Export Growth and Credit Constraints*

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Abstract

We investigate the effect of credit constraints on the growth of exports at the micro level. We develop a model showing credit constraints play a key role in early stages of exporting, but not in later stages. Our empirical results using product level data on exports to twelve European Union members and the U.S. support the model's predictions: exports from more credit constrained exporters grow faster. Export growth rates decrease with duration and converge across countries. Larger initial export volume reduces subsequent growth. While an important force in early stages, the effect of credit constraints is not persistent.

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1 Introduction

Firms have two basic sources of financing their activities: internally from retained earnings and externally by borrowing from banks and other financial institutions. The ease with which firms are able to access financial assets has a great effect on their actions. Credit constraints have been shown to be an important determinant of international trade flows (Beck 2002, Manova 2008, 2010). However, the dynamic role and persistence of these effects at the firm level, important factors for policy makers, are yet to be modeled and examined rigorously. An exception are Amiti and Weinstein (2011) who show that deteriorating health of banks during a crisis is an important factor explaining the growth of a firm's exports relative to domestic sales. We build a model which allows us to examine the role of credit constraints in a dynamic setting and find that they play an important, but not persistent role in the growth of exports.

The lack of attention paid to the persistence of credit constraints is a consequence of the modeling strategy adopted in many papers in this literature. Credit constraints are usually set exogenously for a given country. At best they are endogenized on the efficiency of a country's financial system or capital abundance. Since these factors tend to be relatively stable over time, the persistence of credit constraints' effects is implicitly built into such models. The impact of credit constraints would be persistent if they matter at any given point in time and their severity varies very little over time.

While average credit constraints in a given country might indeed be robust over time, this is not necessarily the case from the perspective of an individual firm. The severity of credit constraints faced by a particular firm may vary dramatically even in the short run, depending on the firm's performance. A firm attempting to export for the first time might face rather unfavorable financing terms due to skepticism of lenders toward a first–time exporter.[1] Once the exporter proves to be successful, however, it can improve the terms of financing. As long as the early success is positively related to the future performance, the perceived riskiness of the firm's exporting activity will decrease. The successful firm will have an easier time financing its activities either through its current lender, and be

[1] Greenaway, Guariglia, and Kneller (2007) show that new exporters in the UK are deemed riskier than incumbent exporters.

reevaluated as less risky, or by finding new sources, domestic or possibly, which become available because of its success.

A new Chilean wine exporter to the U.S. might originally borrow at a higher interest rate than a new French exporter because of its higher risk. As a result, its initial footprint in the U.S. will be smaller. However, for exporting firms that succeed in establishing their presence in the U.S., country of origin plays a much lesser role from the credit risk perspective. Established exporters are no longer bound by credit conditions of their home country as their success makes other financing avenues available. Established French and Chilean exporters will have access to similar sources of credit and will borrow under similar conditions. This provides the Chilean exporter with an opportunity to catch up to the French exporter by growing faster, which is possible given its smaller initial footprint. Over time the domestic credit constraints will matter to a much lesser degree, if at all.

We capture this idea by building a stylized dynamic partial equilibrium model of a representative firm in which the rigidity of credit constraints is a function of the level of risk associated with the activity requiring external financing. The level of risk affects both the size and the cost of a loan a firm can acquire, with less risky activities resulting in larger and cheaper loans for new exporters. We conjecture that after establishing itself as a successful exporter, a firm can improve the terms of credit by greatly reducing the perceived risk associated with exporting. As a result, a firm which starts with worse initial terms of credit, but manages to succeed, will see its exports grow at a higher rate. At the industry or product level this effect will be more pronounced for countries with a shorter history of exports, since they will have a higher share of firms transitioning from being new and unproven to becoming experienced and successful.[2] As the duration of exporting increases, however, financial constraints the exporter faces in its home country will matter less and less for export growth and, as a result, export growth rates will converge across exporters.

We examine the predictions of our model using annual exports to twelve European Union members and the United States at a highly disaggregated product level: 8–digit

[2]The actual number of new exporters in a given year depends on multiple country and industry specific characteristics (e.g., productivity, factor endowments, international competition). Focusing on export growth and the share of new exporters in the total volume of exports rather than on levels of exports, allows us to abstract from these factors.

Common Nomenclature for the EU and 10–digit Harmonized System for the U.S. Our results support predictions derived from the model. The growth of exports is increasing in the interest rate banks charge and decreasing in the level of financial development. Exports of products more reliant on external financing grow faster as do those produced by sectors with more tangible assets. Exports which begin with lower volumes grow faster. While credit constraints determine growth rates initially, their role decreases and largely disappears as exports survive beyond the first few years indicating that the role of credit constraints is not persistent. We find that growth rates converge across all exporters over time. Our results are robust to product code changes, alternative measures of interest rates, a different way of calculating growth rates, various timing issues, and aggregation to industry level data.

2 Literature Review

We make a contribution to a rich literature on the role of credit constraints in international trade. Most of the early work focused on intensive margin implications at the country level. It put forth the notion that financial development functions as a source of comparative advantage in the presence of credit constraints (Kletzer and Bardhan 1987, Beck 2002, Matsuyama 2004). Much of the recent contribution focuses on the role of credit constraints at the firm or product level.

Our model is similar in spirit to that of Manova (2010) and Feenstra, Lu, and Yi (2011). Manova (2010) models credit–constrained heterogeneous firms in countries with different levels of financial development and in sectors of varying degrees of financial vulnerability. Countries with well developed financial systems are more likely to export bilaterally and do so with larger volumes, especially in industries more reliant on external financing or with few assets they can use for collateral. Feenstra, Lu, and Yi (2011) model why credit constraints arise in the first place by showing banks lend less than firms need in order to maintain incentive compatibility. They show credit constraints reduce exports on the extensive margin, a result supported by data on Chinese firms. Chaney (2005) focuses on financing the fixed cost of exporting in the model with liquidity–constrained heterogeneous firms. He predicts credit constraints reduce the extensive margin, but have no effect on the

intensive margin. Muûls (2008) combines elements of Chaney (2005) and Manova (2010) to show that more productive and less credit constrained firms are more likely to export. In her model credit constraints primarily affect the extensive margin.

Our focus is on the growth along the intensive margin implying that we need to keep track of every single export relationship taking into account its complete history, a novel feature of our approach.[3] Our model is dynamic by necessity, unlike most models of credit constraints in the international trade literature. Some of the implications of our model are in line with Manova (2010). Our model predicts that more credit constrained firms will have smaller volumes of exports in the first year, which is along the lines of Manova's (2010) finding that more rigid credit constraints reduce export volumes.

Egger and Kesina (2010) and Minetti and Zhu (2011) examine whether a model such as Manova (2010) or Chaney (2005) better fits the data. Using data on Italian firms, Minetti and Zhu (2011) find that credit constraints have a restrictive effect on exports both on the extensive and intensive margins, as do Egger and Kesina (2010) for a sample of Chinese firms. Using data on Slovenian firms, Damijan, Kostevc, and Polanec (2010) find that the effect of credit constraints depends on firm size, while Damijan, Kostevc, and Polanec (2011) find that asymmetry across firm size may be accredited to the new exporters' smaller extensive margin relative to incumbent exporters. Greenaway, Guariglia, and Kneller (2007) similarly find large differences in financial considerations between new and incumbent exporters among UK manufacturing firms. Jaud, Kukenova, and Strieborny (2009) find that better access to external finance results in a longer duration of exports.

A number of recent papers have focused on the growth of exports at the disaggregated level. Muûls (2008) shows that while credit constraints affect the extensive margin and the ability of the firm to begin exporting, once a firm starts to export, credit constraints have no effect on the intensive margin or its growth. Amity and Weisntein (2011) focus on explaining trade collapses or *negative* export growth during financial crisis. Linking firm-level export data to bank health information, they show trade finance and the health of banks providing it, play an important role in the growth of exports.

[3] Jaud, Kukenova, and Strieborny (2009) focus on the role of credit constraints on duration of exports and also take into account the entire history of an export relationship.

Antràs and Foley (2011) study the intensity of use of different modes of financing trading activities and show that during the recent crisis there were larger volume decreases in transactions involving cash–in–advance–of–shipment terms.[4] Chor and Manova (2011) examine the short run effect of the recent financial crisis on the volume of exports, in a static exercise. Paravisini et al. (2011) take advantage of the recent financial crisis to show that the elasticity of exports to credit is larger on the extensive margin than the intensive margin. The distinguishing feature of our model and empirics is that we take into account the complete history of an export relationship.

Albornoz et al. (2011) examine growth at both the intensive and extensive margins in a model of experimentation, where exporters go to new markets in a sequential fashion. They find rapid growth of volume conditional on survival in the first market relative to subsequent markets. They allow for positive correlation of demand uncertainties across various export destinations, while we assume exporting uncertainty to be specific to a given importer-exporter pair. Complementary to our work, Araujo, Mion, and Ornelas (2011) find that countries with weaker institutions experience higher rates of import growth from a given exporter. Their main intuitive point is similar to ours: export growth is larger after early barriers associated with weak institutions are overcome. While they study an exporter's growth from the viewpoint of the importing country's contract enforcement, we explore it from the exporter's initial stage of obtaining credit.

Finally, we make a contribution to the literature shedding light on the role of uncertainty in international trade. Rauch and Watson (2003) show that developed country buyers may first test developing country sellers with small orders in order to overcome the uncertainty of the supplier's ability to supply a quality product. Besedeš (2008) shows such a model can explain many features of duration of trade. Segura–Cayuela and Vilarrubia (2008) incorporate informational uncertainty into the Melitz (2003) and focus on entry into export markets. Nguyen (2011) models heterogeneous firms facing uncertain demand in export markets resulting in firms delaying export entry and explaining why many fail at exporting.

[4]Schmidt-Eisenlohr (2011) studies financing of trade activities, but focuses on bilateral export volumes in a gravity framework.

3 Theoretical Framework

Consider a world consisting of $e = 1, 2, ..., E$ exporting countries and one importer of differentiated varieties. The latter, referred to as Home and indexed by h, exports a numeraire good in return. In any given year, country e's exports will be undertaken by both incumbent firms or survivors and new entrants. Each firm produces and exports only one variety. The number of *new* firms attempting to export from country e is assumed to be constant across time and is denoted by n_e. Note that n_e is allowed to vary across countries, which captures cross–country differences in terms of size, ability to produce new varieties, etc.

3.1 Preferences and Information Dynamics

Consider a representative consumer in Home, whose preferences in any given year y are given by a quasi-linear utility function over many differentiated varieties indexed by v and a numeraire good:

$$U_y = \sum\nolimits_v \sum\nolimits_e \sum\nolimits_t (\lambda_y D_{vet} x_{yvet})^{\frac{\sigma-1}{\sigma}} + z_y, \tag{1}$$

where λ_y is a year-specific preference parameter, $\sigma > 1$ is the constant elasticity of substitution across varieties, x_{yvet} is an individual consumption of variety v imported from country e in year y that has been imported for t consecutive years, and z_y is an individual consumption of the numeraire.[5]

D_{vet} is a binary preference parameter defined as:

$$D_{vet} = \begin{cases} 0 & \text{if} \quad \delta_{vet} \leq k \\ 1 & \quad\quad\ \ \delta_{vet} > k \end{cases}, \tag{2}$$

where δ_{vet} is a stochastic variable measuring consumer's perception of a variety produced by a firm v in country e, where the firm has been a successful exporter for $t = 0, 1, 2, ...$ sequential years. Intuitively, the consumer's subutility from a given variety is positive if and only if the variety's characteristics in the eyes of consumer are above a certain threshold k.[6]

[5] The subscript y denotes the calendar year, while t denotes the age or duration of an export relationship.

[6] The threshold assumption is typical in the literature on the discrete choice of the experience non–durable goods. See, for example, Ackerberg (2003).

Stochastic variable δ_{vet} captures a firm's ability to match its product's characteristics to consumer preferences. All new exporters from a given country e have the same expected match because they face equal access to resources, technology, and information. However, their realized matches may differ because individual firms may make different choices and consumer's taste is stochastic. We assume that the expected match of a variety exported by a new firm varies across exporting countries because of natural differences in access to resources, technology, information, and other factors determining comparative advantage.[7]

To formalize, a match of a new ($t = 0$) variety v produced in country e, δ_{ve0}, is uniformly distributed over a country–specific support $[0, d_e]$.[8] The corresponding probability density function is given by:

$$f_{e0}(\delta_{ve0}) = \begin{cases} 1/d_e & \text{if} \quad 0 < \delta_{ve0} \leq d_e \\ 0 & \text{otherwise} \end{cases} . \tag{3}$$

From equations (2) and (3) the corresponding probability of 'success' of a variety produced by a new exporting firm v in country e is then given by:

$$\Pr(D_{ve0} = 1) = 1 - \frac{k}{d_e} \qquad \forall v, e, \tag{4}$$

with the corresponding probability of failure is given by:

$$\Pr(D_{ve0} = 0) = k/d_e \qquad \forall v, e.$$

For a new exporting firm, the probability of success increases in the length of the support d_e, which represents the best possible match between the characteristics of country e's variety produced by a new firm and consumer preferences. Since the probability of success depends only on parameter d_e, it is equal for all varieties exported by new firms from a given country.

[7]This assumption is consistent with the definition of collective or *group* reputation by Tirole (1996) in that group reputation is formed from aggregation of individual reputation which is ex ante unverifiable. In the international trade context the idea of the country–exporter group reputation was first pointed out by Rauch and Watson (2003) who examined the role of reputation in the search for an appropriate supplier.

[8]We use the uniform distribution due to its analytical simplicity and the possibility to provide an intuitive interpretation of its upper bound. However, the analysis can be easily extended to a more general family of distributions.

In each period consumers decide whether to buy a variety from a given producer. Producers use all available information to match product characteristics to consumer preferences. An established producer will have access to a better information set due to its exporting experience and direct feedback from consumers. The information obtained through its presence in Home's market dominates any information available to new firms. Thus, the exporting country's reputation becomes irrelevant for incumbent exporters. Analytically it is reflected in the new distribution of the match parameter δ_{vet} for $t > 0$:

$$f_t(\delta_{vet}) = \begin{cases} 1/d & \text{if} \quad 0 < \delta_{vet} \leq d \\ 0 & \text{otherwise} \end{cases} \qquad \forall t > 0, \tag{5}$$

where experience–based reputation corresponds to a larger upper bound of variety's match:

$$d > d_e. \tag{6}$$

The length of the support for incumbent exporters is symmetric across countries. We assume that after the first year gaining more experience does not affect the probability of success of a firm, i.e., $d_{t+1} = d_t = d \; \forall t > 0$. The main qualitative results of our model are robust to allowing the upper support to be increasing in experience, i.e., $d_{t+1} = kd_t$, where $k > 1$.

From equation (6), the probability of success of incumbent exporters is larger and does not depend on the country of origin:

$$\Pr(D_{vet} = 1) = 1 - \frac{k}{d} > 1 - \frac{k}{d_e} \qquad \forall t > 0, v, e. \tag{7}$$

Alternatively, the probability of failure is lower for incumbent exporters,

$$\Pr(D_{vet} = 0) = \frac{k}{d} < \frac{k}{d_e} \qquad \forall t > 0, v, e.$$

3.2 Production

Each firm produces one variety at a given point in time, but can update it from year to year. The firm's probability of successfully exporting a variety increases in duration of exporting.

Labor is the only factor of production. Country e is endowed with L_e units of labor which are supplied inelastically. The numeraire sector is characterized by perfect competition and constant returns to scale. One unit of labor can produce w_e units of the numeraire good, which is traded at zero cost. We assume that the numeraire sector is large enough for all countries to have a strictly positive output. This sets the wage equal to w_e in terms of the numeraire. The introduction of the numeraire good in the model simplifies the balance of trade calculation and ties the wage to the productivity in the numeraire sector.

All differentiated goods are produced with the same cost function:

$$l_{yvet} = F + cQ_{yvet},$$

where l_{yvet} is the amount of labor used in production of variety v by a firm in country e and year y which has been produced for t consecutive years, Q_{yvet} is the quantity of that variety, $F > 0$ is the fixed cost of production, and $c > 0$ is the marginal cost. Exporting variety v from country e is subject to Samuelson iceberg transportation costs. That is, to deliver one unit of variety v the exporter has to ship $\tau_e > 1$ units, where $(\tau_e - 1)$ is lost in transit. The cost of production has to be incurred before observing the realization of the demand parameter D_{vet}. A firm borrows a $0 < \eta < 1$ share of the production cost from the banking sector and finances the remaining $(1 - \eta)$ share from its own savings.

3.3 Banking Sector

The banking sector is perfectly competitive with the zero opportunity cost of capital, implying the risk–free interest rate is equal to zero.[9] Banks charge a zero–profit interest rate, r_{et}, which varies across countries and duration of a firm's exports or its experience.

A firm would only apply for a loan if the expected profit is non-negative, implying that profit under positive demand ($D_{vet} = 1$) is strictly positive. If $D_{vet} = 1$, the firm will repay the loan and earn a positive profit. If, on the other hand, the demand is zero ($D_{vet} = 0$),

[9]Feenstra, Lu, and Yi (2011) make similar assumptions about firms obtaining loans from the banking sector. They assume a monopoly bank with an interest rate $i > 0$. Our qualitative results will not change if we assume the same as long as the interest rate is positively correlated with the probability of failure of new varieties across countries.

the firm will announce itself bankrupt and will not repay the loan.[10] The bank will face a default on a loan to new exporters with probability k/d_e, but with probability k/d on a loan to incumbent ones. In the case of a default a firm from country e pays back $s_{vet} \leq 1$ on each dollar borrowed for variety v and experience of t years, which represents the share of tangible assets in the total cost of the firm. We assume that in the first period the collateral, s_{e0}, consists of the firm's tangible assets only and is industry specific. After the first period, the collateral, s_{et} for $t > 0$, consists of both the initial collateral, s_{e0}, plus profits from previous periods. For simplicity, we assume that s_{et} is exogenous to s_{e0}.[11]

3.4 Market Equilibrium

In this section we assume that parameters of the model are such that ex ante a potential entrant earns a non-negative expected profit. To put it differently, markets are attractive enough to induce new exporters to attempt exporting.

We start by finding the equilibrium interest rate r_{e0} at which a country e's bank would lend to a new exporter. Given that the bank operates under zero–profit, the present value of each dollar loaned should equal its expected revenue:

$$1 = (1 + r_{e0}) \left(1 - \frac{k}{d_e}\right) + s_{e0} \frac{k}{d_e}. \tag{8}$$

From the above equation the corresponding equilibrium interest rate is given by:

$$r_{e0} = (1 - s_e 0) * \frac{k/d_e}{1 - k/d_e}. \tag{9}$$

A bank observes the information on the probability of failure of a new exporter and uses it to set the corresponding interest rate r_{e0}. For a researcher the probability of an exporter's failure might not be observable, while the interest rate is. Based on the observed interest rate, a researcher can make inferences about the probability of a new exporter's failure:

$$\frac{k}{d_e} = \frac{r_{e0}}{1 + r_{e0} - s_{e0}}. \tag{10}$$

[10] We do not study explicitly the mechanism design for the contract to resolve the moral hazard problem.
[11] Our qualitative results would not change as long as s_{et} has a weaker relationship with s_{e0} as t increases.

This will be useful for our predictions and empirical analysis.

The expected cost of production (in terms of the numeraire) for a new exporter v in country e is given by:

$$E\left[C_{yve0}\right] = w_e\left(cQ_{yve0} + F\right)\left[\underbrace{1-\eta}_{\substack{\text{financed from}\\ \text{firm's own resources}}} + \underbrace{\eta\left(\left(1-\frac{k}{d_e}\right)\left(1+r_e\right)+\frac{k}{d_e}s_e\right)}_{\text{financed with the loan}}\right].$$

By substituting equation (8) for the expected cost share financed by the loan, we obtain:

$$E\left[C_{yve0}\right] = w_e\left(cQ_{yvet} + F\right). \tag{11}$$

Recall that the exporter earns positive revenue in the case of a success, $D_{ve0} = 1$, and zero revenue in case of failure, $D_{ve0} = 0$. The expected profit function is then given by:

$$E[\pi_{yve0}] = \left(1-\frac{k}{d_e}\right)\frac{p_{yve0}Q_{yve0}}{\tau_e} - w_e\left(cQ_{yve0}+F\right),$$

where p_{yve0} and Q_{yve0} are new exporter's delivered price and quantity produced, and τ_e is the Samuelson iceberg transportation cost. By taking the first order conditions with respect to the delivered price, we get a familiar expression for the delivered price:

$$p_{yve0} = \frac{\sigma c w_e \tau_e}{\sigma - 1}\left(1-\frac{k}{d_e}\right)^{-1}. \tag{12}$$

Under the quasi–concave utility function and constant marginal cost, the price obtained in (12) is a unique local profit maximizer for any positive level of output. From the utility function (1), the profit–maximizing quantity is given by:

$$Q_{yve0} = \lambda_y^{\sigma-1}\left(\frac{\sigma c w_e \tau_e}{\sigma-1}\right)^{-\sigma}\left(1-\frac{k}{d_e}\right)^{\sigma}. \tag{13}$$

For incumbent exporters, the equilibrium price and quantity are obtained similarly:

$$p_{yvet} = \frac{\sigma c w_e \tau_e}{\sigma - 1}\left(1 - \frac{k}{d}\right)^{-1},$$
$$Q_{yvet} = \lambda_y^{\sigma-1}\left(\frac{\sigma c w_e \tau_e}{\sigma - 1}\right)^{-\sigma}\left(1 - \frac{k}{d}\right)^{\sigma}, \qquad \forall t > 0. \tag{14}$$

The price does not depend on the demand parameter in a given year y, λ_y, and thus, in what follows we can use p_{vet} instead of p_{yvet}.

3.5 Aggregate Exports and Growth at the Product Level

Since data we will use in our empirical analysis are recorded at the product level preventing us from observing each firm, we focus on aggregate product–level export flows from a given country e to the Home country. In order to simplify our notation and given the symmetry of the production cost across the same country of origin and experience level of firms, we have suppressed the variety index v in all expressions pertaining to aggregate exports.

In any given year y, aggregate exports of a product from country e depend on the duration of exports from e since they are composed of exports from new firms as well as incumbents. Thus, for a country with T years of successful exporting, aggregate exports in year y can be calculated as:

$$V_{yeT} = \underbrace{n_e\left(1 - \frac{k}{d_e}\right)}_{\substack{\text{Number of}\\ \text{new varieties}}} p_{e0}Q_{ye0} + \underbrace{n_e\left(1 - \frac{k}{d_e}\right)\left(1 - \frac{k}{d}\right)}_{\substack{\text{Number of}\\ \text{incumbent varieties}\\ \text{exported for 1 year}}} p_{e1}Q_{ye1} + ...+$$
$$+ \underbrace{n_e\left(1 - \frac{k}{d_e}\right)\left(1 - \frac{k}{d}\right)^{T}}_{\substack{\text{Number of}\\ \text{incumbent varieties}\\ \text{exported for T years}}} p_{eT}Q_{yeT}. \tag{15}$$

After using the equilibrium values for prices (equations 12 and 14) and quantities (equations

13 and 14), and rearranging the terms, we get:

$$V_{yeT} = n_e \lambda_y^{\sigma-1} \left(1 - \frac{k}{d_e}\right) \left(\frac{\sigma c w_e \tau_e}{\sigma - 1}\right)^{1-\sigma} \left[\left(1 - \frac{k}{d_e}\right)^{\sigma-1} + \left(1 - \frac{k}{d}\right)^{\sigma-1} \sum_{t=1}^{T} \left(1 - \frac{k}{d}\right)^{t}\right]. \quad (16)$$

Since we are interested in the growth of exports, the growth rate is given by:

$$\overset{\bullet}{V}_{yeT} \equiv \frac{V_{yeY}}{V_{(y-1)e(T-1)}} = \frac{\lambda_y}{\lambda_{y-1}} \left[1 + \frac{\left(1 - \frac{k}{d}\right)^{T}}{\left(1 - \frac{k}{d_e}\right)^{\sigma-1} \left(1 - \frac{k}{d}\right)^{1-\sigma} + \left(1 - \frac{k}{d} - \left(1 - \frac{k}{d}\right)^{T}\right) \frac{d}{k}}\right]. \quad (17)$$

By substituting the probability of failure of new varieties, $\frac{k}{d_e}$, with equation (10), we obtain the following expression for the growth of exports from country e:

$$\overset{\bullet}{V}_{yeT} = \frac{\lambda_y}{\lambda_{y-1}} \left[1 + \frac{\left(1 - \frac{k}{d}\right)^{T}}{\left(\frac{1-s_{e0}}{1-s_{e0}+r_{e0}}\right)^{\sigma-1} \left(1 - \frac{k}{d}\right)^{1-\sigma} + \left(1 - \frac{k}{d} - \left(1 - \frac{k}{d}\right)^{T}\right) \frac{d}{k}}\right]. \quad (18)$$

3.6 Predictions

We now formulate testable predictions. Following directly from equation (15), controlling for aggregate demand shocks, the number of varieties exported from country e will increase over the years.[12] The total volume of exports might either increase or decrease due to the variation in the year–specific demand shock λ_y. As a result, our predictions are valid for both positive and negative growth rates. Our first proposition ties export growth to financial market parameters.

Proposition 1 *Ceteris paribus, the growth rate of exports from country e is positively correlated with*

a) the interest rate charged by banks on loans to exporters of new varieties (r_{e0});

b) asset tangibility of exporters of new varieties (s_{e0}).

[12]This result follows from our assumption of non-negative ex ante profit for new exporters.

Proof. Follows directly from equation (18). ■

Ceteris paribus, a higher interest rate r_{e0} indicates a higher level of risk associated will lending money to new exporters and results in higher production costs for new exporters. New exporters in countries with high r_{e0} will start with smaller volumes, but if successful, will grow faster. Similarly, higher asset tangibility increases the amount of collateral a firm can use for a loan. At first glance higher asset tangibility should decrease the cost of borrowing. However, in the proposition above we study the effect of higher asset tangibility controlling for other effects, including the interest rate. For a given interest rate, higher asset tangibility indicates higher level of risk associated with a given loan and a lower optimal export volume on the part of a new exporter (as indicated by equation 13).[13]

To be more specific about the role of asset tangibility, consider two industries, 1 and 2, with the same interest rate r, but different asset tangibility, $s_1 = 0.2$ and $s_2 = 0.4$. Both industries face the same interest rate, r, in equilibrium. Given equation (8), the equilibrium zero-profit interest rate should satisfy the same condition for both industries:

$$1 = s_1 \Pr(D_{1e0} = 0) + (1 + r)(1 - \Pr(D_{1e0} = 0))$$
$$1 = s_2 \Pr(D_{2e0} = 0) + (1 + r)(1 - \Pr(D_{2e0} = 0))$$

where $\Pr(D_{ie0} = 0)$ is the probability of failure in industry $i = 1, 2$ in the firm's first year of exporting. Given the values of asset tangibility, a bank recovers 20 cents on the dollar from industry 1 and 40 cents on the dollar from industry 2 in case of failure. From the above equations $\Pr(D_{1e0} = 0) < \Pr(D_{2e0} = 0)$. In other words, for a given interest rate, higher asset tangibility indicates a higher probability of failure on a firm level and higher growth rate at the sectoral level.

Our next proposition concerns the dynamics of growth rates for a given exporter and across all exporters.

Proposition 2 *Ceteris paribus, export growth rates*

[13] In our data, the measure of asset tangibility does not include profits from the previous activity. Thus, when evaluating our model, we ignore the effect of s_{et} for $t > 0$ on export growth rates. Also, empirically the asset tangibility is sector-specific, whereas interest is country-specific. This will allow us to evaluate the effect of asset tangibility in a given country across sectors.

a) decrease with duration;

b) converge across exporters as relationships age.

Proof. Follows directly from equation (17). ■

Our last proposition examines the persistence of the effect of credit constraints as an export relationship survives. As the duration of exports from country e increases, the share of new firms in the total mass of exporters decreases, and so does the effect of credit constraints on export growth. Thus, over time, the growth rate of exports depends less on the country of origin's credit constraints and may become independent of them.

Proposition 3 *Ceteris paribus, the longer is the duration of exports from country e, the smaller is the dependence of the growth rate on the probability of success of new varieties from country e,* $(1 - k/d_e)$.

Proof. Part (a) follows from equation (17):

$$\partial \left| \frac{\partial \dot{V}_{yeT}}{\partial \left(1 - k/d_e\right)} \right| \Big/ \partial T = \frac{\lambda_y}{\lambda_{y-1}} \ln\left(1 - \frac{k}{d_e}\right) \frac{(\sigma - 1)\left(1 - k/d_e\right)^{\sigma-2}(1 - k/d)^T}{X^2} \left(1 + \frac{2d/k}{X}\right) < 0,$$

where $\ln\left(1 - \frac{k}{d_e}\right) < 0$ and $X = \left(1 - \frac{k}{d_e}\right)^{\sigma-1} + \left(1 - \frac{k}{d}\right)^{\sigma-1} \frac{d}{k}\left(1 - \frac{k}{d} - \left(1 - \frac{k}{d}\right)^T\right)$.

Part (b) can be verified from equation (18) in a similar fashion. ■

Note that these propositions do not apply to export volumes. As follows from equation (16), export volumes strongly depend on the probability of survival of new exporters. Thus, the dependence on financial constraints need not vanish over time as is the case with export growth.[14] Moreover, the volume of exports in any given year will depend on multiple country–specific characteristics, such as technology, comparative advantage, proximity to the importer, etc. (captured by n_e). As long as these parameters and financial constraints differ across countries, differences in export levels will persist over time.

[14] In fact, Manova's (2010) results suggest credit constraints have a persistent effect on the level of exports, although she does not take into account the entire history (duration) of an export relationship.

3.7 Extensions

3.7.1 Multi-Sector Model

For brevity we restricted the above model to having only one differentiated sector. We now show that it can be relatively easily extended to a multi-sector case, with differentiated varieties imported by Home in each of the $g = 1, 2, 3, ..., G$ sectors. In particular consider that a Home's representative consumer has the following utility function:

$$U_y = \prod_{g=1}^{G} \left[\sum_v \sum_e \sum_t \left(\lambda_y D_{vet} x_{yvet} \right)^{\frac{\sigma-1}{\sigma}} + z_y \right]^{\mu_g}$$
$$\text{with} \quad \sum_{g=1}^{G} \mu_g = 1 \quad \text{and} \quad \sigma > 1. \tag{19}$$

On the supply side, production costs, transportation costs, and the probability of exporting success are allowed to vary across sectors. The original qualitative predictions hold in the extended model. In addition, the growth rate in a given sector is now a function of sector-specific characteristics which is useful for our empirical application.

3.7.2 Country-Specific Risk Levels for Experienced Exporters

Our model assumes that the probability of success of experienced exporting firms does not depend on the country of origin, as stated by equation (7). We assume this to present our intuition in the simplest manner. This assumption can be easily relaxed. The qualitative results of our model will not change if we allow the risk level of experienced firms to vary across countries of origin, as long as the gap between the success probability of experienced and that of inexperienced firms is greater for countries with higher original risk. Intuitively, for the model to generate the above predictions, we only need the assumption that inexperienced exporters gain more in countries with the original level of risk being higher. Formally, the following condition has to be satisfied:

$$d_{j1} - d_{j0} > d_{i1} - d_{i0} \qquad \forall d_{j0} < d_{i0},$$

where d_{j1} and (d_{i1}) is the upper support in the distribution of the match parameter δ of an experienced exporting firm from country j (i) in equation (5), and d_{j0} (d_{i0}) is the upper support for an inexperienced exporting firm from country j (i) in equation (3).

4 Data

We examine the validity of our model using product level data on exports to the United States and twelve members of the European Union between 1989 and 2007. Exports to the United States come from the U.S. Census Bureau and are recorded at the 10–digit Harmonized System (HS) level. European Union data come from EUROSTAT and are recorded at the 8–digit Common Nomenclature (CN) level. The unit of account is an export relationship, an exporter–product pair, recording exports of a product by one of 236 exporting countries to one of the thirteen reporting countries. For example, it captures exports of 'wooden kitchen cabinets designed for permanent installation' (HS=9403409060) or 'ski, cross–country, and snowboard boots with rubber or plastic' (HS=6402120000) on the part of Canada, China, the Czech Republic, France, Italy, Japan, and Spain, all of which exported the two aforementioned products to the U.S. in 2002. This is the same definition used by Besedeš and Prusa (2006a,b) and others in the duration of trade literature.

4.1 Export Growth Rates

In the eighteen years of data there are 28,095,762 annual observations. Since our model pays particular attention to the entire history of an export relationship, we convert annual data to spells—episodes with two or more continuous years of positive exports. There are a total of 8,408,156 exporting spells. Given the various lengths of spells we can calculate a total of 19,687,606 growth rates. Since a relationship may have more than one spell of service, the number of spells exceeds the number of relationships, which is 5,047,210.

Our investigation imposes two limits on our data. Our predictions hinge on observing a relationship from its inception. In order to identify such relationships we drop all observations on spells active in 1989, as they could have started in 1989 or any prior year. The second limitation is the availability of credit constraint variables. Both limitations reduce

the sample to 5,459,393 annual observations on 1,419,691 spells for 1,137,165 relationships giving rise to a total of 4,322,228 growth rates. Descriptive statistics on all gross growth rates as well as those used in our analysis are collected in Table 1.[15]

	All data				
	Average	Standard deviation	Median	Growth rates	Annual observations
Belgium–Luxembourg	15.39	2,165	1.02	1,550,434	2,166,817
Denmark	9.67	606	1.02	1,094,382	1,582,830
France	10.88	1,111	1.02	2,016,644	2,816,204
Germany	5.44	138	1.02	2,499,798	3,446,780
Greece	10.97	440	0.99	875,327	1,318,355
Ireland	16.36	3,735	1.02	671,624	1,038,877
Italy	11.11	731	1.01	1,824,334	2,612,677
Netherlands	37.53	13,746	1.01	1,660,985	2,411,801
Portugal	20.17	3,293	1.00	1,000,351	1,434,509
Spain	18.21	1,168	1.03	1,413,751	2,013,941
United Kingdom	14.23	1,750	1.00	2,020,386	2,913,137
United States	5.10	97	1.05	3,059,590	4,339,834
	Data used in regressions				
	Average	Standard deviation	Median	Growth rates	Annual observations
Belgium–Luxembourg	26.30	3,199	1.04	320,443	407,385
Denmark	16.19	1,006	1.06	264,024	337,206
France	20.39	2,144	1.06	421,265	529,996
Germany	8.09	211	1.06	568,217	699,095
Greece	13.99	338	1.04	212,009	272,623
Ireland	21.19	1,285	1.03	172,348	225,338
Italy	12.82	392	1.04	458,310	571,556
Netherlands	34.21	2,013	1.04	423,591	531,501
Portugal	38.35	6,824	1.02	189,863	246,617
Spain	24.68	1,458	1.06	304,480	388,641
United Kingdom	15.91	1,379	1.03	483,331	608,629
United States	7.86	127	1.11	504,347	640,806

Table 1: **Descriptive Statistics**

The distribution of gross growth rates is very skewed for every destination country. Looking at the bottom panel of Table 1, the average annual growth rate is the lowest for exports to the U.S. at 686%, while exports to Portugal have the largest average growth rate of 3,735%. In all cases the average growth rate is close to or higher than the 90^{th} percentile. Median growth rates are much more reasonable in magnitude, with exports to the U.S. having the largest median growth rate of 11% and exports to Portugal having the lowest one at 2%. Such skewed distributions are not uncommon in product–level trade

[15]The net growth rate is calculated as $g = (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$.

data. Besedeš (2008) shows that the distribution of the volume of exports to the U.S. in the first year of a relationship is similarly skewed with the mean volume around the 90^{th} percentile of the distribution. Given the skewness of the distribution of growth rates, we use the natural logarithm of the growth rate in all regressions.

	All data	
	Number of	
	countries exporting to	products exported to
Belgium–Luxembourg	198	16,048
Denmark	199	15,730
France	199	16,041
Germany	199	15,960
Greece	195	15,602
Ireland	196	15,642
Italy	199	16,006
The Netherlands	199	15,764
Portugal	197	15,721
Spain	199	15,964
United Kingdom	198	15,932
United States	236	22,395

	Data used in regressions	
	Number of	
	countries exporting to	products exported to
Belgium–Luxembourg	128	10,985
Denmark	114	10,252
France	130	11,273
Germany	130	11,262
Greece	115	9,677
Ireland	119	9,648
Italy	128	11,073
The Netherlands	130	10,675
Portugal	119	10,020
Spain	125	10,755
United Kingdom	130	11,040
United States	131	14,966

Table 2: **Data Coverage**

To underscore that our data reflect all reported exports to the thirteen countries in our analysis, in Table 2 we present the number of countries reported to be exporting along with the number of products exported to each of the thirteen countries. In the upper panel, where we report counts for all data, the difference between the number of countries exporting to EU members and the U.S. has to do with the U.S. Census Bureau reporting trade with a larger number of very small countries, while the difference between the number of products exported to EU members and the U.S. has to do with the different level of aggregation of

product–level data. Differences between the upper and lower panels of the table are due to the two limitations imposed on our data: availability of credit constraint variables and the need to clearly observe the beginning of a spell of exporting. While virtually no exporting country is eliminated by the latter limitation, some 10% of product codes are.

4.2 Credit Constraints Data

In the absence of direct measures of credit constraints at the firm or product level, we use several proxy variables. We use two country–level variables to capture the characteristics of the financial environment in which the exporter is initially operating. While we are unable to observe the interest rate each firm pays on its loans, we are able to observe the average lending rate charged by the banking system in exporting countries. Lending rates are available from IMF's *International Financial Statistics* on an annual basis. The country–level lending rate corresponds to the interest rate banks charge firms in our model.[16] Since a higher lending rate indicates a more expensive and smaller initial loan, resulting in a higher growth rate should the exporter prove successful, we expect the lending rate to have a positive effect on the growth rate of exports.

The second country–level variable is financial development measured as the share of private credit in GDP. It measures the relative amount of credit extended by banks and other financial intermediaries to the private sector (Beck, Demirgüç-Kunt, and Levine 2000) and has been used in the credit constraints and international trade literature (Manova 2010) as well as in the finance and growth literature (Braun 2003, Aghion et al. 2010). It is an outcome–based measure of the size of the financial system reflecting the actual use of external funds. We use it as another measure reflecting the cost of a loan. In an underdeveloped financial system costs of borrowing will generally be higher as there are fewer funds to be loaned out. Thus, a lower share of credit in GDP is a proxy for higher costs of borrowing. We expect financial development to be estimated with a negative sign indicating that exporters from less financially developed countries grow faster since their initial cost of borrowing is higher and loans smaller.

We use two industry level measures constructed by Chor and Manova (2011), asset

[16] In Section 6.2 we use two alternatives to interest rates finding qualitatively identical results.

tangibility and external finance dependence. Both are based on Compustat North America's annual industry files on publicly owned U.S. companies and are averaged for the 1996–2005 period. Asset tangibility is defined as the share of net property, plant, and equipment in total book–value assets for the median firm in a sector. It corresponds to asset tangibility as defined in our model, but measured at the sectoral level. If two industries are subject to the same level of risk, but one has fewer tangible assets, it will face a higher interest rate for its loans and we should asset tangibility to have a positive effect on the growth of exports. External finance dependence proxies for the overall cost of a loan. It measures the share of capital expenditures not financed with cash flows from operations for the median firm in each industry. Industries which are more dependent on external finance will usually face a larger cost of a loan as they have few other options, leading to a lower initial loan and a higher growth rate, resulting in an expected positive effect.

4.3 Other Data

As our model predicts that the growth rate decreases with duration, we include a variable capturing the current length or duration of a relationship. In other words, in the third year of a relationship, this variable has the value of three, irrespective of what the ultimate length of the relationship in question proves to be. We include initial exports as one of the channels through which credit constraints affect growth rates are initial exports—more restrictive credit constraints reduce initial exports which results in a higher growth rate for successful exporters. In addition to these variables which correspond directly to elements of our model, we include several other variables which may play a role in determining the growth of exports at the product level.

We use a measure of distance between the largest cities in two countries weighted by the population of those cities (Head and Meyer 2010). We use dummies to capture contiguity and common language. We control for the economic size of the exporter by using the GDP measured in constant dollars. We use the relative real exchange rate to capture how competitive the exporter's currency is relative to all other exporters. This variable was created separately for each exporter exporting to each of the thirteen countries in our data set. For each importer we first calculated a trade–weighted real exchange rate

for its currency. We then divided each exporter's real exchange rate by the importer's trade–weighted real exchange rate to arrive at the relative real exchange rate. Finally, in the case of the U.S. we have two additional variables measured at the product level: the transportation cost (by dividing import charges excluding duties with cost, insurance, and freight value of imports) and the tariff the exporter paid (by dividing duties collected with dutiable value). A data appendix lists all sources of data.

5 Results

Our empirical investigation proceeds in several steps. We first examine the role of credit constraints as outlined by Proposition 1, followed by the dynamics of export growth as outlined by Proposition 2. We end with the persistence of credit constraints in the growth of exports outlined by Proposition 3.

5.1 Export Growth

Proposition 1 states that the growth rate of exports is increasing the more restrictive are the credit constraints. The growth rate should be decreasing in the level of financial development, and increasing in the lending rate, asset tangibility, and external financial dependence. We regress the log of the gross growth rate on all variables described in the previous section and collect the results in Table 3.

In every regression we include calendar year, spell, and spell length fixed effects. Calendar year fixed effects control for unobserved macroeconomic shocks and correspond to year–specific changes in demand shocks λ_y/λ_{y-1}. Spell fixed effects control for any differences that may arise across multiple spells for a particular relationship. An ideal test of our model would entail observing the very first instance of positive exports from a particular country. Such an approach is impractical since it is virtually impossible to know with certainty when the first instance of exports occurs without having much more detailed data with a longer time series. We should note, however, that our model is applicable to any instance when exports begin anew after one or more years without positive exports. All we need to be able to identify is the first year of a spell, not the first year of the truly first spell

	Belgium Luxembourg	Denmark	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	United Kingdom	United States
Initial exports (ln)	-0.137***	-0.169***	-0.144***	-0.130***	-0.157***	-0.166***	-0.136***	-0.151***	-0.148***	-0.142***	-0.149***	-0.157***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Financial development	-0.029***	-0.030***	-0.031***	-0.023***	-0.055***	-0.015*	-0.035***	-0.032***	-0.055***	-0.025***	-0.020***	-0.078***
	(0.006)	(0.007)	(0.005)	(0.004)	(0.007)	(0.008)	(0.005)	(0.005)	(0.008)	(0.006)	(0.004)	(0.004)
Lending rate	0.147***	0.110***	0.082***	0.003	0.039**	0.193***	0.090***	0.108***	0.071**	0.136***	0.081***	0.121***
	(0.018)	(0.021)	(0.011)	(0.008)	(0.016)	(0.038)	(0.010)	(0.015)	(0.031)	(0.017)	(0.012)	(0.014)
External finance dependence	0.020***	0.007***	0.013***	0.011***	0.010***	0.015***	0.015***	0.024***	0.015***	0.018***	0.013***	0.032***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Asset tangibility	0.263***	0.307***	0.212***	0.104***	0.187***	0.179***	0.223***	0.349***	0.331***	0.252***	0.257***	0.557***
	(0.022)	(0.024)	(0.018)	(0.014)	(0.026)	(0.031)	(0.017)	(0.021)	(0.032)	(0.023)	(0.017)	(0.017)
Duration	-0.083***	-0.073***	-0.079***	-0.083***	-0.074***	-0.087***	-0.072***	-0.080***	-0.091***	-0.094***	-0.081***	-0.087***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Distance (ln)	0.028***	-0.018***	0.006***	-0.034***	-0.018***	-0.033***	0.002	-0.022***	-0.045***	0.021***	0.007***	0.150***
	(0.002)	(0.003)	(0.002)	(0.002)	(0.005)	(0.006)	(0.002)	(0.002)	(0.005)	(0.003)	(0.002)	(0.005)
Contiguity	0.097***	0.060***	0.073***	0.035***	-0.053***	0.010	-0.057***	0.165***	0.146***	0.070***	-0.033**	0.075***
	(0.014)	(0.018)	(0.008)	(0.005)	(0.015)	(0.019)	(0.010)	(0.022)	(0.016)	(0.012)	(0.016)	(0.011)
Common language	0.023***		-0.026***	-0.060***		-0.069***	0.083***	-0.058	-0.074***	-0.066***	-0.012***	-0.023***
	(0.007)		(0.006)	(0.009)		(0.012)	(0.012)	(0.049)	(0.021)	(0.009)	(0.005)	(0.004)
Exporter GDP (ln)	0.002	0.001	0.003*	0.004***	-0.003	0.008***	-0.007***	0.009***	0.012***	-0.007***	0.004***	-0.019***
	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)
Relative real exchange rate (ln)	0.010***	-0.008***	0.006***	0.006***	0.009***	-0.006**	0.010***	0.005***	0.007***	0.006***	0.005***	0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Transport costs (ln)												-0.190***
												(0.002)
Tariff (ln)												-0.043***
												(0.002)
Constant	0.168***	0.723***	0.481***	0.756***	0.697***	0.711***	0.696***	0.439***	0.422***	0.520***	0.310***	1.066***
	(0.056)	(0.061)	(0.044)	(0.037)	(0.078)	(0.092)	(0.043)	(0.051)	(0.091)	(0.059)	(0.042)	(0.060)
Observations	320,443	264,024	421,265	568,217	212,009	172,348	458,310	423,591	189,863	304,480	483,331	504,347
Spells	86,942	73,182	108,731	130,878	60,614	52,990	113,246	107,910	56,754	84,161	125,298	136,459
R^2	0.037	0.048	0.038	0.039	0.043	0.046	0.036	0.039	0.041	0.044	0.039	0.061

The dependent variable is the log of the gross growth rate, $1 + (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$. Calendar year, spell number, and spell length fixed effects included, robust standard errors clustered on relationship in parenthesis with *, **, *** denoting significance at 10%, 5%, and 1%. Observations report the number of annual exporter–product observations and spells report the total number of spells with positive exports of various length used in the analysis.

Table 3: **Export Growth and Credit Constraints**

of exports.[17] Spell length fixed effects control for differences that may exist across spells of various lengths, since a four year long spell may be different than a twelve year long spell.

The effect of the four credit constraint variables is as expected for every country–importer. Exports from countries with more developed financial systems, where credit is generally cheaper, grow at a slower rate. The slower pace of growth is due to new exporters being able to obtain larger loans to finance larger initial export volumes. A one percentage point higher financial development reduces the rate of growth by between 0.015 (for exports to Ireland) and 0.078 (to the U.S.) log points. Exports from countries with higher lending rates grow faster. A one percentage point higher lending rate increases the growth rate by between 0.039 (to Greece) and 0.193 (to Ireland) log points. The only exception are exports to Germany, where the lending rate has virtually no effect.

Exports of products in sectors that depend more on external finance grow at a faster rate as they enjoy a greater benefit from successful exporting. As firms in such sectors start to export, their greater reliance on external finance makes banks leery of lending to as they are perceived to be riskier. Once they prove themselves, the banks' reluctance is reduced allowing them to grow at a faster rate as the relative increase in financing available to them allows them to increase exports at a greater rate. Asset tangibility increases the growth of exports to every country. Since firms with more tangible assets are more likely to stop exporting showing themselves as unsuccessful, banks will be leery to lend to them, forcing them to start with smaller volumes. As a result, those exports will grow faster.[18]

Export relationships commencing with larger volumes grow at a slower rate. A one percent higher initial volume reduces the growth rate by between 0.130 (to Germany) to 0.169 (to Denmark) percent. Significant effects of the initial volume and credit constraints indicate that the effect of the latter on growth through reducing initial volume is stronger than the pure effect of initial volume. The growth rate decreases the longer the export relationship by between 0.072 (to Italy) to 0.091 (to Portugal) log points per year of duration.

[17] In Section 6 we show that qualitatively identical results are obtained if we restrict the analysis to either the first observed spell or to single spell relationships.

[18] Since external finance dependence and asset tangibility are sector specific and constant over time, the direction of their effect is of greater interest than the magnitude, as is customary in the literature. Both variables can be thought of as providing a ranking of sectors along these two dimensions, in which case the magnitude of their effects are not as meaningful as the sign of the effect. See Manova (2010) for a discussion.

None of the other variables have a consistent effect across the thirteen importing countries. Distance decreases the growth of exports to Denmark, Germany, Greece, Ireland, the Netherlands, and Portugal, while it increases the growth of exports to Belgium and Luxembourg, France, Spain, the U.K., and the U.S., and has no effect for Italy. Exports from contiguous trading partners tend to grow faster except in the case of Greece, Italy, and the U.K., for which the opposite is true. Common language increases the growth of exports to Belgium and Luxembourg and Italy, while it has the opposite effect for France, Germany, Ireland, Portugal, Spain, the U.K., and the U.S. Exports from larger countries grow faster if they are destined for France, Germany, Ireland, the Netherlands, Portugal, and the U.K., while they grow slower if destined for Italy, Spain, and the U.S. Exporter GDP has no effect in the case of Belgium and Luxembourg, Denmark, and Greece. Higher valued currency increases the growth of exports to all countries except Denmark and Ireland, where the opposite is the case. Finally, higher transportation costs for exports to the U.S. reduce the growth rate, as does a higher tariff assessed on exports to the U.S.

5.2 Dynamics of Export Growth Rates

Proposition 2 states that growth rates decrease as the spell continues to survive and that growth rates converge across exporters as duration increases. The estimated coefficient on duration in Table 3 confirms the first part of the proposition, that growth rates decrease with duration. We now offer evidence on the second part.

One approach to examining convergence of growth rates is to calculate the standard deviation and regress it on duration. However, it does not control for the nominal size of growth rates. This is particularly problematic given the first part of proposition 2. When comparing all spells it implies that the average growth rate across all exporters is decreasing as spells survive. It is reasonable to expect that the standard deviation is decreasing as well. We instead calculate the coefficient of variation of growth rates for each product separately for all spells of equal length and separately for multiple spell cases. We divide the standard deviation of growth rates with the average growth rate across exporters at every duration (year in the spell). We only include products with at least five exporters at every duration. We regress the coefficient of variation on the duration of exports and include spell number

	Belgium Luxembourg	Denmark	France	Germany	Greece	Ireland
Duration	-0.021***	-0.012*	-0.016***	-0.021***	-0.027***	-0.019**
	(0.004)	(0.007)	(0.003)	(0.002)	(0.006)	(0.008)
Constant	1.362***	1.155***	1.340***	1.523***	1.261***	1.438***
	(0.125)	(0.068)	(0.095)	(0.081)	(0.079)	(0.331)
Observations	16,418	13,037	22,632	31,395	10,782	8,450
Products	6,249	5,416	7,413	8,778	5,017	3,847
R^2	0.090	0.080	0.095	0.142	0.090	0.075
	Italy	Netherlands	Portugal	Spain	United Kingdom	United States
Duration	-0.024***	-0.015***	-0.021***	-0.038***	-0.017***	-0.029***
	(0.003)	(0.003)	(0.007)	(0.006)	(0.003)	(0.002)
Constant	1.591***	1.303***	1.406***	1.484***	1.484***	1.451***
	(0.118)	(0.114)	(0.105)	(0.075)	(0.094)	(0.083)
Observations	25,639	24,707	8,673	15,594	28,692	46,338
Products	7,552	7,204	4,574	6,345	8,267	12,921
R^2	0.119	0.110	0.086	0.093	0.104	0.103

The dependent variable is the coefficient of variation of growth rates at the product level. Industry (2–digit SITC), spell number, and spell length fixed effects included, robust standard errors clustered by products in parentheses with *, **, *** denoting significance at 10%, 5%, and 1%. Observations report the number of annual product observations, while products report the number of products analyzed.

Table 4: **Convergence of Export Growth Rates**

and spell length fixed effects, as well as industry fixed effects at the 2–digit SITC level. Table 4 collects our results. The estimated negative coefficient on duration indicates that the coefficient of variation decreases with duration and provides strong evidence that growth rates converge across exporters and duration.

5.3 Persistence of Credit Constraints

Our final investigation focuses on whether the role of credit constraints decreases with duration as predicted by Proposition 3. Equations (17) and (18) imply that credit constraints play a crucial role in the first year of growth, but become progressively less important beyond the first year as successful firms obtain access to cheaper sources of financing and outweigh new entrants in terms of the volume of exports. We expect to find a decreasing role of credit constraint variables as the duration of a spell increases.

We first examine qualitatively whether the effect of credit constraints diminishes over time by re–estimating regressions in Table 3 and including the interaction of each credit constraint variable with duration. If the effect of credit constraints diminishes with duration,

	Belgium Luxembourg	Denmark	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain	United Kingdom	United States
Fin. dev.	-0.071***	-0.050***	-0.060***	-0.004	-0.124***	-0.059***	-0.056***	-0.049***	-0.130***	-0.094***	-0.068***	-0.125***
	(0.010)	(0.011)	(0.008)	(0.007)	(0.012)	(0.015)	(0.008)	(0.009)	(0.015)	(0.010)	(0.007)	(0.007)
Fin. dev.	0.008***	0.004**	0.005***	-0.005***	0.014***	0.010***	0.003***	0.003**	0.017***	0.013***	0.009***	0.008***
× duration	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Lending rate	0.268***	0.286***	0.198***	0.185***	0.105***	0.148**	0.207***	0.146***	-0.019	0.216***	0.119***	0.263***
	(0.041)	(0.046)	(0.024)	(0.019)	(0.037)	(0.068)	(0.021)	(0.031)	(0.041)	(0.034)	(0.027)	(0.029)
Lending rate	-0.039***	-0.055***	-0.036***	-0.050***	-0.021**	0.011	-0.035***	-0.012	0.027***	-0.031***	-0.016**	-0.046***
× duration	(0.009)	(0.011)	(0.006)	(0.004)	(0.008)	(0.018)	(0.005)	(0.008)	(0.009)	(0.009)	(0.007)	(0.007)
Ext. fin. dep.	0.026***	0.022***	0.024***	0.020***	0.016***	0.029***	0.025***	0.036***	0.029***	0.030***	0.018***	0.040***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)
Ext. fin. dep.	-0.001***	-0.003***	-0.002***	-0.002***	-0.001**	-0.003***	-0.002***	-0.003***	-0.003***	-0.002***	-0.001**	-0.002***
× duration	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Asset tang.	0.296***	0.517***	0.340***	0.153***	0.250***	0.313***	0.352***	0.591***	0.388***	0.311***	0.390***	0.629***
	(0.043)	(0.046)	(0.034)	(0.029)	(0.049)	(0.059)	(0.032)	(0.042)	(0.060)	(0.043)	(0.033)	(0.032)
Asset tang.	-0.007	-0.044***	-0.025***	-0.009**	-0.011	-0.028***	-0.024***	-0.049***	-0.011	-0.012*	-0.027***	-0.015***
× duration	(0.007)	(0.008)	(0.006)	(0.004)	(0.007)	(0.010)	(0.005)	(0.007)	(0.009)	(0.007)	(0.005)	(0.005)
Duration	-0.085***	-0.062***	-0.073***	-0.072***	-0.084***	-0.092***	-0.065***	-0.069***	-0.108***	-0.100***	-0.082***	-0.086***
	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.005)	(0.002)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)
Constant	0.153***	0.650***	0.428***	0.674***	0.691***	0.683***	0.657***	0.377***	0.442***	0.488***	0.286***	1.034***
	(0.057)	(0.063)	(0.045)	(0.038)	(0.078)	(0.093)	(0.044)	(0.052)	(0.093)	(0.060)	(0.043)	(0.060)
Observations	320443	264024	421265	568217	212009	172348	458310	423591	189863	304480	483331	504347
Spells	86942	73182	108731	130878	60614	52990	113246	107910	56754	84161	125298	136459
R^2	0.038	0.048	0.038	0.039	0.044	0.046	0.036	0.040	0.041	0.045	0.039	0.061

The dependent variable is the log of the gross growth rate, $1 + (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$. Calendar year, spell number, and spell length fixed effects included, robust standard errors clustered on relationship in parenthesis with *, **, *** denoting significance at 10%, 5%, and 1%. Observations report the number of annual exporter–product observations and spells report the total number of spells with positive exports of various length used in the analysis. Distance, contiguity, common language, exporter GDP, relative real exchange rate, transportation costs, and tariffs were included, but are not reported.

Table 5: **Credit Constraints Interacted with Duration**

we should find that interacted coefficients are of the opposite sign compared to the coefficient on credit constraint variables themselves. This is precisely what we find in Table 5—the longer the exports the smaller the effect of each credit constraint. There are a few exceptions. In the case of exports to Germany, exporter's financial development on its own has no effect, while its interaction has a significant positive effect. In the case of exports to Portugal, the lending rate on its own has no effect, while its interaction has a positive and significant effect, opposite of what we expect to find. In the case of exports to Ireland and the Netherlands, the lending rate on its own has the expected positive effect, while its interaction with duration does not have a negative effect.

Since the interaction terms impose a linear effect of each variable with respect to time, to better gauge when credit constraints cease to play a role we replicate regressions from Table 3 for each year in a spell. In other words, we replicate our regression for the second year in a spell, the first year in which we can observe growth. We do so again for the third, the fourth, and so on until the last observed year.[19] We present detailed results for the U.S. in Table 6.

In the case of the U.S. the quality of the exporter's domestic financial system is significant and negative in each of the first seven years. Higher lending rate increases the growth rate only in year two, while external finance dependence is positive and significant in the first four years. Asset tangibility has the most persistent effect, being significant in all years but the fifth one. The effect of other variables tends to be more persistent. Distance increases the growth rate in every year, while transportation costs decrease it in every year. Contiguity has a significant effect in the first two years, as does exporter's GDP. The tariff rate and relative real exchange rate have a significant effect in each of the first four years, while common language plays no role after year two.

Rather than presenting a detailed table for each country, we offer a summary table (Table 7) due to space concerns[20]. We report the number of years in which each credit constraint coefficient is significant and of the appropriate sign. We do so in two ways: we report the number of consecutive years from the start of a spell and the total number of

[19] We present results up to year ten due to space concerns. Results for all years are available on request.
[20] Detailed results are available on request

	Year in spell								
	2	3	4	5	6	7	8	9	10
Initial	-0.413***	-0.112***	-0.064***	-0.046***	-0.041***	-0.034***	-0.039***	-0.025***	-0.033***
exports (ln)	(0.002)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)
Financial	-0.137***	-0.062***	-0.047***	-0.087***	-0.071***	-0.042*	0.023	-0.064**	-0.016
development	(0.011)	(0.015)	(0.017)	(0.019)	(0.020)	(0.022)	(0.025)	(0.026)	(0.030)
Lending	0.196***	0.059	0.059	0.005	0.004	-0.069	0.052	-0.016	0.302*
rate	(0.024)	(0.036)	(0.045)	(0.054)	(0.066)	(0.083)	(0.106)	(0.130)	(0.157)
Ext. fin.	0.091***	0.018***	0.012***	0.004	0.012**	0.003	0.001	0.001	0.007
dependence	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)
Asset	1.225***	0.386***	0.309***	0.068	0.467***	0.216**	0.198**	0.248**	0.269**
tangibility	(0.043)	(0.059)	(0.069)	(0.078)	(0.085)	(0.092)	(0.100)	(0.112)	(0.121)
Distance (ln)	0.283***	0.112***	0.125***	0.118***	0.059**	0.061**	0.100***	0.077**	0.103***
	(0.013)	(0.018)	(0.021)	(0.023)	(0.026)	(0.028)	(0.030)	(0.034)	(0.037)
Contiguity	0.205***	0.101***	-0.011	0.059	-0.046	-0.006	-0.027	0.012	0.034
	(0.029)	(0.038)	(0.043)	(0.048)	(0.051)	(0.054)	(0.058)	(0.065)	(0.068)
Common	-0.074***	-0.012	-0.024	0.014	0.022	0.047**	-0.001	-0.006	0.022
language	(0.011)	(0.014)	(0.017)	(0.019)	(0.021)	(0.022)	(0.024)	(0.026)	(0.028)
Exporter	-0.057***	-0.008*	-0.008	0.006	0.001	0.009	0.000	0.008	-0.012
GDP (ln)	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)
Rel. real	0.023***	0.011***	0.009***	0.008**	0.005	0.017***	0.010**	0.010**	0.007
ex. rate (ln)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Transport	-0.255***	-0.182***	-0.166***	-0.168***	-0.165***	-0.135***	-0.154***	-0.129***	-0.127***
costs (ln)	(0.004)	(0.005)	(0.007)	(0.008)	(0.009)	(0.010)	(0.011)	(0.012)	(0.013)
Tariff (ln)	-0.110***	-0.036***	-0.021***	-0.020**	-0.004	-0.011	-0.013	-0.039***	-0.032**
	(0.005)	(0.006)	(0.007)	(0.008)	(0.009)	(0.010)	(0.010)	(0.012)	(0.013)
Constant	3.008***	0.277	-0.421*	-0.699***	-0.387	-0.877***	-0.868***	-0.925***	-0.716*
	(0.137)	(0.186)	(0.219)	(0.243)	(0.270)	(0.289)	(0.316)	(0.354)	(0.386)
Observations	145,243	87,052	60,486	45,357	35,324	27,973	22,734	18,294	14,761
Spells	116,763	77,607	56,921	43,945	34,808	27,807	22,701	18,294	14,761
R^2	0.226	0.047	0.034	0.031	0.029	0.028	0.031	0.022	0.025

The dependent variable is the log of the gross growth rate, $1 + (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$. Calendar year, spell number, and spell length fixed effects included, robust standard errors clustered on relationship in parenthesis with *, **, *** denoting significance at 10%, 5%, and 1%. Observations report the number of annual exporter–product observations and spells report the total number of spells with positive exports of various length used in the analysis.

Table 6: **Persistence of Credit Constraints for the United States**

	Number of years with a significant coefficient (10%) of the correct sign Consecutive years from the start				
	Initial exports	Financial development	Lending rate	External fin. dependence	Asset tangibility
Belgium-Lux.	7	2	1	2	2
Denmark	9	1	1	1	2
France	8	1	2	2	1
Germany	9	0	1	2	1
Greece	6	2	1	1	1
Ireland	5	0	1	1	1
Italy	7	1	3	2	1
Netherlands	6	1	1	2	2
Portugal	8	1	0	2	1
Spain	7	1	2	1	1
United Kingdom	7	1	2	1	1
United States	9	6	1	3	3
Average	7.3	1.4	1.3	1.7	1.4

	All years				
	Initial exports	Financial development	Lending rate	External fin. dependence	Asset tangibility
Belgium-Lux.	8	2	2	2	2
Denmark	9	1	1	1	2
France	8	2	3	2	2
Germany	9	3	1	2	3
Greece	6	3	1	1	1
Ireland	7	2	2	1	2
Italy	8	4	4	2	1
Netherlands	8	3	2	2	2
Portugal	8	2	1	2	1
Spain	8	1	3	1	1
United Kingdom	8	1	4	1	2
United States	9	7	2	4	8
Average	8	2.6	2.2	1.75	2.25

Table 7: **Persistence of Credit Constraints Summary**

years in which coefficients are of the appropriate sign and are significant at at least the 10% level. Either approach indicates that the effect of credit constraints on the growth of trade is short lived. The average number of consecutive years at the start of an exporting spell during which financial development plays a significant role is 1.4 years, while lending rates matter for the first 1.3 years. External finance dependence and asset tangibility are significant for the first 1.7 and 1.4 years.

6 Robustness

Before concluding we perform several robustness exercises. We examine whether our results are affected by accounting for changes in product codes, which we are able to do for the U.S. only. We are able to perform all other robustness exercises for every country–importer. Due to space consideration we present results for the key variables for four representative countries only (France, the Netherlands, the U.K., and the U.S.). Complete results are available on request. We examine whether results are robust to two alternatives to lending rates, calculation of growth rates using the mid-point formula, and using data on first spells only or on single–spell relationships. We examine the necessity of excluding data on spells active in 1989, the first year in the data. Finally, we examine whether aggregating data to the industry level affects the results. For all robustness exercises we report coefficients for the key variables of interest: initial exports, credit constraint variables and duration.

6.1 Product Code Redefinitions

One potential issue with product level data is that product codes tend to be revised on an annual basis by the administrative bodies which maintain them. In the case of the U.S., for example, the U.S. International Trade Commission adjusts the definition of product codes on at least an annual basis, with some codes disappearing and new ones being created.[21] We use the Pierce and Schott (2009) algorithm to concord the U.S. Harmonized System codes across time and control for exogenous changes in product codes. An alternative approach is to exclude all product codes affected by revisions. We re–estimate the export growth regression from Table 3 for the U.S. and present results in Table 8 along with corresponding results from Table 3 for ease of reference. Product code changes do not affect our results in any notable way.

[21] Redefinitions come in three flavors: a product has declined in volume partially or completely so that a separate code is no longer warranted, a product has grown in volume or is brand new where a separate or new code is needed, or a product's code is revised for consistency reasons. See Pierce and Schott (2009) for a complete discussion.

	From Table 3	Pierce–Schott concordance	Unchanged HS codes
Initial exports (ln)	-0.157***	-0.148***	-0.152***
	(0.001)	(0.001)	(0.001)
Financial development	-0.078***	-0.091***	-0.088***
	(0.004)	(0.005)	(0.006)
Lending rate	0.121***	0.116***	0.117***
	(0.014)	(0.014)	(0.018)
Ext. fin. dependence	0.032***	0.029***	0.032***
	(0.001)	(0.001)	(0.001)
Asset tangibility	0.557***	0.670***	0.576***
	(0.017)	(0.018)	(0.022)
Duration	-0.087***	-0.085***	-0.085***
	(0.001)	(0.001)	(0.001)
Observations	504,347	446,301	302,460
Spells	136,459	111,418	76,111
R^2	0.061	0.060	0.061

The dependent variable is the log of the gross growth rate, $1 + (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$. Calendar year, spell number, and spell length fixed effects included, robust standard errors clustered on relationship in parenthesis with *, **, *** denoting significance at 10%, 5%, and 1%.

Table 8: **The Effect of U.S. HS Product Code Changes**

6.2 Alternatives to Lending Rates

Rather than using the lending rate as provided by the IMF's *International Financial Statistics* as a measure of the interest rate banks charge on loans, in the first column of Table 9 we use the net interest margin while in the second column we use overhead costs. Both measures come from the Financial Structure Database (Beck et al. 2000). Net interest margin measures the accounting value of a bank's net interest revenue as a share of its total earning assets essentially capturing the difference between lending and deposit interest rates. Overhead costs equal the accounting value of a bank's overhead costs as a share of its total assets. Both variables reflect the efficiency of a banking sector and are constructed from bank–level data. Using either alternative as a proxy for interest rates yields qualitatively very similar results.

6.3 Calculating Growth Rates using the Midpoint Formula

We calculate all growth rates by using the previous year as the base. An alternative is to use the midpoint formula, which smooths out any extreme annual changes. In addition, it addresses a potential bias in calculation of the first growth rate. Our data are recorded

	Net Interest Margin	Overhead Costs	Midpoint Growth Rates	First Spells	Single Spell	1989 Spells	5–digit SITC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				France			
Initial exports (ln)	-0.148***	-0.148***	-0.082***	-0.139***	-0.108***	-0.045***	-0.134***
Financial development	-0.030***	-0.041***	-0.020***	-0.039***	-0.051***	-0.033***	-0.053***
Lending rate	0.881***	0.941***	0.051***	0.050***	0.040**	0.001	0.031**
Ext. fin. dependence	0.011***	0.011***	0.008***	0.015***	0.014***	-0.000	0.014***
Asset tangibility	0.231***	0.235***	0.127***	0.264***	0.270***	-0.042***	0.268***
Duration	-0.075***	-0.075***	-0.053***	-0.073***	-0.058***	-0.019***	-0.074***
Observations	581,571	582,837	421,265	138,528	95,072	536,133	236,241
Spells	127,733	128,101	108,731	44,906	25,729	87,875	48,454
R^2	0.037	0.037	0.035	0.042	0.033	0.012	0.034
				Netherlands			
Initial exports (ln)	-0.154***	-0.154***	-0.078***	-0.140***	-0.111***	-0.052***	-0.141***
Financial development	-0.028***	-0.039***	-0.021***	-0.038***	-0.040***	-0.021***	-0.034***
Lending rate	0.516***	0.296***	0.056***	0.071***	0.067**	0.006	0.059***
Ext. fin. dependence	0.023***	0.023***	0.012***	0.026***	0.019***	0.003***	0.024***
Asset tangibility	0.350***	0.352***	0.190***	0.334***	0.336***	-0.021	0.332***
Duration	-0.077***	-0.077***	-0.049***	-0.070***	-0.068***	-0.025***	-0.072***
Observations	534,112	534,499	423,591	151,614	71,226	411,085	257,280
Spells	124,977	125,029	107,910	48,003	21,448	68,462	51,410
R^2	0.040	0.040	0.036	0.041	0.038	0.014	0.034
				United Kingdom			
Initial exports (ln)	-0.155***	-0.155***	-0.086***	-0.149***	-0.116***	-0.051***	-0.139***
Financial development	-0.011**	-0.024***	-0.016***	-0.055***	-0.050***	-0.016***	-0.016***
Lending rate	0.975***	0.818***	0.045***	0.034**	0.020	0.002	0.048***
Ext. fin. dependence	0.015***	0.015***	0.008***	0.014***	0.011***	0.001	0.013***
Asset tangibility	0.272***	0.274***	0.158***	0.220***	0.192***	-0.036***	0.257***
Duration	-0.080***	-0.080***	-0.054***	-0.076***	-0.060***	-0.022***	-0.074***
Observations	645,935	646,363	483,331	146,711	97,809	489,405	272,992
Spells	146,122	146,259	125,298	50,105	28,078	86,527	55,277
R^2	0.040	0.040	0.037	0.045	0.034	0.013	0.035
				United States			
Initial exports (ln)	-0.160***	-0.160***	-0.093***	-0.144***	-0.113***	-0.051***	-0.112***
Financial development	-0.060***	-0.085***	-0.054***	-0.078***	-0.056***	-0.070***	-0.029***
Lending rate	0.961***	0.285***	0.069***	0.062***	0.106***	0.005***	0.007
Ext. fin. dependence	0.036***	0.035***	0.020***	0.030***	0.024***	0.011***	0.021***
Asset tangibility	0.591***	0.590***	0.337***	0.521***	0.429***	0.345***	0.237***
Duration	-0.083***	-0.083***	-0.058***	-0.081***	-0.063***	-0.031***	-0.084***
Observations	648,705	648,806	504,347	174,791	119,153	708,739	290,776
Spells	159,763	159,738	136,459	56,761	31,019	103,920	56,468
R^2	0.061	0.061	0.055	0.060	0.050	0.030	0.034

The dependent variable is the log of the gross growth rate, $1 + (\text{exports}_{t+1} - \text{exports}_t)/\text{exports}_t$. Lending rate is substituted by net interest margin in column (1) and by overhead costs in column (2). Calendar year, spell number, and spell length fixed effects included, robust standard errors clustered on relationship, with *, **, *** denoting significance at 10%, 5%, and 1%.

Table 9: **Select Robustness Results**

on an annual basis. It is possible that a relationship becomes active midway through a calendar year or at its very end. In such cases, the first growth rate may be exaggerated as the change in volume is potentially based on a full year worth of exports relative to exports over only a part of the first year. As results in column (3) of Table 9 indicate using the midpoint formula has no qualitative effect on our results.

6.4 Multiple Exporting Spells

We have argued that our model is valid for any instance of an exporting spell as it relies on differences between new and incumbent exporters in the current spell of service. In other words, our model is not valid only for the very first instance of a spell of positive exports. There are two ways in which we can address the possible concern that we should only use data on the very first spells. We can either use data on the first observed spells (column (4) of Table 9) or on single–spell relationships (column (5) of Table 9). Neither approach alter our results.

6.5 Export Spells with Unobserved Beginning

We have argued in Section 4 that our model requires us to restrict our data to only include export spells for which we can clearly determine the first year. This required we drop information on all export spells which are observed in 1989 as that is the first year we observe in our sample making it impossible to determine whether that is the first year in the spell, or the second, or the tenth. Including such spells would introduce a bias as we would treat all spell as if 1989 was their first year. We examine the validity of such spells in column (6) of Table 9. While financial development has the predicted sign in all four cases, the magnitude of its effect is reduced. Lending rate has a much smaller effect and is significant only in the case of the U.S. External finance dependence also has a much smaller effect and is significant for the Netherlands and the U.S. Asset tangibility is estimated with a significant negative coefficient in all cases but the U.S. Omitting spells observed in 1989 is warranted as their inclusion would result in biased estimates.

6.6 Aggregation of Trade Flows

Our model was developed with multiple exporters of the same product in mind. It is possible that in the highly disaggregated product level data we use many products are exported by single firms in a given country. To address this issue we aggregate our data to the 5–digit SITC level and examine the validity of our model in column (7) of Table 9. Our results are qualitatively identical to those at the product level.

7 Conclusion

The role of credit constraints in international trade is not relevant only to the volume of trade and various aspects of extensive and intensive margins of trade. They also play an important role in determining the growth of trade at a highly disaggregated product level as we have modeled and documented.

Using a dynamic partial equilibrium model we derive several testable predictions. Exports from more credit constrained firms grow faster, while the growth rate of all exporters decreases over time. In addition, growth rates converge across all exporters of the same variety. Finally, credit constraints do not have a persistent effect on the growth rate of exports: as an export relationship survives, credit constraints become irrelevant to its growth. We test and confirm these predictions using highly disaggregated export data to the United States recorded at the 10–digit HS level and the twelve members of the European Union recorded at the 8–digit CN level.

The reduced role of credit constraints over time points to their large role at the margin for new export relationships. Credit constraints are an important and debilitating initial barrier. They reduce the initial volume of exports by limiting the ability of constrained firms to finance their activities. However, as our results show, the debilitating effect seems to disappear relatively quickly, within the first three years of an export relationship. The immediate policy implication of this result is that subsidizing credit for first–time exporters may allow them to overcome the initial barrier imposed by credit constraints. Of course, the design of such an ultimately export promotion policy has to overcome mixed results of such policies as discussed in Bernard and Jensen (2004), Görg, Henry, and Strobl (2007), and Lederman, Olarreaga, and Payton (2010), for example.

Our paper adds a new dimension to the assessment and design of export promotion policies, for we study how long financial barriers to exporting persist. Our study suggests that a policy of promoting exports through easing of credit constraints is needed only in early stages of a firm's exporting endeavor as credit constraints play no role in the growth of exports once a firm becomes even a modestly successful exporter.

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A Data Appendix

Data used in this paper are available from public sources.

Data	Source
Exports to the U.S. at the 10–digit HS level	U.S. Census Bureau, U.S. Imports CDs and DVDs
Exports to the EU at the 8–digit CN level	EUROSTAT, http://epp.eurostat.ec.europa.eu
Financial development, net interest margin, and overhead costs	Financial Structure Database
Lending rates	IMF's *International Financial Statistics*
External finance dependence and asset tangibility	Chor and Manova (2011)
Distance, contiguity, and common language	CEPII, http://www.cepii.fr/anglaisgraph/bdd/gravity.htm
GDP	World Bank's World Development Indicators
Real exchange rates	ERS International Macroeconomic Data Set, http://www.ers.usda.gov/Data/Macroeconomics/
Transport costs and tariff rates	Based on U.S. Census Bureau data