12% |
| | (0.035)*** | (0.002)*** | (0.002)*** | (0.001)*** | (0.004)*** | | | |
| *Electric and Electronic Equipment* | -0.411 | -0.017 | 0.038 | 0.026 | 0.054 | 0.57 | 777,192 | 42.69% |
| | (0.047)*** | (0.002)*** | (0.003)*** | (0.002)*** | (0.005)*** | | | |
| *Mineral Products (Stone, Clay and Glass Products)* | -0.098 | -0.026 | 0.031 | 0.021 | 0.050 | 0.63 | 559,488 | 36.82% |
| | (0.066) | (0.003)*** | (0.004)*** | (0.002)*** | (0.006)*** | | | |
| *Textile Mill Products* | -0.198 | -0.020 | 0.055 | 0.013 | 0.046 | 0.62 | 727,560 | 37.67% |
| | (0.048)*** | (0.002)*** | (0.004)*** | (0.002)*** | (0.004)*** | | | |
| *Paper and Allied Products, Lumber and Wood Products* | 0.018 | -0.026 | 0.018 | 0.017 | 0.062 | 0.58 | 944,136 | 41.34% |
| | (0.067) | (0.003)*** | (0.004)*** | (0.002)*** | (0.006)*** | | | |
| *Chemicals and Allied Products* | -0.011 | -0.018 | 0.024 | 0.016 | 0.056 | 0.64 | 1,284,228 | 35.98% |
| | 0.034 | (0.002)*** | (0.002)*** | (0.001)*** | (0.003)*** | | | |
| *Fabricated Metal Products* | 0.110 | -0.030 | 0.037 | 0.013 | 0.038 | 0.59 | 2,218,212 | 40.25% |
| | (0.041)*** | (0.002)*** | (0.003)*** | (0.001)*** | (0.005)*** | | | |
| *Electric and Electronic Components* | -0.205 | -0.022 | 0.036 | 0.024 | 0.044 | 0.62 | 431,460 | 37.88% |
| | (0.063)*** | (0.003)*** | (0.004)*** | (0.002)*** | (0.007)*** | | | |

***: significant at the 1% level.
Standard Errors, clustered at the firm-destination level, are reported in parenthesis.
(8) Fraction of variance of $Y_{ict}$ explained by $u_{ict}$.

Table 14: State dependence analysis with interaction terms. Linear probability model. The dependent variable is the export status of firm $i$ to destination $c$ in period $t$. The explanatory variables are lagged export status, interactions of lagged export status with distance, GDP, GDP per capita and productivity, as well as firm-time and destination-time dummies.